SCIENTIFIC MALAYSIAN

ISSUE 7 / JAN 2014

INVERSE PROBLEM

Have you identified it?

THINKING, FAST AND SLOW
Review of the book by Nobel Laureate Daniel Kahneman

MEET THE SCIENTIST
Interview with Prof. Sudesh Kumar

SCIENCE IN THE ART OF STORYTELLING
How science plays a role in constructing fiction

SCIMY NEWS

MINI-INTERVIEW

REVIEWS

ARTICLES

LIFE AS A SCIENTIST

CREATIVE CORNER

PERSPECTIVE

ON THE COVER

The cover for this issue illustrates a back-to-back mirror image of two question marks for the "Inverse Problem" article written by Sean Lim (pg. 10). These question marks symbolise the basics of inverse problem theory whereby one has to keep asking question to reach a unique solution while the mirror image of the two question marks represents the opposite relationship between forward and inverse problems.

ILLUSTRATED BY

Kong Yink Heay
http://heay-e-gallery.blogspot.com

SCIENTIFIC MALAYSIAN MAGAZINE is published in a web format (http://magazine.scientificmalaysian.com) and in a downloadable digital magazine format (PDF). Our digital magazines are distributed to Malaysian societies around the world to reach out to as many Malaysian scientists as possible. The Scientific Malaysian Magazine will be published tri-annually and is FREE of charge.

CONTACT US

Email:
magazine@scientificmalaysian.com

Website:
http://www.scientificmalaysian.com

Twitter/Facebook:
@ScientificMsian
http://facebook.com/ScientificMalaysian

FOREWORD

EDITOR'S FOREWORD

Welcome to the 7th issue of the Scientific Malaysian Magazine! We hope all our readers are feeling rejuvenated and ready to accept more challenges in 2014.

2014 will be a year full of positive changes for Scientific Malaysia. For this first issue of 2014, we have lined up articles focusing mostly on mathematics and psychology – an attempt to break the conventional (but less than true) view that science has places only for biology, chemistry and physics.

After our usual news highlights (pg. 4), we recap the rare earthquake that shook Baling (Kedah) in August 2013. **Dr. Afroz Shah Ahmad Shah** and **Habibah Hanan Mat Yusoff** offered their opinions on lessons we can learn from this geological jolt, and how Malaysia can prepare better for earthquakes and natural disasters (pg. 8). Next, we feature an article on Inverse Problem by **Sean Lim Wei Xinq** (pg. 10), a simple yet fundamental concept in mathematics. Most importantly, we are faced with "Inverse Problem"s everyday without realising their impact on our lives.

Science communication has emerged as a hot topic in recent years, and new positions are being created for scientists who wish to communicate science in better ways (the SciMy Magazine team nodded their heads vigorously). Therefore, when an opportunity to attend the Science Communication Workshop (organised by Academy of Sciences Malaysia and the British High Commission) arose, **Kong Yink Heay** snatched it up and went on to share a summary of the workshop (pg. 12). In a similar vein, **Azilleo Kristo Mozihim** conducted a brief interview with **Dr. Sin How Lim**, who received the IAS-NIDA Research Fellowship Award 2013 (pg. 14).

Being a scientist could be exciting. We believe **Prof. Sudesh Kumar** (pg. 16), **Mamduh Zabidi** (pg. 20) and **Juliana Ariffin** (pg. 22) can vouch for that in the "Life as a Scientists" section. On pg. 25, **Gabriel Chong** reviews a popular math book meant for both mathematically sound and illiterate readers. For those who are interested in psychology, check out **Vivian Eng**'s review on a popular psychology book (pg. 27).

Science is easier to understand if it is told in a fictional manner. **Lim Yen Kheng** discusses the art of storytelling for science fiction, and deconstructs "fiction" into scientific plots (pg. 29). In our new section called "Perspective" (where we invite readers to share their personal triumphs, disappointments, or even random thoughts related to science with the Scientific Malaysian community), **Dr. Sylvia Hsu-Chen Yip** narrates her clumsiness during her scientific training in three countries (pg. 31).

Happy New Year to all, and we look forward to bringing you a wider spectrum of science in 2014!

Dr. Valerie Soo
Editor-in-Chief
valwc.soo@scientificmalaysian.com

WRITE FOR SCIENTIFIC MALAYSIAN MAGAZINE

Would you like to contribute articles for Scientific Malaysian Magazine? We welcome articles on any aspect of scientific research and/or articles relevant for public understanding of science.

Please get in touch with us via email: magazine@scientificmalaysian.com

DISCLAIMER:

NEWS HIGHLIGHTS

Snippets of the latest news published on Scientific Malaysian website

OCTOBER 2013

Awardees of the Merdeka Award 2013

The Merdeka Award is one of the most prestigious accolades that can be conferred to both Malaysians and non-Malaysians to duly recognise their immense contribution in their respective fields to the people of Malaysia. Five outstanding Malaysian received the Merdeka Award in 2013, including Dr. Lim Boo Liat who made great contributions to the conservation of Malaysia's biological diversity; Tan Sri Dr. Yahya Awang who pioneered the development of clinical research and cardiac surgery in Malaysia; and Emeritus Professor Dato' Dr. Lam Sai Kit, who made tremendous contributions to medical virology and emerging infectious diseases in Malaysia.

Photo: Merdeka Award

NOVEMBER 2013

US$100 million partnership deal for green tech ideas and innovations

Malaysia has partnered with Japan-based Asian Energy Investment Pte Ltd in a US$100 million investment to fund Southeast Asian green technology ideas and innovators. This investment is part of an effort to accelerate the development of green energy products and businesses in Malaysia and within the region.

Photo: Seth Anderson/Flickr(CC)

DECEMBER 2013

Diet can reverse type II diabetes

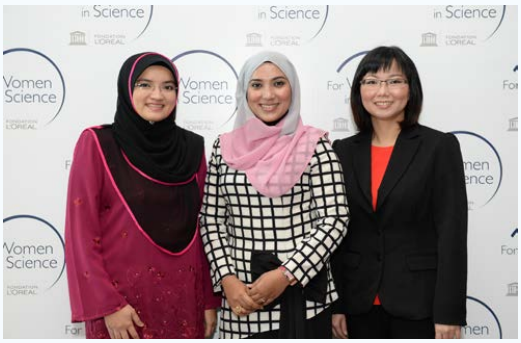
It has been long held that the progress of diabetes is irreversible and ultimately leads to daily dependence on insulin injections. A clinical research team from the Newcastle University Medical School (UK) comprising a Malaysian endocrinologist, Dr. Lim Ee Lin, discovered in 2011 that dietary energy restriction alone was sufficient to reverse diabetes, specifically Type II Diabetes. This finding opens up the possibility that diabetes could be a reversible disease and therefore, a cure for diabetes could be within the grasp of many sufferers in the future.

Photo: Heather Aitken/Flickr(CC)

DECEMBER 2013

L'Oréal Malaysia Honors Three Outstanding Women in Science

This year, another three outstanding young women in material science was awarded the L'Oréal-UNESCO For Women in Science fellowship and each will also receive a research grant worth RM20,000. These three young women scientists were selected out of 68 submissions by an esteemed jury panel, their research proposal was evaluated based on the scientific impact, quality of research, publications, work experience and previous awards received.



(L-R): Dr Suriani Abu Bakar,Dr Ruslinda A. Rahim, Dr Chuah Lee Siang (FWIS Fellowship recipients 2013)

UTAR and UM students emerged as winners of the 2nd Outstanding Technopreneur Competition 2013

Universiti Tunku Abdul Rahman (UTAR) and Universiti Malaya (UM) Master degree students emerged as joint-winners of the 2nd Outstanding Technopreneur Competition 2013 under the Young Intellectual Category. The Competition which was organized by Malaysian Scientific Association and WENCOM Career Consultancy and began in 2012 is one which provides career development for Science and Technology students with entrepreneurial potential.

From 2nd left, Ms. Wee, Rick Tay, Dato' Dr Rosli, Prof. C. P. Ramachandran, Datuk Dr Tan. Far right is Alexander Stedtfeld.

Science Essay Competition for ASEAN Young Talents (ESTI 2013)

Undergraduates, postgraduates and young engineers, architects, technologists, industrialist of ASEAN countries are invited to use their innovative ideas and analytical skills to compete for one of three ASEAN ESTI Essay Writing Prizes. The Theme for the Essay Competition is 'The Importance and Challenges of Promoting Science, Technology and Innovation Education to The Young Children in ASEAN Region'. The closing date for this competition is 31st of January 2014.

Photo: Andrew Huff/Flickr(CC).

The full news articles are available on our website at www.scientificmalaysian.com. We welcome press releases and research news articles; please get in touch with us by email at news@scientificmalaysian.com

CONFERENCES

Upcoming conferences and symposia in Malaysia and Singapore

JANUARY 2014

Malaysian Society of Hypertension (MSH) 2014 - 11th Annual Scientific Meeting
Date: 17 - 19 January 2014
Venue: Shangri-La Hotel, Kuala Lumpur
More info at http://www.msh.my/index.php

EmTech 2014 - MIT's biggest global tech conference
Date: 20 - 21 January 2014
Venue: Marina Bay Sands, Singapore
More info at http://www.emtechsingapore.com/index.php

International Symposium and Workshop on Functional Genomics and Structural Biology 2014
Date: 21 - 24 January 2014
Venue: Mine Wellness Hotel, Seri Kembangan, Selangor
More info at http://fgsb.upm.edu.my

FEBRUARY 2014

Asian Federation of Biotechnology Regional Symposium 2014
Date: 9 -11 February 2014
Venue: Seri Pacific Hotel, Kuala Lumpur
More info at http://www.ars2014.upm.edu.my

MARCH 2014

Golden Jubilee of the Malaysian Society of Parasitology and Tropical Medicine (MSPTM) & 6th ASEAN Congress of Tropical Medicine and Parasitology (ACTMP)
Date: 5 - 7 March 2014
Venue: Intercontinental Kuala Lumpur
More info at http://www.actmp2014.com

The 2nd Malaysian Pharmacoeconomics and Outcome Research Conference 2014
Date: 7 - 9 March 2014
Venue: Royale Chulan Hotel, Kuala Lumpur
More info at http://myspor.my

MAY 2014

International Conference on Beneficial Microbes (ICOBM 2014)
Date: 27 - 29 May 2014
Venue: PARKROYAL Penang Resort, Penang
More info at http://www.icobm.usm.my

INTERESTED IN JOINING THE SCIENTIFIC MALAYSIAN TEAM?

Scientific Malaysian is on a rapid expansion and we need your help! By being part of us, you will have the opportunity to enhance your skills and improve your CV by working flexibily and contributing remotely from wherever you are.

We are now seeking for enthusiastic and passionate volunteers to join our team for the following positions:

a) Web Developers
- Role: Maintaining and adding new functionalities to our websites.
- Knowledge in *WordPress* is essential.

b) Scholarship Officers
- Role: Maintaining our scholarship directory, and liaising with scholarship funding bodies.

c) News Editors
- Role: Writing short news reports on scientific research and development news in Malaysia, to attend/report on scientific events/conferences.
- Good writing and reporting skills are essential.

d) Magazine Designers
- Role: Designing our magazine layout and format.
- Knowledge in *Adobe InDesign* is essential.

Photo: *www.lumaxart.com/Flickr*

e) Publicity Officers
- Role: Promote awareness of Scientific Malaysian especially via social media, distributing SciMy digital magazine, liaising with relevant organisations.

f) University Ambassadors
- Role: Promote awareness of Scientific Malaysian at university campuses and research institutes locally (Malaysia) or abroad. May involve organising events (such as talks or discussion forums).

If you would like to contribute to Scientific Malaysian in other ways not mentioned above, please do contact us - we are always looking forward to new ideas!

