## SPECIAL REPORT HIV/AIDS in Pakistan



Issue 1, Vol. 1 Autumn 2011

# The Heart of the Matter

**FEATURE** 

Neuroscience and the Law

From Science as a discipline to Science as culture in Pakistan

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Drones are as revolutionary for combat warfare as armor must once have been.

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The Box Move is a science magazine and blog by students at the LUMS School of Science and Engineering (SSE).

URL: http://theboxmove.weebly.com/



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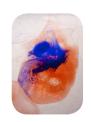
A collection of our favorite photos from submissions from locally-based photographers.











### **ON THE COVER**

The Box Move is a popular science endeavor attempting to stage the great scientific comeback in Pakistan. This is an photograph by Masooma Raza for an assignment on spirituality at the Indus Valley School of Art and Architecture.

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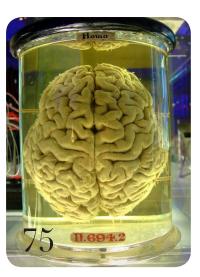
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By **KAMIL AHSAN** *Chief Editor* 

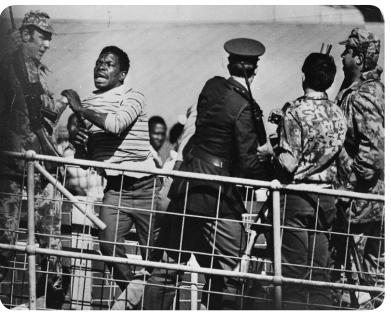


# Editorial

# The Heart of the Matter

or students of the 1976 Soweto uprisings in South Africa, the Soweto '76 archive must be a godsend. From a purely academic perspective, the uprisings by black high-school students against the adoption of Afrikaans as a primary mode of instruction have always been a difficult study because of skewed official estimates of the death toll and a lack

of eyewitness accounts. This has changed with the Soweto '76 project which uses new archival information from the Hector Pieterson Museum to collate photographs, video footage and sound recordings and reconstruct in 3D a street in the town of Soweto. Such an interface allows students to closely interact with the battlegrounds of one of the South Africa's most shadowy historical events, seen today as a



Music have increasing access to vast databases of recordings and use them to trace the evolution of Jazz music. This is a big change, and here's why. Ever since C.P. Snow's The Two Cultures, academics have bemoaned the viewing of science as some sort of vague relative nobody really wants to visit. But everybody understands the internet. And perhaps with the digitization of knowl-

edge, fields as far apart as Physics and Literature can finally find common ground.

The heart of the matter is that all these delineations are, on some level, purely cultural. Anybody whose parents have ever preferred Medicine over Literature should know that fairly well. But if your parents assume that you're going to spend your entire life reading books as a Literature major and will make little

decisive event leading to the overthrow of the Apartheid regime.

For one who has been cultured in a system such as Pakistan's, the movement known as Humanities 2.0 sweeping universities across the world may seem bizarre. The study of the humanities has always been seen as particularly bookish, with no need for the visual and diagrammatic aids that the technical sciences require. This is changing with the digital humanities, and for good reason. Academics worrying about 'dying disciplines' are delighted by an intermingling of new technologies with the humanities to produce a richer, fuller narrative. French and History professors at Stanford have built complex maps to trace the correspondence between great thinkers such as Voltaire and Locke to trace the flow of ideas during the Enlightenment. A Theatre professor at Bryn Mawr College uses 3D digital renderings to visualize the staging of Shakespeare's Titus Andronicus at the Globe Theater. Students taking this course can move their principal characters to center stage if that has the most dramatic effect. Students of money, they have a point - a point that everybody, including us, would rather not see. However, with changing informational trends, the value of your favorite Humanities subject should rise exponentially. Here's why: if our History is informed by technology, the change could be as big as the opening of the Soviet archives once was for the discipline. Perhaps then parents will elevate the importance of studying the past relative to studying the laws of the universe.

The recent HSS Conference at LUMS illustrates one thing: we're willing to learn. The Box Move is just such an attempt to cross chasms and reiterate the hoary but uncomfortably resilient cliché that all knowledge is a good thing. The Soweto '76 archives already reveal a higher body count than expected, changing original government figures that hushed up the fact that the police had fired indiscriminately into the crowd as the enraged mob brutally stoned observers to death. Especially in a country where we are most in danger of forgetting our own Soweto uprisings, the want for a transformation is dire

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By **ZAIB-UN-NISA AZIZ** Senior Editor

# **Op-Ed**

# The Forgetting Cycle

hat feelings did the disaster of 11th March in Japan invoke in us? An uneasy combination of sympathy for the victims and admiration for the stoic nation's resilience in the face of an epic catastro-

phe. But what really keeps the Japanese disaster relevant to the world is neither the rehabilitation, rebuilding and reconstruction phases of the disaster management nor the threat of nuclear meltdown. The truth is that disaster management seldom makes good television. Inevitably attention drifts to other more 'breaking' news. But de-

spite this short attention span or perhaps because of it, disasters - all disasters - have long-term consequences.

Pakistan is no different. The effects of the 2010 floods which submerged most of the country last summer are still being felt, though not always discussed. Thousands are still in want of returning home and those who have remain in need of food, shelter and medicine. Apart from these daunting tasks, the floods have had destructive effects for the entire economy. Pakistan's productive capacity and export production was severely affected, the effects of which will spill over into this year. According to the International Labor Organization, job losses amounted to



5.3 million. GDP growth rate is estimated to sharply decline from 4% to -2% to -5% and there is a likelihood of such a trend continuing over the coming years. The economic slump can be accounted by the devastating impact of the floods on the manufacturing industry. The loss

of cotton has adversely affected Pakistan's textile industry which is a pillar of Pakistani exports. Multinational giants with large scale operations' within the country like Unilever and Toyota have announced how the slump in growth will be manifested by production cuts and possible layoffs. Toyota has declared a remarkable decline of

25% in country wide car sales. This has led them to reduce production considerably from the 200 cars a day output prior to the floods. With the economy becoming increasingly weak, it is unlikely that Pakistan should to meet the IMF condition of a 5.1% deficit cap. Moreover, Pakistan's foreign debt, which already sums a staggering \$55 billion, is expected to grow.

June 2011 will mark a year since the ferocious floods consumed so much and so many in the country. Although the angry waters have receded, the Pakistani economy will continue to be in need of rehabilitation and hence there is a stinging need to keep the matter alive

# BOX ON THE WEBSITE

### GALILEO GALELLIE GALELEILELO?

Physics Majors ruminate on classroom content and it devolves into a heated argument. Catch it all at http:// theboxmove.weebly.com/blog.html



### ttp://theboxmove.weebly.com

## OPINION

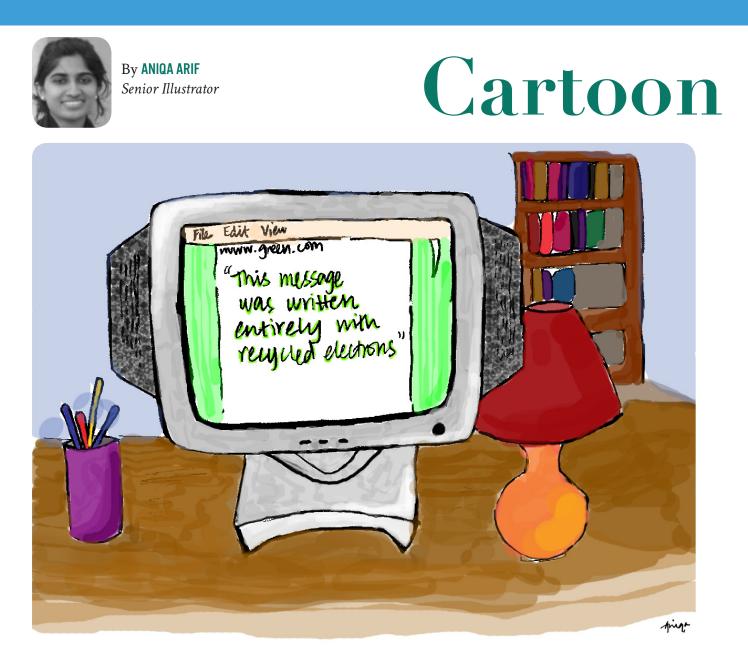
Abdullah Khalid looks towards Richard Feynman during Media Writing class.

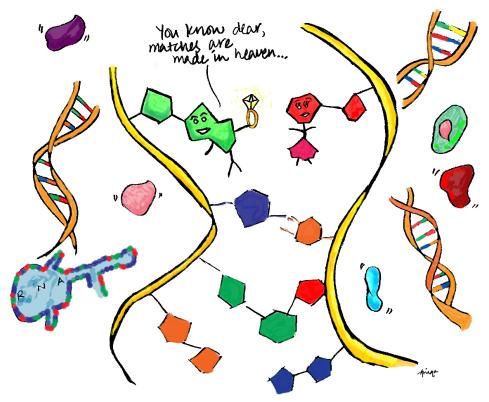
### I RECIPE

Maheen Rashid refuses to follow the recipe for Baked Fish, especially at 4 AM.

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▲ (*top*) Environmentfriendly website, (*left*) Adenine decides to propose to Thymine.

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### TECHNOLOGY

### FEATURE

# **Unmanned** Aerial Vehicles

### BY SHABBIR MARZBAN, HASNAIN LAKHANI AND HAMZA MUNIR

he Digital Battlefield is an increasingly common term in today's world, courtesy the phenomenal technological advances such as the case in point: Unmanned Aerial Vehicles

#### (UAVs).

The evolution of civilization amongst other things has completely transformed the manner in which people engage in conflict. Drones in particular are revolutionizing warfare, not only in gathering information, but also performing admirably at the front line in combat. What is often hidden from public view is the remarkable technology employed and how it's of value in civil(nonmilitary) ventures.

#### Where?

From a purely militaristic perspective, drones eliminate the chance of human error. A drone can be made into a perfect fighting machine, boosting army strength by providing valuable support for human troops. With a mean machine fighting on your side, winning a war definitely becomes simpler. Also, drones are well suited to reconnaissance missions, providing valuable intelligence. Quoting Sun Tzu, "If you know the enemy and know yourself you need not fear the results of a hundred battles". Following on from this point, we see that drones can easily turn the tide of battle.

On the civilian side, drones are carrying out tasks that would have been deemed impossible just a few decades ago. There are drones designed to fly into the hurricanes, carrying instruments to gather valuable weather measurements. These could provide vital information to further scientific research into weather patterns. Another use, which is still in its infancy, is to use drones for automated search and rescue; these have been tried in cases where people have been lost at sea.

### History

When we think of drones, the usual image coming to mind is that of a fully computerized, high-tech aircraft patrolling the skies, armed with the latest and greatest missiles. But that's a highly idealized picture. Drones have been around for far longer than it seems at first glance; and in forms that we might not have thought of.

The first recorded use of an unmanned flying craft for warfare was in 1849. The Austrians launched around 200 hot-air balloons, laden with bombs, towards the city of Venice. The balloons were fitted with timed fuses which would stop the balloon and make it fall to the ground. The bombs would detonate when they hit the ground. In short, these were the precursors to modern unmanned military aircraft.

The first unmanned airplane used in combat was the Kettering Bug, developed during the First World War. It was designed to land on its target and detonate the explosives on board, essentially being the predecessor to assault drones. The Kettering Bug used mass-produced engines and had a simple wooden frame; the real innovation was in the use of a gyroscope combined with a vacuum system to guide the Bug to its target. However, it was not ready in time to be used in the war.

Nowadays, drones are usually controlled remotely. One of the earliest RC (Radio controlled) drones was the Radioplane OQ-2. It had a 6HP engine and could remain airborne for about 1 hour. The main purpose of these drones was to act as targets for anti-aircraft gunners to train on; simulating real targets. Target drones have been used extensively in the military for training purposes and provided the basis for the production of other types of drones. (Interesting tid-bit: Marilyn Monroe was a technician at the Radioplane factory when she was photographed and offered a job as a model).

Target drones were also used as decoys in some cases. Some B-52 bombers used to carry decoy drones. These were deployed and flown to distract attention from the bomber itself, allowing it to penetrate behind enemy lines and carry out bombing raids.

Reconnaissance drones were developed in the early 1960s. The most famous of these, called the "Lightning Bug", was based on drones from the "Ryan Firebee" series. It was radio-controlled and performed surveillance on the target area, providing valuable information about the enemy. The Lightning Bug was invisible to the ground-based radars of the time, allowing it to avoid detection. However, it left a tell-tale contrail (the trail of condensation left behind by an aircraft during flight), which allowed it to be detected in some cases. To overcome this, chlorosulfonic acid was injected into the tailpipe. This created an exhaust of very tiny ice crystals, which were transparent. So it was almost impossible to detect a Lightning Bug, making them extremely useful for stealth missions. It was used for spying on China, Vietnam and North Korea during the 60s and the 70s.

Assault drones were the forerunner of cruise missiles. These were designed for one purpose: to hit the enemy target and explode on impact. These drones carried explosives and were controlled by radio. The problem with these was that they were too large and bulky to be used; especially considering that often multiple strikes were needed against a single target. Their use in WWII was limited to a single 4-drone attack on a Japanese merchant ship. Eventually these assault drones were replaced by cruise missiles, which were much more efficient.

### The details

Simply put, a drone is nothing more than a remotely controlled vehicle. In more recent times, the remote control is being increasingly replaced by artificial intelligence and computer vision. In other words, the drone is no longer dependant on a human controller to operate. A person may choose to either operate the remote control manually, or leave it to the intelligence of the drone to autonomously perform its function; which may



vary from military action, surveillance and environment monitoring to unmanned exploration, both on earth and beyond.

As the scientific world is moving into the realm of quantum electronics with the sizes of the batteries and the solar cells getting smaller and efficient, drone technology is also escalating and has seen some truly stunning and spectacular developments in the recent past. Drones are now smaller, faster and quieter than ever before, such as the recently developed dragonfly spy drones, and with them the prospects for their utilization are growing as well.

Almost all the UAVs have a camera mounted on them. These are typically visual spectrum, infrared, or near infrared cameras as well as radar systems. These are not only able to take pictures but can also extract valuable information and use it to make decisions. One recent example is that of a novel project that uses cameras mounted on unmanned aircraft flying over the Arctic to assess the characteristics of declining sea ice, and then using the same aerial photos pinpoints seals that have hauled up on ice flows using image recognition techniques. These techniques come under the field of computer vision. These also include image stitching: turning overlapping photos into a single seamlessly stitched panorama, 3D modeling: converting one or more snapshots into a 3D model of the object or landscape, inserting 2D pictures or 3D models into your videos by automatically tracking nearby reference points etc. Over the years, such processing algorithms have become much more mature and efficient to be planted on the independent units rather than super computers which has enabled UAVs to make real time decision based on the stream of images it captures.

### **Current Killing Technique**

Combat tactics and warfare method-

ology have changed drastically in the last half century, with the emphasis turning towards stealth and information supremacy rather than brute force. Information supremacy is what wins wars, as does the ability to deliver that information at the right time, to the right person. Drones are playing an increasingly vital part in collecting that information. Among their myriad of potential uses, aerial drones in particular have shown immense competence as reconnaissance vehicles.

So what exactly makes the drones suitable for the task? First, drones can survey areas too threatening for manned reconnaissance, where there is always the chance of aircraft being shot down and the diplomatic embarrassment accompanying the capture of pilots. Further, drones have a distinct cost advantage over conventional manned aircraft. The absence of a pilot and vital safety features also makes them lighter, therefore more fuel efficient, as well as quieter, which in turn allows them to carry out surveillance at low altitudes. Armed with the latest sensors that allow them to collect a wide variety of information, aerial drones have the capability to survey large areas and locate potential targets. Offering the line-of-sight advantage of an aerial vehicle without the limitations associated with a conventional manned aircraft, drones are making great headway into the field of reconnaissance and surveillance.

A wide variety of sensors can be used to collect a wide variety of data. Electromagnetic spectrum and infrared red sensors allow heat signatures to be detected, making target detection easier and more accurate. Drones can also be armed with biological and chemical sensors to counteract biological and chemical warfare. High definition cameras allow live streaming of the target site and keeping one up to date with the enemy's movements.







▲ Drones are indispensable not just for national military forces but also for civilian purposes, as explained in the main text. There are also many types, as depicted above.

The infamous Predator models are also equipped with the sophisticated synthetic aperture radar system, that allowed them to take accurate still images through smoke, clouds or hazy conditions. Although initially used for reconnaissance, it was inevitable that drones, in particular, aerial UAVs (Unmanned Aerial Vehicles), would eventually be armed to carry out surgical strikes on targets. The Predator UAV models have been armed with anti-armour Hellfire missiles, and can accurately target stationary objects. Introduction of laser and satellite guidance has further improved their precision. UAVs gives true meaning to the term 'silent but deadly', as the missile itself is supersonic and the UAV is much quieter than conventional manned aircrafts. Although civilian casualties have brought their accuracy under question, they have been largely attributed to non specialized missile system for the UAVs.

Although current technology has yet to reach the level where UAVs can be used for air to air combat, they nonetheless show immense promise in aerial combat, as they are not limited by the pilot's limit of G-force endurance, and can thus turn tighter and faster, and the plane that turns harder, faster is more likely to win.

### Surprisingly, civilians can use them too

While most of us relate drones to metallic birds out of a science fiction movie, designed solely for the purpose of long nosed spying and cowardly sharp-shooting, drones do have a gentleman's air to them. Although the name takes out a lot of action, sulphur and lead from the image, the applications that have been found for them are quite genius. In the U.K. for example, the weapon systems company BAE is working on developing UAVs for domestic surveillance. The use of UAVs will revolutionize management, policing and intelligence. Police plan to use these aircraft to monitor motorists, protesters, agricultural thieves and fly-tippers, in a vital expansion of state surveillance. Officials say it will also become easier to track criminals like car thieves.

The British interest in UAV technology for domestic use grew after the Mumbai terrorist attacks. With the 2012 Olympics deadline set, the British government wants security to be top priority. UAVs will greatly enhance the scale at which law enforcement can operate. Surveillance data can be archived and can be referred to when needed.

The UAVs being developed by BAE systems will fly autonomously at a height of 20,000 feet. The prototypes take off on their own, follow a pre-programmed flight path and return to base. Engineers are working to develop systems which will help automatically detect suspicious situations. In such a case the UAVs will deviate from the flight path to investigate and operators can then program further decisions. It has also been proposed that the technology can aide border control departments in controlling illegal immigrants. The United Sates already has begun using a modified version of the Predator drone to help at its notorious border with Mexico. The Predator helps the helicopter and ground forces in tracking down drug traffickers and groups trying to enter US territory. The drone can laser-tag suspects making it impossible to hide in the terrain. Helicopter teams can then easily round up suspects. The routes famous among smugglers have already been exposed, for which the security teams thank the Predator.

However, the Civil Aviation Authority (CAA) does not trust autonomous UAVs in normal airspace and has only licensed them to operate in restricted areas. The main fear is collision with other aircraft. In manned flights the pilot is responsible to avoid aerial obstacles, a doctrine called "see and avoid". Northrop Grumman has started testing a system that uses video cameras and advanced image processing to detect incoming aircraft and obstacles. An equivalent detect and avoid system is not very far off then, but Aviation Authorities want flawless performance. Nick Sabatini, Associate Administrator for Aviation Safety at the Federal Aviation Authority (US) has said, "We are interested in accommodating the needs of unmanned aircraft, but we're not going to compromise safety in order to do that. We have a fundamental belief that starts with this: First, do no harm. We have a [manned aircraft] system that has evolved over many years. We have 100 years of experience. And that is why our system is so incredibly safe."

### Conclusion

Technological innovation has redefined almost every aspect of life in the last decade. Civilian quality of life has improved by leaps and bounds. With that in mind it's easy to forget that the brunt of scientific research is funded by military, not civilian, institutions. We may marvel at the latest mobile phone, not realizing that the actual innovative parts inside it were probably developed for some military application that's already outdated.

Drones are just one aspect to the re-invention of warfare in this technological age. Drones have in some cases helped reduce civilian casualties. Some of them have found civilian applications and are being used to further research and save yet more lives. Indirectly, drones have also helped other areas of research. All that work into Computer Vision and Artificial Intelligence can and will be applied to other fields, for example exciting new applications of Computer Vision for medical diagnosis. As technology continues to improve and revolutionize the world, one can't help but wonder where things will be in 10 years◆



### **GLOBAL ENVIRONMENT**

Comprehensive universal solutions on global warming are the only way forward and Pakistan would do well to listen.

**BY NAYAB ABIDI AND KAMIL AHSAN** 

FEATURE

# **Procrastinating on Climate Change**

s far as trends go, some of the most disturbing are those that are the most common but the least confessed; things which everybody agrees are necessary in theory but are forgotten when its important. Here's one: brushing one's teeth twice a day. Here's another: holding the door open for the person behind you. In many ways, that's probably why diplomats and heads of state see global environmental issues as irritants: vexatious problems that you feel other folks are thinking about too much for no good reason. Perhaps that is why it is easy for many people to commit to going green but hesitant to buying a green product that costs just a tad bit more. The global equivalent of this is what we have seen in climate change conferences - states seem to want to take their time in considering climate change an issue. This procrastination has been painfully obvious as states

compete at conferences like Copenhagen and Cancun to do less for the environment. It also has another outcome: scientists panicking about the effects of climate change are viewed by skeptics as little more than hacks – no good science with results we can't see.

Even in Pakistan where green policy understandably takes a backseat to the political wrangling and terrorist threats, we stand a chance of getting left behind while the rest of the world stops grumbling and sorts out its mess. Ergo, an examination of the state of the climate change community is necessary for government policy, federal law and a reassessment of industrial standards and performance. Such examination yields three stumbling blocks. First, climate science is new and still fairly uncertain, not to mention constantly reeling from attacks by skeptics. Second, different countries feel different responsibilities depending on their old and new

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geopolitical roles. Third, any more procrastination simply cannot be afforded, not just for the quality of human life, but for human life itself.

### The power of the uncertain

Uncertainty first. This has most to do with the statistics that the global community relies on which are published by the Intergovernmental Panel on Climate Change (IPCC) based on peer-reviewed publications of the latest climate change research. In the wake of Climategate, a much-hyped controversy that began as a ton of emails and documents from the University of East Anglia's Climatic Research Unit were leaked, much has been stated about the credibility of climate science and in particular the conclusions of the 2007 IPCC report.

And what did Climategate reveal that was so damaging anyway? First the IPCC's claim that "the glaciers in that caution and a little more care would do the IPCC a world of good - especially when they're relying on secondhand sources. In a November 2010 article in Scientific American, Judith Curry, a climate researcher who believes with full certainty that global warm-

**Policy-makers** would do well to live by the 'precautionary principle'

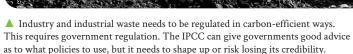
ing is a threat, asserted that the community's research is riddled with a whole lot more uncertainty than they can do anything about and that it must be factored in. She says: "There's a whole host of unknown unknowns that we don't even know how to quantify but that should be factored into our confidence level." One famous example she cites is that of the hockey-stick graph, a graph first published in Nature in 1998 which uses tree rings

> to estimate temperatures over the past thousand years. Michael Mann, who produced the hockey-stick graph was implicated by hundreds of Climategate emails as having falsified the data - a claim dismissed by an independent inquiry. But the criticism lies more in the method: nobody seems to agree that tree rings can be dated to give an appropriate measure of temperatures in past years!

