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Highlights

New Light on the Mysteries of Primes

by Dr LAU Yuk Kam, Department of Mathematics

If you are a movie buff, especially on mystery dramas, you may have watched the two films "Perfect Number" and "Suspect X" adapted from the same novel "The Devotion of Suspect X" (嫌疑犯X的獻身) of the popular series "Detective Galileo" (神探伽俐略). The story is about a math teacher who ever has a dream of solving the Goldbach conjecture or the Riemann hypothesis. These two great problems relate intimately to the fundamental elements of natural numbers, called primes, such as 2, 3, 5, 7, 11, 13, 17 ..... (Recall that P is a prime if P is a natural number that has *exactly two* positive divisors 1 and P.)

As well, you might recall a plot of the movie "The Solitude of Prime Numbers"[1] (質數的孤寂), saying "The primes are suspicious, solitary numbers. Perhaps they would prefer to be ordinary numbers, but for some reason they could not do it. There are some that almost touch — 17 and 19, 41 and 43 — but are separated by an even number. As the numbers expand, these so-called twin primes become ever rarer, and the presentiment develops that these were accidents, and that solitude is the true destiny. But then, if you count long enough, you'll find another pair of twins, clutching each other tightly." (The speculated endless occurrence of twin primes is the Twin Prime Conjecture.)

From The Editor

Dear readers,

The prince of mathematicians Gauss said that "Mathematics is the Queen of the Sciences and Number Theory is the Queen of Mathematics". In spite of her condescendence to render service to astronomy and other natural sciences, in all relations she is entitled to the first rank. In this issue of Science@HKU, we report a very important discovery in number theory which is closely related to an earlier result by Professor Ming-Chit Liu, a retired Mathematics Professor in HKU.

Yours sincerely,

Professor Hoi Fung CHAU
Chief Editor

Progress on the Goldbach Conjecture

In the Second International Congress of Mathematicians (of the year 1900), David Hilbert posed a list of 23 contemporary unsolved problems and the 8th one comprised three big open problems in number theory: Riemann Hypothesis, the Goldbach conjecture and the Twin Prime conjecture.

The Goldbach Conjecture is one of the puzzles attracting numerous amateur mathematicians, perhaps because it is easy to understand. The conjecture is originated from a letter of Christian Goldbach to Leonhard Euler in the year 1742 and actually consists of two parts:

G(2).
Strong Goldbach Conjecture
Every even integer $n > 2$ is a sum of two primes P and P', i.e.
$n = P + P'$.
For example,
$8 = 3 + 5$ and $16 = 5 + 11$.

G(3).
Weak Goldbach Conjecture
Every odd integer $N > 5$ is a sum of three primes P_1, P_2, P_3, i.e.
$N = P_1 + P_2 + P_3$.
For example,
$7 = 2 + 2 + 3$ and $19 = 3 + 5 + 11$.

[1] *The film is based on the novel of the same name and was nominated for the Golden Lion at the 67th Venice International Film Festival. The author Paolo Giordano, who was born in 1982 and got a doctoral degree in theoretical particle physics, won the Strega Prize — the most prestigious Italian literary award — in 2008 with this novel.*

Euler could not prove either of them and in fact no big progress was made until more than a century later.

In 1937, Ivan Matveevich Vinogradov virtually settled G(3) by showing that G(3) is true except possibly for a finite number of cases. His proof made use of the circle method — a method invented by Hardy, Littlewood and Ramanujan in the decade of 1920-30. However the number of possible exceptions not covered in Vinogradov's proof is as huge as $10^{6846169}$. No supercomputer today can check through them within an acceptable period of time.

Twelve years ago this huge number was reduced to a smaller number, less than 10^{1347}, by Ming-Chit Liu (廖明哲) with his collaborator. Liu was a professor of the HKU Mathematics Department and retired in the year 2000. He founded the research of number theory at HKU and promoted many exchanges with number theorists in Mainland China. The framework of their work is also the Hardy-Littlewood Circle Method. Novel variant treatments and tricks in both theoretical and computational aspects are invoked for better numerical constants.

In 2013, Harald Helfgott of École normale Supérieure announced that the gap is closed up and all suspicious cases are not exceptions, so the weak Goldbach Conjecture G(3) is fully proved. (His work is under vetting.)

Professor Liu and UGC project exhibition in 1995

An Obscure Mathematician's Triumph

2013 is a champagne year to analytic number theory. In addition to the good news on the weak Goldbach conjecture, a breakthrough towards the twin prime conjecture was achieved by Yitang Zhang (張益唐) of the University of New Hampshire in America.

