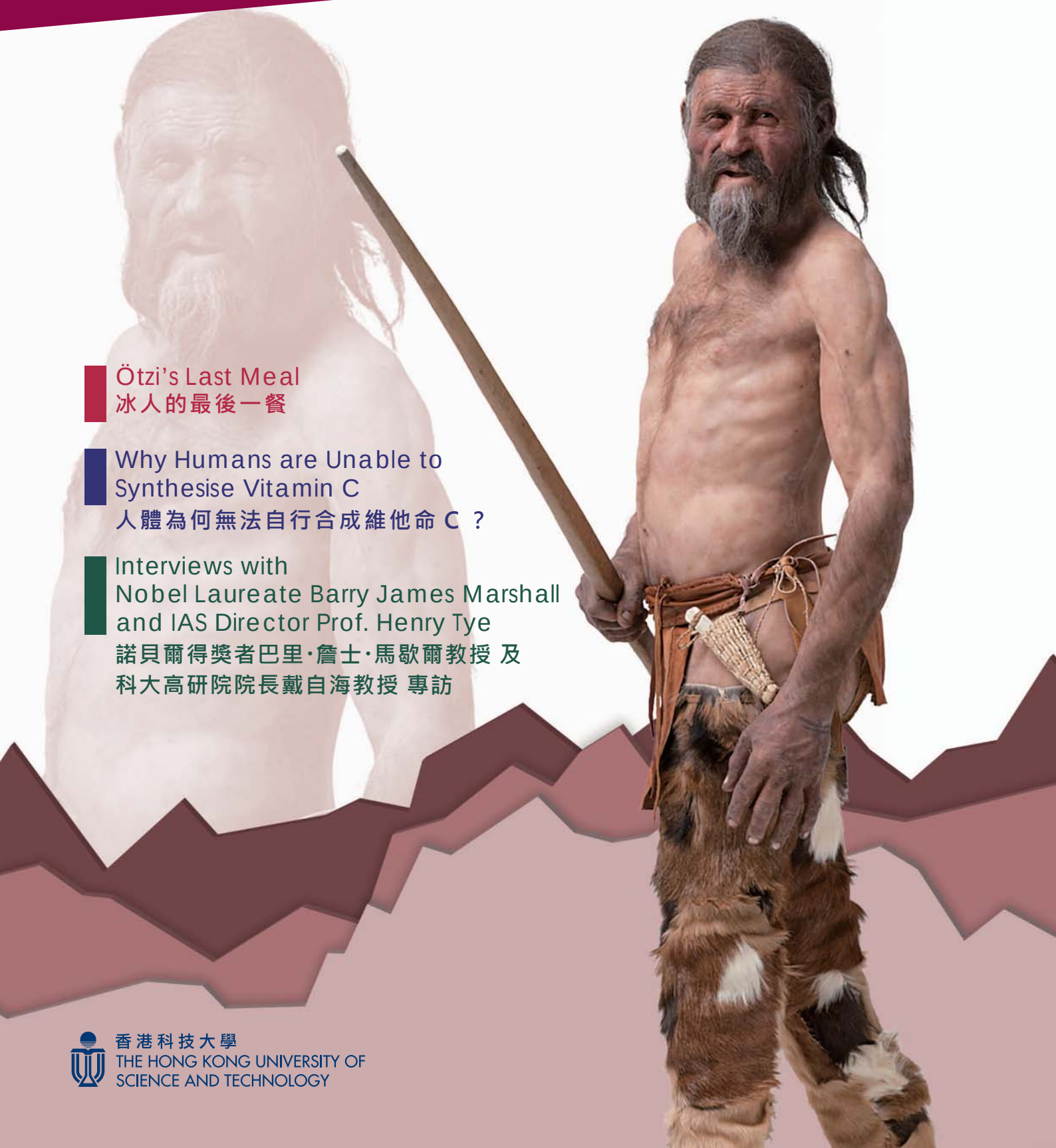
SCIENCE FOCUS 科言

Issue 002, 2014



Ötzi's Last Meal
冰人的最後一餐

Why Humans are Unable to Synthesise Vitamin C
人體為何無法自行合成維他命 C ？

Interviews with Nobel Laureate Barry James Marshall and IAS Director Prof. Henry Tye
諾貝爾得獎者巴里·詹士·馬歇爾教授 及
科大高研院院長戴自海教授 專訪

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Contents

Science Focus 科言
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What's Happening in Hong Kong? 香港科技活動

The Astropark: 3 zones for 3 levels 1
香港天文公園

Hong Kong Science Park: Science Explorer
香港科技園：科學探索行

The Space Museum: Astronomical Telescope Making
香港太空館：天文望遠鏡製作活動

Global Education 環球教育

Guide to University Applications in the UK 2
申請英國大學指南針

Science Today 今日科學

Smart Tags for Food Freshness 4
食物變質智能標簽

3D Bio-printing 6
3D 生化列印

Bitcoin 8
比特幣

Ötzi's Last Meal 10
冰人的最後一餐

Amusing World of Science 科學趣事

Why Humans are Unable to Synthesise Vitamin C 12
人體為何無法自行合成維他命 C ？

Hair-Raising Effects of Lightning 14
毛髮豎起的雷電現象

Bee Pheromones 16
蜜蜂費洛蒙

Who's Who? 科學巨人

A Gamble with Life – Prof. Barry James Marshall 18
一場人生賭博 – 巴里 · 詹士 · 馬歇爾教授

Failure – The Essential Stage to Becoming an Outstanding Scientist: Prof. Henry Tye 20
失敗 – 成就優秀科學家之路 : 戴自海教授

Test Yourself! 22
測一測

Acknowledgements 特別致謝

Message from the Editor-in-Chief 主編話語

Dear Readers,

Welcome back to the second issue of *Science Focus*.

In this issue, we have provided current, relevant and well-researched articles which will hopefully stimulate your scientific interest. Some of our articles are aligned with the current DSE science curriculum, which teachers may find useful for classroom instruction. In addition, I want to bring special attention to the article, *Bee Pheromones*, which was written by a group of secondary school students who participated in the HKUST Dual Programme – well done.

I wish to take this opportunity to encourage proactive participation from student readers who are interested in science writing. Readers may recall that the Science Focus Article Submission Competition was created in the last issue. The competition is open to **Form 4 to Form 6** full-time students and submissions related to any discipline of science will be judged on originality, creativity and rhetoric. The winning article will be published in the next issue of *Science Focus* and the author will be awarded an Apple iPad. The new deadline for the competition will be in late August 2014. Student readers are also invited to join our mailing list to enter a lucky draw for an Apple iPad mini. Registration and more information can be found on the *Science Focus* homepage.

I sincerely hope that you will enjoy this issue of *Science Focus* and we welcome your suggestions

Prof. Yung Hou Wong
Editor-in-Chief

親愛的讀者 :

你好 ! 歡迎你閱讀「科言」第二期。

我們在這一期繼續為你搜羅當下關切的科學資訊，希望能引起你對科學的興趣。其中有些文章配合香港中學文憑課程，或可有助老師教學。我特別要推介由一組修讀科大中學 / 大學雙修課程的同學所撰寫的「蜜蜂費洛蒙」，值得讚賞。

在此，我希望鼓勵對科學寫作有興趣的讀者，積極參與科言徵文比賽。歡迎**中四至中六**的全日制學生，提交以任何科學領域為題的作品。評審團會以作品的原創性、創作意念以及修辭技巧，選出優勝作品刊登在下期「科言」，其作者可獲蘋果 iPad 一部。截件日期為 2014 年 8 月底。此外，請於網上登記你的電郵地址，即可參加抽獎，有機會贏取 Apple iPad mini 一部。

我們歡迎你提出寶貴的意見和建議。祝你閱讀愉快 !

主編 王殷厚教授
敬上

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What's Happening In Hong Kong ?

香港科技活動

By Yi Qi 戚益

Want to have an exciting experience of science in Hong Kong? Then make good use of your spare time in the Astropark, Hong Kong Science Park and the Space Museum, where you won't regret your decision!