> Problems in methodology go even further. Renewable energy systems, says the community, should replace countries' dependence of fossil fuels for energy. The European Union has been investing in renewable sources such as wind and solar power for years now - in Denmark, they provide upward of 16% of total energy consumption. But a recent study

at Cornell University found that renewable biomass fuels (such as ethanol) have been underestimated in the amount of greenhouse gases they emit. Why? Apparently only carbon dioxide was being treated as a greenhouse gas. Methane and carbon monoxide, arguably more harmful greenhouse gases, were not even factored in.

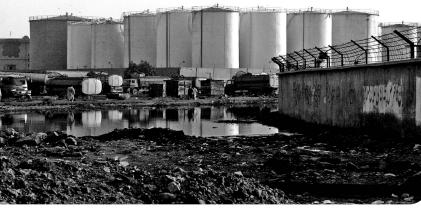
What could countries do in the face of such uncertainty? For starters, policy-makers would do well to live by the 'precautionary principle' that states that if uncertainty exists, we should err on the side of caution and do something; better safe than sorry. This means that countries and firms shouldn't just sit around remaining uncommitted to the fight. Further, a reevaluation of the standards of emissions and reasonable reduction cut-offs would be good for science, but more importantly, it would make for good science. It seems easy to accept skeptics' argument that the IPCC is fudging statistics, but the hard reality remains that even if the IPCC were underestimating their values



the Himalayas are receding faster than in any other part of the world and, if the present rate continues, the likelihood of them disappearing by the year 2035...is very high" turned out to be an error. This prompted much finger-pointing. Then Mr. Pachauri's personal interest in the report's findings was called into question. Since then, the report has been more or less exonerated. Probes by the UN, the British government and the InterAcademy Council found no evidence of fraudulence and claim the effects are negligible and not damaging to the report's central thrust. Indeed, it seems to Elizabeth Rosenthal in The New York Times that "the general consensus among mainstream scientists is that the errors are in any case minor and do not undermine the report's conclusions." Nevertheless it seems that the IPCC's reputation has been struck a major blow.

Even within the scientific community many feel





by many factors, something that seems unlikely given the broad consensus in the field, temperatures rising due to uncontrolled emissions incontrovertible. seems

### And you thought that was it

But the uncertainty doesn't stop there. Countries respond to the crisis in innumerably different ways. One distinction is between the developed and the developing. In recent times, much has been said about the change from the system of developed haves and the developing have-nots to a globalized world where emerging economies have an increasingly large slice of the world's trade, GDP growth and indeed, emissions. Today, amid news that China may soon eclipse the United States as the world's biggest manufacturer, predictions that countries like China and India will develop an appetite too voracious to be sustainable ring true. An incisive report in Foreign Affairs on China's appetite four years ago said that, "China's developers are laying more than 52,700 miles of new highways throughout the country. Some 14,000 new cars hit China's roads each day...it is expected to have even more cars than the United States [by as early as 2040]". Four years later, the real statistics are beating the

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Diplomacy has a knack for promising much m i s t less than is necessary

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to more big emitters which have no intentions to go green any time soon. This affects the diplomacy between countries in a number of ways. First, emerging competitors feel no principle reason to scale back growth which developed countries have been enjoying for years. Second, increased capitalistic exchange drives growth using tools and resources upon which there are currently few restraints. Even more disturbingly, emerging countries often emulate developed ones by taking a similar path to growth. Third, growth in such a manner not only justifies megamalls, Silicon Valleys and extravagant airports but a need to use all this to bring millions of people above the poverty line. Thus, a dimension of responsibility is palpable - decisions not only for heads of state in rich countries but also for heads of large corporations

and firms which have driven their growth in a way now emulated by others. They must decide how best to go green and not doom people to poverty in the process.

Fortunately, the climate change community has come a long way since the days of the Kyoto Protocol where policy on environmental issues was viewed more as a preference than a moral imperative. Louder environmental groups, lobbies and political parties influence the public more than ever, perhaps after years of example in the European Union and Japan. The desperation to do something - anything - was evident in the proceedings of the UN climate conference in late 2010 at Cancun, Mexico. In fact, The Economist's summary report hailed Cancun as a success and said about items of agreement: "One was a pledge of \$100 billion a year from north to south to help pay for emissions cuts and climate adaptation by 2020...[another was] an agreement on REDD+, a system to reward countries for lowering rates of deforestation. [However] moves towards a deal on shipping and aircraft fuels...fell out of the text." We can view the relative success of Cancun in two ways. First, a perceived failure at an earlier conference in Copenhagen galvanised the global community to do more. And second, there was a more active interest by America and China which have traditionally been the biggest obstacles to any consensus. You can almost taste the progress.

But diplomacy has a knack for promising much less than is necessary. How much do firms and corporations contribute to the change? Historically, profit-motivated actors have said that they have the least to gain. But do they? Ecological modernization, a theoretical position in the environmental sciences, believes that these actors have much to gain by actively gearing their industrial processes towards a greener, less-emitting future. This provides the 'first-mover' advantage that European countries like Denmark and Norway now enjoy - access to niche markets as first producers to a more conscious consumer. But the challenge is where countries such as the United States are so deeply "locked-in" to their dependency on oil and other resources, to first get rid of the dependency and begin anew. So, one of the easiest ways to get industry to change is to give incentives to change - taxing those who do badly or giving tax breaks to those who do well.

China, perhaps because it has come under fire in recent years for being so belligerent on the environment, has recently made plenty of foruters reported that a high-level Chi- tune's list of 10 Green Giants pronese official had announced that the vides a few examples: Honda has Chinese government would begin to invested heavily in its hydrogen fuel impose emission targets on regions and cell FCX and promises a reduction highly-polluting industries, a move in emissions from its factories by 5%

recent years, likely most the due to massive incentives the government provides in the form of breaks tax and rewards. This is welcome news. but China still lags behind many European countries. Germany, for instance, added 8,000

megawatts of energy in solar cells - own used hardware and other e-waste. Geophysical Research Letters. They making it a bigger consumer and pro-

ing beacons like Japan and Italy. But But if you felt the panic tapering, showed that over the last 50 years the then, the European Union has always think again. What all scientists agree temperature had increased by 2.7 °C. done better - EU and Japan are well upon is that immediate action needs Results like these have convinced scion track to meeting Kyoto Protocol to be taken. But there are reports entists that that strategies need to be targets of reducing 2008-2012 emis- such as the World Energy Outlook planned to avoid the most disastrous sions to 8% below 1990 levels, and published by the International En- of repercussions. "We now see warmthe EU has committed to even further ergy Agency that go further and say ing is taking place on all seven of reductions before 2015 at Cancun. If that even if we stop emitting right the earth's continents in accord with you're looking for teacher's pet, there now, the current levels of greenhouse what models predict as a response to you go.

ward moves. On January 17, 2011, Re- getting better everywhere. Fordesigned to reduce 2005 emissions by between 2005 and 2010; Tesco plays versity of Washington and colleagues a Reuters headline declared China to list of the greenest companies reveals temperatures in the Antarctic over be one of the major suppliers of so- even more: HP, for instance, takes the past 50 years. They found that the lar voltaic cells and wind turbines in the lead in managing and recycling its warming was taking place in a much

### EU and Japan are well on track to meeting Kyoto Protocol targets

by climatologist Eric Steig of the Uni-40-50% by 2020. Limiting polluting with the new green consumer with detailed the increase in temperatures industries isn't enough, however, and stores that recycle everything, put- across the Antarctic. The team used China seems to be doing better on ting 'carbon cost' labels and powering satellite measurements and historical that score as well - just 5 days before, them using wind power. A Newsweek weather station data to calculate the



▲ We share their skepticism.

### ducer of solar energy than other shin- The shape of things to come

Industry's also shaping up. Solar more of warming. As we write, there York Times." cells seem to be doing well overall, as is ever-increasing evidence of global companies like MiaSole in California warming and several studies have put the create cheaper, more efficient cells forth data that shows the steady rise tors and China seems to producing them in temperatures all across the world. temperatures. like hot cakes. The news seems to be In January 2009, a letter in Nature tries began spewing out enormous

larger area than previously reported and that it exceeded 0.1°C per decade. These results evidence are that human-induced warming is a global, not a local, phenomenon. Later in October of the same year, the results were corroborated by Liz Thomas and colleagues from the British Antarctic Survey in

took ice core samples from the southwestern Antarctic Peninsula which gases will still lead to half a degree greenhouse gases," Steig told the New

> Greenhouse gases (GHGs) are most important perpetrain increasing world-wide Before the indus

amounts of GHGs, the global concentration of atmospheric carbon dioxide used to be 280 parts per million (p.p.m). Author and environmentalist, Bill McKibben (around three years ago) asked veteran climatologist James Hansen, director of NASA's Goddard Institute of Space Studies in New York, to 'identify the maximum concentration of atmospheric carbon dioxide for a healthy planet'? Before Hansen performed the ensuing three-month study, scientists had talked about limiting the GHG level to between 450-550 p.p.m, which was roughly about twice

0.5

0.0

-0.5

-1.0

1000

1200

(0°)

temperature

5

Departures

to 1990 average

from the 1961

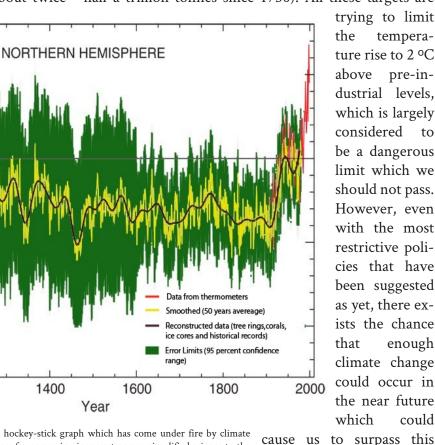
be hard put to recover from such a blow. Once more this highlights the importance of deciding on solid defensive and preventive long-term policies that should be put into action. Scientists have defined targets that should not be exceeded if we want a relatively safe future. These include the already mentioned global atmospheric concentration of 350 p.p.m, peak global emissions in the year 2015 and a total amount of one trillion tonnes of carbon dioxide in the atmosphere (we have already released more than half a trillion tonnes since 1750). All these targets are

pre-inthe dustrial concentration. Hansen's figturned ure to be out 350 p.p.m. If nothing else, this ought to have been the cue for governments to implement policies which would control the GHG emissions, since the increase concenin tration levels

was rising fast and the safe levels rapidly decreasing.

The imminent danger of rising temperatures is rising sea levels. The exact amount by which the levels

will rise is still under debate. There are a number of causes because of which sea levels can rise: 'thermal expansion' of water due to high temperatures, 'calving' of icebergs (breaking off of huge masses of ice from the parent iceberg) and 'dynamic thinning' in which warmer water is causing the ice sheets to melt much more rapidly than previously thought. Various calculations, incorporating different causes have put the range of increase between 0.54 m to more than a meter by 2100. Different studies have shown that the worst hit areas (due to increase in water levels) will be densely populated port cities, especially in Asia. The resulting damage could be huge, having an adverse effect on global GDP. Since areas most exposed to danger are either developing economies, they would



Above is the famed hockey-stick graph which has come under fire by climate change skeptics and others for conveying incorrect or oversimplified science to the public. The creator of this graph, Michael Mann, was implicated by the Climategate leak of documents but exonerated by an independent inquiry as explained in the text. The graph takes temperature measurements mostly from tree ring data, which is a contested measure, replaced by ice core data in other climate science papers. In the graph, note the error bars and the sharp increase near the 1900's.

1400

countries as to a plan of action and the general attitude of the decision-makers which seems loath to do anything till the last minute, scientists have started wondering at what the state of the world would be if we miss our target. In an article in Nature, Martin Parry of the Imperial College of London and colleagues have discussed effects of a 3% yearly decrease in GHG emissions beginning at different times. Our safest bet is an immediate start of such a reduction process (year 2015) in which it is 'just' possible that we meet our target and the temperatures would then start decreasing until they reach the pre-industrial level within a few 'centuries'. The longer the reduction process is delayed, the more severe would be the consequences making it even harder and longer to recover. As a precaution

could

limit. Because of the rapid

increase in global emis-

sion levels, no noteworthy

agreement between the

scientists believe that we should look to adapt to a 4 °C rise in temperature which could mean huge GDP losses, displacement of millions of people, starvation, disease, fire and flooding. In 2009, 65 European research centres concluded, that to avoid overshooting the 2 °C target, the global emissions would have to reach 'zero' till 2100 and even then we would need to pull carbon out of the atmosphere by 2050. M. Granger Morgan has very aptly put it, in the November 2010 article of Scientific American: "If we don't act soon to reduce carbon emissions dramatically, a few more decades may commit us to a course that could lead to global catastrophe. We're not certain about that, of course. But the risk is real, and the odds are not in our favor." Actively pulling out carbon from the atmosphere, i.e. controlling climate using technology is not a thing of science fiction anymore. The rapid progress towards the targets makes it seem as if things are really getting out of control. In such circumstances, even the craziest ideas such as 'geoengineering' are being seriously considered by scientists as the last-ditch effort to save the planet. Geoengineering includes example such as pouring iron into the oceans, so that plankton blooms are caused which can draw the carbon out of the atmosphere into the ocean for hundreds or thousands of years. Spraying sulphate aerosols into the upper atmosphere could be used to reflect sunlight to prevent increase of temperature, or to spray sea-water onto clouds to thicken to achieve the same purpose. Other ideas such as covering sea ice with silicon beads to prevent their melting also fall under geoengineering. However, all these drastic actions are considered to be helpful 'along' with GHG emission cuts, which still should be the major aim of policy-making. A problem with geoengineeing is that it could become a legislative nightmare with countries trying to come up with laws which were to govern global climate. There's also this problem of how little we know of the consequences of measures like these. Messing with the climate could have unforeseen and possibly destructive outcomes. Experts are calling for more research in this area to be better able to know the different possibilities and difficulties that no one has even anticipated. In every case, more information would help to make an informed decision on the subject.

### Uncomfortable wrap-up comments

Needless to say, we feel that every country should make a concerted effort to cut down GHG emissions as best they can. Pakistan, although statistically not a big polluter standing at a little more than 30 million metric tonnes of carbon emissions or 0.4% of global emissions, needs to do more. That's not to say that Pakistan is as belligerent as say, China. In fact, Pakistan has been committed to reducing GHG emissions since 1992 when it signed the United Nations Framework Conven-Change (UN-FCCC) at the Earth Summit.

Pakistan is one of the top 20 countries most tion on Climate likely to be vulnerable to climatic extremes.

Pakistan also became a signatory to Kyoto in 1997 where it undertook Kyoto's Clean Development Mechanism (CDM), ostensibly the only instrument that helped developing countries to propose low-emissions projects. The successful implementation of projects under the CDM was meant to lead to the generation of carbon credits/Certified Emission Reduction (CER). Theoretically, these CERs were then meant to be purchased by developed countries thus creating a workable incentive. Here, Kyoto policies went awry. Pakistan has garnered little financial benefit as yet, even though many sectors were eligible for CDM (Energy, Transport, Mining, or Waste Management for instance). Only one project was approved, which put us at number 16 on the list of successful countries. In contrast, China, India and Brazil, though noisy at conferences, are top three at the moment. Currently, beyond CDM, Pakistan is doing projects with Global Environment Facility, World Bank, and a collaboration between the Ministry of Environment and the Railway in a Carbon sequestration project involving reforestation. Two conclusions can be drawn. First, incentives for developing countries need to be more practicable. Second, a tremendous lack of experts on climate change has led to little policy awareness and a general deficit of climate change discourse.

This is a shame, mostly because Pakistan is one of the top 20 countries most likely to be vulnerable to climatic extremes. Clearly, averting disastrous results in not only in the interests of one country, but of our whole civilization. Recently, it has become increasingly difficult to track down earth's energy. The incoming and outgoing energies do not match up. Does earth have a feedback loop that isn't allowing the incoming energy to manifest itself? The answer to this question is complex but one thing is certain - procrastination on such affairs comes with a risk that probably cannot be averted. Even if we put aside everything that we already know, the range of risks from the unknown is immeasurably large. Human involvement could very well set off a series of reactions that could destroy many of earth's as-yet-unknown systems. The uncomfortable thesis is thus this: we're living on a knife's edge and even the smallest act could tip the balance. That act could very well be 'not doing' anything about it. One thing we're sure about species is that they go extinct. Let's not hasten the process for ourselves

# **Renovation Required**

## BY ABDULLAH KHALID

would like to suggest a change to the way we teach Physics, or any science for that matter. I suggest the change because I see a problem. To illustrate • the problem I ask: what is the purpose of learning Physics at a university level? Though there can be many answers, the most typical and generally applicable one is that Sultan - let us call our young apprentice Sultan - would like to go on to become a physicist. But who is a physicist? Let's venture a guess: he is someone who explores the world around us and tends to find models and theories about it.

So I say: shouldn't our education system be trying to

teach Sultan the skills that would help him become a good physicist? I am sure you agree. And I feel that a prime objective should be to teach him to use a set of observations to come up with a model and then develop that model mathematically. Again, let me assume that you agree. Now I would like to ask you: does the prevalent education system teach

this skill? And here, I would like to butt in with my own answer. No, it

does not. Let me explain. Most likely, Sultan would be taught Newtonian Mechanics, Electromagnetism, Quantum Mechanics, Statistical Mechanics, Calculus, Probability and some Differential Equations. But notice: this plan seems to be a little too concerned with teaching current knowledge. Of course this is important: you need to know what has already been done so that you can build upon it. But let's not take this too far. Sultan is not being taught how to come up with new Physics.

Some would argue that teaching it would be like teaching him how to swim. It is learned implicitly, by observing and practicing. You can't tell Sultan to flap his arms like this and push his legs like that. It just doesn't help all that much. Some argue that teaching Sultan to generalize some observations and do some thought experiments like Einstein is as impossible as teaching someone to swim. I agree. From what I know it really is tacit knowledge. But I am not claiming that the system explicitly teach Sultan to come up models. It can do it implicitly.

Every so often, the system needs revisiting and renovating. This is one of those occasions.

My proposed change to the education system is the following: take a formerly developed model and the experimental observations associated with it. Take any models that conflicted with this one at that point in time. Tell Sultan to resolve the issues in the 'old' models and match the experimental observations. What Sultan needs to appreciate is that scientists often lumber about with dozens of incorrect proposed models taking years or decades before some coherence begins to emerge. What we study when we look back final results, the model that explains the experimental observations correctly. Occasionally, effort is made to provide historical perspective. But often

> there is little exposure to the tangle of failed models and only a tracing to the correct one is rigorously performed.

> Before a person is admitted to a PhD program he is asked to give a test which contains an oral component. Your job is to solve

how your thought processes work to test how long it takes to come up with

obvious and non-obvious consequences of what you know. I feel that undergraduates need to be given the opportunity to learn this during college as a mandatory part of curriculum. The reasons are simple. Scientific knowledge that is old but remains accepted, like Newtonian Mechanics, seems obvious to most students. Something like Quantum Field Theory remains non-intuitive and abstract even to the more experienced practitioners of the field. Progress is slow and this research reality must be factored into undergraduate education.

Of course, there will always be a large disparity in scientists' contributions. There are external factors like working with the right people and a good dose of luck. But implicit skills that can be controlled. Really: what were the skills that led to Einstein to come up with not one or two or three but four revolutionary papers in just one year (1905) later termed 'Annus Mirabilis' (Miracle Year)? And if these skills really can be controlled, then it would be a shame to waste the opportunity

a hard problem in front of a number of faculty members. You are asked to show







FEATURE

# **Smitten With Witten**

T all began with Einstein's Dream. The ultimate goal of the unification of all the laws of the universe. Till the moment he died, Einstein was obsessed with 'the theory of everything', something that would resolve two very contradictory things: Quantum Mechanics and General Relativity. Some very brilliant scientists have since worked on a theory called the 'string theory' which might very well bring these two different ideas into harmony. Gabriele Veneziano, Leonard Susskind, John Schwarz and Michael B. Green are some of the scientists who have had a major contribution in the development of string theory. The progress in the area was so much so that Stephen Hawking, in his book "A Brief History of Time" had said with much conviction that physicists would be able to present 'the theory of everything' before the end of the millennium. They really might have done so, thanks to Ed Witten.

Edward Witten took the scientific

community by storm with his presentation of M-theory at a conference at the University of Southern California in 1995. The theory united the five different string theories and now supersedes them. The explanation of 'how' this theory has brought a revolution in string theory would be too complex an undertaking; however, to dwell on the man behind it seems more promising.

Scientific American has claimed that Ed Witten is "the smartest man on earth." He made Time Magazine's list of 100 most influential people of 2004. He was fifty-three when he received the honor. John Schwarz, now a theorist at Caltech, said, "Ed is unique, the kind of person who comes along once a century." Mr. Witten's IQ is as obscure as the reason for the name 'm-theory' but he has the highest h-index of any living physicist. The h-index, for everyone's general information, attempts to measure both the productivity and impact of what Edward "The Martian" Witten, father of M-theory, celebrates his 60th birthday this August.

**BY NAYAB ABIDI** 

a scientist or a scholar has published. It is based on the set of the particular scholar/scientist's most cited papers and the number of citations that they have received in other people's publications. Thus, we can safely assume that Ed Witten is something of a genius.

Edward Witten was born on 26th August 1951 in Baltimore, Maryland, to a gravitational physicist, now an emeritus professor at the University of Cincinnati: Louis W. Witten. Even at the tender age of four, Edward Witten was talking to his father about physics and science like an adult. Much of his early information about science must have been gleaned from these discussions with his father. The tables were soon turned when Louis Witten was sitting in the audience while his son presented his paper on m-theory enlightening everyone else.

The funny thing about Edward Witten is that he excels at things he never really chose to do in the first place. Probably because of his father he was always interested in physics. However, he received his bachelor's degree from Brandeis University in 1971 in History with a minor in linguistics. His goal after graduation was to pursue a career in journalism. With that in mind, he worked in the presidential campaign of George McGovern in 1972, who was a democratic nominee and lost badly to Richard Nixon. After this not-so-successful venture, he derived many conclusions: that he did not have the disposition to shine in these fields, that excellent as these fields were he wasn't really cut out to make a living out of them, that his interest in journalism seemed to be waning and that really political journalism was not his cup of tea. At this point history, linguistics, journalism and politics had been eliminated from his career options. But Ed Witten was far from having made up his mind. He enrolled at the University of Wisconsin for a graduate degree in economics but dropped out only a semester later. Fate was slowly guiding him towards his destiny as he finally joined Princeton University in the field of applied mathematics. He would make yet another change by finally shifting departments to physics and receiving his Ph.D. in it. Edward Witten had started his journey.