The Twin Prime Conjecture has a long history and the greatest advance in the last century is by Jingrun Chen (陳景潤) in 1973. The enormous milestone achievement of Zhang astounds the mathematics community and earns plenty of admiration. "He's not a known expert, but he succeeded where all the experts had failed," a famous number theorist, A. Granville, said.

Being a top student in Peking University, Zhang was admitted to Purdue University and got his doctorate in 1991. But then he did not get an academic job. For several years Zhang worked as an accountant, a restaurant delivery worker, in a motel and in a Subway sandwich shop. Around 2000 he was hired as a lecturer, which is a teaching position without tenure and research support in universities.

"Sometimes I regretted not fixing him a job," his doctoral supervisor T.T. Moh wrote in a recent article. "Maybe it was his destiny to endure and turn out to be great." In an interview, Zhang was asked to cite a poem to depict his feeling (as Zhang likes chinese poems) and he replied,

"庾信平生最蕭瑟，暮年詩賦動江關。"

出處: 杜甫《詠懷古蹟》

English translation:

"Yu Xin throughout his life was most miserable,
The poetry of his waning years stirred the rivers and passes."

In: Poetic Thoughts on Ancient Sites, by DU Fu.

[The translation is quoted from the book "Poetry and painting in Song China : the subtle art of dissent", by Alfreda Murck, Harvard-Yenching Institute Monograph Series, Harvard University Asia Center, 2000.]

Prime Gaps and Sieves

Two consecutive primes P, P_{next} form (a pair of) twin primes if the length of this prime gap, i.e. $P_{next} - P$, equals 2. For instance, 3 and 5, 11 and 13, 431 and 433, 1997 and 1999 are twin primes. So the twin prime conjecture, saying that there are infinitely many pairs of twin primes, can be rephrased as: prime gaps of length 2 appear unceasingly.

Twin Prime Conjecture
There are infinitely many prime gaps of length 2, $P_{next} - P = 2$.

Thus mathematicians study the size of small prime gaps. Not much is known in the 20th century. (More precisely, mathematicians look for a small threshold so that infinitely many prime gaps, $P_{next} - P$, do not exceed the threshold amount. Nobody could suppress the threshold below 0.24 log P in the 20th century.)

In 2003, Daniel Goldston and Cem Yildirim announced a landmark result but shortly afterwards a fatal error was found. The salvage was finally succeeded in 2005 with the help of János Pintz, and Goldston-Pintz-Yildirim (GPY) obtained the following:

Theorem of GPY
There are infinitely many small prime gaps.

(Here "small" means a threshold amount about $(\log P)^{0.5}$.)

On this issue, Goldston had many interviews and wrote the article "My 30 minutes of fame" – "15 minutes of fame and 15 minutes of negative fame", he explained.

The method of GPY makes use of the sieve theory which can be viewed as a mathematical fishing technique with various nets. Such a technique appears more than 2,000 years ago in Greek. The modern sieve methods are somewhat sophisticated. GPY developed a sieve which has a fundamental intimacy with the sieve method — an early approach to the twin prime and the Goldbach problem — invented by Atle Selberg in 1940s.

Selberg is a recipient of the Fields medal, commonly regarded as the Nobel Prize of mathematics. In 1998 he gave, as the Y.C. Wong Visiting Lecturer, a series of lectures on the analytic theory of the prime numbers at HKU.


Professor Selberg's talk at HKU

Current breakthroughs

The theorem of GPY in 2005 gives infinitely many small prime gaps; however the size of these gaps, $P_{next} - P$, may grow to infinity. Qualitatively it is very far from the twin prime conjecture (which predicts infinitely many prime gaps with $P_{next} - P = 2$).

On the other hand, GPY pointed out in their paper, "[our theorem] would appear to be within a hair's breath of obtaining [bounded prime gaps]". (Bounded prime gaps mean that all these gaps have lengths not exceeding a constant threshold, i.e. all such $P_{next} - P$ are less than a constant value.) This remark impressed Yitang Zhang (張益唐) deeply and Zhang started thinking of the problem.

After working solely for several years, Zhang overcame the barrier underlying in the work of GPY and accomplished in 2013 the groundbreaking result:

Zhang's Theorem

There are infinitely many bounded prime gaps with $P_{next} - P \leq 70{,}000{,}000$.

Although it does not guarantee infinitely many prime twins (which require the gap length of 2), Zhang's theorem assures infinitely many "prime cousins".

Zhang's work was widely spread in May of 2013 and drew many mathematicians' attention, not only because of its beauty and significance but also how much the bound size 70,000,000 can be reduced. "This result is, of course, not optimal", Zhang wrote in his paper.

On June 4 (of 2013), Terence Tao (陶哲軒), a Fields medalist, launched the Polymath8 project to improve Zhang's bound. Polymath project is an open online platform for massive collaboration. After a few months, the first phase of the project improved the number 70,000,000 to 4680 by developing the techniques of Zhang. The second phase incorporated the work of a young researcher, James Maynard, which gives a novel and efficient sieve method, to further improve the size to 270.