CONTACT US: **team@scientificmalaysian.com**

Lessons from Baling Earthquake

by Dr. Afroz Ahmad Shah and Habibah Hanan Mat Yusoff

A magnitude 3.8 earthquake shook Baling (Kedah, Malaysia) at 8.26am, 20th August 2013. This raised some of the fundamental questions regarding the causes of earthquakes in Malaysia and primarily, our understanding and preparedness to handle earthquake disasters.

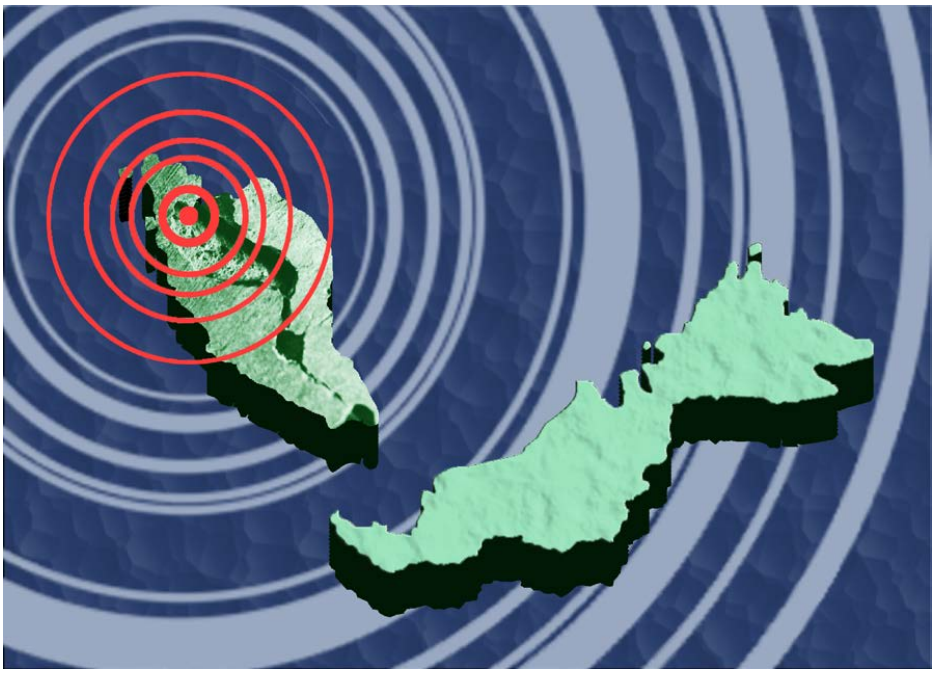


Illustration by Kong Yink Heay

Malaysia is crisscrossed by a number of faults throughout the country, and most of these are not marked on the available geological maps. Since there is not much activity along these faults these are considered to be "inactive" structures. Not much scientific work has been done to understand the earthquake geology of these faults, which needs immediate attention. This is primarily because prior understanding has extensively demonstrated that active faults can also occur in regions formerly considered geologically stable. Therefore, it is significant to cognize the overall earthquake potential of all structures that can be mapped using the satellite images and field investigation.

The cause of earthquakes is well understood - an earthquake involves an "elastic rebound" of previously stored elastic stress. It is like a stretched rubber band, which if broken or cut, releases elastic energy stored in the rubber band during the stretching. Similarly, the earth's crust can gradually store elastic stress that is suddenly released during an earthquake. This accumulation and release of stress and strain is now referred to as the "elastic rebound theory" of earthquakes, which is currently the best explanation available for the cause of the earthquakes.

To understand the cause of Baling earthquake, we have to first understand the earthquake parameters that were provided to us by the Meteorological Department of Malaysia. It was recorded that the magnitude of the earthquake was 3.8 and it occurred at an epicentral distance of 11 km to the south of Baling, however, the depth of the earthquake was not indicated. This is very important to know, because earthquakes occur at various depths and the deepest can go as deep as 700 km. Therefore, to understand this very event, its depth needs to be known. Once that is done, it is possible to determine if this has occurred on a shallow fault or on a deep portion of the fault or elsewhere. These procedures will eventually guide researchers to come up with a strategy and to understand the cause of such events, both of which are imperative for the country and its safety. This is done in a systematic pattern and the primary step is to extensively map all the active structures using the satellite images. This is followed by more vigorous field mapping, geophysical investigations and trenching on certain portions of the fault. Thus, with all the information gathered during these exercises, the earthquake potential along faults can be estimated, and this information is useful for building earthquake resistant structures.

Further, the current understanding of earthquake prediction is wisely crafted in a book "*Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction*" by U.S. Geological Survey geophysicist Susan E. Hough. The author emphasises that predicting earthquakes remains difficult for scientists due to various reasons that are discussed at length in the book. Therefore, with the current knowledge earth scientists cannot predict the exact timing and location of an

"Malaysia is crisscrossed by a number of faults throughout the country, and most of these are not marked on the available geological maps"

"Only a responsible, honest and stable government will be able to implement suitable and effective procedures to counter natural disasters"

earthquake; however, they can forecast these parameters and suggest various mitigation plans to reduce the damages and fatalities during an incoming event. Thus, humans must learn how to live with earthquakes. This can be achieved effectively through implementation of strict earthquake construction standards, careful geological evaluation of building sites, and public education. This is best exemplified by Japanese people, who have largely implemented these standards and therefore succeeded in building earthquake resistant structures and more importantly, a scientifically aware society. However, unlike Japan, a large number of people live in the developing world. Therefore, it is not easy to implement these standards, primarily because of the limited access to earthquake-related information, as well as general poverty, illiteracy and poor administration (*Shah, 2013*).

Bilham and V. Ghar (2013) also highlighted some of these concerns and discussed the earthquake risk in the developing world (e.g. India, Iran, Afghanistan, Bhutan, Bangladesh, Sri Lanka, and Myanmar). It is true that the developing world needs an enormous amount of work, which may take decades, to reach to the standards of Japan. However, the problem not only lies in the gathering of data, but more importantly so, the economic condition of a particular nation. A poor nation will always be more vulnerable to the damaging consequences of natural disasters (e.g. earthquakes, volcanoes, floods etc.), as shown by the degree of destruction caused by the Haiti earthquake of 2010 and the 2005 Kashmir earthquake. Both these earthquakes occurred in countries which are not only economically poor but also poorly governed. Therefore, it would be almost impractical to address the issues of natural disaster management without taking into account the economic and political facets of that country.

Equally challenging is to think that government can easily impose available construction standards on private structures in developing nations, because, this will again depend on the economic, political and administrative responsibilities of a nation. Only a responsible, honest and stable government will be able to implement suitable and effective procedures to counter natural disasters. Also, a scientifically literate and responsible society will help government to achieve such a goal and will also assist others to understand natural disasters. In particular, a significant portion of people in third world countries (such as India, Pakistan, Nepal, etc.) consider natural disasters as divine punishment, and therefore, do not interfere or question such calamities (*Shah, 2013*).

In conclusion, to achieve success in understanding earthquakes and to implement wise strategies, Malaysia needs to join international organizations and collaborate with them for a better future. This is because these groups are well-equipped with the latest developments in earthquake research, which will greatly benefit any country, including Malaysia. Therefore, strong international and national collaborations are required, wherein people from various disciplines can work together towards a common goal. Living with earthquakes is more to do with the overall stability of a particular nation, and that can only be achieved if we take it as a joint duty and work as an organized nation for a strong and stable future. Also, education in earth sciences could make a lot of difference in educating people about natural disasters, and more specifically, earthquakes. This can be achieved by organizing various awareness programs and by introduction of earth sciences as a core field in the academic curricula (*Shah, 2013*).

REFERENCES

[1] Hough, S., *Predicting the Unpredictable: The Tumultuous Science of Earthquake Prediction*, Princeton University Press, 2010, pp. 222.

[2] Bilham, R. and V. Gaur., Buildings as Weapons of Mass Destruction: Earthquake risk in South Asia, *Science*, 2013, 341, 618-619.

[3] Shah A. A., *Kashmir Observer*, 2013. 29 September.

ABOUT THE AUTHORS

DR. AFROZ AHMAD SHAH is a Senior Lecturer (Applied Geology) at the School of Engineering and Science, Curtin University, Sarawak. He obtained his PhD in 2010 (tectono-metamorphic evolution of Precambrian rocks) with Prof. Tim Bell in School of Earth & Environmental Sciences, James Cook University, Australia. He obtained an M.Tech. in engineering geosciences (2006) from IIT Kanpur India. He can be contacted at afroz.shah@curtin.edu.my. Find out more about Dr. Afroz Ahmad Shah by visiting his Scientific Malaysian profile at http://www.scientificmalaysian.com/members/afrozshah/

HABIBAH HANAN MAT YUSOFF is a final year student in geology at University of Washington, Seattle, USA. She is currently working on an independent research about earthquakes and tectonics geomorphology in Southeast Asia focusing in Malaysia. Her collaborators are mainly Dr. Afroz Shah and other geoscience professors at University of Washington, Seattle. She will present her research around March 2014 in the Undergraduate Research Symposium at University of Washington, Seattle. She can be contacted at hhmy@uw.edu. Find out more about Habibah by visiting her Scientific Malaysian profile at http://www.scientificmalaysian.com/members/habibah/

Inverse Problem

What is it and why should you care?

by Sean Lim Wei Xing

Illustration by Kong Yink Heay

The subject of inverse problems in mathematics is an interesting one. In the mathematical community, the subject is classified under applied mathematics, and is generally regarded as a relatively new branch of mathematics. This is true in the sense that the general abstraction of an inverse problem was not considered up until possibly the early 2000s by Albert Tarantola. Tarantola's work was motivated primarily by the seismic inversion problem, which is the task of constructing images of the subsurface of the Earth based on observations on seismic waves. His book on Inverse Problem Theory[a] - available freely on his webpage - is considered one of the standard texts on the theory of inverse problems today. However, particular inverse problems have been studied in the past, going back as early as the Babylonians, but more on that later.

Despite an increasing interest in inverse problems, it is a philosophically non-trivial task to pinpoint exactly what an inverse problem is. In his book, "Inverse Problems: Activities for Undergraduates", Charles Groetsch adopts the approach of Justice Potter Stewart on the subject of defining an inverse problem: "I know it when I see it." He then proceeds to present specific inverse problems considered in the past, and added the comment that "Inverse problems come paired with direct problems and of course the choice of which problem is called direct and which is called inverse is, strictly speaking, arbitrary." Today, the term "forward problem" is more commonly used instead of "direct problem" as a contrast to the associated "inverse problem".

Consider the following problem as an example: Given two integers m and n, compute its product, k. This is the forward problem - given an input, compute its output. Heuristically, the inverse problem is the opposite of this: Given its output, work out what the inputs were. In the given problem this can be rephrased as: Given an integer k, find integers m and n such that $k=mn$. This is a problem of factorization, and one can see that such a problem is not easy to solve, in that it is not unique. For example, if $m=6$ and $n=4$, one can easily deduce that $k=mn=24$. However, given that $k=24$, it is not easy to recover m and n since there are several combinations which produce 24:

$$24 = 1 \times 24$$

$$24 = 2 \times 12$$

$$24 = 3 \times 8$$

$$24 = 4 \times 6.$$

Mathematically speaking, we say that this problem is ill-posed, because the solution is non-unique. When it is determined that a problem has non-unique solutions, one

[a] *Tarantola, A. (2005). Inverse Problem Theory and Methods for Model Parameter Estimation. Society for Industrial and Applied Mathematics. http://www.ipgp.fr/~tarantola/Files/Professional/Books/InverseProblemTheory.pdf*

of four things can be done. First, we try to ask a similar but different question, so that the solution is then unique. Secondly, we study the problem extensively, asking when the solutions are unique and when they are not, and classify them as completely as possible. If one of the two aforementioned tasks are unable to be executed, we resort to the remaining two solutions: We talk to someone about it, in hopes that collaborative effort may yield results. After all, two heads are better than one. If this bears no fruit, we give up and work on other problems. Sad, but such is the nature of mathematical research, not every problem has a solution, and not every solution is easy to find. One may argue that a fifth thing that mathematicians do when they hit a dead end is that they set it as a student project, but we leave the details of this as an exercise for the reader.