### **Glory days**

He still made a few more achievements on the way. After completing his Ph.D. he worked at the Harvard University as a Junior Fellow. He was later accepted at Princeton University as a full Professor at the age of 29, one of the youngest to be appointed to that position. In his research, Witten began his work on quantum mechanics. Even though he showed every sign to be extraordinary, his efforts towards achieving Einstein's Dream, towards 'The Grand Unified Theory' were turning out to be a little of a dead end. It was then that he shifted his focus to string theory. Before Witten made his debut into the field, superstring theory was considered to be an esoteric and eccentric sub-specialty. But this was to make Edward Witten a superstar and string theory the hottest area in physics. He poured in all his energy to further develop string theory and told *Scientific American*, "It was very clear that if I didn't spend my life concentrating on string theory, I would simply be missing my life's calling." His was probably the most roundabout way of finding a life's calling but he can still be happy applying bizarre mathematics to physics (something he considers he's really good at) to the rest of his days.

While Edward Witten was teaching at Princeton, he students had come up with an endearing nickname for him: "The Martian". This in their way was a tribute to his brilliance. It also reflected on his soft-spoken voice and his style of lecturing. He would go into deep thought, gathering his ideas, while his class would wait for him to continue. Ed Witten is as distinct a human being as it could get. In his appearance, in his voice and definitely in his intelligence which has lead other scientists to observe not so immodestly – "we consider ourselves brilliant, but he is so much better than the rest of us." He frequently visits Israel in the efforts to establish peace between Middle Eastern Arabs and Jews.

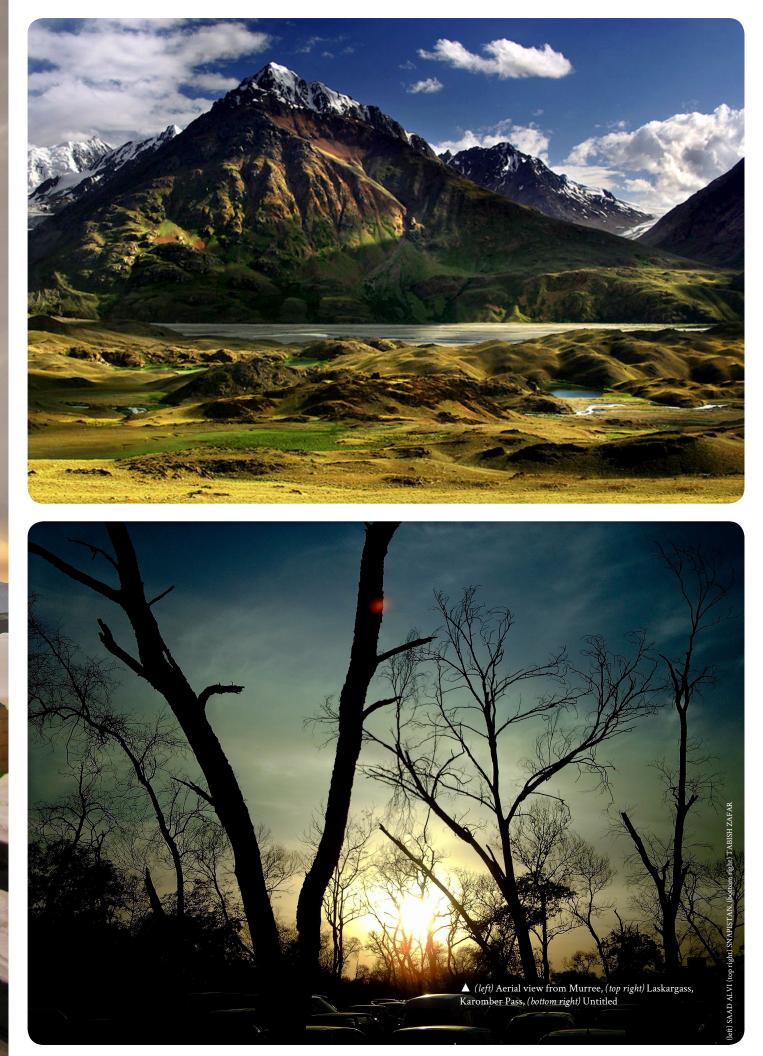
Mr. Witten seems to be leading a charmed life. He has success all around. His brother Mathew Witten is a screen-writer for some of the most popular television shows such as House (which is frankly 'very' cool), Medium and Law and Order. He's married to Chiara Nappi who is also a physicist and a professor at Princeton University at the moment. They met in 1975 when they both were in France attending a Physics summer school in Les Houches. They have three children Ilana, Daniela, and Rafael and a grand-daughter named Nava. Both Mr. and Mrs. Witten, now that their children are in the process of moving out of the house, are thinking of getting down to some serious physics.

Ed Witten is reported to do calculations only in his head. Holds views that scientific theories being old does not mean they aren't wonderful and thus has a great regard for Calculus and thinks that the theory of evolution and the understanding of the genetic code a great insights. Is famous enough to have been mentioned in the 1999 episode of Futurama and the 2002 episode of Angel called supersymmetery. Has a list of awards that can easily put you to appreciating the extent of human genius or into a fit of insecurity, as your nature dictates. Is slightly paranoid, and it is rumoured that making small decisions is an impossible task for him, thus making him a scientist in the truest sense. He also just celebrated his 59th birthday last August

# **SECTION** Nature Photography

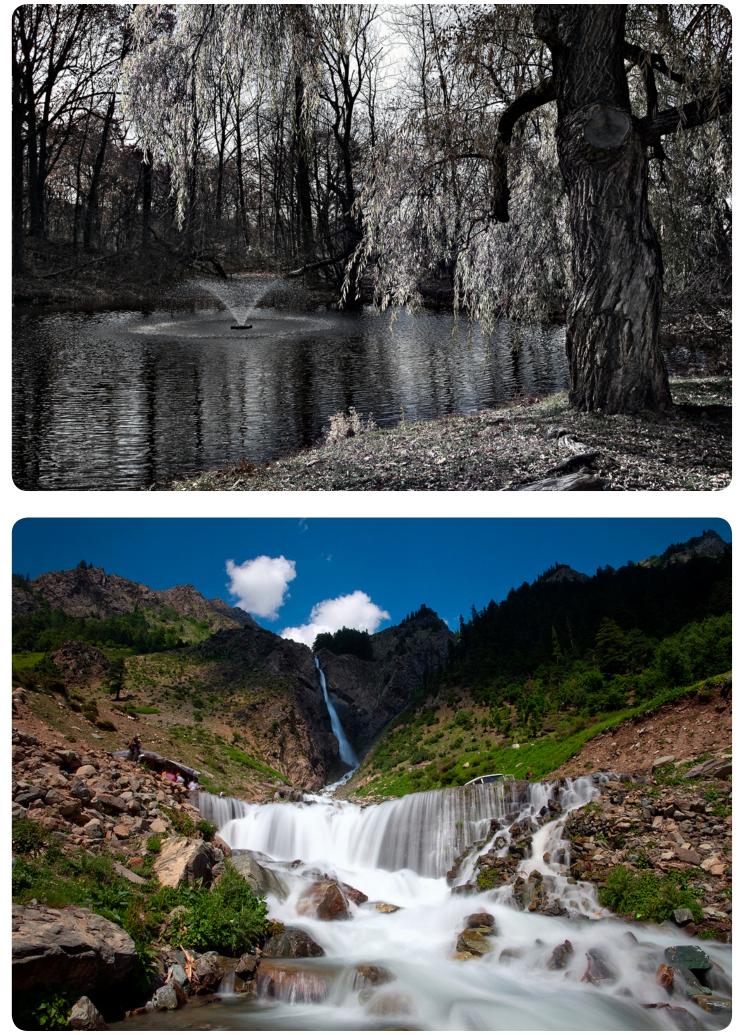
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AND FLATS













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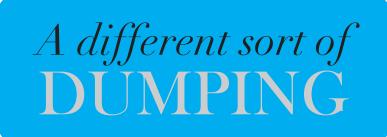


▲ (top left) Deer Farm near Gharo, Sindh. (bottom left, right) These are shots from the Lahore Zoo.



▲ The background photograph is that of Orion. The top inset is the Milky Way over the Cholistan Desert. The bottom inset is the Horsehead. Another sampling by the photographer who shot these photographs is on pages 37 and 38.

SAAD ABBASI



The world is in a pickle with its accumulating e-waste, and developing countries seem too eager to make it worse BY SANA BAJWA

ne of the defining features of humans is their ability to mold the materials available to them in their environment into tools. The oldest evidence of tool making found has been dated to some 2.5 million years ago. From there it took our ancestors all the way till around 5,000 years ago to make another significant jump in technological advancement. But from then on we see technological development advancing at an exponential rate. In his essay published at the turn of the century, Raymond Kurzweil predicted that 'we won't experience 100 years of progress in the 21st century-it will be more like 20,000 years of progress;' and we can see the proof of his statement all around us. We live in a world today in which technological breakthroughs are occurring on an almost monthly basis. We are consumed by the constant desire to get the latest gadgets. We want them upgraded, smaller, better, faster, and sometimes, we just want them in a new colour. But have we ever stopped to wonder where our now archaic desktops go? What the fate of our mp3s and our 3310 Nokias is? It is easy for us to dismiss fashions and old technologies from existance, but the physical proof of them can not be got rid of as easily. With the rapid obsolescence of technology, E-waste has become a major global issue. Not only is it a problem because of the sheer mass of the waste, but it is also a problem because of its toxicity. As a result a conflict arises between the environment and technology. Do we continue to harm the environment for the sake of the centuries of human effort and development that the advanced level of technology today is a product of? Or do we look to limit it and protect the environment instead?

To understand this problem properly, we need to first see how the world has been dealing with it up until now. Initially, e-waste was treated in the same way that conventional waste was treated in; by dumping it in landfills. However as it built up at an increasingly worrying rate and toxins from it started leaking into the environment, there was a call for tighter legislation and a pressure to recycle. While some recyclers did genuinely try to recycle the material, a large amount of this 'recycling', an estimated 50 to 80 percent, took the form of exporting the e-waste to third world countries. Since the cost of safely recycling e-waste is high and the efficiency rates of extraction of useable raw materials from it is low, it is almost inevitable that e-waste will move down 'the economic path of least resistance'. Third world countries are in no position to be able to effectively regulate the e-waste

coming into their country, and are even less capable of recycling it in an environmentally safe manner. Once the e-waste gets there, it is dumped in the open where workers extract raw materials from them through a number of methods, including simply burning them and treating them with acids such as nitric acid and hydrochloric acid. This second process is used as a way of extracting the gold that is used to plate certain computer parts. As a result, the surrounding soil, air and

A 2010 article in Nature News estimated that there were 180 million units of computers being dumped worldwide

water are contaminated by the acids, as well as affecting the health of the workers. It can cause pulmonary edema, circulatory failure and even death because of the inhalation of the fumes from the acids. This process usually takes place by a river, so the acids that are washed away by it also affect the oceanic life and the river banks. The following substances in e-waste have potentially harmful effects on the environment and individuals; lead, cadmium, mercury, barium, polychlorinated biphenyls (PCBs), polyvinyl chloride (PVC), beryllium, carbon black, phosphor and brominated flame retardants (BFRs) including polybrominated diphenyl ethers (PBDE's). An article published in PNAS in 2009 reported that the PBDE levels in workers in Guiyu, a dumping ground for e-waste in



Also in *Science and Ethics*:

Murky Science

ILLUSTRATION BY BURHAN-UD-DUN



China, was 'more than 100 times higher than in Europe'.

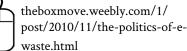
When this issue of dumping and its affects were brought into the limelight, the Basel Convention was created to deal with the issues it highlighted. In 1994, its signatories agreed to a complete ban on the export of hazardous wastes from the first world to the third world. However, its effectiveness proved to be limited, as third world countries did not, and still do not, have the resources to enforce it's laws. As a result, large amounts of e-waste were being imported illegally. In a 2009 PNAS article, Eddy Zeng, an organic geochemist, said that 70% of the world's e-waste was being processed illegally in China. Computer units are also legally exported in working condition, for reuse, to third world countries, but this also adds to e-waste as their life ends in these countries and they end up as simply another contribution to e-waste. This problem has been exacerbated by the consumers of electronics in these A 2010 article in Nature News estimated that there were 180 million units of computers being dumped worldwide and that this number would increase to up to 1 billion units by 2030.

So what needs to be done about this problem? Technological advancement should not be stopped. But the producers of these products should be made responsible for the safe disposal of their products. Their responsibility to their products should extend through to the end of the products life cycle. Another approach would be to make manufacturers use less toxicants in their electronics, as all forms of recycling them simply involve moving them from one form to another. Technological advancement should be carried out in a responsible and sustainable manner. The level of technological advancement present in the world today is a testament to the human intellect and its ability to conceive and create, but this ability should extend to take account of the affects of these advances too

### [FURTHER READING]

**Exporting Harm: The Hightech trashing of Asia** *The Basel Action Network (BAN) and Silicon Valley Toxics Coalition;* February 25, 2002.

## Comment on this article at:





#### Also in Science and Literature:

Evolutionary Fables May the Force(s) Be With You Pullman Physics



# Mathematical Adventures /n/ WONDERLAND

hat happens when a Lecturer in Mathematics at Oxford takes delight in wordplay puzzles, wants to entertain children with stories, and does not like the new developments in mathematics in his age? Why, of course, you get the wonderful Alice's Adventures in Wonderland, Through the Looking Glass, and other delightful stories and poems. Written by Lewis Carroll and still in print, these are the among the most popular pieces of fiction, bringing delight to countless children. However, there is more to Lewis Carroll than meets the eve.

Lewis Carroll, whose real name was Charles Lutwidge Dodgson, lived in a time when a revolution of going on in the world of mathematics and logic. The old guard of that time, of which Dodgson considered himself to be a part of, believed that "mathematics should be based on axioms, the truth of which ought to be self-evident." In contrast, the new guard recognized "that the most we can hope for is a set of postulates which we choose to accept." The difference might seem not too important for someone not familiar with mathematics, but this new idea is the basis of almost all of modern mathematics. Though, the Alice stories on the surface seem meant to entertain children, there were in fact designed by Dodgson to illustrate to his peers in the field of mathematics and logic what he thought was so inherently wrong with their new ideas.

Lewis Carroll's famous children's book was also a critique of the mathematics of his time. BY ABDULLAH

KHALID

### **Curioser and Curioser**

this is by taking the idea his peers cham- pig'. pioned and taking them to their logical limits, where they took up a absurd od's of making his points form. In fact, the whole of the Alice ad- is through clever word ventures take place in a completely new play and puns. For examworld that can be seen as Carroll idea of ple, when the caterpilwhat the world in which the new math- lar advises Alice to "Keep ematical ideas were accepted would look your temper.", if all we do like. Consider, for instance, the scene of is to find him incredibly Alice's meeting with the Duchess and rude or at least extremely her baby. Everything is wrong with this mysterious we are missworld. The Duchess is a very bad aristo- ing the pun that Carroll crat and a horrible mother, paying no at- intended. In his times, the tention to her crying baby. The Cook, if 'temper' was not only used anything, is of the worst kind, putting too in the sense of anger but pepper in the soup and throwing pots and also to mean the properties of an object. pans at her mistress for no reason at all. "Keep your temper." actually means to for In the middle of this the baby is a 'queer- Alice to keep her properties or proporshaped little creature" whose legs stick tions. In Alice's out in all direction. Alice takes it outside, tale, this might only to find that it turns into a pig, albeit only mean for with it's legs sticking out and small eyes her to return to like those of the baby! What's happen- her proper size ing here is that Carroll is mocking the and proportions, idea of continuous functions in topology which (then the field of projective geometry). finding very hard The idea is that if an object is varied in to do. However, a set manner within certain limits, some in the real world it's properties don't change. This was a it's a references new idea in Carroll's time and in Carroll's to symbolic al-



transformed, takes it to it's logical limit don't-- till I tell you ... "

and comes up with the absurdity of an One of Carroll's favourite ways of doing 'ugly' baby turning it into a 'handsome

Another of Carroll meth-

she

gebra and new mathematical inventions such imaginary as numbers, which as the name suggests have no physical inter-

idea of objects being transformed, takes it to its logical limit and comes up with the absurdity of an 'ugly baby' turning into a 'handsome pig'.

He takes the

pretation - or a sense of 'proportion'.

Later on, in Through the Looking Glass, Alice encounters Humpty Dumpty- the one from the popular nursery opinion a step in the wrong direction rhyme - perched on a very thin wall, and from the rigidity of Euclid's Elements that unknown to him very likely to fall. Alice is he valued so highly, being one of the old initially confused when Humpty Dumpty guard. Ridiculing this idea is easy enough uses words that don't seem to fit into the for Carroll. In topology the objects be- context of the sentence in which they are ing transformed are usually geometric used. When she admits that she doesn't figures, but he ignores this for a mo- know what he means, Humpty Dumpty ment as he takes the idea of objects being smiles and informs her, "Of course you



**IOHN TENNIEI** 

### FURTHER READING 1

The Mathematical **Manuscripts of Lewis** Carroll Warren Weaver Proceedings of the American Philosophical Society, Vol. 98, No. 5 (Oct. 15, 1954)

Metalanguage in Lewis **Carroll** Sophie Marret SubStance, Vol. 22, No. 2/3, Issue 71/72 (1993)

Alice's adventures in algebra: Wonderland solved Melanie Bayley, New Scientist, Issue 2739, 16 December 2009.

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### This leads up to the following exchange:

'When I use a word,' Humpty Dumpty said in rather a scornful tone, 'it means just what I choose it to mean--neither more nor less.'

'The question is,' said Alice, 'whether you CAN make words mean so many

different things.'

'The question is,' said Humpty Dumpty, 'which is to be master-that's all.'

Alice is much too confused to ask what he means by 'master', and instead relents to his viewpoint for a while, asking him what he means by words he uses in the dialogue that follows. But later when she leaves him she declares to herself, "of all the unsatisfactory people I ever met-" (p.203), but never finishes the sentence, on account of a loud crash that is nothing other than Humpty Dumpty falling off his wall. The message is clear. Humpty Dumpty is none other than new age mathematicians, who choose to give symbols names as they wish, and who unknown to themselves are in a very precarious position and are soon to fall down to their destruction.

### **Absurdist logic**

Carroll had a penchant not only for including mathematics and logic in his literary works, but also of making his arguments in the field of logic and mathematics in literary style. Most notable among these is What the Tortoise Said to Achilles (1895), in which Carroll borrows the Tortoise and Achilles from the paradoxes of motion of Zeno. In this piece, the tortoise asks Achilles to convince him using logic to accept the conclusions of a simple syllogistic argument based on the given premises. In the highly entertaining dialogue that follows, Carroll sets up a logical paradox that has yet to properly answered. The paradox deals with the metalanguage, the language that describes language itself. For example "my last sentence was about metalanguage" is a statement of metalanguage, for it describes what a statement of language (and not I) talked about. The purpose of the paradox is to note that metalanguage is itself governed by rules similar to those governing language, and so there can exist a meta-metalanguage that describes statements of metalanguage. But then there also exists meta-meta-metalanguage and so on and so forth until we have an infinite number of metalanguages. This is a problem once one realizes that rule of inference which lets us say that "Socrates is a man" and "all men are mortal" and then conclude that "Socrates was mortal", is correct because metalanguage says so. But then to validate this rule, there needs to be a rule in meta-metalanguage about this rule. But for that we need a rule in meta-meta-language... And so we have a infinite regress that has never been properly resolved.

Carroll alludes to this problem with the field of logic much earlier in Through the Looking Glass.

### A dialogue between Alice and the White Knight takes place in the following way:

'Is it very long?' Alice asked, for she had heard a good deal of poetry that day. [...]

"The name of the song is called "HADDOCKS' EYES."

'Oh, that's the name of the song, is it?' Alice said, trying to feel interested.

'No, you don't understand,' the Knight said, looking a little vexed. 'That's what the name is CALLED. The name really IS "THE AGED AGED MAN.""

'Then I ought to have said "That's what the SONG is called"?' Alice corrected herself.

'No, you oughtn't: that's quite another thing! The SONG is called "WAYS AND MEANS": but that's only what it's CALLED, you know!'

'Well, what IS the song, then?' said Alice, who was by this time completely bewildered.

'I was coming to that,' the Knight said. 'The song really IS "A-SIT-TING ON A GATE": and the tune's my own invention.'

At first the reader himself might be quite confused by the semantics of the Knight. But a closer reading reveals that Carroll is talking about metalanguage. The poem belongs to the language level, the name of the song belongs to the level of metalanguage, but what the name of the song is called belongs one level up in meta-metalanguage. Poor Alice, fails to keep this distinction, and gets horribly confused by the answers she receives, though all the Knight is doing is keeping his semantics clean and correct.

It was in these ways that Carroll sought to save the mathematics he knew from the birth of new ideas that were trying to change it into something he was not comfortable with it at all. But he was no martyr. The ideas he was trying to repress were the very ideas that were at the centerfold of mathematics in the decades to come, and resulted in unimaginable developments in human knowledge in ways unforeseen. Without those ideas, the world would have been a much poorer place indeed. But he was no devil either. In at least one place, his contribution is still remembered and debated upon. In other places, which were not the subject of this piece, he had many notable contribution and he is well remembered for them. But forgetting the issue of mathematical and logical contributions for a moment, we can remember that Lewis Carroll wrote two wonderful tales that have brought supreme delight to countless people across a century and a half and from the looks of it will keep on doing so for a long long time. That is contribution enough  $\blacklozenge$ 



http://theboxmove.weebly.com/1/post/2010/12/ mathematical-adventures-in-wonderland.html

# **Subliminal Violence**



A bunch of students at SSE conducted research into Urdu textbooks and found that they often glorify violence and yet are deemed appropriate for school-going children. Here is what they found

exalted

erhaps the most disturbing finding of our research was the ubiquitous narratives in the textbooks that indirectly incite violence, or at least mould a child reader to develop a biased frame of mind. In most cases, these narratives do not explicitly callfor violent behavior, but they do certainly glorify the themes of fighting, revenge and war in a way that can easily captivate a child's mind. Even more dangerous is the fact that many of these stories present religion, ethnicity and nationality as a reason for conflict without condemning it or making any effort to contextualize them. Often the words used against certain nationalities are extremely harsh, reinforcing the arbitrary division between "friends and enemies" from a very early age. Typically, a strong sense of hatred towards Indians is imbibed amongst children by including

### [ THE AUTHORS ]

Mehr-Un-Nisa Shahid (Physics '12), Hassan Bukhari (Physics '12), Wafa Veljee (Mathematics '12) and Ali Raza (Electrical Engineering '12), appalled by textbooks currently in use, feel the need for massive reassessment.

narratives of military heroes in almost every grade's books. Below are some other examples that illustrate the inapropriate nature of the content.

### Qarardad-e-Pakistan

Merely one side of a single printed page has been used to summarize the entire history behind the creation of Pakistan. The complex nature and the causes of evolution of strained Hindu-Muslim relations have been completely disregarded to paint a dry, monolithic picture of history. The usage of strong words against non-Muslims is especially noticeable for example " Angraizon ne apni sazishon se barr-saghir par qabza ker lia... (The British conspired and usurped the control over sub-continent)" - a classic case of demonizing colonialism without any glimpse into the political mistakes of the Mughals or Muslims in general. The distinction between Hindus and Muslims has also been repeatedly highlighted: THINGE rehna namumkin qarar dia....", "Hinduon ne mukhanan ka toofan khara ker dia...", "Hindu or Musalmanon ke raaste alag...". The theme of Anti-Hinduism/Indianism courring one in all books. This selective distoredly highlighted: "Hindu-Muslim donon aqwam ka sath

stanis to continue to hate Hindus is indeed alarming.