Amazingly the seed of Maynard's idea also lies in the paper of Selberg on his sieve theory. Will the size be lowered to 2 to prove the twin prime conjecture? Maynard said, "I feel that we still need some very large conceptual breakthrough to handle the twin primes case."

Nevertheless, such a breakthrough may sneak out as quietly and suddenly as Zhang's!

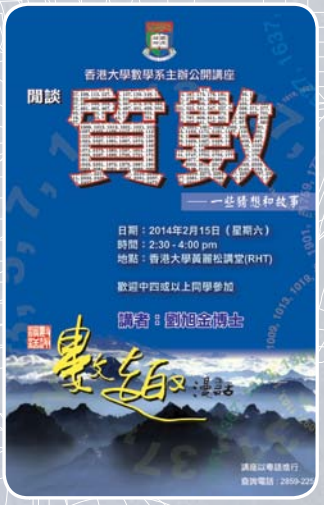
EpilQgue

Primes have many mysteries, some of which lead to modern applications. As well known, public-key cryptography is a vital technique for Internet security and it makes use of number theory and large primes. The digital rights group "EFF" offers a prize of US$250,000 to the first individual or group who discovers a prime with one billion (or more) decimal digits.

However mathematicians are fascinated by the pattern of primes for simple reasons. "The problem is what attracts us, Pure Mathematicians. If a problem is useful, [it is] good; if not useful, [it is] also good as long as it is fundamental and deep," said Peter Sarnak, Professor of the Institute for Advanced Study in Princeton, Chairman of Selection Committee for the Shaw Prize (邵逸夫獎) in Mathematical Sciences.

The 10 Largest Known Primes

rank	prime	digits	when
1	$2^{57885161}-1$	17425170	2013
2	$2^{43112609}-1$	12978189	2008
3	$2^{42643801}-1$	12837064	2009
4	$2^{37156667}-1$	11185272	2008
5	$2^{32582657}-1$	9808358	2006
6	$2^{30402457}-1$	9152052	2005
7	$2^{25964951}-1$	7816230	2005
8	$2^{24036583}-1$	7235733	2004
9	$2^{20996011}-1$	6320430	2003
10	$2^{13466917}-1$	4053946	2001



Departmental public lecture on primes in February, 2014

Brainteaser

Prize: $50 book coupon

Deadline: June 30, 2014

Question

List all the prime(s) P for which $\sqrt{\frac{P+7}{9P-1}}$ is a rational number.

Please email your answer together with your name and school (for students), to scinews@hku.hk. FIVE winners will be drawn randomly from the contestants who give the correct answer.

Question of last issue

Coins have many uses apart from being a medium of payment to facilitate transactions. For instance, coin tossing is a simple and quick way of settling disputes in a civilized way or deciding between two options. To serve such purposes, the coin used has to be fair so that there is an equal chance of getting a head or a tail. Suppose a coin is given but we are not sure whether it is fair. What can we do? How can a possibly unfair coin be used "in a fair way"? You may assume that the tosser is "fair" in tossing the coin each time so that there is no correlation between the outcomes.

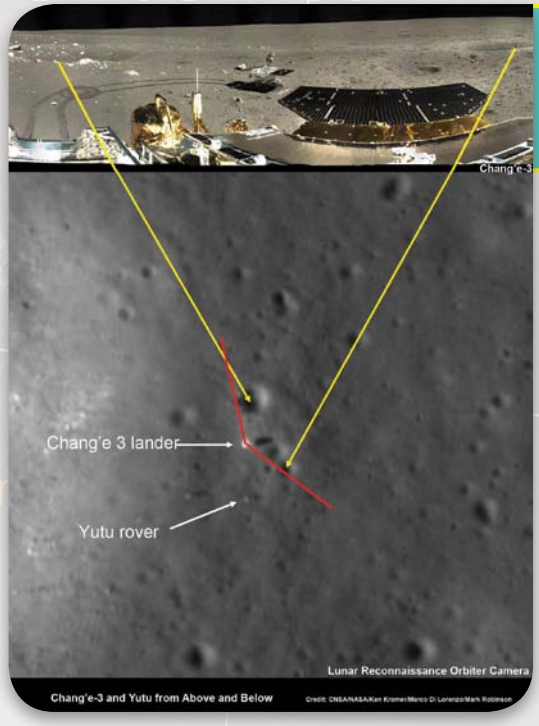
Answer

If you toss the coin twice, you know that whatever the bias, HT (heads then tails) is as likely as TH. So you toss it twice. If it comes up HT, you select option A. If it comes up TH, you select option B. If it comes up HH or TT, you toss the coin twice again until you get either HT or TH. Using this procedure, the chance of selecting option A or B will be the same. Try yourself by repeating the procedures many times, and you will obtain roughly the same number of A and B.