The Astropark: 3 zones for 3 levels

Located within Chong Hing Water Sports Centre, the Astropark is divided into three zones for visitors with different levels of astronomical background and interests. In the Naked-eye Observation Area, casual visitors may watch the beautiful starry sky at night; the Educational Zone enables visitors to appreciate the early Chinese astronomical technologies, and amateur astronomers can bring their own telescopes to the Telescopic Observation Area to watch the sky. The various options provided by the Astropark will certainly not disappoint you especially if you are interested in astronomy!

Hong Kong Science Park: Science Explorer

Should you be interested in the latest innovations in science, you cannot miss the Science Explorer journey at Science Park. Specifically designed as an interactive tour, including several 'play-and-learn' spots, Science Explorer displays the most updated science and technology breakthroughs covering environmental protections (Green Concepts), integrated circuit (IC Development Showcase), fibre optics (Professor Charles K. Kao: The Father of Fibre Optic Communications Showcase) and everyday-life technologies (Tech Universe). Experienced staff will guide you through the principles behind the innovations, making sure that the tour is a fun and informative learning experience.

The Space Museum: Astronomical Telescope Making

Want to do something interesting about science by the end of the school year? The Space Museum has launched the fun astronomical telescope making workshops for you to join! Participants will first attend lectures about related scientific principles behind telescope making before they begin to construct their very own 12 mm reflecting telescopes. The workshops are scheduled to last from mid May to late July, with a quota of 30. Starting from April 1st, you may hand in the application form and receive a 50% discount if you are a full-time student!

香港有什麼地方能讓你體驗科學的魅力？我認為香港天文公園、香港科技園、還有香港太空館都是不錯的選擇。那就讓我們走進這幾處場館，看看那些精彩紛呈的科技展覽和活動。

香港天文公園：特別的選擇給特別的你

香港天文公園坐落於創興水上活動中心，內部共分為三個不同的區域，為前來參觀的天文愛好者提供多種選擇：肉眼觀測區可供一般訪客隨意飽覽星空勝景，天文研習區可讓訪客了解中國古代天文技術之發展，而天文發燒友亦可自攜設備前往望遠鏡觀測區追蹤斗轉星移之奧秘。這裏提供的諸多選擇絕不會使愛好天文的同學們失望，大家或可利用閒暇時間前往一探究竟。

香港科技園：科學探索行

「科學探索行」是香港科技園向訪客展示科技領域最新成果的導賞旅程。訪客將在講解員的陪同下參觀園內多個展區景點，並了解展品背後的技術知識和科學概念。各展區包括介紹節能環保技術的綠環館（又稱綠景樓）；展示集成電路技術發展歷程及產品的集成電路展覽廳；呈現光纖通訊技術應用及發展的高錕教授：光纖通訊之父展覽廳；以及包含奇趣館、創意館和科技之旅三部分，以寓教於樂的科技互動體驗為特色的科技寰宇展覽區。「科學探索行」活動全程免費，想了解最前沿科技發展動態的同學們，趕緊上網預約吧！

香港太空館：天文望遠鏡製作活動

臨近學期末，喜愛科學的你是否希望能夠參與輕鬆有趣的科技體驗活動？自今年五月中旬至七月下旬，香港太空館將舉辦講座與實踐活動相結合的天文望遠鏡製作活動。參與者將先聽取由坐井會資深會員們主講的關於天文望遠鏡背後科技理論以及構造技術的講座，隨後在八次實踐活動中親手製作一件12毫米口徑的反射式天文望遠鏡。該活動共有30個名額，於四月一日起接受報名。喜愛宇宙科學以及動手實踐的同學們可不要錯過這個難得的機會，全時間學生報名更可以享受半價優惠哦！

Guide to UNIVERSITY APPLICATIONS: UNITED KINGDOM

申請英國大學指南針

By Raphaella So 蘇韋霖

Application to universities in the United Kingdom is done through an online system called "UCAS." It is a centralized process where candidates can send their application information to, at most, five university programs. Please note that University of Oxford and University of Cambridge have their own application procedures and are not included in this guide.

Choosing Courses

The application fee is £12 if you only apply to one course and £23 if you apply to two to five courses. Hence, you might as well make the best use of your £23 and pick five courses. You can select your choices based on the probability of being accepted. Universities post recent applicant statistics on their websites. This information serves as a great indicator of the qualifications they are looking for.

1. "Reaches" are "first-choice" schools that can be relatively difficult to get into. You can pick one or two of these.
2. "Targets" are schools that are just around your

level. They would be good places to end up in if you could not get into your first choice.

3. "Safeties" are schools that are slightly under your level, but they would serve as great "safety nets" in case you cannot get any offer from the others. Having at least one "safety" is especially important if you are only considering UK universities in your application process.

Personal Statement

UCAS posts guidelines on how you should tackle the personal statement section of your application. In addition, it asks foreign candidates to explain why they choose to study in the UK. Use your foreign status to your benefit. Make sure your admissions officer knows what you can contribute as a student from a different cultural background.

References

Picking a teacher, advisor or professional to write your recommendation letter can be tough. Not only does he/she have to know you well in an academic context, but he/she also has to like you as a student and genuinely hope for your success.

Deadlines and Important Dates

Applications typically begin from **mid-September**, with deadlines for majors in medicine, dentistry and veterinary science in **mid-October**. Applications for most other majors must be completed in **mid-January** for each cycle.

Post-Application Procedures

Universities give out different types of decisions: 1) unconditional offer where the place is yours or 2) conditional offer, where you must meet the university's conditions upon graduation to be accepted. You may also get an interview or audition before receiving an offer. Candidates who receive unconditional offers to their first choice will be expected to attend. If the offer is conditional, candidates may pick a second choice as backup in case the requirements for the first choice are not met. All other institutions must be declined.

The cost of tuition for international university students in the UK vary wildly. The average tuition fee for 2013-14 was at roughly £11,400 (HK$148,407) per year, not including living costs. For detailed costs please visit http://www.thecompleteuniversityguide.co.uk/media/674803/the_reddin_survey_of_university_tuition_fees2013-14.pdf

考生可以透過UCAS網上中央系統報讀英國大學，同時申請最多五個大學課程。請留意，牛津大學和劍橋大學有個別的申請程序，不包括在此申請指南。

選科

報讀一個課程的費用是£12，兩至五個課程的收費都是£23，因此我會建議你善用報名費，同時申請五個課程。選擇科系的時候應該注意自己被取錄的機率。大學通常會在網上公佈近年的考生數據。這資料對了解它們的收生要求很有用。

1. 「首選校」指心儀但錄取機率比較低的學校，選一至兩間就夠了。
2. 對收生要求接近自己成績，錄取機會頗高的學校，我們可以將它設定為「目標校」。即使不獲「首選校」錄取，也可以進入理想的「目標校」。
3. 對收生要求比自己成績低的學校，我們可以設定它為「保險校」。就算其他學校都不錄取你，你還有升學機會。對於只會考慮在英國唸書的同學們，申請至少一所「保險校」是很重要的。

個人陳述

UCAS網站上已列出填寫個人陳述，大概要注意的事項。除此之外，UCAS還要求國外的考生在陳述內解釋為何選讀英國的大學而不留在自己國內。你可以好好利用這個「外國學生」的身份，向考官詳細介紹，來自不同文化背景的你可以對學校或科系作出什麼貢獻。

推薦信

要選擇一位肯為你寫推薦信的老師並不容易。除了要充分了解你的學業成就之外，他/她還要喜歡你這個學生，真心希望你成功。

報名期限和重要日期

報名程序通常從**九月中開始**。申請醫學、牙科和獸醫學等專業的學生要在**十月中旬**提交資料。申請其他專業的學生大多要在**一月中旬**完成報名。

報名後的後續事宜

大學會給不同類型的決定：1) 無條件錄取、2) 有條件錄取，或3) 拒絕。報名者也有可能在錄取之前收到面試或試鏡邀請。申請者若被第一志願無條件的錄取就可以入學。若錄取決定是有成績條件，申請者可選擇一所後備學校以防萬一沒有達到第一志願所需要的成績。學生必須拒絕其它申請過的大學。

英國大學學費間間不同。2013至2014年，年均學費約£11,400 (HK$148,407)，不包括生活費用。想了解詳細費用請參觀http://www.thecompleteuniversityguide.co.uk/media/674803/the_reddin_survey_of_university_tuition_fees2013-14.pdf

For more information on UCAS 官方網頁：

http://www.ucas.com/how-it-all-works/undergraduate

Oxidation-reduction, or "REDOX," is a type of chemical reaction involving the transfer of electrons from one element to another. Ascorbic acid is a potent electron-donor (also called "reducing agent" because the negative charge of electrons "reduces" the target), so it can react with positively charged silver ions to form neutral silver metal.