Coming back to the problem of factorisation, we now need a way to "fix" the problem such that it has a unique solution. Mathematically speaking, when a problem has non-unique solutions, it is considered "ill-posed", and to "fix" an ill-posed problem such that it becomes well-posed is called the process of regularisation. In this problem, the regularisation comes in the form of the prime numbers. For the purposes of this article, let us define prime numbers to be positive integers with exactly two factors, or divisors — the number 1 and itself. Hence by definition, 1 is not prime, and 2 is the smallest prime. The problem of factorisation now is regularised into a problem of prime factorisation, stated as follows: Given a positive integer n, what is its prime factorisation?

Here are some examples:

1. $9 = 3^2$

2. $120 = 2^3 \times 3 \times 5$

3. $8208 = 2^4 \times 3^3 \times 19$

Now, we would like to ask the question again: Is this prime factorisation unique? In other words, given a positive integer n, is there more than one way of decomposing n into prime divisors?

"Inverse problems come paired with direct problems and of course the choice of which problem is called direct and which is called inverse is, strictly speaking, arbitrary"

True enough, it turns out that there is no other way of factorising a positive integer into its prime divisors! In other words, prime factorisation of integers is unique, and therefore this inverse problem is well-posed, and it is solved! In fact, this fact is of such great significance that it is called the Fundamental Theorem of Arithmetic. It tells us that every positive integer greater than 1 is either a prime or a product of primes, and that the factorisation is unique (up to rearrangements, so that 3×5 is the same as 5×3). Of course, the next question one may ask is, what is so "fundamental" about the Fundamental Theorem of Arithmetic? In other words, given an integer, we now know that we can write it as a product of primes, if it itself is not a prime, but so what?

To start off, this theorem tells us that primes are the basic building blocks of the integers. This means that in order to construct any integer, all we need is to take our building blocks, i.e. the primes, and multiply them, and that gives us a new integer. The primes are to integers what the periodic table of elements are to chemistry, and pawns to chess!

Therefore, to understand the integers, all we need to do is to study the primes. Once we understand the primes, then we can understand the integers. The study of integers and primes form one of the oldest subjects in mathematics called number theory (i.e., the study of positive integers, including their properties). Some of you may recognise the field of number theory as one of the hardest branches in mathematics. Indeed, one of the reasons why questions in number theory have confounded people for hundreds of years (dating back as early as Pythagoras) is because the behaviour of primes are not so easily understood. A host of questions regarding primes and integers have been asked over the years. Today, some have been answered, but there are many problems that remain open even until today.

So there you have it - the reason why we should we care about inverse problems. Turns out it is the inverse problem, and not the forward problem, that gave rise to the study of the numbers that we so often use everyday!

ABOUT THE AUTHOR

SEAN LIM is currently a second year DPhil student in Mathematics at the University of Oxford. He is working in the area of Industrial Mathematics with the Oxford Centre for Collaborative Applied Mathematics (OCCAM) on Bayesian Inverse Problems and Seismic Inversion, a project currently sponsored by BP. Prior to this, Sean obtained an MSc in Mathematical Modelling and Scientific Computing with Wadham College in the University of Oxford, with his dissertation on Radar and Information theory with Thales Aerospace. Sean also obtained a BSc with a major in Mathematics and a minor in Computer Science in the National University of Singapore, where his undergraduate thesis and studies was focused on pure mathematics. Find out more about Sean Lim by visiting his Scientific Malaysian profile at http://www.scientificmalaysian.com/members/seanlim/.

Event Report: ASM Science Communication Workshop

by Kong Yink Heay

The "Science Communication Workshop: Science needs a new language" on the 14th of November 2013 was held in conjunction with the World Innovation Forum KL 2013 at the KL Convention Centre, Kuala Lumpur. This workshop was organised by the Academy of Sciences Malaysia (ASM) and the British High Commission. Approximately 30 participants from ASM, Petrosains and Malaysian Biotechnology Information Centre (MABIC) attended this workshop. Its aim was to connect the 'why's' and 'how's' to more effectively communicate science with the public.

The workshop was officiated by a senior fellow of ASM, Prof. Ho Chee Cheong (Universiti Tunku Abdul Rahman). In the opening speech, he said,

"Science communication is important because it can generate public awareness on scientific findings and knowledge. Furthermore, the public needs to be in the know. However, scientists tend to use jargons to express science which could be alien language to the public. Therefore, scientists need strong language skills to communicate science to the public more effectively. As there is decreasing number of people who gain information from printed media, science communications should be raised to the next level to deliver the message to every strata of the society".

In this workshop, speakers from the UK were invited to cover four main topics in science communication: "Science in news media", "Public engagement targeting students", "Public engagement targeting the public", and "Discussing science policy with the people".

Science in news media

Dr. Fiona Lethbridge (UK Science Media Centre) shared her role in getting scientists and journalists to talk to each other so that the public have access to the best expertise. The UK Science Media is responsible for collecting questions from journalists, and getting scientifically correct answers from scientists. For this reason, the centre maintains an enormous database that documents approximately 3000 scientists. The centre also invites journalists from all newspapers and relevant scientists to meet in their media briefings twice/thrice a week where journalists can ask questions to the scientists regarding a specific topic. The aim of the briefing is to ensure the scientific information is sent across accurately, not only to reduce inaccurate reports but also to prevent reporting false hope and misleading headlines. Media briefings can be divided into news briefing and background briefing. News briefing is held based on new research findings in journals (e.g. stem cell could cure deafness) while background briefing is held based on emerging news or controversial findings (e.g. the horsemeat crisis).

Public engagement targeting students

Dr. Gale Cardew from the Royal Institute (RI) described hands-on strategies for educators to make science appealing to students. RI's activities centers around the core aim of encouraging people to think further and more deeply about the wonders and application of science. For instance, RI is known for its Christmas Lectures[a], which is a series of science lectures presented in an informative and entertaining manner aimed at general audience. In 2009, RI launched the L'Oreal Young Scientist Centre, where youngsters are encouraged to have more hands-on experience on science subjects. Dr. Gale explained that in regular classrooms, students carry out scientific experiments based on only given guidelines and they have no freedom to do other experiments. The centre encourages the youngsters to try something new, to fail and to think for themselves. RI also has Maths and Engineering Master classes on every Saturday morning where approximately 1000 teachers, mathematicians and engineers expose youngsters to the world of maths and engineering. RI also trains engineers and mathematicians on how to teach their subjects to the youngsters.

[a] *Christmas Lectures was initiated by Michael Faraday in 1825 and has been ongoing ever since. Christmas Lectures is available online at the RI Channel http://richannel.org/christmas-lectures.*

The workshop participants at one of the breakout sessions.

Public engagement targeting the public

Dr. Amy Sanders from the Wellcome Trust elaborated the ways taken by the organisation in engaging with the public. Wellcome Trust funds media, talks, lectures, publications and exhibitions to inspire and educate the public, as well as to make research more widely accessible. In addition, the Trust funds consultations, panels and discussion events (e.g. Café Scientifique, "I'm a scientist get me out of here", and science debates in schools among teenagers) that encourage conversations rather than information transmission, and allow opportunity for questions/values/views to be explored. Further, the Trust allows students to participate in real research where students have a chance to publish a peer-reviewed paper with the scientists.

Wellcome Trust publishes "Big Picture" magazine biannually to be distributed to 100 teachers online. They also distribute simple science-learning kits to every UK school, college and science centre so that teachers can teach their students about science in a new and interesting way. To target the youngsters, the Trust designed scientific games such as "Axon" and "Epigenegesis". In order to reach people who rarely go to science events and museums, Wellcome Trust also organised science exhibitions in balloon fiesta, music festival and agricultural shows.

Discussing science policy with the people

Dr. Alice Bell, a research fellow at University of Sussex and a science blogger at the Guardian UK, shared strategic ways to communicate science policies in ways that garners readership from the masses. Dr. Bell said that science should not be shielded from the public by limiting the accessibility of scientific articles from the public. In addition, raw data from scientific experiments should be made available online to other fellow researchers so that the findings can be checked and/or used for other different research purposes. Sharing methods is also important because by making the research methods available, the validity and reproducibility of the research can be evaluated by fellow researchers. In addition, open methods can also allow the public to do science as a hobby (e.g. Galaxy Zoo). Finally, Dr. Bell explained that opening policy means science policies such as funding and ethics should be made interesting and understandable for public discussion. However, Dr. Bell also suggested some parts of science should be remain undisclosed to some extent, for example in terms of control of sensitive information from research findings which might be misused (e.g. bioterrorism).

"...more work should be done to train scientists to better translate science into layman context..."

During the breakout sessions, the workshop participants were given a chance to interact with the speakers and fellow participants to brainstorm for strategies to solve current problems in science communications in Malaysia, in terms of public and media engagement. To this point, ASM, Petrosains and MABIC have been organising satellite activities on public engagement particularly aiming to boost interests in science among school students. However, all participants came to an agreement that these satellite activities are not sufficient and are skewed towards academics. A collaboration among these centres should be established to organise more diverse public engagement activities with a specific goal in increasing acceptance level among public towards science (e.g. GM food, nuclear power). In terms of media engagement, more work should be done to train scientists to better translate science into layman context, using interesting photos/infographics to attract public to read scientific articles. Catchy headlines, better usage of both mainstream and non-mainstream media to cover scientific information, can also help to reach out to the public.

ABOUT THE AUTHOR

KONG YINK HEAY is a research assistant at the Cancer Research Initiatives Foundation (CARIF). She is also an illustrator for Scientific Malaysian. Having passion and experience in both science and art, Yink Heay has always wanted to bridge science and art towards the general public. She feels that science can be better understood when presented in images. She wishes to play a role in science communication using interesting images to aid the understanding of scientific findings. Find out more about Yink Heay by visiting her Scientific Malaysian profile at http://www.scientificmalaysian.com/members/yinkheay/

Dr. Sin How Lim - recipient of Joint IAS-NIDA Research Fellowship Award 2013

The International AIDS Society (IAS) and National Institute of Drug Abuse (NIDA) Research Fellowship is a fellowship programme established in 2009 to promote research in drug use and HIV. It facilitates the learning of new techniques, career advancement and transfer of knowledge to the institution or country of origin.

The fellowship programme consists of two types of awards: US$75,000 to be awarded to a junior scientist for 18 months of post-doctoral training; and US$75,000 to be awarded to a well-established HIV researcher for eight months of professional development training. Both take place at leading institutes excelling in research in the HIV-related drug use field. Applicants can be from any country except from the US and they must be junior investigators with a doctoral degree obtained no more than six years before the time of application.

The fellowship was first awarded in the 5th IAS Conference on HIV Pathogenesis, Treatment and Prevention (IAS 2009) and it has been subsequently annually awarded since then. This year, it was awarded to four outstanding recipients during the 7th IAS Conference on HIV Pathogenesis, Treatment and Prevention (IAS 2013) held in Kuala Lumpur.

One of the recipients is Dr. Sin How Lim, a postdoctoral researcher from the University of Malaya. Scientific Malaysian News Editor, Azilleo Kristo Mozihim had the opportunity to speak to him at the IAS 2013 conference.

Where were you from and can you please briefly describe your educational history?

I was born in Malacca and I graduated from the National University of Singapore with a bachelor degree in Biochemistry. I continued to do my PhD in Epidemiology at the University of Pittsburgh and obtained it in the year 2009.

Why did you choose to do a PhD in Epidemiology despite graduating with a bachelor degree in Biochemistry?

After doing my bachelor degree, I got acquainted and become interested in Epidemiology. It is a field that is always been taken for granted by the public and most people are unaware of its contribution in the healthcare system. Epidemiology allows us to understand the determinants and distribution of diseases in a population.

Consequently, we are able to devise and implement a plan of action to reduce the incidence as well as the prevalence of a particular disease. Many general knowledge regarding diseases such as the fact that lung cancer is caused by heavy smoking are the result of epidemiological studies. Sadly, most people are ignorant about this and are even oblivious to the existence of this field.