A Trip to the Moon

by Dr LEE Man Hoi, Department of Physics and Department of Earth Sciences

Background: Image of Mare Imbrium where Chang'e 3 landed. [Credit: NASA/GSFC/Arizona State University]



Part of a high-resolution panorama taken by the Chang'e 3 lander, showing the Yutu rover and impact craters on the lunar surface (top), and image of the Chang'e 3 lander and Yutu rover on the surface of the Moon taken by NASA's Lunar Reconnaissance Orbiter (bottom). The Yutu rover has moved between the two images. [Credit: CNSA/NASA/Ken Kremer/Marco Di Lorenzo/Mark Robinson]

The successful soft landing of China's Chang'e 3 mission on our nearest celestial neighbour, the Moon, on December 14, 2013 – the first one since 1976 – represents a major milestone in lunar exploration. The Chinese space programme aims to return robotically samples of rocks and soil from the Moon as early as 2017, paving the way for astronauts to set foot on the Moon again in the future. As with the space race between the United States and the Soviet Union that eventually led to the Apollo astronauts' visits to the Moon between 1969 and 1972, there is a political dimension to China's space programme. But it is important to note that human lunar exploration have had, and will continue to have, major impacts on our understanding of the formation and evolution of not just the Moon, but of the entire Solar System.

The Chang'e 3 lander [Credit: CAS]

The Yutu rover [Credit: CAS]

One of the scientific legacies of the manned Apollo and robotic Soviet missions are the lunar samples returned to Earth. Laboratory analysis of the samples showed that the composition of the Moon is different from that of the Earth. It is depleted in volatile elements that have relatively low condensation temperature, as well as siderophile elements that tend to affiliate with iron, but it is enriched in refractory elements that have relatively high condensation temperature. To explain this unusual composition of the Moon, the masses of the Earth and Moon, and the amount of rotation (angular momentum) in the Earth-Moon system, the giant impact theory, where the Moon accreted in a debris disk generated by the giant impact of a Mars-sized planetary embryo with the proto-Earth about 4.5 billion years ago, was proposed and is now widely accepted. Furthermore, large impacts and frequent impacts are now considered to be a fundamental process in planet formation.

High-resolution panorama taken by the Chang'e 3 lander, showing the Yutu rover and impact craters on the lunar surface. [Credit: CNSA/Chinanews/Ken Kremer/Marco Di Lorenzo]

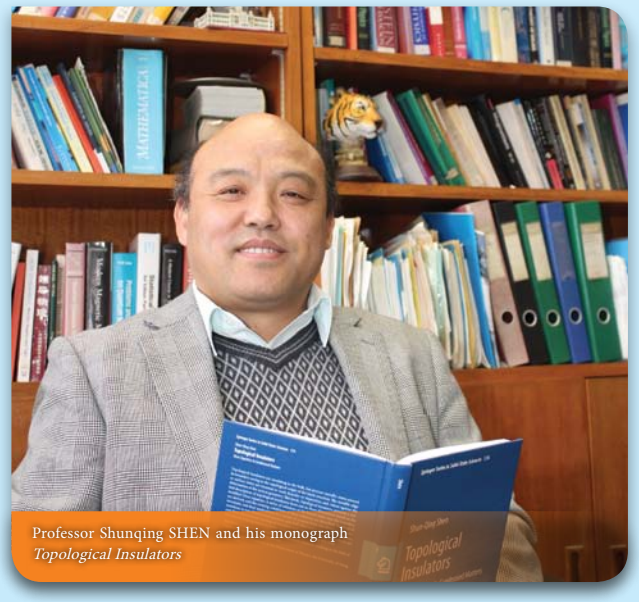
Impacts on both the Earth and the Moon have continued to the present time, as recorded by the numerous impact craters on the Moon. Radiometric dating of samples obtained from different areas of the Moon allows scientist to study how the rate of impacts has changed with time. The impact rate was much higher in the early Solar System due to the presence of a lot of debris left over from planet formation. Surprisingly, some data suggest that there was a peak in the impact rate about 3.9 billion years ago or about 700 million years after the planets formed. This so-called Late Heavy Bombardment is one of the puzzling properties of our Solar System that led to the radical idea that the orbits of the giant planets in the outer Solar System were originally much closer together. According to the Nice model (named after the city Nice in France) proposed in 2005, the slow migration of the orbits of Jupiter and Saturn eventually led to a sudden large scale instability in the outer Solar System, in which Uranus and Neptune were scattered to orbits much further from the Sun. The Late Heavy Bombardment could be explained by this global instability scattering many asteroids and comets into the inner Solar System. Recent models in which the outer Solar System started with five giant planets and lost one during the instability may work even better than the original Nice model.