#### Sacha Khwab

This chapter describes the story of Sultan Noor-ud-din Zangi who apparently uncovered a plot to encroach into the grave of Prophet Muhammad (S.A.W.). Keeping the religious or political significance (if any) of the incident aside, the lessons to be derived from the story are far from being diplomatic. The story ends with the plotters admitting that their Jewish origins and the Sultan slaughtering them straightaway upon hearing of their crime "Talwar nikal kar donon ki gardanain ura din". Considering that this is perhaps the only instance that a primary Urdu textbook even mentions Jews, this chapter is especially dangerous in terms of inculcating religious bias towards Jews in a typical child's mind. Moreover, the story bypasses all routes indicated by law in order to punish a crime, giving the impression that it is justified to resort to immediate killing of anyone who may insult your religion.

#### Jawan Mardi

Ominously titled Jawan Mardi is actually a modified version of the famous legend of Tees Mar Khan. Needless to say that the title is shockingly absurd because the story does nothing except making the reader accept that violence is a norm to be proud of. The cruel killing of thirty sparrows is what earns the protagonist his title; he then witnesses people's bodies being torn apart by lions in a fair and finally burns a magician alive. The story is a clear instance of ridiculous glorification of physical power and its needless exercise. It also depicts that there is nothing wrong with being a silent spectator to violence.

#### **Ek Bahadur Khatoon**

This particular chapter is another occasion where an incident from Islamic history is selected and lauded in an extremely twisted way. Hazrat Khaula bint Azwar has been depicted a mysterious female warrior, as if from an epic movie, who goes on to free her brother Hazrat Zarrar from the enemy prison. But the love for a sister for her brother is completely overshadowed by the grossly depicted drama of war against the Romans. Some of the imagery is indeed very violent but the chapter actually glorifies such acts "Lapak ker naiza uske seenay mein utar dia". The ridiculous style in which the story has been told is indeed an insult to feminist literature; it actually portrays that the only way a woman can feel empowered is if she fights for her men◆



# A Brief History of Star Finding

Marcia Bartusiak's book The Day We Found the Universe is a deeply human account of the history of astronomy, events that unfolded while thousands of future scientists gazed up at the night sky in amazement, and changed the way we see stars forever.

**BY MEHR-UN-NISA SHAHID** 

### COSMOLOGY

Have you ever felt that Dr. Watson has a charm of his own that is always overshadowed by Sherlock Holmes' cunning intuition and luck? Have you ever been intrigued to just skip past the protagonist's gimmicks and explore the sidekick's life instead? The Day We Found the Universe fulfills exactly that desire of yours. It is the story of several Dr. Watsons, the unsung heroes and forgotten places set against the backdrop of the most significant era for cosmology and modern Physics i.e. the early 1900's. The story is special because the whole drama and all characters are real; Edwin Hubble playing your Sherlock Holmes and the mystery delved into being the entire expanse of the Universe.

The author starts her narrative from 1888, the days when the universe was a rather simpler collection of many stars sprawled across the void of the night sky; the world only beginning to develop the technology required to determine how old the stars were and what they were made of. The establishment of the Lick Observatory at Mount Hamilton in California has therefore been described in considerable detail as the harbinger of the trend of giant reflecting telescopes amongst the astronomers at that time. The readers are introduced to the pioneers of spectroscopy such as James Keeler with their role in the merger of astronomy and physics, now termed as astrophysics. The writer then takes you through the developments in optics that further facilitated astronomers' gazing into past allowing them to catalog hundreds of new celestial bodies in a very short span of time. It was almost like the remarkable world opened to a microbiologist with the advent of an electron microscope.

While the frontier of discoveries was being lit up continuously, it brought to scientists' attention the overwhelming vastness of the universe itself and affirmed the Copernican view that our place in the universe may not be that privileged after all. Yet, these developments were not enough to provoke the general public and the scientific community to ask or attempt to address more fundamental



questions such as the origin of the universe, the shape of the cosmos or the age of the galaxies. The stage had nevertheless been set; and the act of staring into an eye-piece day and night was soon to yield astounding results.

Having built up the scene for the ultimate experimental development, the author takes a dive into the world of theoretical Physics which was also undergoing its most exciting phase in history. On the one hand, the discovery of X-rays, the electron, the inception of quantum theory was bringing to light the hitherto unimagined complexities of the sub-atomic world; on the other, there had been no major refinement of the world view on cosmology and the nature of space-time since the days of Newton. The night sky was just what it seemed: a motionless expanse dotted with numerous stars no ripples and no accelerations. It was a static boring picture that Einstein began to repaint. General Relativity revolutionized the scientists' perception of the universe, with some of its results so counter-intuitive they seemed unbelievable. Yet the elegance of Mathematics would win at the end of the day. And here we see an instance of how hard it is to do away with one's long-held beliefs about the world. A curved space-time was acceptable, bending of light beams could be imagined, even a dilated time dimension appeared to be a possibility; yet an expanding universe seemed unnatural. The idea of an expanding universe was in fact so bizarre that when Ein▲ Lick Observatory on Mt Hamilton at night taken from Grant County Park, timed exposure tracks movement of stars in sky and car driving down Hwy 130 from the mountain.

A curved spacetime was acceptable, bending of light beams could be imagined, even a dilated time dimension appeared to be a possibility; yet an expanding universe seemed unnatural. calculations lead him to this result he inserted an additional cosmological constant in his equations to fit the model of a static universe. No wonder, Leonardo Dicaprio terms "an idea as the most persistent parasite" in the movie Inception.

This is where the power of experiment comes in and the parasite is doomed. Edwin Hubble, in his observation of distant nebulae noticed that the light from these distant bodies was red-shifted. This was nothing but the Doppler Effect at work, leading Hubble to conclude that the stars were moving away from us. Hubble himself was shocked at this rather 'blasphemous' conclusion, yet there seemed to be no other rational explanation of his results. It took the scientific community a number of years to acknowledge the implications but eventually there were left no detractors. Hubble came to be known as 'the guy who made Einstein change his mind', an honor that was only second to a Nobel Prize in Physics in those days according to the author.

The book ends with a note on what the establishment of an expanding universe meant for Physics and deeper questions on Philosophy and even religion. Scientists only needed to run the film in the reverse direction to speculate the Big Bang and to start a whole new era of research into the composition of the universe seconds after its origin. It was a humbling experience for humanity as a whole, to realize the earth's speck-like existence in an infinite space-time in the middle of trillions of clusters of stars.

One of the most impressive things about the book is the author's diligent research into the minutest of details. She has made every effort to reveal the human side of the major role players by writing in great detail about their personal lives, their attitudes towards work, their love affairs and even the law-suits against them. It is fantastic to notice how between the politics and personal grudges, the scientific method emerges untainted and never fails to reward its pursuers. The book also sheds light on interesting aspects of what inspires collective scientific development by mentioning the role entrepreneurs played in the establishment of Observatories and Universities in America. Even the rivalry between America and Britain has been accredited with the great progress U.S. made in Science in the early 20th century.

The only drawback of this book - which to many readers may not even qualify as a drawback - is that it's all history and almost no science. An unaccustomed reader may emerge at the end of the book knowing about Einstein's wife's shopping woes and yet not aware of the difference between a nebula and a supernova. Sometimes the author would just drag on the narrative without adding a personal comment or explaining the significance of a particular event. At other places,

It was a humbling experience for humanity as a whole, to realize the earth's speck-like existence in an infinite space-time in the middle of trillions of clusters of stars seemed unnatural.

however she does pleasantly surprise you with amazing references to classical literature and even mythology.

On the whole, Marcia Bartusiak has put together a fascinating account of one of the most volatile periods in the history of cosmology, for the eager science-history student, the astronomy buff and even the popular science reader hungry for an exotic ride into discovery. Summarizing in the writers own words, "Perhaps never again will astronomy face such a dramatic shift in its conception of the universe. It took only three short decades...



when weighed against humanity's life-span, to make this mindaltering transition." The Day We Found the Universe lets you relive those special virtual seconds◆

# **SECTION** News and Reviews

BY ANUM KHAN, MARYAM ASGHAR, MAHEK MAJID, ANAM ISLAM, FAIZAN QURESHI, RABIA ASLAM, KONPAL ALI, SYED ALI RAZA AND HARIS BAIG

**COMPILED BY ANUM KHAN** 

Also in News Scan:

The Importance of Being Pluripotent The Mathematics of Cardiology Guinea Worm Hates Abate It's Raining Heavy Metals TEDx Lahore: A Recap CANARY's and PANTHER's Life around Death Poor Man's Broadband The Moon is Down Balls to Dots Brain Speaks Invisibility cloaks Too Much Chromatin On Scientific Journals Solar Impulse A New Frontier for Medicine Lend me your Ears Special Report: In Denial SSE Labs

## The Importance of Being Pluripotent New Ways to Solve Old Problems

tem cells have always been a touchy subject. Ethical concerns on the use of embryonic cells have led to wide arguments as to the legitimacy of the use of such cells and further, what the definition of life is. This has led to new solutions to the problem. In recent years, another way of generating stem cells has gained traction: using normal adult or 'somatic' cells and 'reprogramming' them into undifferentiated stem cells which are pluripotent i.e. have the ability to differentiate into any type of specialized cell. These are often referred to as iPSC's: induced pluripotent stem cells. iPSC's get around the ethical issue entirely - instead of using embryonic cells which are bound to create a furore, transcription factors are used which can reverse the differentiation process in adult somatic cells such as liver cells or muscle cells. Current research has made a trend of using uncontroversial iPSC's to answer broader questions that have plagued developmental biology: what are the main mechanisms by which cells differentiate and what goes wrong in the differentiation of diseased cells?

It has been known for some time that one of the features of stem cells is unusually 'open' structure of nuclear chromatin. The openness of chromatin refers to the relative presence of euchromatin, which is associated with actively transcribing DNA and is characterized by looser, uncompact chromatin as compared to heterochromatin which is associated with inactive DNA and appears denser and more compact. The openness of the chromatin in cells that retain pluripotency, then, means that there is a transcriptional network of genes that maintain more euchromatin in the undifferentiated state. Here, developmental biology meets epigenetics for a whole host of epigenetic marks, including histone acetylation and methylation are involved in maintaining open chromatin along with an entire portfolio of regulatory proteins including chromatin-remodeling proteins, histone acetyltransferases and others.

A recent review published in Nature 'Open chromatin in pluripotency and reprogramming' by Gaspar-Maia et al (January 2011) captures the strides made and remaining challenges of the field. Revolutionary, of course, the paper agrees, is the use of iPSC's as models for diseases for which therapies are still missing. Since embryonic cells are so controversial, iPSC's can be used to wide effect to model all sorts of diseases where differentiation plays a major role, not limited to cancer. Researchers at Mount Sinai School of Medicine, for instance, used iPSC's to model LEOPARD, a rare developmental disease whose acronym, the authors explain, is made of its defining features (lengitines, electrocardiographic abnormalities, ocular hypertelorism, pulmonary valve stenosis, abnormal genitalia, retardation of growth and deafness). The lesson is well-learnt: undifferentiated iPSC's from LEOPARD patients showed major differences in cardiac muscle cells and the organization of the sarcomeric units that make up muscle cells.

iPSC's couldn't come at a better time. The use of stem cells as a viable therapy has been known for many years, but the medical community has been fraught by ethical allegations for almost as long. The United States, as of an Executive Order issued in March 2009, lifted the limits on stem cells research enabling researchers to obtain federal funding. But elsewhere, it is still contentious. In South Korea on 7 January, prosecutors launched an investigation into allegations that local biotechnology firms had been using stem cell therapies – here, as in many other countries including most European ones like Germany, Austria, Italy and France, embryonic stem cell treatment is still illegal. Perhaps the use of iPSC's can circumvent that entirely◆

## The Mathematics of Cardiology

n an article to be published in in the April 2011 issue of the *Notices of the American Mathematical Society*, John W. Cain, a mathematician at Virginia Commonwealth University, describes some of the major problems that Bio-medical engineers, Mathematicians and Statisticians need to solve in order to fully understand the science behind electrical wave propagation in the heart tissue. These include the search for better approximations that solve the non-linear partial differential equations in the mathematical model, taking into account the geometry of the heart and quantifying the interval between the heartbeats on an ECG for different patients

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## GUINEA WORM HATES abate

he guinea worm is one of the best historically documented human parasites. The original name for the guinea worm is Dracunculiasis which is derived from the Latin "affliction with little dragons". This nematode has lead to a disease which is endemic in Africa. Guinea worm disease is caused by a person drinking stagnant water contaminated with infected larvae: the larvae matures into an adult inside the human body. As the worm moves downwards in the leg, infected person experiences a painful, burning sensation which has led to the disease being called "the fiery serpent". After a year, the worm slowly emerges through a painful blister in the skin. Some worms can take up to two months to be completely expunged and the process is excruciating. Humans are the only known hosts of the Guinea worm. When infected people step into water, thousands of new larvae

new larvae are released by the worm which has lead to a drastic increase in the number of these worms. The tragedy is that here is no vaccine or medicine to treat or prevent Guinea worm disease.

However, chemists at BASF(world's leading chemical company) have designed a chemical that kills this parasite. When applied to stagnant water in which insects breed Abate <sup>®</sup> kills larvae before they develop into mature insects and prevents insect population from returning. In Africa, Guinea worm cases have reduced since 1986 by using Abate <sup>®</sup> larvicide. This efficient water treatment product kills insect larvae and makes contaminated sources safe again.

Killing these dangerous parasites means a substantial change in African mortality rates. One can say it is no miracle, just brilliant use of chemistry

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## It's Raining Heavy Metals

he use of heavy metals is of cardinal importance in a variety of industrial processes - the downside is, however, that they are extremely toxic . This issue has lead to imposition of strict limits on the concentration of heavy metals in waste water. As an attempt to achieve the target, heavy metals are usually precipitated and then separated by neutralizing the waste water with caustic soda or lime. But this procedure has not met the desired heavy metal limits because a complete hydroxide precipitation does not take place especially in the presence of complexing agents.

However, addition of Organosulfid TMT 15<sup>®</sup> yields good results by compelling precipitation and reducing remaining heavy metal residues to very low levels. TMT 15<sup>®</sup> reacts with heavy metals such as copper, cadmium, mercury, nickel, lead and silver to from stable and insoluble metal TMT connections. TMT 15<sup>®</sup> is applied in neutral to slightly alkaline pH range and forms a solid which can be easily separated. Mercury emission levels that are present in alkaline scrubber wet flue gas cleaning system can also be reduced by addition of TMT 15<sup>®</sup>. The mercury is bound in the scrubber as Hg TMT connection and is thus separated from the flue gas with its emission in clean gas minimized.

The successful use of TMT 15 <sup>®</sup> in hundreds of treatment plants worldwide relies on its efficacy and the approval of its toxicological and ecological properties along with safe handling. Thus, TMT 15 <sup>®</sup> is efficient, safe to handle, environmentally-friendly and has proven its worth. Now chemists have a challenge to bring forth something even more beneficial













From the top: Omer Sheikh technology enthusiast, Asher Hassan CEO Naya Jeevan, Arif Hassan architect, Dr. Nadeem ul Haq Planning Commission of Pakistan, Ajmal Kamal Editor AAJ

hore. It came as big news to Lahore and there was a collective frenzy about it because of massive hyping by the electronic and print media. Needless to say, this meant a great deal of sleepless nights for the management team, which consisted almost entirely of students, myself included.

It was 12:30 PM on the 31st of July 2010. The event was due to start at 2:00 PM. Attendees had started streaming in by the dozens about an hour and a half before the designated time. "Lahore traffic is bad so to be on safe side we left early", exclaimed one elderly gentleman. In fact, so enthusiastic was the crowd that only 2 attendees arrived after 2 PM!

The cheers of the audience filled the large Auditorium. It was an animated crowd. There was a good deal of enthusiasm and also much grumbling about security and seating. Further, a good many people had not been selected - from 1000 applicants, only 350 attendees comprising a diverse bunch of teachers, designers, engineers, journalists, technologists, entrepreneurs, students, professors, sportsmen, artists, writers had been selected. Obviously, this prompted much criticism.

The theme of the evening, exemplified by a drum circle, the official TEDx soundtrack, the merging colored circles motif, was collective genius. The talks were up for live online streaming and there were several viewing parties in Pakistan and at few Pakistani embassies abroad. There were 15 talks out of which two in particular spoke to me most acutely.

Omer Sheikh and Jabran Rafique spoke about their involvement in marking Google maps for areas in Pakistan. Sheikh graduated from Cornell with an MS in Engineering Physics and Rafique, an

n the 31st of July 2010, the from Staffordshire, received the 2009 largest TEDx in Pakistan took Google Distinguished Super Mapper place at Ali Auditorium, La- Award. They spoke about mapping the Attabad district in the Hunza Valley following several landslides that changed much of the geography of the area, and how the mapping of the area was crucial to the efficient utilization and management of resources because it allowed the specific localization of information update points across the valley. Their talk was a simple reminder of how innovation in the remotest of areas can have profound consequences.

> Dr. Zeeshan Usmani, a Computer Science Professor at Ghulam Ishaq Khan Institute of Engineering and Technology (GIKI) works as a Counter Terrorism Planner. His work, mentioned in the Wall Street Journal, AOL News, Wired Magazine, NPR, MIT's Technology Review, Florida Today, and The Economist, has received many accolades. The demonstration involved a simulated suicide attack modeled using the Usmani-Kirk model and served as a wider commentary on the state of terrorism in Pakistan.

I found TEDx Lahore to be extremely illuminating. Overwhelmingly, I found while chatting with Noor Zehra over tea and meeting several other people during the networking break, that a great deal of people are not pessimistic about Pakistan. Instead, this gathering of people seemed to feel very strongly that there exist tangible solutions to some of our most insoluble issues. On way back to LUMS at 10:00PM in the night I was musing whether this was another conference of merely sitting, talking and adjourning (nashistand, guftand, barkhastand in Persian). Would TEDx Lahore be able to prompt action and solution? I wasn't sure. But I do feel that TEDx Lahore made people think. Maybe its too premature to talk about large-scale social change. But maybe MSc Web Development student we're heading in the right direction

EDXLAHORE.



CANARY'S AND PANTHER'S

iological agents as potent weapons is not news. Found easily in nature and difficult to detect, they have potential to be used in all

sorts of public places wreaking all sorts of large-scale damage.

Scientists and engineers at MIT have come up with a pioneering biosensor that can detect microorganisms in the air in less than two minutes. "There is a real need to detect a pathogen in less than three minutes, so you have time to take action before it is too

late," said Harper, the lead scientist developing the sensor.

The technology used is known as the CANARY sensor technology. It uses nature's own defense system: the B cells present in the immune system of humans. The technology uses an array of these B cells - each specific for a particular bacterium or virus. The advantage of using B cells is their sensitivity and speed as compared to other sensors.

#### Straight-to-DVD

This technology has been used in a device called PAN-THER (Pathogen Notification for Threatening Environmental Releases), that is not only portable but also



▲ This canary acts as a book-sensor.

enables testing of air samples. The device brings air samples in contact with genetically-engineered biosensors to detect dangerous bio-organisms. It contains an-

> tibodies that can be used to detect different microorganisms present in the air. When a certain pathogen comes in contact with the antibodies they give off a photon of light of a particular wavelength. Detectors are used to measure these wavelengths and determine the type of pathogen corresponding to the wavelength. The machine then gives a list of any pathogens that

may be present in the air. If a dangerous pathogen is present the sensor goes off, thus alerting anybody in harm's way. The operation of the device, according to scientists, is as easy as loading a DVD player.

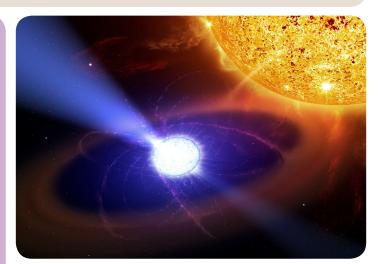
#### Jellyfish in the office

The CANARY technology uses jellyfish DNA that has been injected into mouse cells using high voltage. As a result we get cells that have the ability to glow. The glowing cells go off when pathogens are detected by the PANTHER device. The device can be used in subways, buildings and other public areas. Currently it can detect 24 pathogens including smallpox and anthrax

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## Life Around Death

othing gets astrophysicists and astronomers more excited than the hope of discovering the signs of extra-terrestrial life; and that is why the possibility of finding an earth-like planet around white dwarfs is being seriously studied by astronomers at the University of Washington Seattle. The 'white dwarf' stage is reached is much later in the life of a star, following the 'red giant' phase. A white dwarf is essentially a dying star, shining not due to any nuclear reactions but the heat left over in the hot core, eventually cooling and fading. With mass and temperature values in the vicinity of our Sun, scientists have reasons to hope for finding a habitable earth-like planet near a white dwarf  $\blacklozenge$ 



▲ Not all white dwarfs merely cool and fade away. This one, called AE Aquarii, emits high-energy radiation in the form of X-rays as it spins on its axis. It is thus the first star of its type to emit pulsar-like pulsations.



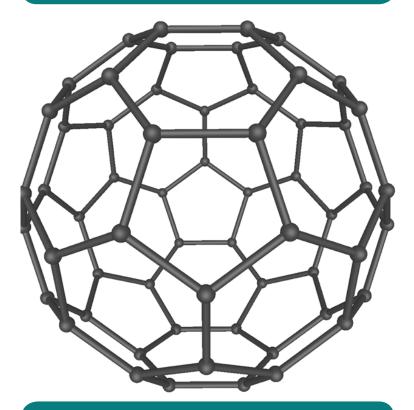
## Poor Man's Broadband

stablished by Dr. Umar Saif in January 2006, the LUMS Network of Emerging World Technologies (NEWT) lab specifically aims to bridge the digital divide between the developing and the developed world. ICT technology research is often informed by the assumptions of the developed world: the affordability and accessibility of high-end computing devices, broadband communication infrastructure, continuous power supply for instance. One of NEWT's key projects is Poor Man's Broadband which focuses on using a combination of dial-up connections to enhance internet speed. Along with projects such as donatebandwidth, it aims to address the poor state to bandwidth which impedes the widespread accessibility of internet for users. Featured in New Scientist and the MIT Technology Review, Poor Man's Broadband is touted as the new answer to the problem of lack of integration into the global network of remote areas in developing countries - what New Scientist calls the 'internet's future'



## BALLS TO DOTS

ian Ping Loh and colleagues at the University of Singapore, in an attempt to create quantum dots successfully decomposed Carbon-60 buckyballs (graphene) at high temperatures on a ruthenium metal surface. Such a breakthrough holds much promise for nanoscale electronics development, especially in the hunt for single-electron transistors. Quantum dots consist of a few thousand atoms that form tiny compound semi-conductor crystals. The research will now direct its goal towards isolating these dots and fabricating semi-conductor devices out of them



## The Moon Is Down\*

n the 19th of March, 2011 we enjoyed what is called the supermoon. The moon follows an elliptical path around the earth, which means that it is at different distances from the earth at different times. The point when it is closest to the earth is called the perigee and the moon hits that point about once every year. This March, however, the the perigee of moon coincided with the full moon, resulting in a moon much larger and brighter than typically seen. In fact, such an event last happened in March 1993  $\blacklozenge$ 

\* A reference to an *Explosions in the Sky* song, in case you were wondering.