Dr. Sin How Lim upon receiving the fellowship award at the IAS 2013 in Kuala Lumpur

With the acquisition of the award, what is the plan for your subsequent research project?

I am planning to study the concurrency of substance use and the sexual risk behaviours among men who have sex with men. My mentor will be Professor Fredrick Altice from Yale University, United States.

What is your opinion on the current state of scientific research in Malaysia?

I cannot give insightful comments regarding the state of scientific research in general but I can give my opinion regarding HIV research in Malaysia. In terms of research in the basic science of HIV, Malaysia has a strong performance in this area. However, compared to the developed countries, Malaysia still lags behind in the area of clinical and treatment research of HIV.

Finally, would you like to send a few words of advice to budding Malaysian scientists and/or to those who are planning to be involved in scientific research?

Scientific research is most of the time a collaborative activity. Teamwork is the key to a successful research project. I am grateful to my colleagues who have been greatly cooperative during my time when I was doing my previous research projects. I am particularly grateful to Professor Adeeba from University of Malaya who has been supportive in my early scientific career and whose empathetic guidance was unparalleled in my eyes.

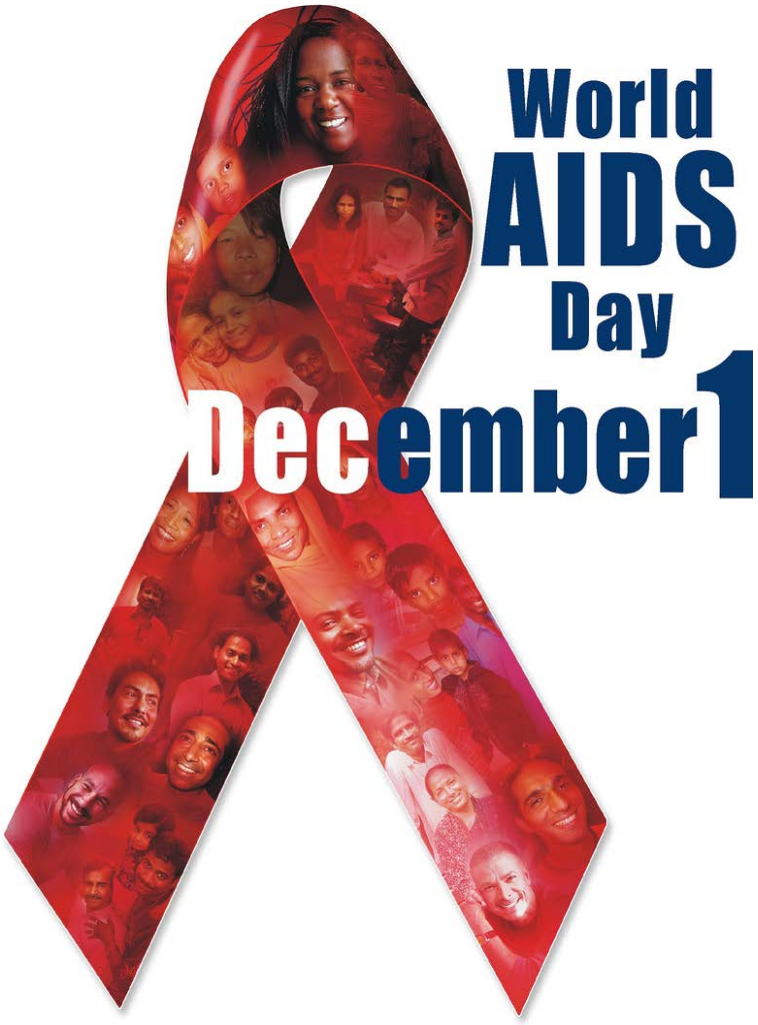
REFERENCE

IAS-NIDA Research Fellowship Website:
http://www.iasociety.org/iasnida.aspx.

Note: Applications for 2014 round will be open from 8 December 2013 – 10 February 2014.

ABOUT HIV/AIDS, DID YOU KNOW THAT...

- Approximately 34 million people have HIV worldwide as of 2011.
- AIDS, caused by HIV infection, is a global pandemic that has killed more than 25 million people since 1981.
- In Malaysia, as of 2008, there have been more than 84 thousand confirmed HIV-infected individuals.
- Two primary routes for HIV infection: (i) Sexual contact with an infected person, with unprotected anal intercourse being the most dangerous; (ii) Sharing syringes, needles or other injection equipment with someone who is infected.
- World AIDS Day, observed on 1st of December every year since 1988, is dedicated to raising awareness pertaining the disease. [right picture; *U.S. Embassy New Delhi / Flickr(CC)*]
- World AIDS Day is vital to remind the public and the government that HIV/AIDS remains a pandemic; to raise funding for research and access to treatments; and to curb prejudice against HIV-infected individuals.



HIV does not make people dangerous to know, so you can shake their hands and give them a hug. Heaven knows they need it.
- Princess Diana

SciMy Interview: Prof. Sudesh Kumar

interviewed by Dr. Lee Hooi Ling and Dr. Wong Kah Keng

Prof. Sudesh Kumar (PhD, RIKEN Institute & Saitama University, Japan) is a Professor of Microbiology and Biotechnology at the School of Biological Sciences, Universiti Sains Malaysia (USM). His specialisation is in the field of microbiology, genetics and polymer chemistry of microbial polyesters (bioplastics). Prof. Sudesh has published more than 90 original research articles, two books, four patents, with more than ten PhD students graduated under his supervision, and he was awarded with multiple national and international grants. He is currently a RIKEN[1] programme coordinator in USM. In this interview, we gain insights into his humble academic path to becoming an established scientist in biomaterials research.

Q1. What motivated you to delve into biological sciences research?

I think it is the influence of teachers. I remember having very good teachers who made the subject of biological sciences very interesting when I was in secondary school. When I was an undergraduate at Universiti Kebangsaan Malaysia, I majored in Zoology. I especially liked animal behaviours, the diversity of life and environmental biology.

Q2. Your research areas are interdisciplinary consisting of molecular biology, chemistry and material sciences; why is that the case?

My main research is on an interesting plastic-like material produced by some bacteria. I started working in this area as a research project for my Masters in Biotechnology at Universiti Malaya. I found it very intriguing that a plastic-like material can be produced by some bacteria. What was even more fascinating is the fact that this plastic-like material was also completely biodegradable!

When we look at things from their apparent physical form, then there seems to be a clear difference between those things that are alive and those that lack the qualities that we use to define a life form. The study of anything that is alive can generally be categorised as biology. The term *bios* in Greek means 'life'. However, if one looks deeper into all forms of life, the structural components that make up all forms of life are no different from the components found in lifeless forms.

As mentioned by Richard Feynman, "*everything that living things do can be understood in terms of the jiggling and wiggling of atoms*". In other words, if one studies biology deeper then at some stage, chemistry and physics become essential. In order to understand biology better, one needs to know the structure-function relationship of biological components at the molecular level.

I use microorganisms to produce plastics. These microbial plastics have properties that are quite similar to the chemical plastics that we use widely nowadays. In order to produce the microbial plastics efficiently, one needs to understand the biology of microorganisms or microbiology. However, the knowledge of microbiology alone is not enough because one also needs to characterise the microbial plastics. Here, one needs to know some polymer chemistry and materials science. In this aspect, I was very fortunate because I had excellent supervisors who had trained me well in all aspects of the subjects. Hence, the interdisciplinary research is already part and parcel in my work.

"If one studies biology deeper then at some stage, chemistry and physics become essential"

Signing of a comprehensive agreement between USM and RIKEN for research and academic collaborations.

From left: Mr. Motohide Yokota (Director of Global Relations Office), Prof. Ryoji Noyori (Nobel Laureate and President of RIKEN), Dato' Prof. Omar Osman (Vice-Chancellor of USM) and Prof. Sudesh Kumar (Coordinator and Administrative Advisor for USM-RIKEN collaboration)

Q3. As a RIKEN programme[1] coordinator in USM, can you explain more about the programme?

RIKEN is a premier research institute in Japan, and it is not a university. Therefore, RIKEN could not award degrees but nonetheless collaborates with various local and international universities so that university students could conduct research alongside scientists at RIKEN. Most RIKEN scientists hold visiting professor positions at various universities. For example, my PhD supervisor, Prof. Doi, held a visiting professor position at Saitama University where I was registered as a PhD student. This allowed me to do my research in his laboratory at RIKEN.

When I became a lecturer at USM in 2001, RIKEN signed an MoU with USM to enable students from USM to carry out PhD research at RIKEN. This was the beginning of a programme called Asian Program Associate (APA) between RIKEN and USM. Since then, the programme has further expanded and is now known as the International Program Associate (IPA). Currently, there are about ten USM students doing their PhD research at RIKEN under this programme. RIKEN has also selected USM as a strategic partner for long term academic and research collaboration. Since I have been involved in this programme from the beginning, last year RIKEN appointed me as an Administrative Advisor to further strengthen and expand collaboration between RIKEN and USM. Among my roles are to expand the collaboration between various researchers and disciplines in USM and RIKEN. In addition, I also monitor the progress of USM students at RIKEN by gathering feedback from them and also their supervisors.

Q4. What is your advice to potential candidates in the application for the RIKEN programme?

There is a big difference between researches carried out at universities in Malaysia and those at RIKEN. Highly qualified scientists and postdocs are the ones doing the research at RIKEN. In addition, the research topics are often very fundamental in nature. Several years are spent on fundamental research questions before papers are published. The research ecosystem at RIKEN is therefore very intense. Thus, interested students must be prepared to work in a demanding and competitive environment. The research support system at RIKEN is very well-established. It is not an exaggeration to say that RIKEN is a paradise for researchers. Everything that researchers need is there. Since 2003, under the leadership of the Nobel laureate Dr. Ryoji Noyori, RIKEN has become increasingly internationalised. President Noyori proposed a set of initiatives which is known as the Noyori Initiatives. Among these initiatives are efforts to make RIKEN into an institution that motivates its researchers. Compared to the RIKEN that I knew 15 years ago, it is now a more vibrant and visible institute that is more comfortable for foreigners.

Q5. What are the main research questions that you are tackling at the moment?

We are doing scale-up works to produce biodegradable plastics from renewable resources that are available in Malaysia such as the products and by-products of our oil palm industry. In addition, we are also developing new applications for the biodegradable materials that we produce.

Q6. What do you think can be done to reduce the cost of plastics made of polyhydroxyalkanoate (PHA)?

Polyhydroxyalkanoate (PHA) is polyester produced by bacteria that biodegrades easily. We have found that vegetable oils are excellent feedstock for high cell density fermentation as well as for the production of PHA. It is possible to obtain more than 100 g/L of dry cells containing about 80 wt% PHA from palm oil. In addition, we are also currently developing efficient processes for the collection, treatment and utilisation of used cooking oil for the production of PHA. With all these new developments, I believe that it is possible to reduce the cost of PHA.

Examples of biodegradable plastic test samples that can be produced using microbial polyhydroxyalkanoates (PHAs)

Q7. What are the advantages of using or manipulating microorganisms from the tropical environment to generate biodegradable materials?

Studies on the production of PHA have been conducted in many countries all over the world. Many types of microorganisms have been isolated from various environments for this purpose. A few years ago, we found a very interesting bacterium from water samples obtained from the Seven Wells, Langkawi. The key enzyme involved in the synthesis of PHA in this bacterium was found to have the highest activity among all known PHA synthase enzymes[2,3]. By using the PHA synthase gene from this bacterium, we have developed an efficient recombinant microorganism capable of producing PHA from palm oil. I am sure that there are many more superior microorganisms in the tropical environment waiting to be discovered.

"We have developed the technology to produce biodegradable plastics from various vegetable oils"

Q8. Do you think that Malaysia is in a strategic position for the production of biodegradable plastics?