Despite these major advances in our understanding of the Moon and the Solar System, key questions remain. Recent re-analysis of lunar samples using modern laboratory techniques has shown that the Moon may have more water than previously thought. The evidence for the Late Heavy Bombardment on the Moon also remains controversial. The collection of samples from new areas of the Moon by future missions may help scientists to answer these questions and lead to new puzzles.

Topological Matters

by Professor Shunqing SHEN,
Department of Physics

Professor SHEN was the recipient of University Outstanding Researcher Award 2012-13.



Professor Shunqing SHEN and his monograph *Topological Insulators*

Some materials have exotic conducting edge or surfaces while their inner part are insulating, looking like good insulators covered by a thin layer of good metal (see Figure). The conducting boundaries are formed by the topological effects, which are insensitive to the shape or geometry of materials. Even when a material is cut into two halves, the new interfaces are still conducting. Such novel materials are named topological insulators, which provide new routes to generate new quantum phases or particles. Exotic electric and magnetic properties of these materials will have potential applications in the next generation of electronic devices and topological quantum computation.

Studies of topological matters were dated back to 1970s and 80s. Discovery of the quantum Hall effect opened a new window to explore novel quantum states of matter. Almost at the same period it was found that the conducting polymers have very special structures, and their charge carriers are the domain walls of two distinct one-dimensional structures, and reveal topological properties. In 1972 it was observed that liquid helium He3 becomes superfluiding, and two different phases at very low temperatures. The three irrelevant topics more than thirty years ago are now realized to have the same topological origins, and belong to the same family of topological matters.

A milestone in the field is the prediction of the quantum spin Hall effect by Kane and Mele in 2005. The effect was soon verified experimentally and generalized to three dimensions. A series of materials are discovered to be topological insulators, which initiates a "Gold Rush" in the search of topological matters. Professor Shunqing Shen and his group entered this field at the early stage, and made significant contributions. In 2004 he proposed a relation between the Berry phase and quantum spin transport. In 2005 he discovered a new type of force on moving electron spin in an electric field, which plays an essential role in quantum spin transport. In 2008, he and his collaborators found the finite size effect of the boundary states, which was soon verified experimentally. In 2009, he and his students discovered a new type of topological insulators driven by disorders or impurities, named topological Anderson insulator, which becomes now a topic in the field. In 2011 he and his collaborators proposed a quantum transport theory for topological insulators and predicted a crossover from weak anti-localization to weak localization, which also has been observed experimentally by several groups.

In 2010, Professor Shen realized a single mathematical equation as a key to understand the topological matters. The equation is a modification to the famous Dirac equation for relativistic quantum mechanics. He found that a large class of topological matters could be well described by this equation. It covers materials from one, two, to three dimensions, and from insulators to superconductors, or superfluids. The main results are summarized in his single-authored monograph, *Topological Insulators* (Springer Series in Solid State Science 174, 2012), which is the first such publication on the frontier topic.