氧化還原(英文 oxidation-reduction)是個轉移電子的化學反應。抗壞血酸是個很強的復原劑,它可以把自己的電子送出去把對象的氧化數降低。因此,抗壞血酸可以和正氧化數的銀離子產生化學反應,製造中性氧化數的銀金屬。

Smart Tags 食物變質智能標簽 For Food Freshness

By Raphaella So 蘇韋霖

This article may be useful for classes learning about "Redox Reactions" based on the DSE Chemistry syllabus.
根據DSE化學科目,這篇文章有助學習關於「氧化還原」的課程。

Consumers rely on expiration dates to judge whether a perishable good has gone bad. However, the date calculation is often difficult to estimate and sometimes inaccurate, as the package may go through unpredictable conditions throughout the manufacturing and delivery processes. Hence, opening an "unexpired" milk carton only to be greeted with sour or discoloured milk is a situation familiar to many. Wouldn't it be helpful if an indicator could tell us the level of freshness before we even open the package to avoid the smell, or worse, food poisoning?

Other than contamination, there are two main reasons for the spoilage of food: bacterial growth and biochemical degradation. These two factors are highly dependent on the storage temperature: at warm temperatures, bacteria multiply faster, and chemical degradation also occurs more rapidly. Therefore, we can attempt to resolve the problem if we can create an indicator that simulates the rates of these two reactions, and attach it to the packaging during manufacture so that it experiences the same temperature variations as the food.

Engineering the tag is easier said than done. How do we programme the indicator to mirror the specific food inside the package? How do we make it easy for the consumer to understand the indicator? Perhaps most importantly, how do we make the indicator affordable for large-scale commercial use?

References

[1] Zhang C. et al. *Time-Temperature Indicator for Perishable Products Based on Kinetically Programmable Ag Overgrowth on Au Nanorods.* Retrieved from http://pubs.acs.org/doi/abs/10.1021/nn401266u

Researchers led by Dr. Chao Zhang from Peking University seem to have found a solution. The group made use of an oxidation-reduction reaction between silver nitrate and ascorbic acid (a form of vitamin C) [1]. This reaction deposits a shell of silver metal onto gold nanorods. First, researchers mixed gold nanorods with cetyltrimethylammonium chloride (CTAC). This colloidal solution is initially red in colour. As the reaction progresses and deposits more silver onto the nanorods, the mixture releases shorter wavelengths – orange, yellow, etc. – until the colour turns green. The team deliberately chose green as the final colour, as opposed to shorter wavelengths such as blue and violet, for easier identification.

By altering the pH and concentrations of chemicals, Dr. Zhang was able to program the mixture for use in different perishables. Furthermore, adding weak acids such as acetic acid and lactic acid could ensure proper synchronization between food spoilage and mixture colour change at a range of temperature conditions. Therefore, the chronochromic changes of the mixture serve as a true "time-temperature indicator": red means the food is very fresh, orange and yellow show varying levels of bacterial growth, and green means the food is no longer suitable for consumption. For simplicity in real-life applications, Dr. Zhang's team solidified the liquid indicator into an agar hydrogel that is sealed from external oxidation.

"Hang on," you may ask, "is the indicator both safe and affordable?" Gold is an inert metal. While silver nitrate can be corrosive, the addition of CTAC renders it harmless by forming a silver chloride precipitate. Other chemicals added have low toxicity and are often found in medicines, cosmetics and even food. As for affordability, gold and silver, though expensive, are used at very low concentrations and do not contribute much to cost. In fact, each smart tag costs less than HKD $0.20 to manufacture.

The development of this smart tag has far-reaching implications. Not only can it tell us whether food has gone bad, but it can also be applied to other industries with expiry dates such as pharmaceuticals and cosmetics. Hence, we may see little red gels on our perishables in the near future.

消費者往往是憑包裝上的「到期日」來決定食物是否適宜食用。可是，要準確推算到期日並不容易，再加上在製作和運輸過程中，會遇到無法預計的變化，以致日期不能充分反映食物變質的程度。很多人便曾遇到打開包裝，卻發現沒到期的牛奶已變質發臭的情況。如果有一種標籤，讓我們不需要打開包裝，就可以得知裏面的食物有多新鮮，我們可以避過臭味和食物中毒。這樣不是很好嗎？

除了在製作過程中受到細菌污染之外，食物變質還有兩個主要原因：細菌增長和食物分解，兩者都與儲存溫度有關，隨著溫度上升而加快。如果我們製作一種標籤，可以模擬這兩個過程的速度，然後將標籤黏在食物包裝外，讓它們經歷同樣的溫度變化，那麼消費者從標籤就可以看出食物是否有變壞。

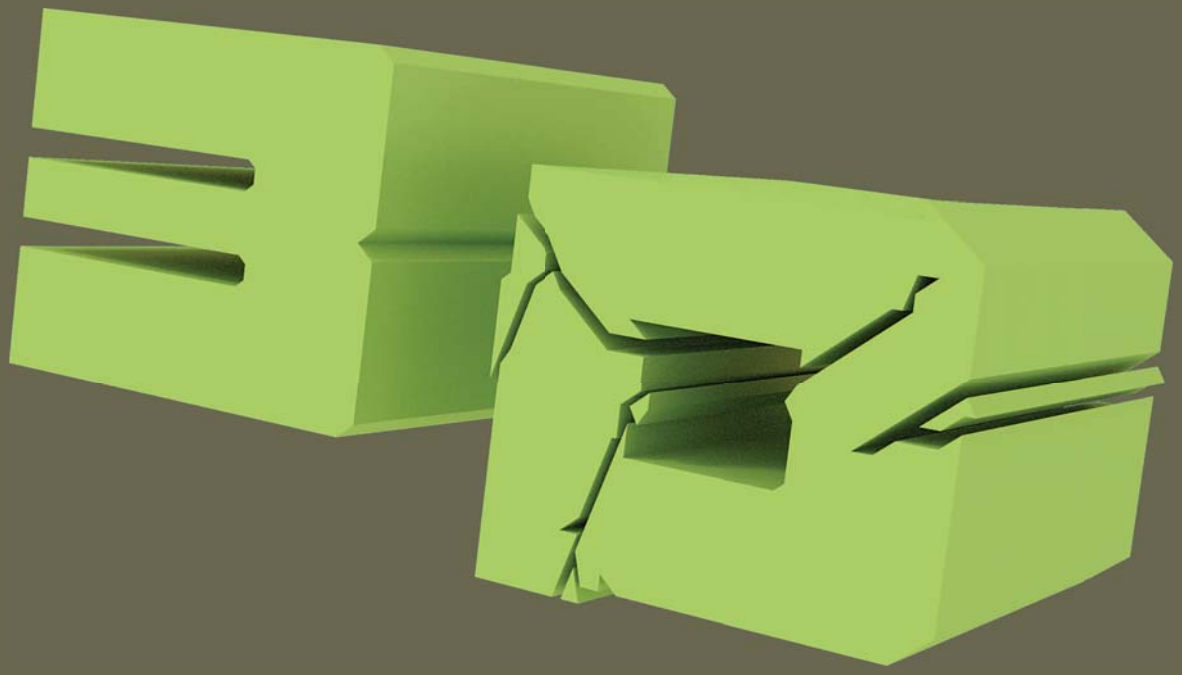
可是，要製造這樣的標籤談何容易：如何做到標籤正確反映食物的品質變化？如何做到標籤清楚易明？最重要的是如何把成本降低到大眾負擔得起的水準呢？