Yes, we have the renewable resources for it. Unlike most other countries that rely on sugar-based feedstock, we have developed the technology to produce biodegradable plastics from various vegetable oils. Our studies have shown that the yield of biodegradable plastics from oils is much better than that from sugars[4]. Therefore, it is possible to produce biodegradable plastics at lower cost.

Q9. What do you think of the research funding situation in the public universities now as compared to ten years ago?

When I first joined USM in 2001, there were not many specialised research funds like what we have now. At that time, there was Short-Term Research Grant from the university and IRPA grant from the ministry. Now we have more grants *e.g.*, Research University grant and APEX University grant from the university. We also have several funds from the ministry such as the eScience Fund, TechnoFund, and Fundamental Research Grant Scheme (FRGS). There are also specialised research grants for prototype development and commercialisation.

Q10. Finally, what is your advice to potential scientists and young researchers?

Nowadays there is a tremendous pressure to publish. This is because publication is one of the measurement criteria used to rank universities. Thus, many universities and research institutions are seeking to increase the number of publications they produce yearly. Among the various Key Performance Indexes (KPI) for researchers and lecturers, publication occupies the centre stage. Knowing the growing demand for publication, there are now some journals that would publish questionable studies for a payment.

Well established and reputable journals are on the other hand getting stricter with their selection of manuscript for publication. This is because world-class journals are also competing with each other to increase their Impact Factor, which is a metric commonly used to rank the popularity of journals. Potential scientists and young researchers should be aware that their publications are a testimony of their work. If their list of publications includes papers published in questionable journals, it would reflect negatively on them. It is better in the long term to spend time generating reproducible data and publish our work in reputable journals than to publish many papers in dubious journals just for the sake of publishing.

Prof. Sudesh with Dr. Lee Hooi Ling at the interview session.

REFERENCES

[1] http://www.riken.jp/en/

[2] Bhubalan *et al.* (2011) *Appl. Environ. Microbiol.* 7(9):2926-2933.

[3] Gene Encoding Microbial Polyester Synthase. Granted patent on 31st July 2012 in Singapore. Grant P-No.: 175705.

[4] Sudesh *et al.* (2011) *Appl. Microbiol. Biotechnol.* 9(5):1373-1386.

Looking to promote your research work?

Searching for research collaborators in Malaysia or abroad?

Sign up for Project Collab:

www.scientificmalaysian.com/project-collab

Education experience from different continents (Part I)

by Mamduh Zabidi

I had a rare opportunity to pursue a degree in Biochemistry at Purdue University, USA with a scholarship from the Malaysian government. An American undergraduate degree is typically a 4-year programme. The course grading is typically made up of 3 major exams (exams 1, 2 and final exam). Some courses do assign regular homework which obviously requires consistent work. Almost all courses have evening 'help sessions', where attendance is not compulsory. These sessions are run by graduate students from the department every week, where students get to ask questions about the course or homework.

The Purdue Bell Tower during autumn.

There is no requirement for a student to work on a final-year research project nor he needs to do an internship at any company in order to graduate. However, usually students take their own initiative for internship at industry or other research institutions, of which opportunities are advertised in the department. At the university itself, interested students can join a laboratory as an undergraduate research assistant for credit hour or for pay. Furthermore, if the lab head agrees, the student can enter honours research programme, which runs concurrently during regular semester. This requires huge time and effort commitment; nonetheless I have to say that the commitment required for an honours programme far exceeds the benefit.

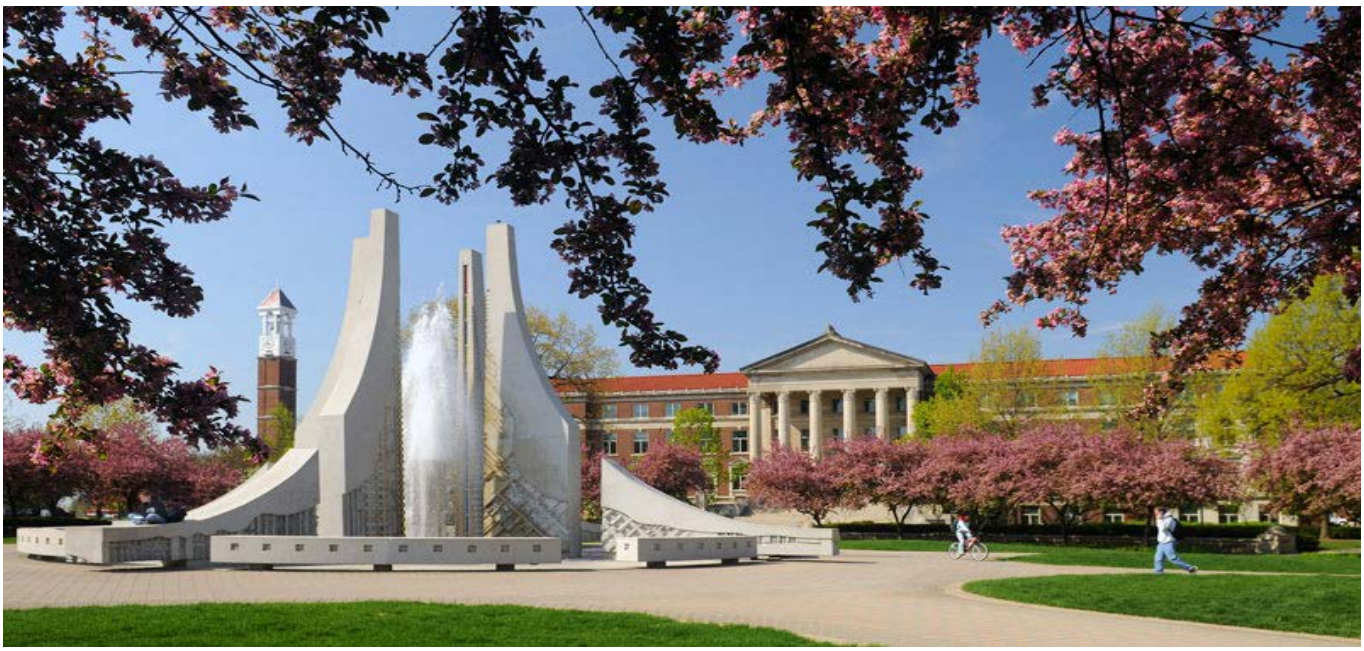
In the beginning of the programme, the student is required to write a short research proposal with the help of either the supervisor or the graduate student/postdoc that he is paired with. Attending classes notwithstanding, the student is familiarized with full-time research environment, including lab safety, lab meetings and journal clubs (I have to confess that I ditched classes just to work on my project).

> "... the focus in American system is always more on content than length: my thesis was less than 10 pages in total"

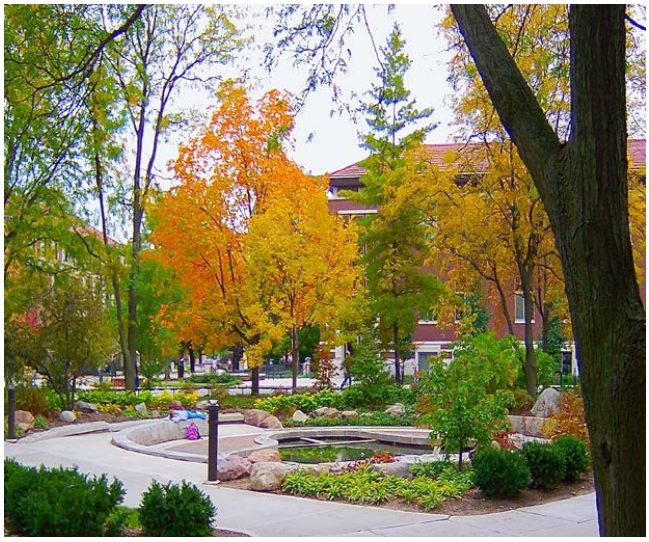
Finally, at the end of the programme the student will submit a short (typical of American style) thesis, and present the research to the department in oral and poster format.

Furthermore, my research advisor not only cares about my research but also my career direction. Even though the duration of the programme is short, at the undergraduate level I was already exposed to the different facets of full-time research environment from scientific writing, presentation and most importantly being in charge of my own project.

There are several aspects of American culture that I would like to highlight from which we can learn. Firstly, the faculty typically expects them to be addressed by only the first name, with no need for mentioning of honorific Dr. or Prof. This encourages an air of cordiality between the student and the supervisor and spur exchange of ideas. The students also ask a lot of questions, reflecting their culture to speak up.



The Engineering Fountain, also known as the Purdue Mall Water Sculpture, with the Purdue Bell Tower in the background. The fountain serves as free shower for students to cool off during scorching Midwest summer. Source: Purdue University.



A pond at Purdue during autumn (early October). The leaves are about to set ablaze by autumn.

In addition, the focus in American system is always more on content than length: my thesis was less than 10 pages in total with only a required conformity to a loose basic format - contrast this to our adherence to British-based system where it is typical to write pages and pages of thesis. The students and the faculty also care less about the race or nationality than the quality of work produced. This is in stark contrast - at least in my view - in our local universities where students typically eat, congregate, walk, or form study groups with only their race.

At the same time, the student is trusted with the responsibility of his own career. For example, the requirement outside coursework is little, if not non-existent, but help is always provided: if the student needs to polish up his CV he can look for an internship or research experience of which information is posted at the department. Similarly, attendance at lecture is not required, but help sessions are available every week for anybody interested.

"The students and the faculty also care less about the race or nationality than the quality of work produced"

In my next article, I will share my experience in my doctorate programme in the Institute of Molecular Pathology, Vienna, Austria.

ABOUT THE AUTHOR

MAMDUH ZABIDI was born and bred in Bagan Datoh, Perak. He obtained a BSc degree with a major in Biochemistry, Cell Development and Molecular biology, and a minor in Chemistry and French from Purdue University, USA. He then returned to Malaysia and worked at Cancer Research Initiatives Foundation (CARIF) towards a MSc degree in Molecular Medicine from University of Malaya. He is now a doctorate student in Bioinformatics at the Institute of Molecular Pathology (IMP), Vienna, Austria. He loves words and enjoys reading, writing, as well as learning new languages. He considers himself as an amateur photographer, and he hikes, plays soccer and badminton. Find out more about Mamduh by visiting his Scientific Malaysian profile at http://www.scientificmalaysian.com/members/mamduh/

A PhD Down Under: Doctorate Studies in Brisbane

by Juliana Ariffin

Brisbane is a sprawling city that sits on either side of the gentle curves of the Brisbane River. It is a city of bridges and parks and is best seen from the deck of a CityCat while it glides down the length of the river, or from the top of Mt Coot-tha (the highest point in Brisbane and home to the lush Botanical Gardens and Sir Thomas Planetarium). As a lover of nature, I find that the best thing about Brisbane is its proximity to forest reserves with excellent hiking trails, beautiful beaches with great surf, and the three largest sand islands in the world (Fraser, Stradbroke and Moreton Island) where you can camp, dive, snorkel, surf or go whale and dolphin watching.

Brisbane city as viewed from Victoria Bridge which crosses over Brisbane River and connects to South Bank.

I first arrived in Australia to pursue my degree in biomedical science in Brisbane in 2007 and made a decision to start my PhD four years later. At the time, I was looking forward to conducting research, publishing papers and going to international conferences. I had also planned to thoroughly enjoy the best of Brisbane and to keep exploring down under. I had plans of flying to Melbourne in the winter for skiing, shopping in Sydney, diving the Great Barrier Reef in Cairns, and hopping over to visit the 'Middle Earth' in New Zealand. To say the least, I was full of optimism and anticipation when I left for a short holiday in Malaysia before starting my PhD in Australia. But fate had other things to offer.

My journey as a PhD student began with me returning to Brisbane after a lovely holiday with suitcases packed to the brim and a heavy heart. It was February in the year 2011 and the most disastrous flood in Queensland's history rendered me homeless and swept away all the belongings I had accumulated throughout my years of living in Brisbane. Instead of immediately beginning my PhD at the Institute for Molecular Biosciences (IMB) at the University of Queensland (UQ), I found myself camping on a friend's sofa bed and putting off my PhD for a month while I looked for a new place to stay.