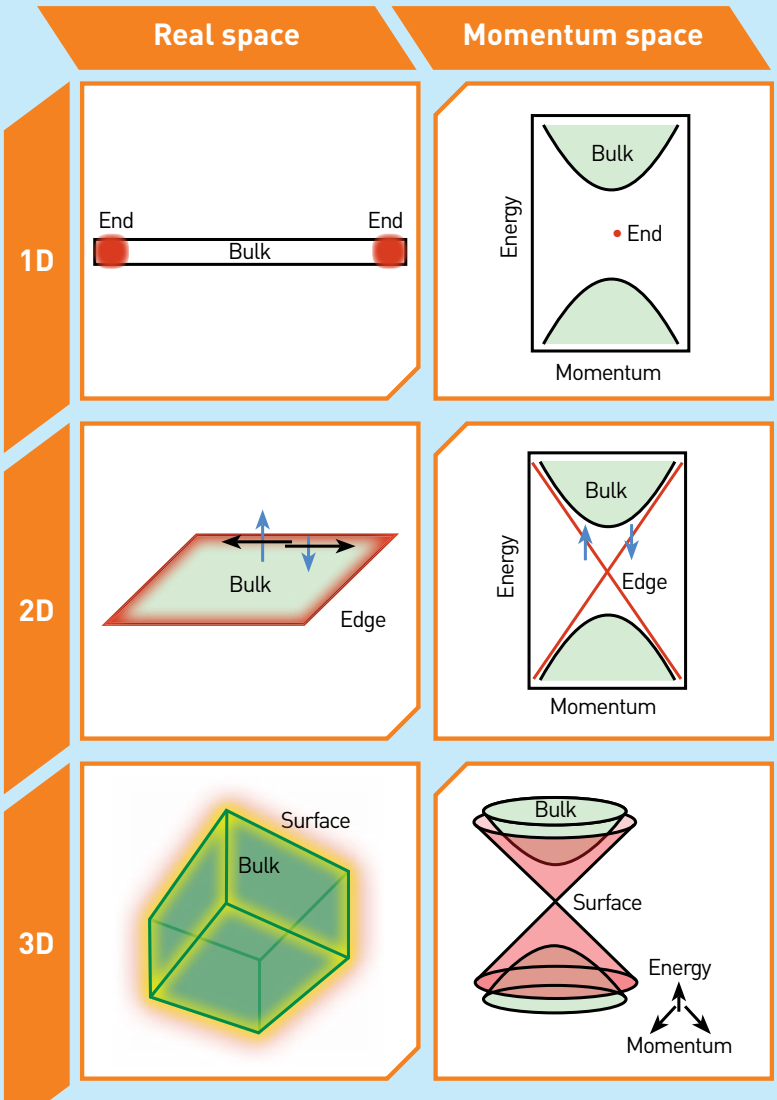


Figure: The boundary states and their dispersions of topological materials. A d-dimensional material has (d-1)-dimensional boundary.

Changes in Global Biodiversity Pattern Driven by Temperature and Climate

by Dr Moriaki YASUHARA, School of Biological Sciences, Swire Institute of Marine Science, and Department of Earth Sciences

Dr YASUHARA was the recipient of University Research Output Prize (Faculty of Science) 2012-2013.


Dr Moriaki YASUHARA

Dr Moriaki Yasuhara (School of Biological Sciences, Swire Institute of Marine Science, and Department of Earth Sciences), in collaboration with Smithsonian and US Geological Survey researchers, discovered that dynamic changes in large-scale geographic patterns of number of species (biodiversity) are driven by climate, especially temperature, and there has been a strong and remarkable stability in the relationship between biodiversity and temperature over the last three million years. Their finding has important implications for global warming as the very strong temperature control of biodiversity suggests that future temperature rise will alter present-day ecosystems. Thus, scientists can now predict that this warming will give rise to substantial local changes in biodiversity. The result was published in *Ecology Letters* in October 2012.

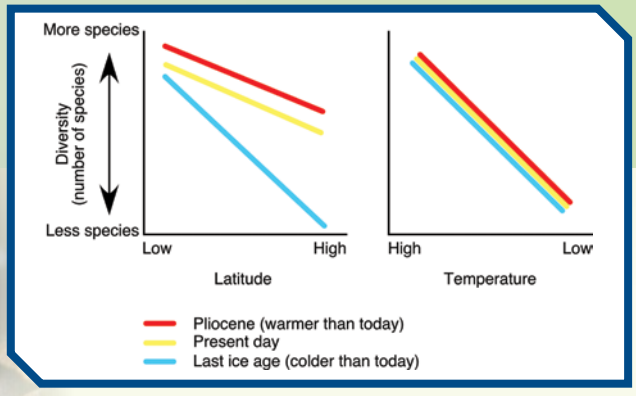
Planet Earth shows striking latitudinal gradients in species richness and biodiversity with, typically, more species in tropical regions and fewer in polar regions. For instance, tropical rainforest contains many more species than forests further north, and coral reefs host many more species than Artic Ocean. Understanding to the causes, stability and potential changes through time of such latitudinal species gradients is limited. By studying fossil of planktic marine animals from more than 200 sites covering the whole North Atlantic Ocean, and using it as a model system to reveal global patterns, the research team discovered that the quantitative relationship between diversity and latitude has been dynamic, but the diversity versus temperature relationship has remained remarkably constant throughout the past three million years. Dr Yasuhara and his research team compared three time periods of present day, last ice age (colder than today), and Pliocene (3 million years ago: warmer than today), and temperature differences among these periods are clearly reflected in diversity. In other words, warmer Pliocene had higher diversity and colder last ice age has lower diversity than the present day. Furthermore, the latitudinal temperature gradient was steeper during the last ice age than today because of polar regions were much cooler in the past than they are now and tropical regions were not much, and thus the latitudinal species diversity gradient was steeper. So, all of such changes over time are reasonably explained by the underlying constant biodiversity-temperature relationship (see Figure). These results provide strong evidence that temperature controls biodiversity.

"Our results will largely advance our understanding on mechanisms controlling biodiversity. This is a very important topic in our rapidly changing world with serious concern on biodiversity conservation", said Dr Yasuhara. It remains an open question as to whether these results will allow scientists to predict biodiversity changes in the future, since the rates of global warming and temperature rises are beyond those seen in the last three million years. However, the findings certainly indicate that biodiversity will change in response to temperature, and these temperatures beyond the historic ranges may well result in substantial reorganization of global pattern of biodiversity.