北京大學的張超研究員及他的科研組似乎找到了答案。他們利用硝酸銀和抗壞血酸的氧化還原反應，將銀金屬沈澱在金納米棒上。研究員先把金納米棒放到十六烷基三甲基氯化銨（簡稱CTAC）裏，製成紅色的膠體懸浮液。氧化還原反應會產生越來越多的銀金屬，發出的可見光波長隨之而縮短，顏色從紅色逐漸轉為橙色、黃色等，直到標籤最終變成綠色。雖然藍色和紫色的波長比綠色更短，但肉眼對綠色特別敏感，所以研究員選擇綠色為最終的顏色。

透過改變化學成分的酸鹼度和濃度，張博士可以將標籤應用在不同的食物上。加入醋酸和乳酸等弱酸更可以讓食物的腐化和標籤顏色的改變，在不同的溫度下均能以相同速度進行。標籤可以作為"時間－溫度顯示器"，反映食物的品質：紅色代表食物非常新鮮，橙色和黃色代表不同程度的細菌增長，綠色則意味著食物已變壞。為了方便使用，張博士把液體標籤製成密封的瓊脂水凝膠，免受外來氧化反應影響。

你可能會問：「標籤是否安全？價錢大眾化嗎？」其實，金是惰性金屬，不容易產生化學反應。硝酸銀可能有腐蝕性，可是CTAC會將銀離子轉變成氯化銀，轉化成無害物質。其他化學成分不含高毒性，在食物、藥物和化妝品中經常出現。至於價錢方面，雖然金和銀是貴價金屬，可是使用的濃度較低，不會對成本構成太大影響。每一塊智能標籤的製作成本低於港幣$0.20。

智能標籤的開發有廣泛意義，不單可以告訴我們食物是否變質，還可以應用在其他非耐用品，如藥物以及化妝產品等。不久將來，我們可能會在包裝上看到小小的紅色標籤。



BIO-PRINTING

人類智慧和科技的一大突破－3D生化列印

By Oi Ying Wong 黃靄盈

2D printers are now ubiquitous in Hong Kong homes. Basic scanning and printing can be completed with an effortless click of a mouse button. Could this be the reality for 3D printing? 3D printing is a relatively new technological process that does exactly what it describes – print 3D objects. Theoretically, any object can be printed, including glasses, earrings, toys, car parts and potentially, even human organs.

Traditionally, the creation of objects from tools to engine cylinders would require either cutting or shaving of an initial block of material or the casting of a mold. This is unnecessary in 3D printing. 3D printing involves building the object from the bottom up. Prior to printing, the 3D printer reads an object template in the form of computer aided design files (CAD) and converts the design into isolated 2D cross-sectional slices. The material used for the object is initially melted and then heated upon deposition, layer by layer until the object develops. Design patterns can become quite complex depending on the desired end-product. Templates are controlled by parameters that can be altered by loci to generate different geometric patterns. Iteration and recursion are also methods to generate highly complex and interesting patterns. For example, the design of a hollow ring can be enhanced by using these parameters to indicate the number of holes or the size of the hollow area.

The medical industry has seized advantage of this technology by attempting to print human tissue for medical investigation, in a process called bio-printing. Instead of printing layers of metal or plastic as in the printing of other objects, bio-printing involves the layering of live cells, to form human tissue. While the technology to print actual human organs is currently out of reach, the printing of tissue is a significant stepping stone toward that direction. Part of the hurdle to overcome in this process is to be able to create tissue with a functioning vascular system possessing the ability to provide essential nutrients and oxygen to sustain the life of cells. Furthermore, organs require many different cells to function properly in combination, thus

printing tissue composed of one particular cell is inadequate.

Another part of the puzzle is to be able to create CAD files for bio-printing. Non-living objects can be easily designed, altered on the computer and still perform but printing biological tissue requires knowledge of cell location and vascular structure. Imaging technology such as magnetic resonance imaging (MRI) is unable to pinpoint exact cell locations and there is no computer software that can handle the complicated structures of an organ. In addition, there is no telling what it is that makes an organ functions. Cornell engineer Hod Lipson, who attempted to print a meniscus (the cartilage that cushions joints) explained that "You can put the cells of a heart tissue in the right place together, but where's the start button?" [1]

It might still be at least a decade before the technology will be advanced enough to print on small enough scales for a functioning organ. Simplified structures that are printed so far, however, are still useful for medical research and pharmaceutical testing. Most oral drugs take years of testing to be available on the market, and testing on printed tissue can potentially save time and money by screening out certain drugs before they reach human trials.

現在普遍家庭的家中都有一部多功能打印機，相信你我對打印或複製文件等這些簡易的工作已經駕輕就熟。但你曾否想過在家中除了可以打印文件檔，還可以打印出立體的物件來呢？三維 (3D) 打印機就正正擁有這個功能。日常生活的物件小至眼鏡、耳環、玩具、時鐘，大至車子、樂器等，統統都能夠通過這新科技複製出來。相信在不久將來甚至連人體器官都有可能被印出來。

以往製作物件需要從一塊材料剪裁或塑造成型。而3D打印機只需透過讀取電腦輔助設計 (CAD) 檔案，或是對原來物體進行360度掃瞄，就能把物件打印出來。3D打印技術先透過電腦輔助軟件把3D物件一層一層「分割」成多層的2D切面。塑料需先被溶化成液體，然後一層一層地把2D切面由下而上列印出來，堆疊成為3D立體模型。視乎成品的結構，產品設計的檔案可以是非常繁複的一般是經由所定義的各參數變化，把圖形不斷改變，來產出不同的幾何形態。我們亦可以利用重疊(iteration)、遞迴(recursion)等等原理來產生有趣、高度變化的圖形。例如，利用各項參數來設定一個空心環狀物體內孔的數目及面積大小。

最近，醫學工業利用3D打印技術開始試圖打印出人體組織作醫藥研究之用，被稱之為「生物打印」(bio-printing)。生物打印技術以活細胞代替金屬或塑料，層疊形成人體組織。雖然目前的技術還沒發展到能夠打印出整個人體器官，但已踏出打印活組織這重要的一步。過程當中其中一個最難的部份就是把有完整功能的血管製造出來，為器官組織提供必要的營養及氧氣。沒有血管，細胞在未完成打印之前已死亡。此外，打印出來的器官需要多種細胞的組合協作，單獨一種細胞是不能夠組成完整的器官。

另一個難題就是設計出生物打印的CAD檔案。在電腦上設計非生物物件尚算簡單，而且設計可以用軟件修改圖案，但打印生物組織需要把細胞和血管結構設定在精確的位置上。以目前的成像技術，譬如磁力共振成像(MRI)等都未能夠準確確定細胞的位置。此外，我們尚未清楚知道一個人體器官是如何正常運作的。美國康奈爾工程師 Hod Lipson 試圖打印「半月板」(滑液關節內的軟骨墊)，他直言：「你能把心臟組織的細胞湊在一起，但啟動鍵在哪？」[1]

生物打印技術可能在未來十年以上才能在以較小規模打印出人體器官。然而，現在應打印出的簡單生物組織在醫療研究和藥物測試還是大有用處的。大多數的口服藥物需要多年檢測才能在市場上出售，在人體試驗之前，以打印組織進行測試可以加快篩選藥物，節省時間和金錢。

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Bit Coin 比特幣

Early 2009 年初

Bitcoin is created by an anonymous internet user.
一個匿名網民創造比特幣。

Jan. 2014 一月

A hearing on how to regulate Bitcoin was held in U.S.
美國展開有關如何監管比特幣的聆訊。

By Yang Yang 楊揚

Virtual is not new: it's a surging norm. Most of the known virtual products are derived from tangible concepts affecting only certain segments of a market. Virtual video games like Nintendo Wii target gamers, simulation tests cater for training pilots, and virtual medical programmes such as Karlsruhe Endoscopic Surgery Trainer[1] assist surgeons to perform minimally invasive surgeries. What about a bigger virtual idea derived from a commodity that everyone uses: a virtual currency like bitcoin? How does it operate, what would transactions be like, and how would it orient our daily lives? What is bitcoin ?