RESEARCH FOCUS

# BRAIN SPEAKS

Angular gyrus

Broca's area

Wernicke's area

Supramarginal gyrus

Primary auditory cortex

nal of Neuroscience used a special kind of electrodes in his study on an epileptic man. These electrodes do not penetrate brain matter and thus are non-invasive. These are known as microECoGs, since they are a smaller version of electrodes used EcoGs (electrocorticography). in

Penetrating micro electrodes are often used for brain-computer interfaces (BCI), because of their ability to record single unit activity (SUA) as well as local field potentials (LFP's).

Greger's subject was an epileptic man who already had his skull removed temporar-

n a study involving paralyzed patients who are ferent and distinguishable signal could be associated unable to speak, it has been found that words can with a single word. Each of the two grids were placed be decoded by using brain signals. This was done over one of the two speech areas of the brain: the facial by placing two sets of 16-grid electrodes beneath motor cortex, which controls the muscles involved in the skull but atop the brain. Bradley Greger from the speaking, such as tongue, lips etc. and the Wernicke's University of Utah who detailed his work in the Jour- area, an area of the brain that is little understood but

is usually associated with language comprehension and understanding. The study also revealed that when the patient was involved in speaking the words, the facial motor cortex was most active, indicating its role in control of facial muscles producing sounds. However, when the subject was thanked for speaking the words or

during a conversation, Wernicke's area lit up indicating its role in the understanding of language.

Further elucidated by Greger's lab was 'locked-in- syndrome' which is a condition where damage to the brainstem due

ily. Each time the subject was asked to read ten dif- to pathological reasons can leave a patient fully aware ferent words (such as yes, no etc), different neuronal of his surroundings but paralyzed. With better patient pathways and hence, different signals were generated. training and decoding methods, in addition to wireless The study showed that a different and distinguish- grid covering more of the brain cortical area for betable signal could be associated with a single word. ter capturing the signals, Greger's technique offers such patients a chance at a better life $\blacklozenge$ 

## Too much chromatin

n recent years, genome-wide analyses and Systems Biology have brought new meaning to the search for regulatory genes and patterns within networks constructed through gene expression data. Recently, the first genome-wide study that implicates one specific gene was conducted on schizophrenia patients (Nature Vacic et al). Further, Ernst et al recently used chromatin profiling for 9 different cell types to differentiate different disease variant states characterized by histone modifications which cause enhancer sequences to act in different ways using a multivariate hidden Markov model to differentiate chromatin states from combinations of chromatin marks. The study supports the idea that cell types have varying profiles and that disease states can be localized to elements which are specifically active in certain cell types but not others $\diamondsuit$ 

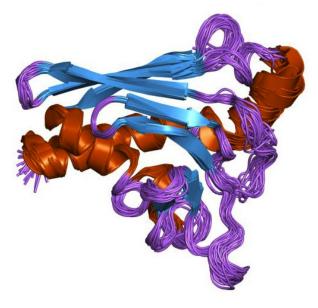


Diagram depicting how genes placed in clusters can show structural similarities that can give clues as to the cluster's functionality. The cluster shown here is the Calicheamicin gene cluster.

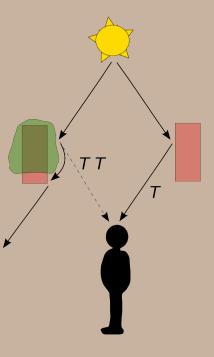
## **INVISIBILITY CLOAKS**

ibility cloak. They will be using meta-flex to accomplish this task.

Meta-flex is an independent, flexible stack of meta-atoms from a metamaterial. Meta materials are the materials which gain their properties from structure rather than composition. We know that materials are composed of atoms and molecules and when light waves enter a material, the electric and magnetic waves cause electrons to move around. The exchange of energy with the atoms and molecules of the materials is the means by which materials control and manipulate light waves.

Usually spacing of atoms in naturally occurring materials is of the

order of angstroms while visible light has a range of wavelength in hundreds of nanometers. Thus, when light strikes a material it reflects back making that material visible for us. If we adjust the composition of a material such that size and spacing of atoms are



he Ting Chang and others at Hong Kong much smaller than the wavelength of light, light can University are not far making a real invis- no more resolve its structure and it becomes a meta-

> Such material then bematerial. comes a cloak which refracts the light that strikes it so that the light moves around, past the cloak reflecting nothing and leaving the cloak and its contents invisible.

RESEARCH FOCUS

Such an invisibility cloak has been made in 2D for micro-range. This was done by carefully designed split-ring resonators with a structure size much smaller than the wavelength. Only ten stacked layers were enough to make a 2D invisibility cloak. But for 3D, the challenges are greater. The first step would be to make meta-atoms small enough to interact with light and second step would be detaching fabrication of meta-materials from hard surface making a meta-flex.

Another research team led by EPSRC Career Acceleration fellow Dr. Andrea Di Falco is developing an elaborate technique to free the meta-atoms from substrate. Once this is done, we can think of having our own brand of invisibility cloak

# **On Scientific Journals**

o state that the scientific method is a contentious phrase would be a gross understatement. Since Francis Bacon's 1620 publication of Novum Organum, which at its time claimed to be the epic overthrow of the scientific and logical establishment, most scientists have had something to say about the inductive method. They have also had something to say about the exaltation of science: surely, the distinction of science from all else is an important one. In the aftermath of all this indecision, students of the often inglorious history of science are surely wont to ask: has a coherent scientific method finally been decided upon? Today's science, although admittedly still abstruse and undefinable, almost certainly has a framework that has come into widespread acceptance. Leading scien-

tific journals that lay down specific criteria in accepting scientific research publications, as well as popular electronic publishers, should take a lot of the credit for putting that framework into practice.

Scientific journals such as Nature, Science, PNAS (Proceedings of the Natural Academy of Sciences) have come to establish a monopoly on publishing cutting-edge research across scientific disciplines. Journal submissions have stringent criteria on citations, abstracts, research notes, extensive methods sections, algorithms used, analytical tools, copyrights and reprints - all of which are meant to augment the 'peer-review' system. The surge in scientific development across the developing world takes advantage of such a system, researchers in India and Israel being big hopefuls for submissions to the most selecselective journals in the field.

Even so, on the 22nd of August, two submissions from the Indian Institute of Technology (IIT) Kanpur were retracted by the journal Biotechnology Advances, on the grounds that some material had been plagiarized from, of all the credible sources, Wikipedia. This is not the first time Indian universities have been victim to plagiarism allegations. Clearly,

there is a discrepancy in scientific standards.

#### Stay still for a moment, please

This is not helped by the fact that standards never remain static. Scientific journals, even though they have never been lax on plagiarism, have changing expectations. Clarifying laboratory method down to the last microliter has become necessary. An editorial in Nature in July 2006 spoke about how far too few submissions laid out exactly what their reagents were. One of the reasons for these changes is the outstripping of old standards by new technologies, which is what the editorial ascribed their concern to. For the editorial, this was especially pertinent in the context of new techniques relating to RNAi, a revolutionary development of the past decade which allows gene expression to be tracked. Where technology previously only abstracted the purpose of one's publication, explaining the technologies involved is now the only means by which scientists can truly regulate each other. As a result, long appendices on technologies used in a lab are now commonplace accompaniments to research papers.

Of course, there are far too many scientists in the world and too few journals, so having more and more obvi-



ously transparent experimental systems is just easier for editors and reviewers to deal with. This is great, because it establishes a fairer system for all. The PNAS, for in-stance, recently got rid of backdoor submissions - submissions by scientists who instead of submitting the right way, sent their submissions through friends and colleagues who were Academy members. But it

isn't all peaches and cream - the system is also extremely elitist and often counterproductive. Opining in Nature, Peter A. Lawrence wrote in 2003:

Scientists are increasingly desperate to publish in a few top journals and are wasting time and energy manipulating their manuscripts and courting editors. These trends are fuelled by the increasing pressure in biomedical science to publish in the leading journals. Even our language reflects this obsession — we say that Jim Jargon did well as a graduate student because he published a "Cell paper", illustrating that we now consider the journal to be more important than the scientific message. If we publish in a top journal we have arrived, if we don't we haven't.

#### Better off

Much of this is understandable as one grasps the iron grip on scientific intellectualism that top leading journals, and the largely Western universities that are represented in them, have over journals elsewhere. As scientific journals' expectations keep changing and the global scientific community adapts to these expectations, it must also be recognized that there will almost certainly be an erosion of power and re-evaluation of standards due to the rise of scientific communities elsewhere. This could be for the better and for the worse. Perhaps we would be better off arguing the inductive method ◆

## Comment on this article at:

http://theboxmove.weebly.com/1/post/2010/10/ on-scientific-journals.html

## [FURTHER READING]

Science Academies Must Learn to be more Transparent TV Padma and David Dickson *SciDev. net* 15 October 2010

The Academy's Journal Becomes Less Friendly to the Academy Members Sam Kean Science 9 September 2009

RESEARCH FOCUS

## A NEW FRONTIER FOR MEDICINE

ancer has affected humans throughout recorded history. It is the abnormal growth of cells and has more than a hundred types. The creation of masses or lumps of tissues called tumors can vary in severity depending on whether the tumor is benign or malignant. Nonetheless, the sooner the body is freed of a tumor the better, to put it mildly. Data from population-based registries under National Cancer Registry Programme indicate 700,000 new cases of cancer annually and 75% of the cases are discovered at an advanced stage due to late detection and inappropriate treatment. Mazumdar Shaw Cancer Centre (MSCC) medical director Dr Paul Salins said "Most patients come to us with stage four tumors that are expensive to treat. However, if cancer is detected early, not only can it be properly treated but will also be economical for the patient."

#### Check your cell phone...

To encourage early detection, MSCC in Narayana Hrudayalaya Health campus, along with SANA, a research group under Harvard Business School and MIT, has launched 'mhealth' that uses mobile phones to detect cancer. The pioneers behind the SANA software are Russell Ryan and Sidhant Jena. The technology the SANA software has developed includes a health worker directing certain questions to a patient. If answers to most of the question are positive, the health worker then takes a high quality picture of the lesion using the mobile phone camera. The assessment of patient's diagnosis is made by the software's decision support algorithms or by uploading the patient's data to the Centre's EMR system for a specialist to consider. If the lesion is malicious then a suitable treatment plan is suggested for the patient. This is the first ever cancer mobile application that gives an instant analysis on the risk assessment of the

## Solar Impulse

magine a world free of global warming. Here's something that can allow you to envisage that: the recent invention of a manned solar aircraft that can achieve a maximum speed of 68 knots. What was launched as a project in 2003 after careful study by EFLP has now produced a prototype that has a record 26 hour flight. This aircraft is powered only by solar energy, without the use of fuel or risk of pollution. patient's condition using sophisticated image analysis techniques. It is the most affordable and fast way to identify cancer; all a person needs is a camera enabled mobile phone that allows a person to send images using the SANA software application. The factor of immense importance is that this software can be downloaded in any model of mobile phones. Other than this there is tremendous potential in this technology, the same system could be used for ECG and other chronic diseases.

#### ...here's your diagnosis

The SANA software technology was employed to diagnose oral cancer in Belgaum, Raichur and some parts of Banglore. This project was launched under the name of 'Pilot Project'. The project aimed at setting health camps and training physicians, nurses and medical students of KLE Dental Hospital, Bangalore and Navodaya Medical College, Raichur to use the software. The outcome is tremendous with 400 high risk cancer patients screened over a period of six months. Further plans are to train more staff from other medical colleges in Banglore and to carry out a door to door cancer screening.

The technology has tremendous potential and if applied correctly can lead to a sharp decline in deaths due to late detection of cancer. The government can provide immense support in this regard by allocating budget for scaling up the medical institutions which have staff trained to use this software. Along with that awareness should be spread about the benefits of the technology and efforts should be made to reach a wider population. This technology should be further extended for covering other chronic diseases like heart diseases, diabetes and chronic liver diseases. On the bright side the detection of cancer using mobile phones is a turning point in the history of cancer and marks a dawn of hope for those caught in the clutches of this disease

Now the goal for Solar Impulse is to embark on a world tour in a zero fuel aircraft capable of taking off autonomously, flying night and day on solar energy and able to climb up to 12,000 meters altitude. So far, the aircraft has had 12 successful flights. The numerous characteristics of this aircraft include a massive wingspan, an expansive body, capacity for many solar cells and an average flying speed of 70 km/hr. Solar Impulse stands as an affirmation that with a positive outlook towards renewable energy, we can save the ecological system  $\blacklozenge$ 

#### 🔵 🔵 🛑 RESEARCH FOCUS

# Lend me your ears

ext time you think of committing a crime, don't forget to hide your ears! In lieu of the fascinating new developments taking place in the field of biometrics where the possibility of identifying the person through the structure of the ear has been deemed as successful, we may have to rethink how we conceptualize the unique identity of a person.

Mark Nixon who leads a team from the Electronics and Computer Science Department at the University of Southampton spearheaded development of the tech-



▲ Another way to identify canines.

nique, achieving a staggering 99.6 per cent success at identifying from more than 250 images. The process involves using a shape-finding computer algorithm called Image Ray Transform which can highlight structures such as ears using scanned pictures. The technique is capable of highlighting tubular structures such as the helix of ear, and uses the elliptical shape of the helix as a basis for specification.

The ear structure, in contrast to other biometric traits such as the iris pattern, retina, vein structuring or fingerprints, is remarkably stable from birth to old age – in fact, it only gets larger in comparison to the whirls/distinctive patterns on fingerprints which according to Professor Nixon's reasoning, could rub off. Furthermore, with ears, identification can take place unbeknownst to the subject.

Airports in the United Kingdom are already considering the possibility of planting ear scanners at security gates. British Passports already carry chips that can hold biometric information on them so recording ear structures pictorially shouldn't be too much of a modification

## IN DENIAL

### A Special Report reviewing the HIV/ AIDS crisis in Pakistan

or years, HIV/AIDS in Pakistan has been believed to be the scourge of foreigners whose traditional values were very different from the Pakistani culture and that Pakistan, due to its cultural and religious values, is largely immune from the crisis. However, the current data on HIV/AIDS is suggestive of the fact that Pakistan has a well concentrated HIV/AIDS epidemic among increasingly large numbers of Injecting Drug Users (IDUs) and Sex Workers (SWs). Numbers affected by HIV/AIDS in Pakistan have increased relentlessly since the first case reported in 1986. Perhaps our customary beliefs on the dissemination of HIV/AIDS in Pakistan need to be challenged.

HIV/AIDS, which is almost universally fatal to humans, has been found to have ancestors in monkeys and apes. Humans have been hunting monkeys for millenniums, and SIV, a variant present in monkeys, is believed to have been transmitted to humans and then have evolved. HIV viruses are present in two strains, HIV-1 which is the more common, and HIV-2, mostly confined to West Africa. HIV-1 has a number of subtypes, but the prevalent one in Pakistan has been B, C, and CRF-01AE.

A major outbreak of HIV/AIDS for Pakistan was discovered in Larkana in 2003. Statistically speaking, IDUs are the prime cause of HIV/AIDS prevalence throughout the country. According to the HIV/AIDS surveillance report, Hyderabad and Larkana topped the charts with about 30% for HIV pervasiveness among the IDUs. Other major cities like Karachi, Sargodha, Faisalabad and Lahore were also prominently represented.

#### Trying to understand it

Significantly high rates of HIV infection have also been documented among sex workers and their clients, a section of the population nobody seems to want to protect. Male Sex Workers (MSWs), mostly reported to be unmarried and known to be infected with HIV/AIDS are high in number in larger cities. Hijra Sex Workers (HSWs) and Commercial Sex Workers (CSWs) form another group where HIV/AIDS victims have thrived. And the problem is getting worse. Recent findings indicate that female sex workers (FSWs) and their clients report low condom use. Many of have reported to have limited understanding of safe sexual practices. One reason is that clients often refuse to pay for sex if they have to use a condom, and use intimidation or violence to enforce unprotected sex. There is little attempt to do anything about all this. Sadly, any interaction within these high risk groups augments the problem and has, therefore, diminished the efficacy of the limited preventive programs. Add to this the easy mobility of modern times, the lack of blood screenings before transfusions in medical practice and the widespread sexual illiteracy among the classes most actively involved in HIV proliferation, and Pakistan has officially become as blind to its HIV/AIDS crisis as any African country which has traditionally garnered much criticism from the international health community.

#### International perspectives

The International AIDS conference is the major platform that introduces new policy mechanisms and strategies that can cope with the crisis and serves as a forum for multidisciplinary networking and sharing of information. The most recent conference took place in June 2010 in Vienna. Aside from acting as an accountability and feedback system for the international community, the Conference likens measures to battle the crisis as important from a human rights perspective. Amid much new research, however, the cost of HIV/AIDS treatments is debilitating to international efforts. Alvaro Bermejo, executive director of the International HIV/AIDS Alliance says: "The HIV/AIDS epidemic is a costly time-bomb for families, governments and donors. For every two people who get treatment, 5 others get infected." This has much to do with being a poor country but perhaps more to do with the lack of state investment.

On the research front, HIV has always been a unique case. It is a rapidly evolving virus, which means that targeting a drug specifically to it is a bit of an issue. What researchers have come up with is to target those metabolic processes of the virus that are most fundamental for its survival and thus less subject to evolutionary change. HIV treatments do not eradicate HIV from host cells but inhibit virus replication and delay the onset of AIDS. This is possible due to antiretroviral drugs of which there are three types: Nucleoside Reverse Transcriptase Inhibitors (NRTIs), Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs) and Protease Inhibitors (PIs). These drugs target viral replication machinery so that the virus is not able to make copies of itself and spread within the host. These drugs also target the enzymes responsible for breaking down larger, immature proteins into mature ones, rendering the virus unable to develop. However, these drugs only when taken in combination constitute an effective therapy - together they constitute a highly active antiviral therapy (HAART).



#### Does it work?

According to trial reports, people with HIV reduced the risk of transmitting the AIDS virus by an astonishing 92% while they were taking antiretroviral drugs. The awareness regarding the therapies and precautions, however, still remains an area where the Pakistan government and NOP's are grossly negligent. Pakistan desperately needs to scale up on HAART along with ongoing HIV prevention programs and communication about safe sex practices.

One of the most hyped successes of the preventive system in recent years was the clinical trial of a microbicide – the gel women can apply to their vaginas to kill the virus before they can infect them. Trials for yet another antiretroviral drug contained in a vaginal ring, dapivirine, are ongoing. The drug cannot be taken orally because this limits its efficacy. The vaginal ring, however, increases absorption in the body.

HIV has away of integrating just enough viral DNA into host DNA to avoid extreme genomic instability and thus escape programmed cell death. Another current research focus is about introducing a peptide mix into cell that could stimulate the activity of viral integrase, the enzyme needed for adding viral DNA to host DNA. This stimulation would result in an increase in the number of the viral DNA molecules integrated into the infected cells that could lead the infected cells into "panic mode," causing self-destruction. In fact, it was recently documented that antiretroviral drugs of a particular class have therapeutic potential in myelomas and lymphomas. Nelfinavir is one such unique drug. Such research, if followed through in Pakistan, could work wonders. Maybe this should be a boon for the private sector, if not our government.

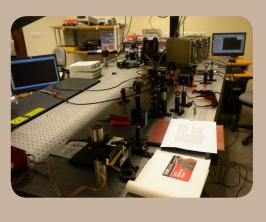
The Pakistani government has a history of treating such issues peripherally. There is an almost criminal pattern of mouthing support to principles at international fora and not following through. As the death toll mounts and more of our population falls prey to HIV/AIDS, it is a shame that the government doesn't do more  $\blacklozenge$ 

# SSE LABS

## Condensed Matter and Opto-spin Physics

uantum Entanglement is a property of quantum systems, in which the information describing two different objects is inextricably linked such that performing a measurement on one immediately alters the properties of the other no matter what the distance between them. For example, if you have two entangled particles – separated by a thousand kilometers - spinning one of them would make the other particle spin instantaneously. This is a fascinating phenomenon as it opens a host of new possibilities, for instance, the speed of light no longer being the limit on the transfer of information. Currently research, led by Dr. Sabieh Anwar, Amrozia Shaheen and Dr. Ayesha Khal-

ique is being Quantum enin macronetic systems mization of s e q u e n c e s information in the labs in ver a quanlaboratory is lished which a test bed



done on tanglement scopic magand Opti-NMR pulse for quantum processing SSE. Moreotum optics being estabwill become for exciting

quantum effects such as quantum teleportation, photon antibunching, quantum key distribution, optical computing and quantum information processing.

Further research is being done in collaboration with the Chemistry department in making supercapacitors. The project investigates nanoparticles grown on fibrous structures with high dielectric constants. Further, the SSE Physlab is developing Thermoelectric oxides for renewable energy conversion technologies. This research project aims at developing perovskite-based oxide materials that are stable and thermoelectrically efficient at the high temperatures common in Pakistan. Spin Caloritronics is a very new and exciting research field. The well known Spintronics focuses on the use of the charge and the spin of electrons as information carriers in devices, while the new field of Spin Caloritronics goes beyond this scheme and additionally involves thermal aspects, i.e. in particular magnetic heat transport, magneto-thermal response, and spin related thermoelectric effects. The project in the Physlab involves using a custom built optical cryostat and other optical means to measure spin caloritronic effects. The final goals include Optical detection of the spin Seebeck and spin Hall effects and exploring the pure optical detection of magnetic resonance  $\blacklozenge$ 

## POCKET-SIZED

RESEARCH FOCUS

Nuclear magnetic resonance imaging (NMRI), is a medical imaging technique used in radiology to visualize detailed internal structures of the human body. A lab has made considerable progress in the invention of portable NMRI apparatus. Work is being done to develop a compact and mobile benchtop NMR/MRI apparatus. This will enable the miniaturization of both the NMR and widespread technique, extending it to developing countries for the purposes of on-field inspections and testing as well as ambulatory medical care in disaster-struck areas. The Lab is also in the process of developing a real-time pocketsized PCR. The Polymerase Chain Reaction (PCR) is a very important tool for medical diagnostics sics. Furthermore, the researchers are currently performing the air conduction test, which in turn is used for the diagnosis of outer and middle ear diseases  $\blacklozenge$ 



▲ Building a pocket-size PCR. For more information, log on to <u>physlab.lums.edu.pk</u>

## FURTHER...

he Physlab is developing a AFP (Atomic Force Microscope). These are high resolution microscopes which can measure up to 0.16 nanometers. It can be used to measure any type of samples from solid metals to biomedical specimens. Both teaching and research grade AFP are being manufactured.

Many research projects have already been completed successfully at the Physlab including the devising of the Dielectric Cell. Dielectric Measurements are a basic means of evaluating electronic components and materials. Every material has a unique set of electrical characteristics that are dependent on its dielectric or insulation properties. Accurate measurements of these properties can provide valuable information for applications. A dielectric cell was successfully designed and constructed for measuring frequency and temperature dependant dielectric properties of rigid flat materials such as Ceramics, Polymers and composites at elevated temperatures



▲ Muhammad Wasif and Dr. Sabieh Anwar's research group is involved in the development of an *Atomic Force Microscope*.