The Paper

Yasuhara, M., Hunt, G., Dowsett, H. J., Robinson, M. M., Stoll, D. K., 2012. Latitudinal species diversity gradient of marine zooplankton for the last three million years. *Ecology Letters*, 15: 1174–1179.

This image shows deep-sea sediment including numerous fossil zooplankton (Foraminifera).



This figure is a simplified graph to explain latitude-biodiversity (left) and temperature-biodiversity (right) relationships. Note large differences of the latitudinal diversity patterns among the three time slices of present day (yellow), last ice age (18,000 years ago, a period colder than today: blue), and 3 million years ago (Pliocene, a period warmer than today: red), and remarkable similarity of the temperature-diversity patterns. Temperature-diversity lines of three time slices are well overlapped, suggesting strong and constant temperature control of biodiversity.

学习园地

Surrounded by so many happy faces

Promoting Science across the Border

by Charmaine Cho,
Year 3 BSc student (Major in Biotechnology)
and member of Science Outreach Team

"Science without Borders" is a science service trip organized by the HKU Science Outreach Team. A total of 16 students from diverse science disciplines went to Heyuan City, Guangdong province from Dec 25 to 28, 2013, spending their Christmas with Mainland pupils from rural area. One of the aims of this project is to encourage students from the Faculty to make use of their science knowledge to promote science to general public. At the same time, we also strive to inspire the underprivileged kids with simple experiments in order to arouse their interests towards science. The project is supported by the Faculty of Science and is funded by SERVICE 100 Fund.

Eight workshops were offered to over 200 students of Heyuan Yangming Primary School. Each workshop featured mini-experiments in 4 major themes: Microscope, Optics, Pressure and Magnetism. Kids were all thrilled to observe magnified hair and leaves under microscopes. Some of them were amazed by the optics illusion created by simple apparatuses such as lenses, mirrors and beakers of water. Others kept playing around with the electromagnets and railgun. Not to mention the exciting suction cup battles, they all loved what we did for them.

After the first day workshop, the teachers reflected that their students enjoy the experiments very much and requested for an extra session after school for the preschool kids on the second day. Considering the age of the kids, instead of teaching science, we tried to impress them. They were very happy seeing beautiful light rays generated by laser pointers, ray boxes and prisms, etc. We could see eyes full of curiosity. Kids were just inspired by the beauty of nature, while we were inspired by their instinctive curiosity and their passion to ask why. All our effort seemed to pay off when we were surrounded with so many happy faces.

What we have done in the trip was like igniting a fire with sparkles, and we should think about how to keep up the flame. Witnessing the contrast between the kids' enthusiasm for science and their compromising situation of science education, we were eager to help improve the status quo with our consecutive contributions.

Regular service trips and stable connection with rural schools are important in enlightening the kids with science. Furthermore, we should even consider extending our attention to other underprivileged children in Asia. Where are we going? No one knows for sure. We just want to keep inspiring others and getting inspired.

You are welcome to revisit the highlights of our service trip at:
http://www.youtube.com/watch?v=cFrG01UdyXY

or find us on facebook:
https://www.facebook.com/scienceoutreach.hku

Recording every moment

Team members discussing on demonstrations between workshops

At magnetism workshop

Little girl amazed by what she saw in the microscope

Achievements

University Awards

↗ **Professor CHEUNG Wing Sum**, Department of Mathematics, was granted the ***University Outstanding Teaching Award 2013***, for his dedication to teaching, tireless and creative efforts to make learning enjoyable, and the impact that he has made on his students' learning.

↗ **Professor Shunqing SHEN**, Department of Physics, was granted the ***University Outstanding Researcher Award 2012-13***, of which the highly-coveted award is made to researchers of discintion and of international merit.

↗ **Dr Zonghui LIU**, Department of Earth Sciences, received the **University Outstanding Young Researcher Award 2012-13** for his involvement in high-impact applied research work.

↗ **Dr Wang YAO**, Department of Physics, received the ***University Outstanding Young Researcher Award 2012-13*** for his outstanding research accomplishmets. Dr Yao is also the recipieint of an external award – ***the 2013 Croucher Innovation Award,*** which was set up to support exceptionally talented young scientists.

↗ **Dr Moriaki YASURAHA**, School of Biological Sciences and Department of Earth Sciences, received the **University Research Output Prize (Faculty of Science) 2012-13** for his research published in a journal entitled "Latitudinal species diversity gradient of marine zooplankton for the last three million years" was published in *Ecology Letters*, Volume 15, No. 10, October 2012, pp.1174-1179.