"Thankfully UQ recognised the trouble incoming students were going through and provided me with temporary accommodation..."

I had already experienced the stress of house hunting in Brisbane during my undergraduate years due to the rising cost of living in Australia and high demand for housing. This was most apparent to me in the price of rental properties near the university, where even garages are refurbished and rented out to poor students. With the floods, the situation worsened and rental prices skyrocketed. Thankfully UQ recognised the trouble incoming students were going through and provided me with temporary accommodation until I found a new place to stay.

[1]*CityCats (short for City Catamarans) are the fleet of ferries that shuttle passengers from ferry terminals situated at the city and various suburbs along the Brisbane River till the last stop at the University of Queensland.*

After the floods, I slowly got back on my feet. In Australia, first or second upper class Honours year graduates may skip doing a Masters degree and immediately apply for tuition fee and living allowance scholarships for PhD. However these applications are increasingly competitive as Masters graduates or research assistants with a couple of publications under their belts are often awarded the scholarships.

Determined candidates may even volunteer to work in labs for free while they gain experience and authorship on papers to become more competitive for scholarships. In my case, I was fortunate enough to be supported by my principal investigator (PI) and the IMB for my living allowance, and received a tuition fee scholarship from UQ. I also spent some time tutoring to supplement the stipend I received.

Once I started my research project, I found that unlike my Honours year that in retrospect seemed like a 100m sprint, my PhD was like a marathon that required copious amounts of determination and stamina. My field of research is Immunology and I worked many late nights and weekends isolating macrophages from human blood, then infecting them with bacteria to study human immune responses. Most of my experiments took at least a week to prepare and were performed over several days, as is the norm for most PhD students who work with cells or mice. My first year passed very quickly in this way, with me occasionally fleeing the lab to drive to the coast for a lovely afternoon at the beach, or to go horse riding on the mountain trails.

Soon it was time for me to go through my first 'milestone'. These milestones or yearly tests are especially critical for first year PhD students, who have to give a confirmation seminar and are evaluated on their research project and capabilities by a panel of scientists that consists of their co-supervisors and examiners. Students who do not succeed are allowed a second try after 3 months, then are either downgraded to a Masters degree or expelled. Fortunately, I was thoroughly groomed by my PI to present the best of my research and survived my confirmation without any mishaps.

In my second and third year, I maintained a better work life balance and exercised

The beach at Burleigh Heads, Gold Coast.

Jacaranda trees blooming in November in Brisbane.

A bottlenose dolphin at Amity Point, Stradbroke Island.

The Great Court, St Lucia campus, The University of Queensland. Source: www.scmb.uq.edu.au

regularly while minimising weekend work. Most labs are quite social and would often get together for weekly soccer games, to celebrate birthdays, or for beers on Fridays evenings. We would also go on lab retreats that involve traveling together to an exotic location (the mountainside or beach) to have a series of talks, socialise and discuss future research directions.

Although I was enjoying my PhD, my research was not progressing as well as I had hoped it would and I began to seriously think about the direction of my scientific career. My institute has a weekly seminar series with invited international speakers, alternate career talks for early career researchers (ECRs), and a training program for science ambassadors to engage in science communication with the public. I took the opportunity to attend talks and workshops and began to realise the importance of broadening my skillset beyond basic research skills. I started to pursue extracurricular activities by joining the postgraduate students committee at my institute, and networked with researchers from other institutes to gain a broader perspective on life in science in Australia. I also attended a research commercialisation workshop that is compulsory for third year PhD students at my university. This led me to apply and obtain an internship position at the research commercialisation company where I worked part-time 8 hours a week for three months. Through this, I was introduced to a different aspect of science and learned to evaluate early-stage technology, develop business strategies and conduct market analysis. This helped me to remember the bigger picture and see how interesting scientific discoveries can be, even when my own research was lagging. I enjoyed it so much that I still volunteer at the company even after my internship is over.

Now I am starting my fourth and last year of PhD and thankfully, my research is beginning to turn around. I have found a new, exciting and promising project to work on that has helped me regain my enthusiasm for science. The challenge now is to wrap up my PhD and decide what direction to head to next. I hope to finish my journey soon, while having gained a lot of knowledge and confidence to handle anything that may be in my future.

ABOUT THE AUTHOR

JULIANA ARIFFIN is a third year (going on fourth year) PhD student studying human immune responses at The Institute for Molecular Biosciences at The University of Queensland, Brisbane, Australia. Prior to beginning her PhD, she worked for a year as a research assistant following her Honours degree. In her spare time she reads fiction, dabbles in photography and considers genetically engineering a zombie propagating virus to repopulate the earth. Find out more about Juliana Ariffin by visiting her Scientific Malaysian profile: http://www.scientificmalaysian.com/members/julianna/

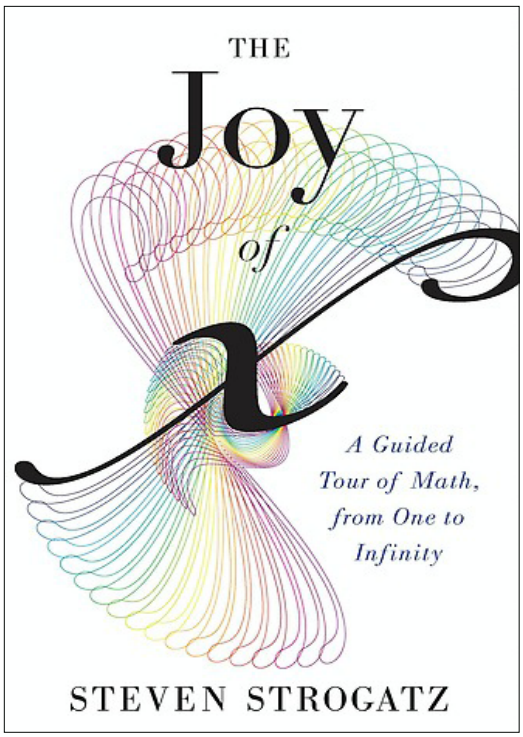
Book Review: "The Joy of x: A Guided Tour of Math, from One to Infinity"

reviewed by Gabriel Chong

When I saw the release of the first batch of *The Joy of x* in bookstores a few years ago, I wanted to get the book immediately. Prior to that, I had enjoyed Strogatz's 2003 bestseller *Sync: How Order Emerges From Chaos In the Universe, Nature, and Daily Life*, based on his highly influential research on synchronized networks and the first in a series of books which subsequently cemented his reputation as one of the most popular mathematics writers of recent years.

The ambitious subtitle, "A Guided Tour of Mathematics from One to Infinity", led me to a false anticipation of the same erudition and scholarship that awed me in *Sync*. This book, however, was rather different from its predecessor. The culmination of a well-received column in The New York Times, *The Joy of x* is printed in a sparse and large typeface, written in a rudimentary style, and accessible to even the most mathematically illiterate reader. Though not intended to be remedial, it strives to communicate what mathematics is about to a demographic that might be otherwise intimidated by the discipline. This does not mean, however, that it is simplistic or completely irrelevant to the mathematically trained. In fact, some of the chapters gave me a fresh insight into the fundamental purpose of many of the most basic mathematical tools that I have been acquainted with since high school.

The Joy of x is divided into six independently arranged sections, "Numbers", "Relationships", "Shapes", "Change", "Data", and "Frontiers", of which the subchapters run the gamut from number theory to geometry, from calculus to set theory. The first chapter begins with the most elementary of mathematical concerns: why we need numbers, by referring a particularly adorable episode of Sesame Street. Humphrey, a dimwitted muppet working at a hotel, calls out as he takes the orders from a roomful of hungry penguins, "fish, fish, fish, fish, fish, fish", until he realises that his exhausting repetition of orders could be avoided with the use of numbers.



However, once he applies the arbitrary symbol "six" to his amount of orders, he cannot escape its logical consequences (for example, that six plus six necessarily equals twelve). Herein, says Strogatz, lies the purpose and strange power of mathematics: "This is how mathematics grows. The right abstraction leads to new insight... Yet despite this infinite vista, there are always constraints on our creativity... Logic leaves us no choice. In that sense, math always involves both invention and discovery: we invent the concepts but discover their consequences."

"... it strives to communicate what mathematics is about to a demographic that might be otherwise intimidated by the discipline"

From there, Strogatz introduces the various fundamental concepts and major branches of mathematics with the aid of visuals and anecdotes, many of which are staples of elementary mathematics books (the Y-shaped diagram of squares which illustrates the Pythagorean theorem, Hilbert's Hotel which explains the paradoxes of set theory, *etc.*), but also some less-utilised analogies and creative allusions to pop culture.

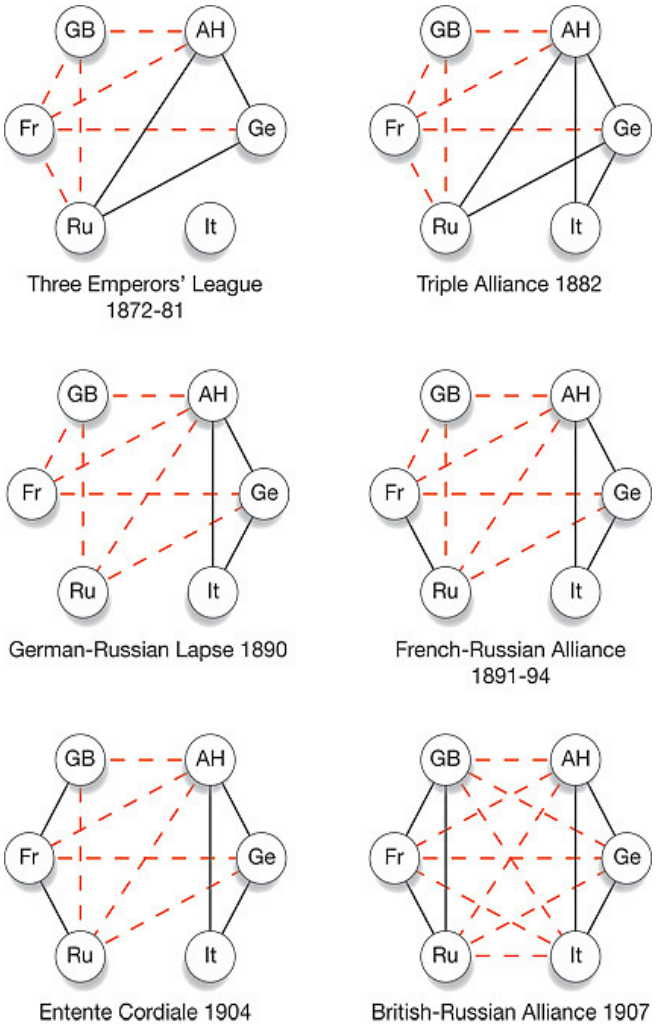


Diagram demonstrating the shifting alliances between Great Britain, France, Russia, Italy, Germany, and Austria-Hungary from 1872 (modelled by unbalanced triangles) until the consolidation of two implacably opposed blocs (modelled by balanced triangles) in 1907, shortly before World War I. Source: The New York Times, 2010.

In Chapter 3, "The Enemy of My Enemy", Strogatz borrows the concept of balanced triangles to elucidate multiplication between positive and negative numbers. We can imagine the corners of a triangle to be represented by a number each, whether positive or negative, and that the relationship between these various corners must match the logical relationship of multiplication between positive and negative numbers. These triangles have been used by social scientists to model the complex behaviour of social agents and historical trends, such as World War I (see diagram).

In Chapter 7, "The Joy of x", Strogatz comments on the misapplication of algebra in formulating common but nonsensical social rules, such as the rule stating that if your age is x, your date should not be younger than x/2+7.