LITTLE JETSONS -D Laser Scanners for Robotics, led by Dr. Mumtaz Sheikh at the Physics Department, aims to make real world scanners to be used by automated robots. The robots will be able to scan in all the information around them in the real world and then either decide themselves or store and pass on this information to the user so that decisions can be made. This essentially takes information gathering to the next level - the project, almost impressively low-budgeted, is a good omen for the Jetsons-like future our faculty seems to aim to produce

## INTELLIGENT CANALS

roject Smart Canals is a project run by the laboratory for Cyber Physical Networks and Systems (CYPHYNETS) at the Electrical Engineering Department at SSE. It aims at solving one of our countries current biggest problems: the distribution of water for irrigation. The project is a LUMS startup, funded by the HEC at Rs. 7 million a year, making it one of the lowest-budget projects at CYPHYNETS. Dr. Abubakr Muhammad, spearheading this project, aims to automate the current system of water distribution for irrigation in the country.

Pakistan has one of the biggest irrigation systems in the world with its 36 million acres of contiguous cultivated area for irrigation. Unfortunately, this system has not been modified since the 19th century and as a result results in a great deal of wastage and an unbalanced distribution of water. Further, there are only 3 major reservoirs for water storage, 19 barrages, 12 canals for linking rivers, around 45 independent irrigational canal commands and 84 small dams. The idea is to divide the entire irrigation system into a network with interlinked rivers, dams, reservoirs and barrages. The system will be automated and so water levels will be monitored throughout the system, and the demand and supply for water will be controlled upon requirement using sensors. One of the major applications of this technology is in flood control which deserves a great deal more governmental investment after the lessons of  $2010 \blacklozenge$ 

## **DOLPHIN WOES**

he Indus River is home to one of the world's rarest mammals: the Indus River dolphin. A project at the Electrical Engineering Department at SSE in collaboration with WWF aims to protect the endangered dolphins, of which only about a thousand remain. This will be done by tracking the dolphins using sonar signal processing techniques. Dolphins tend to move around in groups as a network, and so algorithms are being devised for determining individuals within a network. Thus, Dr. Abubakr Muhammad and his group will in some sense be able to 'hear' what each dolphin says. Using records of individual dolphins, the decline in their numbers can be reached. This way the dolphins will be protected from, say, getting trapped in irrigation infrastructure. The plan is to disturb their natural habitat in the least way possible, although the development of hydrophones and underwater bio-acoustics techniques are required



We need to do something about crimes of science. For instance, clinical practices in Pakistan have a tendency to prey on the poor. This is all very backward of us. BY HINA IFTIKHAR

pioneer's work always inspires several followers, who in turn amplify the impact and outreach of the initial achievements with every innovation they bring in. History of Science reveals a plethora of such instances: from EinTherapy on women's health. As a consequence millions of women received HRT routinely in the past decade, while Poelhman received \$2 million in the form of funds for the research and trials that he was conducting. It turned out, however, that HRT instead increased

stein using Max Planck's quantum hypothesis to explain the photoelectric effect to Morgan discovering the Chromosomal Theory of Inheritance in Drosophila, having built the research around Mendelian genetics. "Standing on the shoulder of giants" has always been a valuable practice in the scien-



▲ There is little that can depict the horrors of surgical procedures involving organ transfers. This is *Liver Failure*, by Dr. Mohamed Buwe Osman, MD and visual artist.

the health risks in women. The risks were so high that the trial had to be stopped prematurely. Poehlman was found to have fabricated his papers in favor of HRT just to earn funds. His junior disclosed his fabrication and Poehlem was found guilty. He is now serving imprisonment and has paid heavy fines. Another infamous case in-

res involving organ transfers. *ailure*, by Dr. Mohamed Buwe Osman, MD and visual artist. Ranjit Kumar Chandra, a two time Nobel prize nominee and recipient

also been involved in the practice of leg-pulling. From the relatively benign to the horrific, instances of fraud and malpractice have been numerous, casting aspersions over the integrity of scientists and researchers.

tific community, but unfortunately in

some cases the giants themselves have

Fraud in clinical trials has been rather embarrassingly common in medical research. One of the most astonishing cases of biomedical frauds was the case of Dr. Eric T. Poehlman, a leading authority in the field of human aging and obesity in USA. He conducted research on the effects of menopause on health and wrote 200 papers between 1992 and 2000, trying to provide evidence in favor of beneficial effects of Hormone Replacement of Order of Canada. He took money from Nestle (Good start) and Ross (Isomil, Similac) to produce fake studies in favor of the so-called hypoallergic infant formulas. On being found guilty he was sacked by his university in 2002.

#### It's worse at home

The context of Pakistan provides an entirely different issue that demonstrates all too well the fact that clinical malpractice is all the more dangerous because of its ramifications beyond the world of academia. Organ transplantation (essentially kidney transplants) is inextricably linked to the relations between the donors and receivers; trouble arises when these relations go past theconcerns of biological compatibility and develop into a form of trade. The trade is also clearly no longer bound by state boundaries with kidneys being sold to patients overseas in astonishing numbers. The practice is considered to be highly exploitative of the poor for several reasons. First, even though clinics in Pakistan charge on average US \$40 000 for the operative procedure, the donor receives barely \$1500 to \$2000. Second, middlemen and doctors are able to get away with collaborating to dupe donors into selling their kidneys for middling sums. Needless to say, there is no semblance of informed consent. Donors and even recipients are unaware of the medical, financial and social implications of the transplant. Lastly, the problem of almost non-existent post-operative care is a crucial one, leaving many utterly helpless. Dr Najib, The Professor of Medicine and Dean Faculty of Medicine Peshawar Medical College, highlights the issue in an article Organ Transplantation - And Proposed Legislation In Pakistan, by highlighting the misery of an uninformed kidney donor:

"I can't forget Mr. Amjad a young man of thirty who sold all his assets and finally had to "sell" his young daughter for want of money, needed for post kidney transplant medication, which he could otherwise not arrange. I wish that the doctor had explained to him all the post-operative cost and care which the patient had to pay for life long - something that was never told to late Amjad."

#### **Do something**

Laws that regulate this heinous practice are long overdue. In July 2007, late enough by any standards, the Supreme Court of Pakistan issued a ruling which ordered the Government of Pakistan to enact a law regulating the illegal organ trade in the country, especially kidneys. The Government of Pakistan, following the Supreme Court ruling, formulated the Transplantation of Human Organs and Tissues Bill 2007 in the National Assembly. The bill introduced a number of measures, including the restriction of organ donation only to close blood relatives over the age of 18 as well as a ban on donations by those unrelated to the recipients. The law made it mandatory for each donation to be evaluated by a committee of medical experts who would determine whether or not the the donation is fully voluntary. The bill proposed a 10 year jail sentence for anyone found guilty of being involved in the commercial trading of organs. In March of 2010, the Bill was made the basis for an Act against illegal organ trading. Needless to say, regulation needs to be improved but it's a step in the right direction.

Clinical malpractices and dishonesty in trials and scientific research can have dire consequences and may even destroy the trust placed by people upon those who volunteer to enlighten them with novel techniques and solutions. Unfortunately, the threat of discrediting in the scientific community is not enough of a disincentive. In this regard, it would perhaps be a sensible demand to look for – in addition to legal remedies – long term cures of the situation by reforming research institutions as well as the education system. An ethical approach towards a profession can only be adopted if the profession itself is valued and respected by the society. That recognition has to go hand in hand with policy making to achieve the desired target of fostering an ethically motivated culture of scientific and clinical practice in the country.

## LUMS GOES Green

reen LUMS, led by Electrical Engineering instructor Dr. Jehangir Ikram, aims to work towards the optimization of energy usage, starting from right at LUMS with implications of being extended to the entire country at large. A LUMS Energy Optimization Committee has been set up, and is working to not just reduce the wasteful utilisation of energy, but to come up with new ways to generate energy on campus. One way of generating energy that is currently being worked on is the use of solar cells on rooftops. One hopes that a sense of energy responsibility can be instilled in all sorts of ways - for instance, automated light control, which would result in the lights of a particular corridor or room being turned off unless sensors detect a passing person and so on. The hope is that should LUMS become a more efficient consumer of energy that it can act as a first-mover model for other institutions in the country $\blacklozenge$ 

## Computer Vision @LUMS

he Computer Vision lab, headed by Dr. Sohaib Khan's key project includes the development of a Village Finding Tool that uses images from Google Earth to show the user villages that meet a certain requirement as specified by the user. The tool was developed as part of a research paper that presents a methodology of extracting villages from satellite images. It was highly beneficial in accounting for the villages during last year's floods. The CV Lab is also renowned for its contributions towards solving the Non-Rigid Structure from Motion Problem  $\blacklozenge$ 

# SECTION

## Science and Literature

▲ DORIS Lessing's visionary Canopus in Argos: Archives collection of space fiction tells many fantastical tales about two intergalactic empires, Sirius and Canopus and their enemy, Puttiora. Earth is depicted as a colonized planet, called Rohanda or Shikasta (the stricken). This is an artist's depiction of the impact believed to have created the Moon.

# EVOLUTIONAR FABLES

Nobel-Prize winn fiction shares com

concepts 1

themes with evolutionary conctuated equilibrium.

here are ideas in Doris Lessing's visionary space fiction 'Canopus in Argos: Archives' series that occasionally transcend mere allegory into fully-fleshed ideas of biology and philosophy. The third book of the series, The Sirian Experiments, gives numerous examples wherein Ambien II, of the Five (alien emissaries) that represent one of Lessing's fictitious planet-empires, the Sirian Empire, conducts bio-sociological experiments on Earth involving ideas of a crudely forced evolution that flows gradually, speeds up, or doesn't occur at all. Her process is mysterious, much like the concepts she involves to tell her story.

She tells us about the Lombis, a species transplanted from their own planet to Rohanda (a colonial name for Earth, coined by another inter-galactic empire: the Canopean Empire) by the Sirian Empire. Most of such experiments, including the experiments on the Lombis, ended in their [the Lombis'] degeneration into rough stock. Furthermore, both big Empires talk about a Necessity which justifies colonization and arbitrary experiments on lesser-evolved species from other planets. The idea is to construct societies and races, as if they were dolls, by taking them from their home planet and putting them on another, and then tracking their evolution, which almost always leads to disastrous consequences.





The Necessity later leads to something known as a Lock between the alien Canopean Empire and Earth – ruminations as to what a Lock is continue throughout the series: we never find out. Towards the end of the Sirian Experiments, Lessing succinctly expresses her idea of the quietly savage nature of forced evolution:

Large-scale experiments of the bio-sociological kind are in progress – the kind that one of our wits has summed up as What if we...? In other words, populations are subjected to this and that stress, or the planets of planets moved about – all that class of thing. And I am far from claiming that this does not cause suffering ... But it is not possible to avoid such disturbances of a Colonized Planet altogether. What would then be the purpose of colonizing one?

Lessing's colonized folk remember 'the shining one' – people from the stars who brought them from Planet A to Planet B centuries ago; they remember old songs and dances as quickly as they distort them and they distort not gently but crudely. All this is viewed by Ambien II from a vantage point (insert here the Big Brother-like image of aliens viewing human progress from a spaceship or time machine). The progress, or rendering into redundancy, of the colonized species can be charted by Sirians who, of course, live much longer than colonized folk because evolution credits 'higher' races with longer lifetimes. The story is of a drive into evolution purposely set into motion by an Other – not nature, not circumstance but an alien empire. At times this could seem the most heretical of all nonsense ever assumed about an evolutionary process, at others a calculated critique of human history and the fate of Earth.

#### The hierarchy of species

History is self-motivated. Dips and peaks in intellectual development are created not just by what is popular notion at the time but also by the popular notion of what is radical at the time. Stephen Jay Gould, that avid supporter of Darwinian theory who has recently become something of a hero for me, writes es-

says that actively put into perspective ideas that would be considered deplorable today, but which at the time reflected conventional wisdom. Darwin's inevitable linking with the ideas of Social Darwinism, for instance, (for think about how pop culture has painted him out to be such a believer in an awfully deterministic inequality within the human species) he defends plausibly by separating the grain of ▲ Doris Lessing at lit. cologne in 2006. Currently 91 years of age, she won the Nobel Prize in Literature in 2007 for a lifetime of work that spanned multiple genres.

Often people rebelled against the colonizers, but only rarely did it compel the colonizers to take notice the times of Darwin from the chaff of an assumed morality, and then takes it a step further and pleads for Darwin because [Gould claims] he was not a believer in "biologically fixed and ineradicable inequality".

The evidence Gould gives is an assessment of Darwin's acts during his lifetime, none of which could be called acts of racism. Furthermore, contrary to common knowledge, the extension of evolutionary theory to the human species was not Darwin's work but of those who came after him – here, Francis Galton, that famed eugenicist comes to mind. Gould does all that because human history must have a logical progression of ideas into the constructed mores and values we hold so dear today – at some point we must have committed the crime to discredit it so much today.

Today, the equality of human beings is an absolute concept, but in the same manner that a round Earth was not an absolute till a certain point in history, neither was the concept of equality. Think about it and it all boils down to your assumptions about human nature. Is evil innate? Does our species have an expiration date? Is the human race forcing itself to degenerate? [Can I stop rhyming before it's too late?]

Lessing's aliens certainly seem to think so. Her allegorical Earth, wasted, filled with anguished spirits, is beautiful with its plains, ravines, plateaus and mountains, but despicable by the same measure because of lost vitality. The knee-jerk response is: people wasted there, in that sickly expanse of land that feeds on energy and goodness. The lively, purposeful, occasionally matriarchal races that integrated and adapted well are replaced by cruel, authoritarian, always patriarchal races a few centuries later, overseen by the colonizers. Often people rebelled against the colonizers, but only in the rare event did it compel the colonizers to take notice, and even then they took umbrage at the cheekiness of a rebellion. Note the tone in the following words by Ambien II:

We already had billions of privileged peoples [people of their own Empire] entitled to every benefit of technology. We did not want to discover, and then colonize, planet after planet of savages or semisavages who then, it seemed almost at once, would become privileged citizens. In short, we needed a reservoir or bank of populations whom we could use for ordinary, heavy, undifferentiated work.

Towards the end of the book come the insights that set Ambien II on a corrective path. It is not an altogether painless process. For much of the book, she rejects humanistic values and acts vainly but defends herself with the 'greater good' of her parent race, the Sirians. Indeed, there are claims of unavoidable acts, 'sacrifices that must be made', but Ambien II becomes fond of Rohanda (Earth). Her final moments are those of disrepute, she is demoted from the Five for having become too different in thought. The larger question, however, is if such thought is essential and innate. We view Darwin's work today through a smoke screen, one we have created after the codification of numerous laws which are accepted the world over about how human beings are undoubtedly equal in stature and that there are no distinctions between race. But when Darwin fails to pass the nonracist test, is it because for him to say that the tribes of Africa and South America were not savage would be too radical in those times? And if we let Darwin off the hook, is that like saying that the only reason we think human beings are equal is because it's the law?

#### The mechanism of evolution

Unlike the idea of superiority and inferiority, which is never taken for granted in Lessing's book, her implication of evolution - that it's a continuous, gradual process – is never challenged. The scientific response to this idea of evolution

can be found in Gould's early career success on the theory of punctuated equilibrium (presented in the paper Punctuated Equilibria: An Alternative to Phyletic Gradualism with Niles Eldredge in 1971 at the Annual Meeting of the Geological Society of America). Gould's theory of punctuated equilibrium goes like this: allopatric speciation constitutes but a split second in geological terms. Gould's theory claims that most evolution is concentrated in such moments in direct comparison to the long (and since we're speaking geologically, this means very, very long) periods of stasis that the species - however long it is able to survive before going extinct - experiences: essentially evolution not along a continuum but in steps, jumps and starts. What does this mean for Lessing's colonized?

Speciation constitutes but a split second in geological terms.

## LITERATURE

It means that Gould does not think it possible that brains can grow smaller gradually (for a million years), flowing through uncountable intermediates, within the same race.

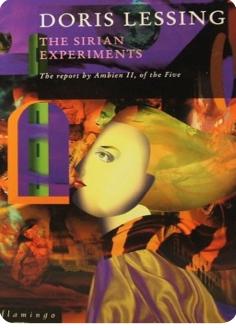
Comparison with another idea of evolution will make this easier. This idea of evolution is in (almost) direct contrast to phyletic gradualism which could be imagined as a continuous curve which at some point breaks in two (divergence). In essence of course, that means, that a species which is known to have Beak Size A in Year 0 and Beak Size B in Year 2000 did not undergo a continuous evolution (i.e. beak sizes did not slowly grow over the years: if they did that would be phyletic gradualism) but experienced speciation in short bursts of time which cannot compare in length to the long period of time for which the species' state was constant (speciation occurred and an isolated population which had broken away from the big population mutated to obtain Beak Size B: punctuated equilibrium).

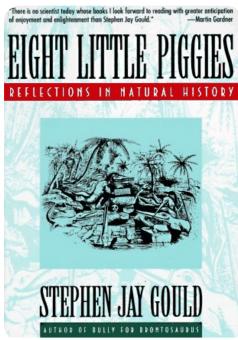
Punctuated equilibrium is revolutionary in its (not entirely direct) approach towards correcting the ideas of a continuous change in species. Indeed, it does not disconfirm the idea that deleterious mutations and variation continue to play significant roles, just that the effect they have are not incremental from one generation to another. Furthermore, its assumption that large populations are more able to absorb the effects of variation is not and was not a new idea. Thus, it is possible for a large pop-

ulation to not exhibit the cumulative effects of variation. What does this mean for our lives? What does it mean for history? Gould's comfort with his theory is telling:

There is a lesson, not merely frustration, in the message that change occurs in infrequent bursts and that stability is the usual nature of species and systems at any moment.

This is optimistic and Gould defends human social structures by stating that, as an extension of his theory, dark events in human history are isolated incidents that can't compare in frequency to the millions of kind acts that go unnoticed. It's just that one act of violence counts for much





Many of us have the impression that daily life is an unending series of unpleasantness – that 50 percent or more of human encounters are stressful or aggressive. But think about it seriously for a moment. Such levels of nastiness cannot possibly be sustained. Society would devolve to anarchy in an instant if half our overtures to another human being were met with a punch in the nose.

more than the many acts of kindness that human beings

commit towards one another - thus the title of his essay:

'Ten Thousand Acts of Kindness'. Note the implications:

That makes sense, but think about the implications of what has been said and the feeling is unavoidable that even Gould's justification accepts that ten thousand acts of kindness will go unnoticed. His logic goes like this: violent act is the jump/burst in evolution, kind acts are the stability that follow for many more years thereafter. But both Punctuated Equilibrium and Phyletic Gradualism bring us to the same end-point. Gould accepts:

One supposed insult, one crazed act of assassination, can undo decades of patient diplomacy, cultural exchanges, peace corps, pen pals – small acts of kindness involving millions of citizens – and bring two nations to a war that nobody wants, but that kills millions and irrevocably changes the paths of history.

Species diverge, become extinct, evolve. And that's irrefutable and inevitable. By extension, thus, does that mean that the ten thousand acts of kindness that Gould talks about have no causal effect on the end-result other than the many years of stability that they

bring, for inevitably bursts and changes can only be caused by violence/widespread mutation? If so, then to all logic, human agency has been limited.

Lessing's book feels the same. The nature of the biosociological experiments conducted by Ambien II is such that despite an overarching trend towards certain traits, random events are just as insidious and powerful. Reading about forced evolution is dangerous because the

structure of the argument relies on making individuals powerless against

▲ The material for this essay was drawn from two books. The first was the third of Doris Lessing's fantastic space fiction series *The Sirian Experiments*, and the second by the famed essayist Stephen Jay Gould, a writer whose style I still find unparalleled. change". Are we willing to accept that we can't change anything because the universe is so much bigger than us?

This is not intuitive and it certainly isn't a comfortable idea – the debate over whether humans have the 'agency' to change events runs through many disciplines – political realists say that individuals are powerless and states are all-powerful; evolutionary biologists point to the competition between species in natural selection. Lessing has the privilege of writing space fiction so in her world, there is a reason. The reason is the evil empire, Puttiora, which brainwashes, infiltrates, degrades, pervades innocent races and makes them savage. So, evolution is forced. The question is, is there really an evil empire Puttiora? Can evolution in the real world also be forced or do species have the power to successfully oppose the winds of change? There is no answer, just the whispers of a mysterious process called evolution.

Allegory is a powerful tool to understanding. During Ambien II's travels, she encounters a woman called Elylé, possibly a Puttiorian but definitely an enemy. In Elylé's captivity, Ambien II notes her captor's psychological influence on the captives. There is a moment of ambivalence – caught in the crossfire between old and new thought, Ambien II notes about these Earth beings:

But sitting there in that gilded, amiable, pleasure-loving scene, which had over it a sort of silky dew as if it were drenched with ethereal honey... I understood it all, and only too well – because I was being affected as I sat there, trying to preserve a correct, if not an official, air...And what I was understanding. Oh yes, the woman was magic! I understood that she was a daughter of old Adalantaland; I remembered... but there in that time it had a very different function. The wonderful females of that island had been in a correct alignment...one could sense their oneness with their surroundings. But this descendent of theirs...had in addition a witchery that had slipped out of its place, and become sufficient to itself.

Thoughts and beliefs are like that – soundless, they shift and encompass. The history of the world, even in a parallel universe, must cleave, rethink, create – evolve. Maybe if in a modern world, we could reconcile ourselves to ideas of evolutionary change as diverse as punctuated equilibrium and as uncomfortable as the loss of human agency; to ideas of society as antiquated as Social Darwinism and as rational as justified exoneration. Maybe then, we too, could see the woman is magic



**article at:** http://theboxmove.weebly.com/biology.html

## **3D Images**

ver wonder how they make 3D movies? Well here's how. The first step is understanding how our mind perceives 3D, or to put it simply 'depth'. Each of our eyes sees a slightly different image and the brain puts these together to form a 3D image. If you close one eye you are technically seeing 2D however, your brain assumes so many things that it doesn't make much of a difference. But if you hold up something close to your face and then look at it with one eye in turn you will notice a huge difference in the image. All that needs to be done is to fool the brain into thinking that it is getting two images and let it put them together to form a 3D image. Animated 3D movies are made normally but when they render them they make two movies from two different carefully placed cameras that represent each of the viewers' eyes. When shown in cinemas both the recorded movies are projected onto a special screen using two projectors. The projectors project

### **BY HASSAN BUKHARI**

perpendicularly polarized light with respect to each other and the screen maintains this polarization. All that is needed are simple 3D glasses with polarized frames that make sure that the image made from the right camera coming from the right projector goes into our right eye and the light from the left projector goes into the left eye and our brain puts it all together to give us stereoscopic 3D vision of a 2D screen! Earlier cinemas used to project a red and a blue image along with the normal colored movie that were adjusted to go into the left and right eye by the help of glasses made of red and blue transparent films that acted like filters. These 3D movies could be projected in any cinema as the light did not need to be polarized. Cinemas in Pakistan have featured 3D movies like 'Spy Kids in 3D' and others with the help of the older technology. The recently launched Atrium Cinema in Karachi hosts the newer polarizing projectors and offers a 3D viewing experience not seen before in Pakistan. Magic, no. Physics, yes! igoplus

Also in *Science and Literature*:

Evolutionary Fables Mathematical Adventures in Wonderland Quantum Tales



# May the Force{s} Be With You

One of the editors argues that literature has provided science with a unique discourse. Case in point: Aldous Huxley's Brave New World.