虛擬並非新聞，而是當下的新潮。已知的虛擬產品大部分是從實體概念衍生，影響細分市場。例如虛擬遊戲 Nintendo Wii 針對遊戲玩家、 飛行模擬測驗用於培訓飛行員、虛擬醫藥程式 Karlsruhe Endoscopic Surgery Trainer 輔助醫生進行微創手術。若將廣泛使用的商品轉化為虛擬概念，例如虛擬貨幣「比特幣」，又會怎樣呢？比特幣究竟是怎麼運作的？虛擬貨幣的交易是怎樣的呢？對於日常生活又有何影響呢？什麼是比特幣？

The idea of this virtual currency was conceived in 2008 when a research paper named "Bitcoin: A Peer-to-Peer Electronic Cash System" was published. Perhaps in response to the financial recession in 2008, this paper proposed an alternate digital transaction where payments are sent directly from transacting parties *without* going through an established financial institution [1].

As a mathematically-based protocol, bitcoins are generated at an approximate rate of 50 coins per 10 minutes through a process called "mining", where a computer solves complex algorithms. A bitcoin is mined at the arrival of a solution. This decentralized system is structured so that ultimately only 21 million bitcoins could be mined by 2140 in the Bitcoin system, making supplies limited. The problems are increasingly difficult to solve and require more powerful computer systems as the remaining number of solutions diminish. To put the difficulty into perspective, finding a solution is analogous to 'finding a grain of sand from all the grains of sand on Earth' (Ken Shirriff http://www.righto.com/2014/02/bitcoin-mining-hard-way-algorithms.html). Like most commodities, bitcoins' value is determined by supply and demand. As demand rises, so does the price of bitcoin. In fact, its demand has risen as high as USD$637 per coin as of June 2014 and continues to fluctuate.

Transactions using bitcoins are transparent and neutral. A digital ledger called "block chain" logs every single transaction that occurs within the Bitcoin system so that accounts are available for real-time verification. Transactions occur between user addresses without revealing personal information (though this anonymity may be a double-edge sword depending on the purpose of transaction).

Usage is convenient and easy. So long as a user is connected to the internet, obtains bitcoins either directly through a miner or purchases them with real money and is able to find another bitcoin user willing to accept bitcoins, a transaction can take place. The transaction process is similar to e-payment using Paypal with a user identifying an amount to pay and transferring it to the recipient's address. Without going through an institution, payments using bitcoins are cheaper with a lower transaction cost than Paypal.

Bitcoin Timeline 比特幣時間線

Feb.6 2014 二月六日

The first public Bitcoin retailer, Bitcoin Shop Inc., that was named after Bitcoin was founded.
首個以比特幣命名的比特幣零售商成立。

Feb.11 2014 二月十一日

The share of Bicoin Shop Inc. worth USD 3.40 a share.
比特幣零售商Bicoin Shop Inc. 每股價值為3.40美元。

Is bitcoin here to stay? High risks and fluctuation are associated with Bitcoin. Many have lost money exploring it, making it more of a risk than a trend. However, more and more startups as well as online retail stores are beginning to accept bitcoins as payment. In fact, bitcoin ATM machines have been installed in Vancouver, New York and even here in Hong Kong since October 2013. While there are various unknowns related to bitcoins' value and stability as a reliable form of currency and even more legalistic issues that require exploration, virtual currency is riding on the 21st century technological bloom. Bitcoin may be a prototype with an enormous untapped potential.

虛擬貨幣這一概念誕生於2008年的一篇公開論文Bitcoin: A Peer-to-Peer Electronic Cash System。或許是出於對2008金融危機的反響，論文提出替代的數碼交易模式，交易方不須經過任何金融機構安排付款。

比特幣以數學為基礎，電腦解破複雜的演算法，每找到一個答案，就可以通過一種叫做「貨幣挖礦」的程式，得到1枚比特幣，每10分鐘約可產生50枚貨幣。非集中化的比特幣系統經過設定，到2140年為止，只能採集到共2,100萬枚比特幣，所以供應有限。未發現的答案數目正在減少，難度逐漸提高，電腦系統亦要更強。有人比擬，要找到一個答案，就跟在地球上所有的沙粒中尋找一顆沙粒同樣困難 (Ken Shirriff, http://www.righto.com/2014/02/bitcoin-mining-hard-way-algorithms.html)。比特幣如同一般商品，價值與市場的供應需求密切相關。市場需求高，比特幣的價值就跟著上漲。比特幣在2014年6月一度上漲到每幣637美元。

以比特幣進行的交易透明度高，保持中性。比特幣系統的所有交易都記錄在一本數碼總帳中，可以實時驗證核對帳目。比特幣的交易中無須透露個人資訊。(匿名交易可以是把雙刃劍，是好是壞視乎交易目的。)

比特幣簡單易用。用戶只需在網上連線，通過比特幣的礦工程式或以現金購買，取得比特幣，再找到另一名願意以比特幣交易的使用者，就能夠進行交易。交易過程與現有的網上支付相似。比特幣用戶指定繳付數額，然後將數額轉入收款人的名下就完成交易。因為比特幣交易無需任何金融機構經手，所以交易成本比Paypal網上支付平台要來得低。

比特幣能否持續呢？投資比特幣的風險極高，價格波動也頗大，許多前期投資者蒙受損失，使大眾普遍認為比特幣是風險投資而非新趨勢。即使如此，許多新公司和零售行業都已開始接受比特幣交易。另外，自2013年10月起，比特幣提款機分別在溫哥華、紐約及香港陸續出現。沒錯，比特幣的價值和穩定性以及相關的法律問題，還有許多尚未明確之處。但隨著21世紀的科技飛躍，虛擬貨幣乘勢而起。比特幣作為原型，可能尚有巨大的潛能有待挖掘。

[1] A virtual medical procedure that help surgeons work on tiny surgical procedures on a larger scale. For more information, see http://www-kismet.iai.fzk.de/KISMET/docs/UKMITAT.html

[2] It's important to discern between "Bitcoin" and "bitcoin." Bitcoin with a capitalized "B" refers to the entire system and is used in the same way as words like Spanish, Science, and Solar System. "bitcoins" refers to the actual virtual currency used in exchange.

[3] 0.0001BTC is the lowest transaction fee.

[4] For more information, see http://www.scmp.com/news/hong-kong/article/1448009/three-companies-set-launch-bitcoin-atms-hong-kong-within-days.

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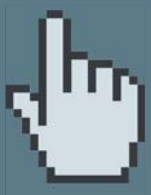

ÖTZI's LAST MEAL

By Flora Ng 吳紫瑜

On 19 September 1991, a 5,300 year old naturally preserved mummy was discovered in the Ötzial Alps, near the Similaun Mountain and Hauslabjoch on the Austrian-Italian border. The mummy was named Ötzi after the location of discovery and is the oldest and most well-preserved prehistoric human ice mummy. Cold temperatures, strong sunlight as well as dry winds made sure that very little decomposition occurred. For nearly two decades, basic computer tomography (CT) scans and magnetic resonance imaging (MRI) were the only technologies available for the analysis of his stomach contents. Recently, however, scientists were able to learn much more by examining Ötzi's gastric residue, now known as the "Iceman's last meal".