↗ **Professor Hongzhe SUN**, Department of Chemistry, received the **University Outstanding Research Student Supervisor Award 2012-13**, for his guidance to his research students.

Others

↗ **Professor Zidan WANG,** Department of Physics, shared the **2013 China National Award in Natural Sciences (2nd class)** with Siliang ZHU of South China Normal University.

↗ **Professor Sun KWOK**, Dean of Science, received the ***Outstanding Achievement Award*** from his alma mater, the University of Minnesota. This award recognizes graduates who have attained unusual distinction in their chosen fields or professions, or in public service, and who have demonstrated outstanding achievement and leadership on a community, state, national, or international level.

↗ **Professor CHAN Lung Sang** of Department of Earth Sciences, was selected by the Local and International Editorial Boards of the Hong Kong Medical Journal as the ***Winner of the Best Original Paper Award*** this year for his article entitled *"Utility of infrared thermography for screening febrile subjects"*.

↗ **Professor Frederick LEUNG Koon Shing**, Mathematics alumnus and Professor of Faculty of Education, was awarded the ***Hans Freudenthal Medal for 2013*** by the International Commission on Mathematical Instruction, in recognition of his distinguished research in the areas of comparative studies of mathematics education.

Faculty Awards

↗ **Professor Aleksandra DJURIŠIĆ**, Department of Physics, received the ***Faculty of Science Award for Teaching Excellence 2012-13***, for her outstanding teaching performance and the continuous efforts she has put in arousing students' learning interests.

↗ **Dr Philip YU**, Department of Statistics and Actuarial Science, received the ***Faculty of Science Award for Service Contribution 2012-13***, for his contributions in service, departmental administration, and outreach activities in the Faculty.

↗ **Miss CHAN Bin San Vera**, PhD candidate supervised by Dr Vengatesen Thiyagarajan of School of Biological Sciences, received the ***Faculty of Science Excellent Teaching Assistant Award 2012-13***, for her contributions in outstanding performance in providing teaching support and interaction with students.

↗ **Dr Jason PUN Chun Shing**, Department of Physics, received the ***Faculty Knowledge Exchange (KE) Award*** for his outreach project on light pollution entitled "Dimming the "Bright Pearl – Informing the Public on Light Pollution".

↗ **Mr WONG Tsun Yu Jeff**, MPhil student supervised by Dr Eric C K Cheung of Department of Statistics and Actuarial Science, received the ***Faculty of Science Excellent Teaching Assistant Award 2012-13***, for his contributions in outstanding performance in providing teaching support and interaction with students.

↗ **Ms Irene CHEUNG**, Administrative Assistant of Department of Statistics and Actuarial Science, received the ***Faculty of Science Award for Best Non-academic Staff 2012-13***, for her excellent performance among non-academic staff.

↗ **Mr CHUNG Ming Long,** MPhil student of the School of Biological Sciences, was the **1st Runner-up of the University Three-minute Thesis (3MT®) Competition** held in March, 2014 for his excellent presentation of his research entitle "Oxygen: Angel or Demon?—Lipid Peroxidation and Its Relevance to Pheromone Production in Marine Fish under Oxidative Stress". Mr Chung is under the supervision of Dr Jetty C Y Lee.

↗ **Mr Zhuo DENG,** PhD student of the Department of Physics and **2nd Runner-up of the University Three-minute Thesis (3MT®) Competition**, also had outstanding performance for the presentation of his research "Who Stole My Electrons?" — Electron Loss Process in 3rd Generation Solar Cells". Mr Deng is supervised by Dr Shijie Xu.

↗ **Miss Akala LI Teng and Miss XING Shuang,** PhD students of School of Biological Sciences, won the **Golden and Silver Kingfisher Prizes** for their talks at the China Ornithological Society 2013 Conference at Zhejiang University respectively. The two students were under the supervision of Dr D Thomson.

Miss Akala LI Teng **Miss XING Shuang**

↗ **Dr Terence NG** of The Swire Institute of Marine Science and School of Biological Sciences, received the annual **Award of the Malacological Society of London** for his thesis entitled "Sexual selection in marine snails using littorinids as model species". Dr Ng was under the supervision of Professor Gray A Williams.

↗ **Mr Kaiwen CHEN**, a high school student who has worked with **Dr Kono LEMKE** in the Department of Earth Sciences on a geochemistry research project for more than a year, attended AGU's Fall Meeting, the largest worldwide conference in the geophysical sciences in San Francisco in December, 2013. Apart from attending talks and poster sessions, Mr Chen presented his own poster entitled "An ESI/ FTICR- MS Study of Zinc Sulfate" as part of AGU's Bright Students Training as Research Scientists (Bright STaRS) programme.

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