**BY NIMRA ASI** 

hat place does science have in our world? Is it a mere tool, to be used to our own ends or a

fantastic beast to be approached with caution? Is it an amulet to place above our hearths or a sky-darkening idol to kneel to. Do we make of science a god or a lamp, a blade or a trap? And if we worship at the altar of progress, will this god prove to be a hollow one?

What are the dreams that science conceives of? What future will technology spin? In this day and age when scientific knowledge seems a monster with a thousand heads and the growth of knowledge outpaces wisdom, too often scientists seem to be sitting on a merrygo-round spinning faster and faster. What is the point of this relentless motion? Can we get off? Or is it too late, the world too changed for us to go back? After all, look up and there is one less planet in our skies, turn your gaze downward and the earth beneath our feet is a warmer one.

Who is it that can tell me who I am? These same questions resonate throughout Aldous Huxley's 'Brave New World' when the world seems indeed to have been made anew but in the image of our worst nightmares: a hive society that is all the more chilling for the complacency with which its subjects view their mechanized existence. I say 'subjects', but they seem rather to our 20th century sensibilities, victims. Huxley, with this novel did

And like in the brave new world, so too today, science births monsters while sprouting miracles. something extraordinary; he took his fears regarding the possibility of "scientific dictatorships" or using biological and psychological means to control people and breathed life into them in a tale both funny and horrifying. This skill, and imagination is what takes a cautionary tale that could have been mere lecture and moves it into the region of enduring classic.

For example, one of the most memorable scenes in the novel is the Director's first meeting with our protagonist's mother. Linda was left behind in a 'Savage' Reservation some years ago and has the sagging skin, bent body and old age to show for it. She has also committed that most loathsome of offenses; given birth and been a 'Mother.' The Director's open disgust and shame at this meeting is searing to witness in the face of Linda's desperate hopefulness. Thus, without resorting to pedagogy Huxley exposes the insidious power of outside forces to distort human experience so that the most fundamental of human relationships is an unspeakable deviancy and that which is natural becomes ugly. If even our idea of beauty is subject to the influences of sci- to do these things and yet it is in our powslyly as we purse 'Progress'.

#### Striving to better, oft we mar what's well

lost, what value in it?

cally foods is that it is 'not our place' eyes. Who would not "claim them all"?



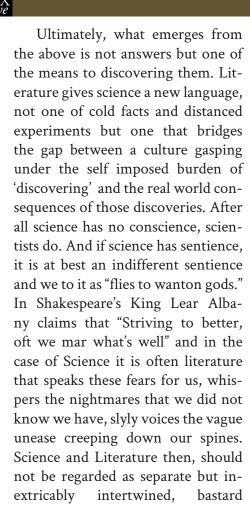
ence what then is sacred? We have in this er to alleviate the pangs of hunger and brave new world, Shakespeare's 'eternal prevent the suffering of crippling diseases. summer' but it scans more like a read- And if we still entertain doubt in the face ing of 'Here Be Monsters.' Monsters that of these persuasions, perhaps what we do not lurk under beds but walk hand in lack faith in is not the strength of our huhand with us under sunlight, and chuckle manity but the soundness of our human judgment with the word 'human' as easily meaning fallible as it does 'right.'

Because, while we might reach forward to grasp knowledge, the future built by And like in the brave new world, so too that knowledge is entirely beyond our today, science births monsters even while hold. Reason can only blunder so far into sprouting miracles. So many of these the mists of time and the spiralling consemonsters are rooted in our idea of the quences of our actions remain unknown. 'natural' or 'normal'. There often seems And it is this unknown that gongs dully to be the assumption that there is some- in our consciousness and flits through thing essentially human, quintessentially our dreams to turn them evil. Utopia precious in the original designs of life and turned dystopia is what Huxley shows that to irrevocably, irreversibly this elu- us and as he said in an interview 'This sive thing we cling to is so weak, so easily is possible.' Paradoxically it is this same promise of 'Possibly' that churns out sci-Another familiar refrain from the entists, writers, poets: the ghosts of luquarter that opposes designer ba- minous new worlds brushing past our bies and the dissemination of geneti- fingertips, rushing past the corners of our

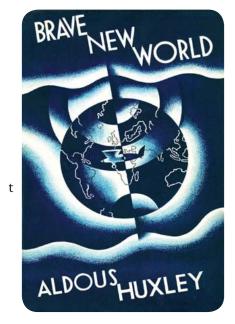
▲ Tales of an apocalypse aren't just limited to literature. The pictures shown here are digital art images constructed painstakingly by Canadian artist Steve McGhee.

> Huxley exposes the insidious power of outside forces to distort human experiences.

## LITERATURE



half siblings with the same mother. Both science and literature have the power to change the world, they are forces for good as easily as for evil,



double edged blades both and the hilt in our hands.

As a student of science I haven't

completely decided where Science and I stand. I only know that I do not claim mastery over the forces of scientific discovery and yet I would not be ruled by them either.tists And that I find the subject itself exciting and frightening and I want what it has to offer. As a lover of literature I know that sometimes it is outside of science that I will find the best ways of understanding what it means to me; that often times it is the non. scientists who have the words to describe our closed discipline best: that in its best form, located not at lofty heights but within the seething chaos of life, Science is not a soulless machine but a:

"Tiger tiger burning bright"

And on a final note it matters less whether we shape science or science shapes us but that we remember to approach it with caution. And wonder.

Always with wonder  $\blacklozenge$ 

## |For the Sci-Fi Fanboy pt. 1

ightsabers are both awesome and cool by definition. A lightsaber can slice through almost anything like butter, including flesh, and can deflect blaster bolts. With every swoop and plunge it hums, crackles, and buzzes as if it has an adrenaline-fueled life of its own. And when two lightsabers clash, it sounds like a WAPDA transformer has exploded.

According to a Star Wars wiki, the earliest lightsabers came in to exist-"when Jedi combined advanced offworld technology with a forging ritual, learning how to "freeze" a laser beam." I have no idea what that means, but the question remains: are lightsabers possible? Given current technology, sadly, no. A lightsaber must be wieldy and easily portable, and neither seems possible. A laser beam, like a light beam, does not come with a predetermined length. Both just keep going on till they're absorbed or reflected. In order to prevent the lightsaber's blade from reflecting off every surface, or being so lengthy and dangerous that its wielder must save himself from its never ending blade, the blade has to be fitted with some kind of cap at its tip – which would significantly reduce the saber's cool value. Even if such a contraption was created, the saber could still be easily deflected using mirrors, hence also making danger- ous for its wielder. A lightsaber would also have to come equipped with a backpack of powering equipment, and a wire to plug it into the main electricity system – which is pretty lame. For a laser as powerful as a lightsaber's to be produced, the hilt must also come equipped with some kind of cooling system so that the saber doesn't over heat and hence malfunction and/or burn its wielder's hands. But can a lightsaber at least deflect blaster bolts, glow in neon colours, and hum? Um. No. Just like you can't see lasers in a laser show tionally smoky, foggy, or dusty environment. Similarly, lasers in lasers show don't hum or crackle. They're silent. And the deflecting? Just like two light beams can pass through each other, so can two laser beams. So not only will a laser powered lightsaber be silent and invisible, it would pass right through any other lightsaber,

and be unable to deflect a blaster bolt. Perhaps freezing lasers is the only way to go  $\blacklozenge$  By Maheen Rashid

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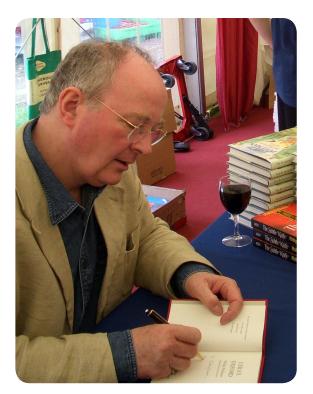
Also in Science and Literature:

Evolutionary Fables Mathematical Adventures in Wonderland May the Force{s} Be With You

# Quantum Tales

hilip Pullman is a master storyteller who shares his surname with a train and a hotel chain when he would be more fittingly represented by a magician's fantastical hat: you never know what he'll throw at you next. Pullman's bestselling series, His Dark Materials are a lyrical concoction of mystery and adventure with much allegory and heavy undertones of Theology and Philosophy. Like a cherry on the top, quantum mechanics enriches his tale and lends it the respectable label of 'science fiction.' Pullman likes to think of himself as a busking storyteller 'sitting on a carpet' rather than a writer and perhaps what lures strangers unto his carpet is that his borrowings from quantum mechanics and metaphysics are just as mysterious and fascinating as his characters and landscapes. He invents parallel universes and juggles with space travel and invisible dimensions. He speaks of dark matter and elementary particles, all relatively novel and widely studied ideas of modern Physics.

It is interesting to observe that much of what readers take for 'science fiction' in Pullman's books is in fact not fictitious at all. Take for example Pullman's ingenious 'different worlds' of Lyra, the tomboyish heroine and Will, the other significant character in the series. Interestingly, both characters are human (unlike in many other pieces of science fiction where ET-like aliens dominate anything beyond the known Earth), come from an Oxford indigenous to their respective worlds and even speak the same language. Now we've all come to terms with the notion that there might be life outside Earth thanks to inexplicable crop circles and and UFO sightings and unidentified blips on the sonar screen, but the idea of an exactly (or almost quite the same) Earth in pre-



**BY MUSTAFA MIRZA** 

▲ Philip Pullman, author of *His Dark Materials*, intensely signing at a book-signing.

cisely the same (or almost quite the same) position seems rather indigestible. More bizarre is the thought of another you. Does that mean that you can be at two different places at the same time? Or that there is another you, an alter ego perhaps, that lives on another Earth? If so, where is the other you and this other Earth? And why can't you see yourself?

#### **Bubbles**, bubbles

Truth in our case is stranger than fiction for the question that scientists ask themselves is not whether there exists a parallel universe but how many kinds of parallel universes are there? "We are in an existential shock" says

Professor Michio Kaku, professor of Theoretical Physics at City University, New York and author of a large range of science books. "Our world view has been shattered with the realization that yes, there could be parallel universes." This means that our own universe, infinitely large as it is with its galax-

Is there another you, an alter ego perhaps, that lives on another Earth? If so, where is the other you and this other Earth?

## For the Sci-Fi Fanboy pt.

lex, from Anthony Burgess' dystopian novel A Albert was allowed to play with the rat, and didn't seem Clockwork Orange (or Stanley Kubrick's film of scared of it at all - like Alex was not averse to violence

the same name, whichever you prefer), is cured of his desire for violence by being subjected to the Ludovico technique, which involves Alex being administered nausea inducing drugs, and then forced to watch graphic videos depicting rape and assault amongst other acts of violence. After some time, he begins to feel nauseous when shown these videos even when he hasn't been given nausea inducing drugs. The Ludovico technique "cures" Alex and turns him into a harmless (and defenseless) member of society.

Ivan Pavlov, a Nobel laureate for his work on digestion, was the first to demonstrate such an effect. While studying the digestion of dogs Pavlov noticed that his dogs would begin to salivate even when there wasn't any food around, as long as there was someone or something that

they associated with food around. This meant, his dogs Ludovico technique focused on. Researchers used virtusaw lab coats.

Pavlov continued to study the reactions of his dogs, and thus, classical conditioning was born. It is now used to cure phobias, tics, addictions, etc. One of the most relevant, and unethical, applications of classical conditioning was in 1920 by John B. Watson in his Little Albert Experiment. Little Albert was eleven months old when he was conditioned. He was introduced to a white laboratory rat.

Being the adventures of a young man whose principal interests are rape, ultra-violence and Beethoven. E nley Kubrick Production 'A CLOCKWORK ORANGE' Starring Malcolm McDowell • Patrick Magee • Adrienn and Miriam Karlin • Sceenplay by Stanley Kubrick • Based on the novel by Anthony Burgess • Produced an Directed by Stanley Kubrick • Execute Produces Mar L Raab and S Litefert • wasket and the scena constants of the prior to the Ludovico technique. Whenever Albert touched the rat, Watson and his partner, Rayner, would make a loud noise behind Albert's back by clanging metal together. Consequently, little Albert would cry and grow fearful. After several repetitions of this, Albert began to show signs of fear when he encountered the white lab rat. Albert also generalized the fear to most furry white objects, including Watson in a Santa Claus mask.

Now, experiments like the Little Albert Experiment are considered unethical, and are banned. However, last year researchers at Barcelona University found an ethical way to ask and answer the same questions that the

would salivate when they saw Pavlov's lab assistant, al reality to make male volunteers believe they were inwho would commonly feed them, or even when they side a young girl's body. They were then shown a scene in which the same young girl was slapped. After returning to the young girl's body, volunteers reported feeling greater empathy for her, and felt scared and insecure.

> So while it might not be ethical and legal to reform criminals by relying on the kind of aversion therapy used in A Clockwork Orange, it is possible to discourage racism or violence by relying on virtual reality, and the human ability to empathize  $\blacklozenge By$  Maheen Rashid

ies and solar systems, planets and stars, is but only a small droplet in a sea of parallel universes. Scientists have thus far postulated four levels of parallel universes. The Level One parallel universe arises from the understanding that the universe is infinitely large. Therefore, out of sheer probability there must exist within this colossal space a solar system and a planet very much like ours with people not different from you and me. They might even be you and me. But to meet your other self you would have

To plan a very long journey indeed. Professor Max Tegmark of MIT estimates that to travel to the closest parallel universe, one would have to traverse "google-plex yards, where a google is one with a hundred zeroes after it and google-plex is one with google zeroes." The idea of a Level Two parallel universe is even more mindboggling. It suggests the existence of multiple parallel universes in the shape of enormous cosmic soap bubbles afloat in a sea of giant bubbles and is based on the

left) ADRIAN HOI

hypothesis that in the instant of creation our universe expanded abruptly and enormously to give rise to a giant celestial bubble. Moreover, our universes (in the form of soap bubbles) can collide and generate smaller "baby brother and baby sister universes" resulting in a continuous and frenzied budding off of new universes from parent ones much like the branches of a tree. The geek speech term for this is 'Bubble Nucleation'. Put simply, our uni-verse is in fact a multi-verse.

#### Membranous worlds

The Level Three parallel universe takes things a step further. Relying heavily on M-theory, it hypothesizes that our universe is anchored by means of extra dimensions to a colossal, energetic, vibrating membrane afloat in the sea of space usually referred to as the bulk or hyperspace. These extra dimensions are miniscule and invisible as explained by Professor Brut Ovrut of the University of Pennsylvania: "at any single point there may be incredibly tiny and curled up either six or seven extra dimensions that you just don't perceive." The bulk may contain any number of such membranes or walls of energetic matter motioning rhythmically and packed very close together. According to the latest M-theory, in a fraction of the first trillionth of a trillionth of a second, membranes in a pre-universe space collided to produce the Big Bang and almost 13.7 billion years later the resultant bubble of expanding gases and primeval matter developed into the universe that we know today. Scientists believe that such a cosmic episode is not a one-off phenomenon. "If it happened once, it can happen again, and again, and again" believes Professor Michio Kaku.

His views are seconded by those of Joe Lykken of Fermilab who deems it possible for membranes to clash repetitively to produce new universes. To explain this with even the slightest degree

of accuracy would require a firm grasp of the arcane and untested string theory and the even more arcane and more untested M-theory. What scientists are reasonably sure of however is that somewhere in the multiverse there is a planet analogous to ours with much the same life.

Pullman, however, does not delve into the intricacies of space-time. His science is not overwhelming but hackneyed and concise and he introduces the subject in the most casual manner:

"Oxford?' she cried. "That's where I come from!"

"Is there an Oxford in your world, then? You never came from my world."

"No," she said decisively. "Different worlds. But in my world there's an Oxford too.

We're both speaking English, en't we? Stands to reason there's other things the same.

How did you get through? Is there a bridge, or what?"

Unfortunately, not all Pullman's creations can be found in the book of Physics. It is highly unlikely that Einstein's equations can be twisted to prove the existence of witches or talking polar bears. But given the breathtaking advances in Theoretical Physics and Cosmology in the last century, who knows that in the not so distant future you might be able to see yourself in a parallel universe reading a Phillip Pullman book. While your squirrel daemon gnaws at a walnut  $\blacklozenge$ 

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## STRESS AND COPING

Moneeza Akbar Agha reviews the research in the field.

## DREAMING

Mahd Tauseef delves into one of the most elusive aspects of psychological research.

### MAGNET MAGIC

Alamdar Shah feels that with more and more MRI applications, a reminder of how they work might be helpful.

# **Existential** Crisis

## **BY HARIS BAIG**

ntuitively speaking, the progress that scientific research makes is very hard for a layman to appreciate. Research in Computer Science is no different. However, let us try to walk through some of this "invisible progress" and as we do, it shall be explained what the impact of Computer Science has been, and how is it currently impacting our lives without us being aware.

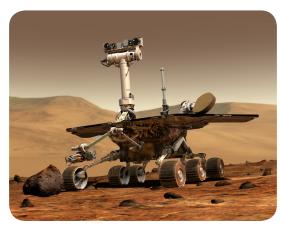
I felt like just such a layman about 2 years ago, with

a limited skill set, just setting out as a Computer Science Major, while trying to look for ideas for some software I could develop. At the time, it felt like everything that could be developed had already been or was in the process of being. What was left to do? It seemed to me that the field had reached apparent saturation!

One critical thing I learnt as I expanded my horizons was that

Computer Science banks heavily on trying to not only to solve problems, but to quote an instructor: "we are after cute ways of solving these problems". For those that do not see that as particularly important, let me elaborate. Computer Scientists love to give the example of sorting to explain how advancement takes place. I tend to find that very boring. So instead I'm going to talk about about how an algorithm for 3D reconstruction was hit upon. Back in 1987, a Russian chap named Kontsevich developed a technique for obtaining the 3D structure of an object just by looking at multiple photos of it taken from various angles. His results were published in some Russian magazine and received very little attention until Tomasi and Kanade ended up re-inventing this nottoo-wheel-like method for reconstructing Rigid (fixed in space and having fixed shape) structure for motion. For a non-computer scientist, this was it. The problem had been solved.

But of course, this isn't enough. Over the course of years, people started refining the method developed by Tomasi and Kanade. Today we stand at a point where we can obtain 3D structures of moving objects by raising the bar higher. Some time ago, we needed multiple cameras, today we say we need one camera viewing a moving object and we can construct the 3D structure just if the camera is moving.



Mars exploration rovers: built by those who are interested in solving problems of space exploration using robotics.

In other words you cannot see 3D with just one eye, but somehow we can use just one camera and render the 3D structure". For us, 'eye = camera'. Now there's a problem solved, cut and dried.

But Computer Science is much broader in scope then just computer vision. Indeed, the famous example of decoding the DNA is also a feat of computing and not a very old one, either. Over the years, its become more important for us to be able to make reasonable use of

> gigantic amounts of data. So we make up methods of storing data that would allow us to access it better, so it can actually be used for something helpful rather than just being a plaque on the wall. Today, Computer Science can increasingly help medical specialists by helping identify mechanisms through the information in their data. Some work in areas of social computing make a completely dif-

ferent kind of impact on everyone's lives. Others spend years trying to attempt hard problems in computing with the assistance of graph theory. Graph theory is a lot about points and lines between points. Its dry but very useful. It solves problems like what's the longest path from where my foot is now to one meter ahead of my foot. No, it doesn't. There is no way to find the longest path.

In fact, modern Computer Science is so diverse that I wonder how all of it can be unified under an umbrella discipline. For instance, consider the very different work of network security specialists. I just bought a few books from Amazon the other day. To analogize for those of you who haven't yet appreciated the feat that is online shopping, its like Little Red Riding Hood going into the forest except the forest is really big and instead of one wolf there's a million. Yet, network security specialists can guarantee her safety.

Thus, from thinking how to find the right amount of feces a fly excretes to looking at the moon on a really cloudy day to solving big issues like internet security, computer science is involved. Every so often, we can do something revolutionary like use robotics and vision in complicated surgeries or use robots that can diffuse bombs in really tough scenarios. Either way, its easy to see how far we've come

# **SECTION** Mind and Brain

Also in *Mind and Brain*:

Definitely not Goldfish The Case for Legal Drugs Moulding with Plasticine The Nuts and Bolts of Guilt Neuroscience and Psychology are increasingly intruding into the hard sciences. A special report expounds on the interdisciplinary nature of the study of the mind.

# Fresh Faces

escartes suggested that the mind and the body are two distinct domains, connected tenu-

ously by the pineal gland, a small lump of cells located in the human brain. While philosophy has remained akin to the human mind, psychology and neuroscience have taken on the role of the pineal gland by rapidly uncovering the workings of the mind and the body, under the domain of the brain.

Though the topic of consciousness, perhaps the heart of what the mind is, remains under considerable debate, other areas such as memory, decision making and so on are slowly chipping away at the inexplicability of the mind. Far from what Descartes assumed, research shows that the human body exerts a sizeable influence on the workings of the mind, and it is this conjunction of the mind and body as symbiotic entities, working as translators for one another that both neuroscience and psychology experts rely upon for their understanding of human behavior.

Human behavior - under neuroscience and psychology - has rapidly become the subject of an interdisciplinary approach, receiving contributions from subjects as diverse as the Biomedical sciences, Physics, Computer Science, Sociology, Economics and Law. The articles in this section, though unable to span the entire breath of diversity in the field, cover a variety of said interdisciplinary collaborations. One examines the causes of a memory disorder and chronicles new research in neuroplasticity. Another reports on clinical trials advocating the use of contraband for treating a psychiatric disorder. The Feature details the contributions of Neuroscience in the courtroom and cautions against its misuse. All of these are emblematic of recent optimism in the scientific world. The hope is that higher levels of analysis and a different approach to the mind can uncover the human body's best-kept secret

**U** MASOOMA RAZA



**FEATURE** 

## The Nuts and Bolts of Guilt

The Law and Neuroscience Project questions the capacity of criminals to make adequate decisions. This has consequences for legal sentences.

#### **BY MUNEEB A. KHAN**

onsider theft. If a man were to steal cars repeatedly, the legal system would sentence him with harsher sentences at each prosecution. On the other hand, as the repeat offences increase, neuroscientists are more likely to question why the man keeps offending. When the law considers crime, it assumes free will in all but a handful of individuals - juveniles, the infirm or the mentally ill - that is, most people make their decisions out of choice. Neuroscience, however, has started to question whether most criminals have the same freedom of choice. Neuroscientists suspect that faulty brain circuitry may hold the key to their bad behavior.

The Law and Neuroscience Project was set up in October 2007, and supported by a \$10 million grant for an initial three year period by the John D. and Catherine T. MacArthur Foundation. It is the first large scale effort to integrate the law and neuroscience and involves scholars from both disciplines from over two dozen universities in all of the United States of America. Initially centered at the University of California, Santa Barbara and now at Vanderbilt University, it was the brainchild of a prominent cognitive neuroscientist, Michael Gazzaniga.