Previous analyses of Ötzi's stomach content revealed no storage of food, concluding that he had not eaten prior to his death. However, Albert Zink, along with fellows from the *Institute for Mummies and the Iceman in Bolzano*, Italy, conducted an axial CT scan of Ötzi and discovered that the organ originally thought to be his stomach was in fact his colon, and that the actual stomach was pushed beneath his rib [1]. The food residue samples taken from his stomach revealed critical information about the last few hours of Ötzi's life.

A large amount of Einkorn, a type of primitive wheat abundant in the Neolithic Era (circa 10,200 BC to 4,500 BC), was found in the sample that weighed only 0.004 ounces (1.134 mg). This is in line with the hypothesis that during the Neolithic Era, people lived in semi-permanent settlements and survived on plant and animal agriculture. The remnants of his last meal also contained muscle fibres and small fragments of burnt bones, identifiable under a light microscope [2]. Researchers determined that these muscle fibres most likely belonged to a wild mountain goat known as an ibex. Ötzi's gastric residue also revealed the presence of pollen [3].

The implications of these findings confirm several hypotheses. Due to the finding of pollen in his stomach residue, Ötzi's time of death was mapped to be around pollination season, between March and June. His last journey was made through a coniferous forest to his final destination. Additionally, contrary to previous beliefs, Ötzi's rich stomach contents revealed that his demise was not preceded by an empty stomach indicating starvation. In fact, he met his death in the form of an arrow to the shoulder, just 30 – 120 minutes after consuming his last meal.

The exciting discoveries of Ötzi's stomach content bridge the disciplines of science and history. These findings aid to portray the environment in which the Iceman lived and died. While many facts may never be any more than pure speculation, science and technology has provided a better understanding of what life may have been like for our ancestors in the Neolithic Period.

冰人的最後一餐

在一九九一年九月十九日，一具距今足有五千三百年，保存良好的冰封木乃伊在奧地利和義大利交界的阿爾卑斯山脈，奧茨塔爾山冰川出土。冰人木乃伊以出土地為名，被稱作「奧茨」。因當地極為寒冷，加上猛烈陽光和乾風，以致分解緩慢，令奧茨成為迄今最古老、保存得最完好的史前人類木乃伊。有近20年時間，科學家只能以電腦X射線掃描和磁力共振掃描技術，分析奧茨的胃內容物。直至最近，科學家對消化物殘渣進行研究後，有了更多發現。

過往奧茨胃部分析沒有發現胃裏儲存食物，由此得到的結論是他在去世之前沒有用餐。 不過，Albert Zink 與其他 "艾伍拉克木乃伊及冰人研究所" 研究員用斷層掃描技術發現，原以為是胃部的器官其實是奧茨的結腸，而真正的胃被推向肋骨下方[1]。取出來的食物殘渣揭示奧茨在世的最後幾個小時的情況。

分析顯示在0.004安士(1.134毫克)的樣本中，含有大量石器時代後期 (約西元10，200至4,500年) 的一種常見耕植小麥。這個結果符合一直以來的假設：石器時代的古人類住在半永久性的聚落，並以農業和圈養動物作為食物來源。樣本還含有肌肉纖維和小塊燒焦的骨片，在顯微鏡下清晰可見[2]。研究員測定肌纖維最有可能是來自一種野生山羊叫做羱羊。除此之外，研究員還在胃內殘渣中發現了花粉樣本[3]。

研究結果證實了幾項假設。由於在胃內發現花粉，冰人的死亡時間可確認為授粉季節，即是三月至六月間。其最後的旅程是通過一片針葉林到他最終的目的地。另外，與以往的推論相反，奧茨的胃內容物揭示他死亡之前不是空著肚子的。事實上，冰人是在進食最後一餐後的30至120分鐘內，被箭擊中肩膊導致死亡。

關於冰人胃內容物的種種發現，將科學和歷史連接起來。研究結果有助描繪冰人生活和死亡的環境。雖然有些事實也許無法證明，但科技仍是協助我們更瞭解人類祖先在石器時代後期的生活。

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Why Humans Are Unable to Synthesise Vitamin C

In 1602, A Spanish fleet began their expedition to the New World. During the long voyage across the Atlantic Ocean, the entire crew of the ship developed symptoms of bleeding gums and spotting of the skin, with many cases leading to death. Nearly two decades later, a British military surgeon John Woodall suggested the consumption of lemons, limes or oranges as a cure for this mysterious disease. However, for more than three centuries, the cause of this fatal disease was unknown. It was eventually discovered to be a disease known as scurvy, which is caused by a vitamin C deficiency. Vitamin C is abundantly present in citric fruits. We, as humans, are unable to synthesise our own vitamin C. Consumption of vitamin C is thus necessary for human survival. During the prolonged voyage, the fleet did not have access to fresh foods containing essential vitamins and thus resulted in such tragedy.

To attempt to answer the question of why we are unable to synthesise vitamin C, we must examine the mechanism of Vitamin C synthesis in organisms that are able to do this. Vitamin C synthesis in vertebrates involves a complex pathway. Specific protein factors are required, and the absence of any single protein will result in the failure of the entire pathway. In the human genome, a mutation at the coding region of a gene known as L-gulonolactone oxidase (GULO) renders this pathway dysfunctional. Thus, humans are unable to synthesise vitamin C on their own. Interestingly, similar defects were found in guinea pigs, gorillas, chimpanzees and other primates, none of which are able to self-synthesise vitamin C.

It has been shown that ancestral mammals, living some 100 million years ago, were actually able to synthesise vitamin C. Therefore, the hypothesis is that humans have lost the ability to produce vitamin C for evolutionary reasons. Yet, natural selection should highlight the traits that positively contribute to survivability and individuals possessing the gene mutation should have a lower chance of surviving and reproducing. Why then, would natural selection continue to include the gene mutation, blocking such a vital biosynthesis capability?

One school of thought suggests that the reason may be attributed to the fact that humans have included vitamin C-rich

By Yi Qi 戚益

為何人體無法自行合成維他命C?

foods in our diet for a very long time and that the mutation in vitamin C synthesis related genes have not proven to be a lethal or severe functional defect in most cases. After all, fruits with readily available vitamin C have been part of the human diet for as long as anyone can remember. This led to the mutated genotype being passed on to future generations, resulting in permanent loss of vitamin C biosynthesis in humans.

The human body is a complex biological environment in which accidental mutations are common but only those that are innocuous are likely to remain. This does not mean that seemingly harmless mutations such as the incapability to produce vitamin C may not prove to be problematic when unpredictable circumstances take place. The deaths of some crew members on the Spanish fleet represented one of such unfortunate circumstances.

1602年,一支西班牙船隊揚帆起航駛向遙遠的美洲大陸。在漫長的航行過程中,許多船員陸續染上了一種「怪病」:他們渾身疼痛,牙齦出血,身上出現可怖的斑點,甚至痛苦地走向死亡。直到將近二十年後,英國軍醫John Woodall才發現檸檬、酸橙等水果能夠治癒這種可怕的怪病,但之後三個多世紀內人類卻無法找出確切的病因。後來人們發現,這種可怕的疾病是由船上飲食缺乏在新鮮蔬果中含量較高的維他命C而引起的壞血病。於是,問題就此產生:為何人體無法自行合成維他命C?

這個問題的確切解答仍然有待研究,但已有多種假說試圖為該現象提供解釋。自維他命C合成機理的角度來看,擁有合成能力的脊椎動物體內的相關機制非常複雜,需要大量的蛋白質參與其中,缺一不可。而人體內所保留的合成維他命C所需的諸多基因中,生產一種名為L-古洛糖酸內酯氧化酶(L-gulonolactone oxidase)的蛋白質的基因發生了突變,導致該蛋白質在人體內的缺失。與人類同病相憐的還有其他靈長類動物以及豚鼠,這些動物也同樣是因為L-古洛糖酸內酯氧化酶基因的突變而無法製造維他命C。

如若上溯一億年,當時生活在地球上的人類的哺乳動物祖先確實擁有自行合成維他命C的能力,並從不受壞血病的困擾。於是我們可以提出一個假設:人類或許是在漫長的進化過程中逐漸喪失了合成維他命C的能力。但是缺乏製造維他命C的能力似乎應該「削弱」了人類在這個星球上的生存能力,那爲什麼導致這種後果的基因突變沒有被自然淘汰掉,反而留存在了人類的基因組裡呢?