In Chapter 23, "Chances Are", he uses the trial of O.J.Simpson to introduce conditional probability. Alan Dershowitz, the defense lawyer, had infamously argued that a very small percent of men with a history of battering their domestic partners went on to murder their spouses. But, as Strogatz pointed out, this was not the relevant statistic to look at. Rather, the relevant question should have been, "What is the probability that a man murdered his wife, on the condition that he had previously battered her and the fact that she was murdered?" Sadly, elementary mistakes in counting probabilities such as these often tamper the process of justice.

In a more light-hearted Chapter 26, "Group Think", Strogatz uses group theory in exploring the question, "How should you flip your mattress to get the most even wear out of it?" - as another curious example of how mathematics applies in even the most mundane experiences of daily life.

Though many popular mathematics books exist out there, the majority of them still have in mind an audience with some high school level mathematical knowledge, which alienates a large subset of society still struggling with even the most basic mathematical concepts. *The Joy of x* is perhaps the most accessible popular mathematics book written by a high-profile mathematician that I have come across yet, and though much of the content is hardly original, it fulfills a much-needed role to introduce elements of mathematics to the larger society. Perhaps more importantly, it debunks the perception of mathematics as an abstruse subject and inspires - as its title implies - a love of mathematics.

ABOUT THE AUTHOR

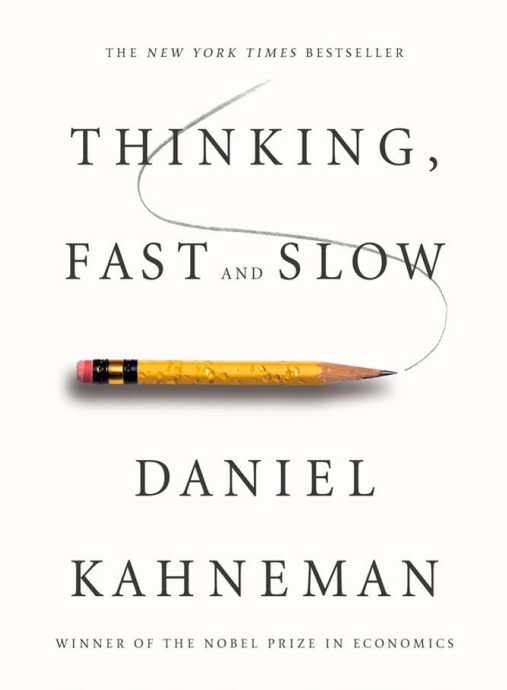
YONG WEI CHONG GABRIEL is a philosophy student at Wellesley College. Her column aims to break down popular topics in science into digestible bits for the lay reader. Gabriel can be contacted at gabrielle@scientificmalaysian.com. Find out more by visiting her Scientific Malaysian profile at http://www.scientificmalaysian.com/members/gabrielle/

SUBMISSION OF A BOOK, FILM OR DOCUMENTARY REVIEW:

Do you have a favourite book, film or documentary (with scientific elements) that you would like to review? Contact or submit your article by emailing us at: magazine@scientificmalaysian.com

Book Review: "Thinking, Fast and Slow"

reviewed by Vivian Eng



Thinking, Fast and Slow by Nobel Laureate Daniel Kahneman is a popular psychology book on decision making that walks the fine line between pop science chock-full of theories, and empirical findings from psychology experiments. Usually circulating only among academics and a niche group of unusually curious folks with an appetite for journal articles, many results from these psychology experiments do not make their way to the masses. This is unfortunate since everyone from entry-level executives to CEOs in the corporate world, for example, make decisions every day that are prone to biases.

We observe, take in information and make judgments based on intuition that, in spite of ourselves, are easily misguided. This is where *Thinking* comes in to challenge anyone who picks up the book to take a step back and reexamine one's own decision-making processes. Kahneman hopes that by bringing awareness to an audience that would otherwise be privy to the many cognitive biases we humans are slaves to, more people would be able to identify such biases and in doing so, make better decisions and judgements in everyday life. The book aims to stimulate intelligent discussions "by providing a richer and more precise language to discuss them", as Kahneman puts it.

Indeed, *Thinking* is rife with terminologies from the more commonly known (at least among students of psychology) "confirmation bias", "hindsight bias", "halo effect" *etc.*, to the less familiar "Florida effect", "Lady Macbeth effect", "conjunction fallacies", and the "Moses illusion". Compiling decades of research in the field into one easily understandable book is no small feat, yet Kahneman manages to accomplish just that, masterfully weaving in biases, fallacies, heuristics, illusions and the likes around two mechanisms of thought that purportedly form the basis for judgment making: "fast" and "slow" thinking.

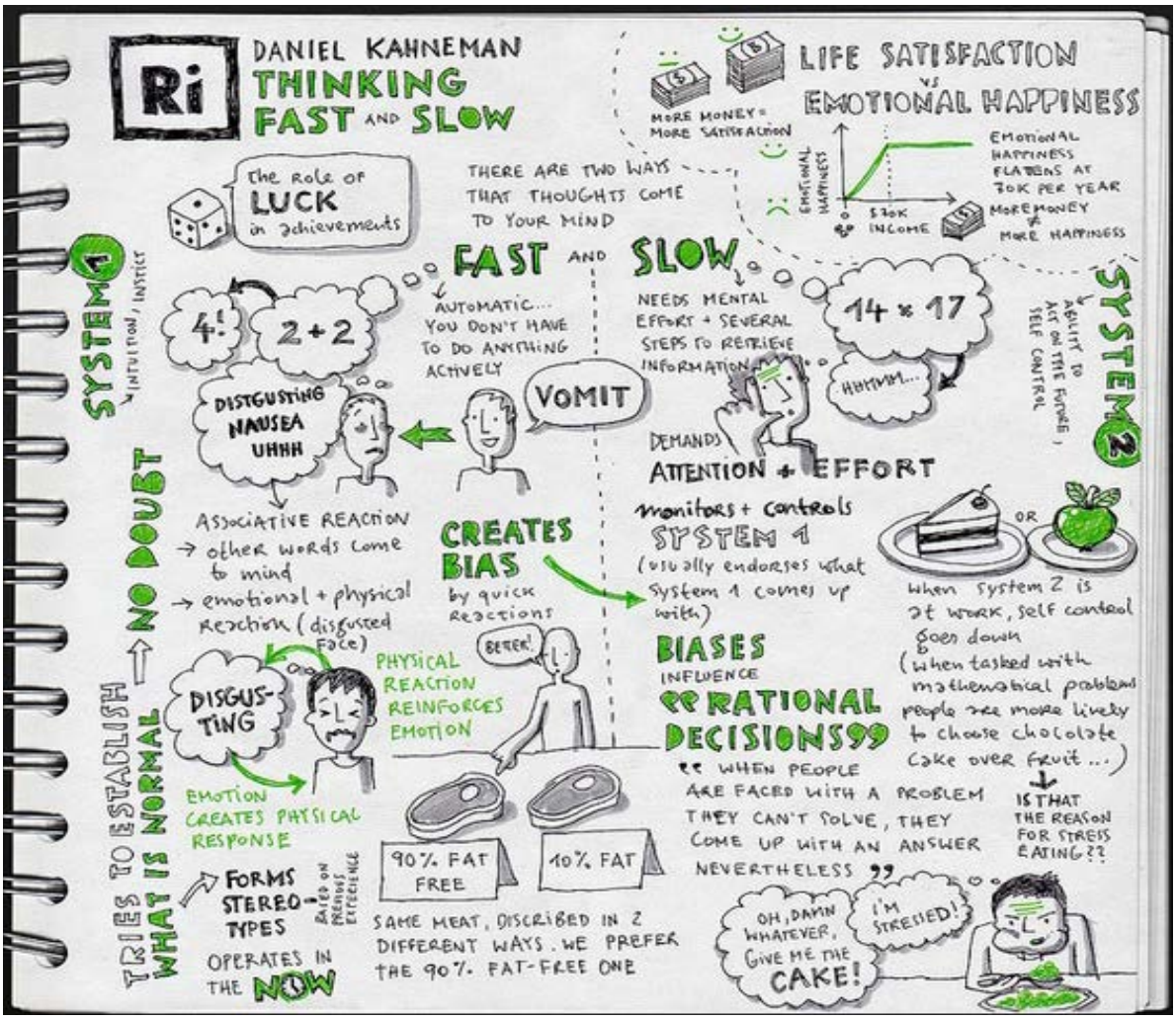
"Fast" thinking, which Kahneman attributes to automatic thinking processes that occurs unconsciously and largely out of our control, is "designed to jump to conclusions from little evidence". While "fast" thinking takes the lead in *Thinking*, "slow" thinking, an effortful and deliberate process, was relegated to a supporting role.

Kahneman illustrates the stark comparison between the two mechanisms by presenting a multiplication problem: 17 x 24. Intuitively, the automatic thinking component of our brain evaluates the mathematical problem and recognizes that there is a limited range of numbers that could be the possible solution. To obtain the precise solution, however, effortful thinking must come into play. Quick exercises like this peppered throughout the book, in order to engage readers to participate though sample vignettes and questions that help prove his points.

"... a fun and entertaining read, as Kahneman has a flair for translating dense scientific literature into layperson terms through fluid and conversational writing"

It is thus a fun and entertaining read, as Kahneman has a flair for translating dense scientific literature into layperson terms through fluid and conversational writing. This is admittedly a refreshing change from reading textbook-style writing, at least in the beginning chapters. However, as I progressed through the book, it started to come across as mildly haphazard and even repetitious at times.

Nonetheless, I am a fan of writings with a personal touch. Mentioned extensively throughout the book is Kahneman's close friend and colleague, the late Amos Tversky. I enjoyed reading about how their



A sketchnote about the book. Photo: Eva-Lotta Lamm/Flickr(CC)

walks together sparked ideas, how conversations were turned into experiments, how disagreements between them propagated lines of research in theirs and other labs. Kahneman wrote of professional visits to financial firms, corporate dinners, family vacations, *etc.* anecdotes from everyday life which not only give context to how the experiments came about, but also served as a reprieve from the theory-laden text. Perhaps these brief personal accounts occupy less space in our working memory and allow us to "digest" and dwell on the theories without reducing our ability to think.

It should also be pointed out that in the relatively short time since the publication of the book, credibility of some of the research cited by Kahneman has been questioned. In particular, certain priming studies' replicability had been challenged[1] and Kahneman himself has addressed this issue[2]. Granted that the nature of rapidly evolving research is that it is open to criticism and constantly updated, readers should be prudent in making their own conclusions and perhaps take phenomena such as the "Florida effect" with a grain of salt.

If one is not bothered by the rambling-style writing, *Thinking* makes for an utterly enlightening read. Kahneman, with his background in behavioural economics coupled with an enthusiasm for story-telling, does a decent job in forcing us to seriously think about the way we think. As easy as it is to rely on intuitive thinking to make snap judgments, I am now much more informed of the cognitive biases that come with it, and would most definitely think twice and try to correct for such biases whenever possible.

REFERENCES

[1] Doyen, S *et al.* (2012) Behavioral Priming: It's All in the Mind, but Whose Mind? *PLoS ONE* 7: e29081.