The aim of the project is to educate jurors, judges, attorneys and legal experts in the possible uses of neuroscience in the courtroom and to conduct research in to the nature of the criminal mind, in order to deal with the guilty in a more efficient and effective manner and reduce prison populations.

#### **Bad gambling**

How can the law and neuroscience be integrated when their core assumptions are at odds? Neuroscience assumes decisionmaking to be controlled by the brain, and builds a case for criminals not being in control of their own actions, whereas the law judges people on the assumption of inherent freedom of choice. To better understand a neuroscientist's view of free will, and how it can be made amenable to the legal definition, let us take an example. Individuals with Obsessive Compulsive Disorder (OCD) are more likely than normal controls to perform similar actions repeatedly. Also, individuals with Amygdala or Ventromedial prefrontal cortex damage repeatedly pick losing decks in the Iowa gambling task, resulting in a net loss. However, healthy normal controls are capable of learning which decks in the gambling task are losing ones and can then choose overall winning decks, resulting in a net gain. The brain damaged patients never produce a net gain in the task, only a net loss. So, for neuroscientists as long as individuals can exhibit a variety of behaviors, and are capable of learning from their mistakes and of changing their behaviors, they are thought to be free. Those that aren't,

are most likely under the coercive influence of a malfunctioning brain. Here neither the OCD nor the brain damaged patients are free to choose according to both neuroscientists and the law.

#### **Ideal bedfellows**

Despite these seemingly fundamental differences, the law and Neuroscience seem to have come together in an attempt to understand the criminal mind. In fact, one could argue that the law and neuroscience are ideal bedfellows because of their combined interest in human behavior. The law judges human behavior and neuroscience claims to have a window into the human mind, the control center of behavior. Neuroscientists use Functional magnetic resonance imaging (fMRI) techniques, which are non-invasive brain mapping machines, and can measure the function of various brain regions and relate them to certain cognitions, emotions and perceptions. In effect, a brain scan can potentially tell if a person is lying, it racially prejudiced, is afraid, is capable of making rational decisions and more. fMRI is a powerful technique which has been unavailable to the legal system until now.

Obviously, there is much work to be done. In May 2010, magistrate judge Tu M. Pham in the western district of Tennessee filed a motion to exclude fMRI lie detection in the case of US vs. Semrau. The lie detection test was administered twice to reliability prove the innocence of Dr. Lorne Semrau. Yielding conflicting results, CEPHOS – the company conducting the tests- decided to administer a third test, citing that Dr. Lorne was tried during the second test, which reduces test efficiency. Based on this, Judge Tu M. Pham filed the motion which dismissed the technique. Under rule 702, for expert testimony to be admissible in federal court, it must be a tested technique, which has been peer reviewed, has standard error rates – on which the weight of the testimony may



▲ The legal system needs to learn to adapt to new explanations of criminality. This is the Pakistan Supreme Court: let's hope our legal system incorporates new changes in the field.

be judged – and because fMRI use for lie detection did not enjoy large support from the scientific community, such a test must be inadmissible in court. Also in May 2010, The Frye court, similarly refused fMRI lie detection testimony, in the case of Wilson v. Corestaff Services.

Despite such challenges, The Law and Neuroscience Project continues to research. In its first phase, 2007 -2011, it has focused on the theme of criminal responsibility. For this purpose it established three research networks: one on criminal responsibility and prediction, and the other on legal decision making.

#### Getting down to business

The network on criminal responsibility and prediction was established because large percentages of prisoners in the largest cities of the United States suffer from addiction, possible psychopathy or some brain damage. Alarmingly, 50-90% of people convicted of a felony test positive for alcohol or a controlled substance and over 25% of violent criminals in prison exhibit behaviors indicative of psychopathy. If neuroscientists can prove that addicts are not in full control of their behavior, is it correct to hold them fully accountable? If psychopaths cannot understand that the harm they inflict is morally wrong, should they be punished for it regardless? If a brain damaged person is likely to exhibit impulsive behaviors, can we blame him for his actions?

The network's main aim is to develop diagnostic procedures to assess and predict future behavior for such individuals, procedures that may be used in court. And to develop therapies and interventions that can rehabilitate

### Moulding with Plasticine

processes. Among the few most important of the affected appendage. types of research involve the explanation of the phe-

europlasticity does not only impact facets brain that were not affected by the initial trauma were of memory and information processing. It now being increasingly engaged in the formation of is also used in a great deal of rehabilitative new neural networks in order to accommodate the use

The same behavior has also been noted in patients

nomena using the concept of 'jumping genes', the use of different forms of therapy such as constraint induced movement therapy and the simpler practice of engaging the brain to sharpen and increase plasticity in our daily lives.

Constraint induced movement therapy as a concept was devised by Dr. Edward Taub of the University of Alabama at Birmingham after having

experimented with Silver Spring Monkeys and inducing functions from limbs that were not dominantly used in still retains its ability to morph according to need is bethese mammals. This can be explained thus: previously cause of 'jumping genes.' These sections of DNA have the notion held was that the brain's has minimal capacity the ability to move about and insert themselves ranto reorganize itself past three years of age when all the ma- domly at different locations in the human genome. As a jor connections have been laid down irreversibly. How- result, it is possible that the DNA sequence contained in ever, recent research has shown that this is not the case. two adjacent neurons may also be different. What this

force the victim to regain use of the affected arm. This manipulate. was a time consuming, and slow process, but it yielded All this begs the question: what else can a lot of thinking results. What Taub found was that those parts of the



who have lost the sense of sight. Over the course of time and with the proper guidance of professionals, it is very possible that the visual cortex begins to form new synaptic connections in order to accommodate the information from the auditory system as well as the sensory system associated with touch. This explains why blind people are often said to have stronger senses of smell and touch.

The reason it is possible to believe that the brain Suppose that a person suffers a traumatic head injury does is confer an advantage of adaptation in the event of that leaves his right arm, or some appendage paralyzed. a rapid change in the external environment. If there is The conventional way to approach rehabilitation would greater variety of genes present in the brain, it is possibe to focus entirely on shifting dominance to the other, ble that the differential gene expression of these regions more functioning limb. However, as the name suggests, causes the brain to respond specific to different stimuli. Taub used a restraint to prevent the use of the unaffect- This also explains the compensatory mechanism that ed arm, and began a rigorous and intensive program to Dr. Taub seems to have gotten a hold of and is trying to

do?

such individuals back to normal non-criminal functioning. Because biases based on race, religion, crime history and so on often affect perceptions of guilt assessment and sentencing in criminal law, the network on legal decision-making was also established. It consists of two branches; one which scrutinizes judge and juror decision-making when determining guilt, and the other, which assesses the use of neuroscientific evidence in the courtroom making recommendations for certain uses, such as the use of neuroscience in understanding memory and in standardizing lie detection.

If this integration of the two disciplines is successful, the entire legal system is likely to change. Legal experts are likely to take a fresh look at accountability, types of punishment and severity of punishments. Neuroscientists have attempted to humanize the criminal, and in the future it is possible that each criminal will have a tailor-made rehabilitation plan designed to get him back to normal as quickly as possible.

It may be a while before neuroscience becomes a regular feature of the courtroom, but the proliferation of Neurolaw degrees is an indication that the integration of the two disciplines is inevitable. The real test for neuroscience now is to prove that it can reliably validate its claims. And perhaps in the future, legal battles will be won in neurolabs instead of courtrooms

### Definitely not Goldfish

nyone who's read Dan Brown's The Da Vinci Code will know that the protagonist Robert Langdon possessed an eidetic memory which was crucial to solving the mystery at hand. Similarly, anyone who's seen the film Rain Man will know that Dustin Hoffman's character was based on the real life story of Kim Peek, a megasavant.

For the layman, an eidetic or photographic memory is an individual's ability to recall vividly and accurately, all details of any experiences or interactions that they have encountered. A savant is a person with a developmental disorder that - despite leaving the person with a debilitating handicap - confers an exceptional level of ability with respect to one area of expertise. Kim Peek, for instance, possessed the ability to read two opposing pages of a book simultaneously, one with each eye. This however, was the result of a disorder called agenesis of the corpus callosum - the fibres connecting the two halves of the brain weren't wired the right way. This meant that despite being able to recall as many as 12000 books solely from memory, Mr. Peek scored an 87 on standard IQ tests – something that would acquire him the title of an idiot.

Naturally, the question that arises as a result of the above discussion is: what is causing things to work the way they are? The answer lies in the research and findings in the area of Neuroscience known as neuroplasticity. In the simplest of terms, neuroplasticity refers to the ability of the brain to form and re-form connections in response to interactions with the external environment. So, your daily activities and experiences have a direct effect in defining the circuitry of your brain.

Now, the human brain being as complex as it is, most current research is still nascent, and is only beginning to shed light on the nature of the phenomena of plasticity. Among the first bits of information is the role that the hippocampus, the visual and the auditory cortex play. The hippocampus being the region that is involved in the transfer of information from short-term to longterm memory, and the visual/auditory cortex are the two largest recepients of external stimuli.

The role of the hippocampus particularly becomes significant in respect to neuroplasticity when taken in the context of the case of Henry Gustav Molaison. This American, born in 1926 and the victim of a devastating bike accident at an early age was left with intractable epilepsy. After having localized the focal point of these seizures as arising from the medial temporal lobe (responsible for auditory perception and long term memory storage) doctors proceeded to remove two-thirds of his hippocampus. H.M, as he came to be known, rose from the procedure free from his epilepsy, but with it he also seemed to have lost any ability to form new memories. The lad had to spend the next 5 decades of his life going through each day like it was the first time he was doing things. Unfortunately, he died on December 2nd 2008, but not before providing researchers with the single biggest indicator that without the hippocampus, an individual will not be able to create the synaptic/neuronal connections necessary for the retention of vast amounts of information as is the case with eidetics and savants.

The role of the hippocampus and the temporal lobe further becomes important when we consider a study carried out in 2001 by Allan Snyder, Director for the Center for the Mind at the University of Sydney. Using a method called Transcranial Magnetic Stimulation, Snyder induced the neurons in the various regions of the brain to depolarize (or fire) using rapidly changing magnetic fields to create the electric currents necessary, and then observe any changes in mental or physical ability. Snyder concluded that stimulation of the left temporal lobe (the higher center of the hippocampus) caused the person to develop a heightened sense of skill in some area of expertise, and in other cases it led to an increased prowess in a talent hitherto unknown by the individual being tested. Under the study, it was found that the subjects' level of awareness, as well as their ability to process and their performance on the tests (which involved counting the number of dots on a screen as fast as possible, and the ability to recall the day of any date on the calendar year) improved significantly. In a separate study conducted by a team at Flinders University in Adelaide, Australia, it was seen that 5 out of 17 volunteers improved in their 'savant skills' - memory, math, and art. This goes on to show that, even if we are to consider the brain a hardwired organ, as everybody in the community did just a

Neuroplasticity may be able to explain why some people have photographic memories.



Homo

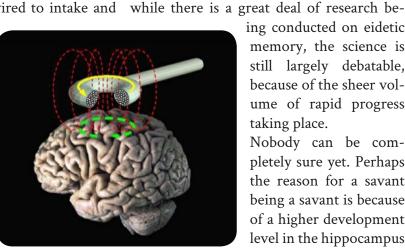
**BY OVAIS RASHEED** 

few years ago, we need to understand that to pay attention to; he will inevitably capture people who possess eidetic memory, or are savants, are genetically wired to intake and

utilize those connections of this hard-wired system that most common people do not. Hence, they can process a larger amount of information at a faster rate than other normal beings.

Needless to say, the calculator is only as smart as the person using it. In other words, unless the pathways that

lead up to the hippocampus and the lobes are not adequately equipped to take in the surrounding environment and the barrage of stimuli that this environment entails, the brain would be stagnant, and yet your head would hurt from having to put up with so much stuff piling up on your 5 senses. Stephen Wiltshire is a British born autistic savant who possesses the ability to recreate with seemingly perfect accuracy the architectural landscape of any region that he visits. He is famous for his 5 and 10 meter long panoramic views of major cities of the world, from Tokyo to Madrid to New York. The kicker is that he manages to accomplish these things after having only briefly viewed the scene he ultimately sketches. At such a point, it is perhaps more prudent to understand how a potential reduction in the level of neural and synaptic plasticity may be an advantage. This is because, in our normal brains, we have developed mechanisms on the synaptic level to discriminate between levels of stimuli that are important or unimportant (also known as adaptation). This discrimination drastically improves attention spans and recall. Now, in the case of Stephen, who absorbs any landscape he sees like a sponge, it is perhaps more advantageous, and possibly the reason for his extraordinary memory skills. While his brain may have formed a higher number of connections between the temporal lobes and the various sensory systems, there is no level of discrimination between them. Which ultimately means that Stephen has no control over which details he wishes



▲ Transcranial Magnetic Stimulation

ing conducted on eidetic memory, the science is still largely debatable, because of the sheer volume of rapid progress taking place.

everything. Do bear in mind, however, that

Nobody can be completely sure yet. Perhaps the reason for a savant being a savant is because of a higher development level in the hippocampus which confers the ability

to rapidly transform in-

formation from the short to the long-term memory regions. Or maybe it's because of a potential reduction in the level of discrimination of newly formed synapses. What we do know is that the answer to the questions lie not only in which region of the brain lights up when we go about our daily activities, but also how these various regions are undergoing constant changes in their structure, function in response to rapidly changing external stimuli. We know it's hard being a savant. What we didn't know is how hard it is trying to figure them out  $\blacklozenge$ 

#### *IFURTHER READING1*

H.M., an Unforgettable Amnesiac, Dies at 82 Benedict Carey, The New York Times December 4, 2008

Unlocking the brain's potential BBC News, March 10, 2001

**Explaining and inducing** savant skills: privileged access to lower level, less-processed information Allan Snyder Philosophical Transactions of the Royal Society, 27 May 2009 vol. 364 no. 1522 1399-1405

### The case for legal drugs

#### **BY MAIRAH T. KHAN**

cstasy is generally considered a recreational drug, known to produce a feeling of relaxation in its users. Needless to say, the drug is addictive. It was developed in the 1920's, and in the 1960's began to be used to treat anxiety and depression, with the chemical name MDMA (3,4 methylene dioxymethamphetamine). However, it's addictive use lead to banning of the substance for medicinal uses.

After a break of 40 years, there has been a renewed interest in the potential of ecstasy in treating posttraumatic stress disorder (PTSD). Private clinical drug trials begun in the United States many years ago in order to treat people with severe PTSD.

PTSD occurs as a result of severe trauma and leads to the following symptoms: reliving the experience as if it is in the present; avoiding thoughts, feelings and situations that bring back memories of the trauma; over-arousal, where the person is continuously scanning the environment for danger signals. PTSD also leads to chemical imbalances in the brain. Increased levels of the neurotransmitters corticotrophin releasing factor and glutamate in the hippocampus of the brain inhibit the hippocampus from processing and storing the traumatic event in long term memory. Therefore recurring flashbacks of the event continue.

The Multidisciplinary Association for psychedelic studies in SantaCruz has been campaigning to legalize ecstasy for the treatment of PTSD. Clinical trials, using psychotherapy along with ecstasy to treat PTSD patients, have shown positive results. Michael Mithoefer, a South Carolina based psychiatrist, lead the clinical trial on 21 patients of severe PTSD - a consequence of crime and war. Within two months only 17 percent of the patients were still diagnosed with PTSD, a much lower result than with psychotherapy alone.

Why is psychotherapy alone not as effective? Many patients are so traumatized by their experience that even the

thought of revisiting the event with a psychotherapist causes anxiety. Ecstasy helps the treatment by increasing the levels of serotonin, a neurotransmitter whose increased activity is related to a feeling of wellbeing. Ecstasy also enhances the level of the hormone oxytocin, which creates a feeling of trust in patients with the psychiatrist during the psychotherapy session and makes reliving the experience much easier.

But why use ecstasy when it is known to cause addiction? During the past 10 years there has been any significant progress in finding drugs that can increase serotonin uptake and treat PTSD in much the same way as ecstasy does. With the sharp increase in PTSD cases - owing to the veterans from the Afghanistan and Iraq war - and a lack of effective alternative treatment therapies, the controlled use of ecstasy with psychotherapy appears to be the best treatment option.

However, ecstasy addiction remains a major problem in the United States. Symptoms of ecstasy abuse include anxiety, depression, convulsions, paranoia and more. According to the National Institute of Drug Abuse, in 2008, 2.1 million Americans had abused ecstasy. With such high figures, should ecstasy be made available on prescription? And should the American government fund programs using ecstasy in clinical trials? Valium, a common anti-anxiety medicine, can be addictive as can a slew of other medicinal drugs currently available in the market. Regulations to prevent to control their use, and prevent addictive use are necessary.

According to David Nutt, chairman of the advisory council on the misuse of Drugs, more people die from bee stings than ecstasy abuse. Regarding addiction, Nutt feels that a very small dosage of MDMA regulated by a psychotherapist is unlikely to lead to any addiction problem. Proving the efficacy of ecstasy as a therapeutic drug is only the first step. If ecstasy use is legalized, pharmaceutical companies are likely to lose billions of dollars in reduced sales of antidepressants. Single treatments or short-term use of ecstasy, rather than long-term prescriptive use of antidepressants, will further lower sales for pharmaceutical companies. For this reason, such companies are reluctant to finance research MDMA research. The Multidisciplinary Association for Psychedelic Studies is undertaking a 10 year, \$10 million plan to make ecstasy into an FDAapproved prescription medicine.

Maybe soon, if ecstasy use for medicinal purposes gains FDA approval, we'll all get high to get by  $\blacklozenge$ 

#### COLUMN

### **Deserts pretending to be forests**

The Pakistan government needs to recognize its lack of forestation efforts.



t doesn't reflect too well on your country's environmental agency when a Google search for forestation in Pakistan is corrected to deforestation. But then you can't really blame Google for the shortcomings of a nation.

Pakistan is currently losing its forests at 2% annually, which is amongst the highest rates in the world. If you add to this equation the fact that ouractual forests are said to occupy only 2.5 percent of the country's area, and that figure suddenly seems quite large. The government disa-grees and places the figure at 5%, but this definition classifies a forest as a region under control of the provincial forest department. So even though there may not be a single tree in the area, it will still be called a forest. Maybe we should just put all the desert areas under the control of the forest departments too then, just to boost the number?

There is a great gap of communication between the government offices, but more disappointing than this is the fact that no government really cares either. Pakistan has just witnessed the worst flooding in decades; you would think that

they would make an effort to plant a few trees and try letting nature help control the environment.

One good thing that seems to have come about is the recent agreement that the Pakistan Ministry for Environment has struck with the World Wild Fund for Nature which stipulates a 15 year effort to conserve the forest regions of Pakistan as well as to develop new ones. I would like to place my faith in this move, because it seems like the first earnest effort that we need, but given my country's history, I hope against hope that our government has the fortitude to see it through

Dry as Bone

#### **BY HASNAIN LAKHANI**

hen I was back in grade school, it seemed like teachers went out of their way to make science boring. Science class usually followed the same dry pattern: The teacher would start off with a new topic,

describe the phenomenon a bit, and then ask us to memorize what was just taught. At the end of the class we would be asked simple questions to test our "understanding" of the topic. Questions from students in the form of "but why does this happen?" were usually discouraged.

Such a style of teach-

ing does not do justice to the beauty and elegance of science. Instead of making students go "wow" and creating a desire to learn science, students are put off from the subject. This is especially true when we consider experimental science. Instead ofhaving students work their way through experiments; what usually happens is that the teacher carries out an experiment while the students watch. And then the students are told to memorize the results, because "that's the way it works".

It should be the other way around: students should be allowed to experiment (within some safe boundaries, of course) and discover what happens. By making their own simple guesses and verifying them experimentally, students can be introduced to the scientific method in a simple manner. Suddenly, class can become something to look forward to, instead of just another boring time-waster.

With this in mind, a bunch of students at the LUMS School of Science and Engineering have initiated a new project to provide students across the country with experimental science workbooks. The goal is to have ex-



it

periments that are not only interesting, but also cheap and easy to carry out so that they can be used in most schools. They also plan on visiting many schools and carrying out demonstrations of these experiments.

A sample experiment would go like this:

1. Take a straw and thread a string through

- 2. Tape the string across the room.
- 3. Blow up a balloon and tape to the straw.
- 4. Release and see it zoom across the room.

It might seem a bit simplistic, but that's exactly what we are trying to achieve.

Experiments that are simple and easy to carry out; and at the same time explaining physical effects. For example, the above experiment can be used as an introduction to jet propulsion, as well as Newton's laws (every force has an equal and opposite reaction); as this is the mechanism by which the balloon zooms across the room.

Imagine a workbook filled with such interesting experiments, each illustrating some vital concept in science. That's what we're aiming to provide to students all over Pakistan  $\blacklozenge$ 





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### A Note on Photography

The Box Move felt that we should feature local photographers in order to showcase some wonderfully poignant and relevant work conducted in Pakistan, but also to get some much-needed local perspective. Here's the photographers whose work you will find in these pages.



#### **RIZWAN QURAISHI**

A LUMS alumnus, Rizwan is a freelance photographer based in Karachi whose work has been showcased in exhibitions at Wharton Business School, University of Calgary and the Photo Club of Karachi. While at LUMS, Rizwan was a LUMS Adventure Society member, influences of which are evident in his wonderful nature photography.

#### TABISH ZAFAR

A student of Computer Science at the *University of Central Punjab*, Tabish is an avid nature photographer trying to reconcile his photography with computer science.

#### SAAD ABBASI

A final-year student of Electrical Engineering at the *University of Leicester*, Saad's astonishing work on Astrophotography reflects his interest in Physics and Cosmology. Currently, he is designing an image stacking application for Macintosh.



#### MASOOMA RAZA

A Communication Design Major at *Indus Valley School of Art and Architecture* with a minor in Photography, Masooma's work featured in this issue, including the cover, is part of a series of photographs submitted for a Spirituality assignment.

#### MALIHA A. PASHA

A Kinnaird graduate, Maliha lives in Lahore and owns her own photography studio 'Shuttered Works', founded in 2010, which specializes in wedding photography and portraits. Contact Shuttered Works at <u>shutterworks@gmail.com</u> or find it on Facebook!

#### SAAD ALVI

A Computer Science graduate of the *Institute of Management Science* in Lahore with a passion for trekking and back-packing, Saad currently works as a Business Intelligence Analyst for Mobilink GSM.



#### ANUM AWAN

Studying Graphic Design at the *Massachusetts College of Art and Design* in Boston, MA, Anum's design and photography portfolio, which includes The Box Move's logo, is extensive and iconic. Find out more about Anum or contact her at <u>www.anumawan.com.</u>

#### **SNAPISTAN**

Co-founded last year by **Natasha Noorani** and **Aizaz Ahsan**, Snapistan is an attempt to present Pakistan in a new and enlightening manner through the medium of photography. Snapistan's website <u>www.snapistan.com</u> features scores of up and coming Pakistani photographers, either in the Gallery section or the Weekly Window, both are which are thematically organized.