這或許是因為人類的靈長類祖先早就開始以植物的葉片果實為食。長時間置身於能夠輕易獲取維他命C的環境中使得體內的合成維他命C機制再無用武之地,其相關基因的突變相應地也不會導致死亡之類的嚴重後果,因此增加了被保留下來的可能性。隨著這種突變的代代相傳,人體中合成維他命C的相關基因終於完全退化,人類也就永久失去了合成維他命C的能力。這在大航海時代開始之前似乎還並不是威脅生存的變化,但隨著人們生活方式的改變,壞血病終於還是成爲了令人頭痛的問題。

這使我們開始重新審視自身內部不斷發生的變化:基因突變隨時隨地都有可能發生,現下看來或許無關緊要的變化或許會被保留下來,也或許會在將來的千萬年內隨著人類生活方式的不可預知的變化而導致新的問題的出現,就像大航海時代的壞血病對一億年前我們那發生基因突變的祖先來說是不可想像的一樣。

Further Reading

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Hair-Raising Effects of Lightning

毛髮豎起的雷電現象

By Sunjung Lim 林宣廷

Being afraid of thunder and lightning is a relatively common fear. Loud claps of thunder and blinding flashes of lightning amidst a backdrop of darkness can be understandably intimidating. Being struck by lightning is perhaps not an often occurrence, in fact, the statistics indicate that the chances of being struck is close to one in a million. However, unfortunate victims can suffer serious injuries and potentially fatal consequences. The good news is that lightning sometimes gives us warnings before it strikes, allowing time to seek cover.

One such precursor is a bone-chilling effect that causes a lighting strike victim's hair to stand on end (Figure 1). The 1975 photograph shows two brothers on a family trip at Sequoia National Park, California, seemingly amused at this strange phenomenon and oblivious to the danger of the situation. Shortly after the photograph was taken, the younger boy (left) was struck and suffered third-degree burns on his back and elbows. In a report after the incident, the older brother on the right explained the urgent situation at the time, "[He] collapsed and huddled on his knees. Smoke was pouring from his back. I rushed over to him and checked his pulse and breathing... He was still alive. I put out the embers on his back and elbows and carried him down the path towards the parking lot, with the rest of the group following."

The frightening phenomenon can be better understood with an explanation of lightning itself. A lightning strike is a naturally occurring electrostatic discharge. Tiny ice particles in the air, forced by warm air currents, collide with each other, causing charges and creating electric potentials within the thundercloud. With a sufficient charge separation, the positive charges and the negative charges try to neutralise. The existence of opposite charges on the ground strengthens the electric field, which is strongest on objects nearest to the thundercloud. These objects are often trees and sky scrapers. A pathway of least resistance is formed, led by 'streamers' and charge is neutralized once the pathway is complete, creating lightning.

But sometimes the closest 'object' to this pathway of least resistance is a person. The precursor to an imminent lightning bolt is exactly the effect of hair standing on end. The principle is similar to the familiar experiment of rubbing a balloon on fabric and placing it next to someone's head allowing their hair to defy gravity. The ions in hair respond to the electrical potential difference between the thundercloud and the Earth, making the victim part of the discharge path of thousands of volts, when the ions eventually neutralise.

Hong Kong's tall concrete jungle largely protects us from being struck by lightning since those objects

This article may be useful for classes learning about "Electrostatics" based on the DSE physics syllabus.
根據 DSE 物理科目，這篇文章有助學習關於「靜電」的課程。

are closer than we are. However, Hong Kong's mountainous regions and summits are also perfect areas for lightning to strike. The best action to take if your hair starts standing on end is to evacuate indoors. Standing under natural lightning rods such as trees or metal umbrellas is equally dangerous because you can still be part of the discharge pathway. In the case that you are completely isolated, crouch low and hope that you are not that one in a million!

害怕雷電是一種常見的恐懼。強而有力的雷聲和耀眼的閃電在黑暗當中也是令人生畏。統計數據表明人被雷劈的機會並不高，接近於百萬分之一。可是，一旦發生了，不幸的受害者可遭遇到嚴重受傷，甚至致命後果。值得慶幸的是，雷擊往往會有先兆，容許避難的時間。

一種雷劈的前兆就是相中的毛髮豎起的現象(圖1)。這張照片是在1975年加州的紅杉國家公園裡拍的，相片中的一對兄弟彷彿對這現象感到十分新奇。他們對自己的危險境地完全渾然不覺。不久之後相中左邊的弟弟就被雷電擊中導致背部和手肘三級燒傷。哥哥憶述當時情況十分緊張：「(他)倒下來，抱著自己的膝蓋。他的背上冒出煙來。我跑過去並檢查他的脈搏和心跳...他還活著。我把他背部和手肘上的灰燼弄走，帶著他沿小路奔到停車場，其他人跟隨在後。」

理解這個現象就要先懂得閃電背後的科學。雷擊是一種自然產生的靜電放電。空氣裏的微小冰粒因暖氣流互相碰撞，

Figure 1 圖1

Photo permission obtained from Copyright © 1975 by Michael McQuilken.

造成雷雲內的電勢。有了足夠的電荷分離，正電荷及負電荷將會設法中和。地面正負電荷的存在導致電場增強，而最強的電場就在離雷雲最近的物體。這些物體常常是高樓或樹。在閃流帶領連成阻力最小的途徑後，電荷得以中和，並發出閃電。

但在有些情況，人成為距離最近的物體。毛髮豎起的效果其實就是雷擊的先兆。原理就和熟悉的實驗相同：氣球與布磨擦後，放於頭側可令到毛髮豎起。頭髮的離子對雷雲與地面之間的電勢差別作出反應，人就處於放電的路徑，受到數千伏特的雷擊。

香港的高樓大廈比我們更接近雷雲，可保護我們免被雷擊。不過，香港也有諸多的高山頂峰區，也是有被雷擊的危險。若你發現毛髮豎起的現象，室內避難就是最佳的上策。站在天然的避雷針如樹或金屬雨傘之下，也有危險性，因為你仍然有可能組成放電的途徑。你若在完全無遮蓋的情況下，立刻下蹲，以及希望你不是那百萬分之一！

BEE PHEROMONES

It may sound audacious to state that the fate of humankind is closely intertwined with bees, and yet there might be a certain amount of truth to this statement. Over a third of the world's food production depends on pollinators, and the honey bee is a key player. Wild bees alone contribute at least $57 billion US dollars per year to America by plant pollination [1]. Industrial agricultural farms often supplement the wild bee's work with bumblebees or honeybees reared by commercial bee-keepers. However, over the past few decades both entomologists (scientists who study insects) and bee-keepers have reported a significant decline in bee populations. Bee-keepers in the US and Europe have reported up to 50% lost in bee hives over a matter of days, a phenomenon known as Colony Collapse Disorder [2]. This rapid decline in global bee population could threaten food production.

The alarming decline in bee populations could be attributed to multiple causes including parasites, diseases, changes in habits and food sources, and the use of pesticide [3]. In 2013, the European Commission enacted a ban on neonicotinoids pesticides. Early use of this pesticide was linked with being harmful to bee health. For example, in Oregon, USA, neonictinoids was used on trees to control the population of aphids; instead 50,000 bees were killed in the process, which is the largest mass bee poisoning to-date.