[2] Yong, E. (2012) Nobel laureate challenges psychologists to clean up their act. *Nature* doi:10.1038/nature.2012.11535

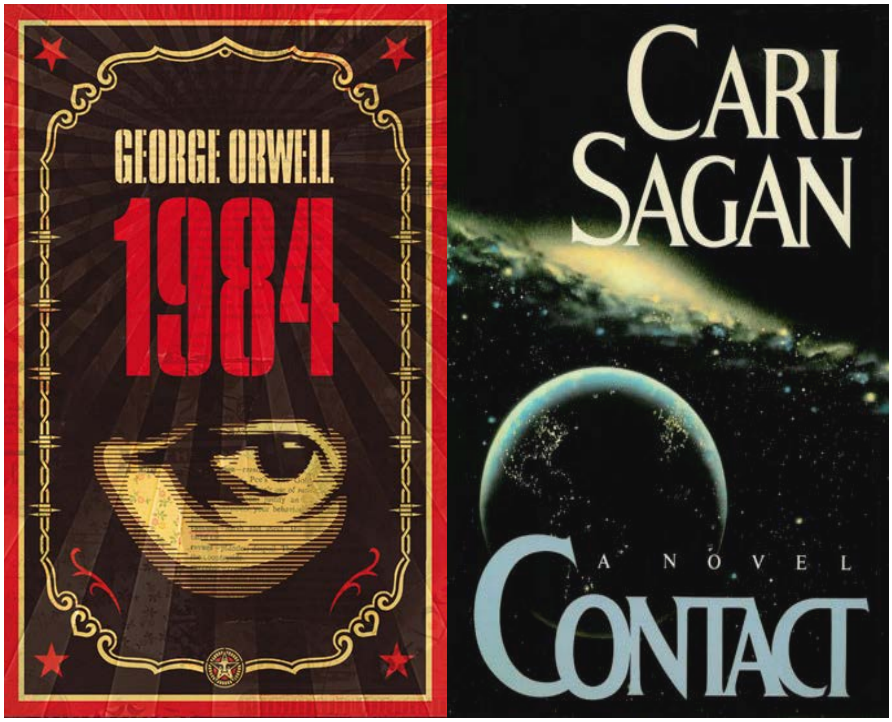
ABOUT THE AUTHOR

VIVIAN ENG is a brain-scientist-in-training who got her feet wet in brain and language research at the NeuroCognitive Imaging Lab. After graduating with a BSc (Hons) in Psychology from Dalhousie University (Canada), she is now a Research Assistant at Duke-NUS Graduate Medical School in Singapore while applying for graduate school. She enjoys travelling solo, reading, and catching up with old friends. Find out more about Vivian Eng by visiting her Scientific Malaysian profile at http://www.scientificmalaysian.com/members/vivianeng/ and her personal page at http://about.me/vivianeng

Science Fiction in the Art of Storytelling

by Lim Yen Kheng

There is a reason why the word 'science' appears in the term 'science fiction' (SF). Science plays a role at multiple levels of writing, from the story's conception to the process of streamlining the plot. In this article we will explore how science is embedded in narrative structures, and conversely, how narrative structures can be used in science.



Science fiction stories that explore the theme 'what if's'

There are varying definitions of 'science fiction'. For the purposes of this article, an adequate one is a quote by Ursula K. le Guin, who said SF stories are regarded as 'thought experiments'[1], something physicists are familiar with. Like thought experiments, SF stories essentially boil down to questions of 'what if's: What if we are able to build intelligent robots? (Asimov's robot stories); What happens if we discover an extraterrestrial intelligence? (Carl Sagan's *Contact*); What would a government do to remain in power? (George Orwell's *1984*).

In many of these stories, the 'what if's are asked, and the stories unfold to explore their logical outcomes. The stories might have a structure as follows:
1) The 'what if' question: At the heart of each story lies a central concept or technology serving as a premise. (Is it about robots? A war story? Space exploration?);

2) World-building: Establishes additional rules surrounding the central concept. ('Is faster-than-light travel possible in this space exploration story?');

3) Character and plot: They are developed according to the rules established by the concept and world-building.

This type of narrative structure might feel familiar to physicists; it is similar to how one thinks about a physical theory; take General Relativity as an example.

A pedagogical text in physics might have the following structure:
1) The postulates: The central concept or an idea. In the example of General Relativity, gravitational and inertial mass are identical;

2) Mathematical formalism could be the analog of 'world-building' *e.g.*, metric tensors, affine connections, *etc.*;

3) The variables and dynamical evolution can be taken as the analog of character and plot. Here theorists attempt to find solutions of a theory. This is the stage where the black hole solutions were discovered in 1916 by Schwarzschild.

Writers may use the structure provided by physical theories to present a consistent story. Take, for example, Christopher Nolan's *Inception* (2010). Within the first minutes of the opening sequence, the setting and concept are built *i.e.*, the ability to enter dreams. It is established early on that the characters could also enter dreams-within-dreams, along with the fact that a character's death in a dream results in his/her waking up from it. Having knowledge of these rules, the audience will know

This shot from the film Inception (2010) is ambiguously teasing and nerve-wracking because we know the rules presented earlier in the film.

the risks faced by the protagonists, thus remain emotionally invested throughout the story.

It is satisfying when a character operates within the established rules to overcome adversities, instead of having to introduce arbitrary plot devices *i.e.*, *deus ex machinas*. To do otherwise would probably render a less exciting story, or worse, lose the audience's interest entirely. This trick comes handy in preparing classes and presentations. When presenting a certain result, it is usually advisable to use the tools, theories or equations established earlier in the presentation such that the result will be a logical outcome (therefore invites less audience questioning later on!).

Sometimes, the reverse may happen. The characters attempt to discover the rules and ideas behind a story. Take, for example, Larry Niven's short story *Neutron Star* [2], where Beowulf Shaeffer is sent to investigate why a spaceship was destroyed upon visiting a neutron star. As the story progresses, Shaeffer struggles while making observations and deductions as to what really happened to the doomed ship. By observing the behaviour of gravity in and around his ship, he finally concluded that the culprit was the neutron star's gravitational tidal force.

In this instance, the 'what if' concept was gradually presented through the eyes of Shaeffer. The narrative structure of the story concept is its scientific analog, the 'idea' itself is already a scientific one *i.e.*, gravity and tidal forces. What Niven did was to embed an outcome of a scientific theory under a layer of story with characters in danger, in a way where the audience became intellectually invested through emotional investment.

> "Science plays a role at multiple levels of writing, from the story's conception to the process of streamlining the plot"

The similarities between stories and science are not too surprising since, in both areas, we seek the best ways for human minds to internalise streams of information. People have been talking, teaching and preaching to each other since humans learned to gather around campfires. And we will continue to do so with progressively advancing technologies.

REFERENCES

[1] Guin UKL, The Left Hand of Darkness. *Ace*, 1969.
[2] Asimov I *et al.* Cosmic Critiques: How & why Ten Science Fiction Stories Work. *Writer's Digest Books*, 1990.

ABOUT THE AUTHOR

LIM YEN KHENG is a PhD student and teaching assistant at the National University of Singapore. His current PhD research is on black holes and higher dimensional solutions in general relativity. He is also currently writing a science fiction novel. Find out more about Yen Kheng by visiting his Scientific Malaysian profile at http://www.scientificmalaysian.com/members/yenkheng/

Dr. Butterfingers

by Dr. Sylvia Hsu-Chen Yip

So I was quite the butterfingers scientist. There was one memorable conversation that I had with my professor:

"So, Sylvia... Can I ask something? Are you a little bit on the clumsy side?"

Taking a deep but short breath, I then heaved a sigh of defeat, "Yeah... I admit so..."

He nodded and pondered, then went on to say, "I'm not trying to be mean and really, it's totally fine, but I can't help noticing the number of equipment that has broken down over the last couple of years since you joined my lab."

"Um, yeah. Unfortunately machines and I never quite got along well."

During my years as a research scientist, mishaps caused by yours truly were so frequent that they eventually became no longer newsworthy. During my postdoctoral training, the first significant blunder I made was forgetting to turn off the brand new, expensive ultraviolet (UV) transilluminator. The bulbs blew out, and the entire department could not visualize DNA post-agarose gel electrophoresis for more than a week.

Then, there was one weekend afternoon in the lab that finished with the lid of a tabletop centrifuge split into two halves. And of course, a shaker inside the 37°C incubator room that had been faithfully serving the department for over a decade, 'perished' after liters of bacterial culture spilled inside the electric circuit because I'd failed to fasten the flasks properly.

Sylvia (centre) and several coursemates who majored in Biochemistry. They graduated in 2006.

At the 16th Intervarsity Biochemistry Seminar with Sylvia's lecturers and coursemates. Sylvia (centre) served as the treasurer in the Universiti Kebangsaan Malaysia (UKM) Biochemistry Club.

"*Abang* was on tiptoe with his hands trembling. When he saw that I'd regained consciousness, he succumbed to catharsis"

During my PhD, I once attempted a stylist post by resting my arm on a shelf while engaging myself in an exhilarating scientific discussion with a colleague. The shelf gave way to my weight, about a dozen 1- and 2-liter measuring cylinders fell, and a mountain of glass debris piled up on the floor. It must have been, this cursed clumsiness and lack of adeptness and passion for benchwork that partly led to my ultimate departure from research. Really, it was for the good of the scientific research community!

As an undergraduate, I cruised through coursework and exams effortlessly. However, I struggled with subjects that encompassed compulsory practical work. One such subject was General Genetics (or *Genetik Am*; course code STBP 1043). The weekly practical sessions in the lab for General Genetics were intense, but there was one afternoon that was even more so, where we first-year students were required to complete two classic genetic experiments within 3 hours. The first experiment was to study Mendelian genetics using three generations of fruit flies or *Drosophila melanogaster*. To examine the various phenotypes of the flies under the microscope, the organisms had to be transferred into a jar containing ether in order to be anaesthetised or "knocked out". I'd inadvertently inhaled ether vapour while doing so.

Our group rushed to finish the *Drosophila* experiment in order to start the second one, the blood grouping experiment. Using a blood lancet to prick my fingertip was an absolute personal challenge – I am trypanophobic, after all. There I sat, at the lab bench, by myself, sterilising the tip of my left pointer finger over and over again with alcohol swabs and opening one lancet cover after another. I poked, and kept poking, but just couldn't bring myself to go all the way. Fine, I'm a chicken.

Our lab technician was a congenial, bespectacled, cuddly Malay gentleman whose name I wish I could remember. He witnessed my struggle, came by my bench and volunteered, "*Mari! Abang tolong cucuk ya?*" ["Come! Big Brother help to prick?"]

I was grateful for *Abang*'s offer and surrendered my left hand to him immediately. He aptly took charge, sterilised my fingertip and pricked it just once. There, tiny drops of blood oozed out. *Abang* and I smiled at each other triumphantly but before we could drop any of my blood onto a glass slide, my mind was canopied by a black curtain and my whole body slipped off the stool onto the floor. With the potent combination of ether-induced light-headedness, fear of needles and chronic hypotension, my body just couldn't take it anymore.

I awoke from my syncope to find myself surrounded by a few anxious lab technicians in their office. One of them had innovated a hand-fan from a stack of magazines to provide me with ventilation. *Abang* was on tiptoe with his hands trembling. When he saw that I'd regained consciousness, he succumbed to catharsis.

"*Adik* OK?" ["Little Sister OK?"]

I nodded weakly, with my newly rebooted brain gradually morphing into the simultaneous realisation and disbelief that I had, actually, passed out during a scientific experiment.

"*Adik mabuk darah! Kenapa adik tak cakap?*" ["Little Sister is haemophobic! Why didn't you say so?"]

I smiled, and it was a smile of both helplessness and slight embarrassment. Needless to say, that incident was the talk of the Faculty for the whole semester. Today, I still reminisce about my wonderful days in college, which also happened to be my final years in Malaysia.

ABOUT THE AUTHOR

SYLVIA HSU-CHEN YIP was born in Ipoh, Malaysia. She holds a BSc (Biochemistry) from Universiti Kebangsaan Malaysia and a PhD (Chemistry) from Australian National University. At Emory University, Atlanta, she continued her postdoctoral research while simultaneously pursuing an internship at the university's technology transfer office. Sylvia now resides in Washington DC where she works as a patent agent in a boutique intellectual property law firm, representing clients to obtain patents in biotech/pharma/chemical technological arenas. Outside her profession, Sylvia serves in the national committee of Women in Bio (WIB), a non-profit organisation for women in life sciences. Sylvia can be reached at sylviahc.yip@gmail.com. Find out more about Sylvia by visiting her Scientific Malaysian profile at http://www.scientificmalaysian.com/members/chopin1810sy

Engage with Malaysian scientists worldwide

Discuss, collaborate, share knowledge and ideas

Join our network at:
www.scientificmalaysian.com