In this gloomy scene, pheromones, a chemical signal secreted by bees may save the day. Pheromones are secreted by organisms to influence the physiologies or behaviors of their conspecifics. In an active bee hive, several types of pheromones are secreted by different members to maintain the health of the colony. The queen mandibular pheromone (QMP) is, perhaps, one of the most well-known set of pheromones. Composed of carboxylic acids and aromatic compounds, it is secreted by the queen bee, the only bee in the entire hive

This article was written by Hong Kong secondary school students enrolled in The HKUST Dual Programme 2014. To learn more about this programme, please visit *http://www.cdgt.ust.hk/eng/Program/Dual_Program/dual_program_overview.php*

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人類的命運和蜜蜂種群是否有著密切的聯繫？在某程度上，兩者確實是息息相關。超過三分之一的世界糧食生產是依靠著傳粉者，而野生蜜蜂擔當著一個關鍵角色。在美國，單是野生蜜蜂通過傳播花粉，每年就至少貢獻了570億美元[1]。工業農場常常須要利用飼養的熊蜂和蜜蜂來補足野蜜蜂的工作。但是，在過去的幾十年內昆蟲學者和養蜂人都曾報告蜜蜂種群的顯然下降。美國和歐洲的養蜂人甚至報導在幾天之內就失去了百分之50的蜂窩。這個現象叫做蜂群衰竭失調[2]。迅速下降的蜜蜂種群可以威脅到糧食生產量。

蜂種群驚人的下降是基於幾個原因，包括寄生蟲、疾病、習慣和食物來源的改變和農藥[3]。在2013年，歐盟委員會制定了新菸鹼類殺蟲劑的禁令。早前使用新菸鹼類殺蟲劑，經已證實會危害蜜蜂健康。舉例來說，在美國的俄勒岡州，以新菸鹼類控制蚜蟲種群，卻因此而殺死了五萬只蜜蜂，這是至今最嚴重的蜜蜂毒殺事件。

拯救蜜蜂種群，也許解決之道在於蜜蜂費洛蒙。由生物分泌出來的費洛蒙可影響同種的生理機能和行為。爲了維持群體健康，不同的蜜蜂成員會分泌出不同類型

capable of reproduction. QMP affects behaviors, including hive maintenance, swarming, mating, and even the ovary development of worker bees.

Another type of pheromone that can significantly affect hive dynamics is the brood pheromones produced by larvae. This pheromone assists nurse bees in recognizing the gender, type, and needs of larvae, so that the most appropriate food and care can be provided. A recent study suggested by adding a low concentration of brood pheromone to a hive, the "division of labour" can be altered such that worker bees spend more time foraging and be enlisted in the "work force" at an earlier age. Increase in foraging effort, in turn, boosts colony growth [3]. Brood pheromone is not used in commercial bee-keeping yet, however, it could potentially be a new tool to combat the decline in bee populations.

Can pheromones alone be the solution to the decline of the bee population? Probably not. Though, the engineering of pheromones may be able to help the dire situation, along with responsible and proper use of pesticides. The exponential growth of the human population has caused exceeding disturbance to the ecosystem in many aspects. An estimated 100,000 species become extinct each year, affecting food chains and causing turbulence in intricately balanced biological systems. It is high time that we learn to leave room for other animal species, especially, bees.

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蜜蜂費洛蒙

的費洛蒙。女王下頜費洛蒙(QMP)是最為人熟知的費洛蒙。QMP由羧酸和芳香族化合物組成，由蜂后分泌。蜂后是全蜂窩裏唯一有生育能力的蜜蜂。QMP影響到蜂群的行為，包括蜂巢維護、蜂擁、交配，甚至於工蜂的卵巢發育。

育雛費洛蒙是另一種可顯著影響蜂巢動態的費洛蒙，由蜜蜂幼蟲分泌。育雛費洛蒙有助育幼蜂辨識蜜蜂幼蟲的性別、種類以及需求，令到蜜蜂幼蟲能得到最適當的食物和照顧。近期的研究結果建議添加少量的育雛費洛蒙，就可以令工蜂延長覓食時間，以及較早加入「勞動隊伍」。這兩項因素有利蜂群增長[3]。養蜂業目前還未曾使用育雛費洛蒙，但這或可助制止蜜蜂種群下降。

單靠費洛蒙恐怕不能阻止蜜蜂種群下降的現象。但是費洛蒙的開發，再加上以負責任的態度正確使用農藥，應可有助解決這嚴重問題。人類群體正以幾何級數增長，漸漸在多方面干擾生態系統。我們每年面對約10萬物種損失，影響食物鏈，破壞生態系統平衡。當下我們必須要學會如何為其他物種(尤其是是蜜蜂)留下空間。

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A Gamble with Life

Peptic ulcer is a fairly common digestive condition, and was widely accepted to be caused by stress and poor diet. This was disproved in 1982, when Prof. Barry James Marshall and his collaborator, Dr. John Robin Warren successfully identified the true cause for peptic ulcers and cancer - *Helicobacter Pylori*, for which they were awarded the 2005 Nobel Prize in Physiology.

Prof. Marshall was exposed to anatomy, physiology and biology during his childhood, being influenced by his mother, a nurse. In 1975, he obtained his Bachelor of Medicine and Surgery from the University of Western Australia, and began his internship and residencies in internal medicine at the Queen Elizabeth II Medical Centre shortly afterward. He began his training as a specialist physician in 1978, and was appointed as a registrar in medicine at the Royal Perth Hospital in 1979. In his third year of training, Prof. Marshall was encouraged to perform a clinical research project, and it was during this time that he met and collaborated with Dr. Robin Warren, a pathologist at the time. Together, they began their research on helical microorganisms.

Prof. Marshall took an interest in understanding the role of bacteria in stomach diseases after meeting Dr. Warren, who had already begun studying curved stomach bacteria. Together they scrutinised the medical literature for any mention of stomach bacteria. Numerous attempts to culture spiral gastric bacteria were unsuccessful. Fortunately, they struck gold one Easter weekend, in 1982, when the slow-growing bacteria were left to incubate in their Petri dishes. The pathogen is now known as *Helicobacter pylori (H. pylori)* - curved bacteria closely related to a bacterium called Wollinella succinoges, which survives in one of the four stomachs of cows.

Despite this finding, much of Prof. Marshall's work was met with criticism and disbelief amongst the scientific community. There was pressure to recreate his results by infecting an animal model with bacteria and attempts were unsuccessful; H. pylori is well-adapted to the stomach environment of humans and animal stomach environments are different. Desperate to demonstrate the causative role of H. pylori, Prof. Marshall drank a beaker of the culture himself. Within the next few days, he fell seriously ill with symptoms of nausea, vomiting and exhaustion, precursors to a peptic ulcer. His stomach biopsies confirmed that he had successfully infected himself with a peptic ulcer, and perhaps more significantly, he was able to cure himself with antibiotics.

Although the ground-breaking discovery caused great reverberation, his hypotheses were still met with scattered doubt. Much of it stemmed from the disbelief that bacteria could survive in the strong acidic environment of the stomach and the deep-rooted theory that stomach ulcers were caused by stress. Prof. Marshall explained that normal day-to-day stress has little to do with ulcers but some ulcers such as 'stress ulcers' are caused by severe trauma 'stress' such as injuries sustained from motor vehicle accidents. Nevertheless, Prof. Marshall was able to cure all peptic ulcer patients simply with antibiotics. With the support of the National Institutes of Health (NIH), the medical community was finally convinced; the discovery revolutionised the entire treatment process of peptic ulcers.

Aside from the discovery of H. pylori, Prof. Marshall has since devised the Helicobacter breath test for diagnosis. He now devotes his time on investigating the epidemiology, genomics, and

一場人生賭博 — 巴里·詹士·馬歇爾教授

- Prof. Barry James Marshall

By Kwan Shu Tse 謝鈞澍

treatment of *Helicobacter pylori* in the Helicobacter Research Laboratory, with the hopes of involving H. pylori as possible carriers for vaccines. His incredible story of self-belief and determination against a tide of doubt has not only transformed the way peptic ulcers are treated but has also impacted the scientific community to be more receptive to novel ideas.

消化性潰瘍是種常見的消化性疾病，以前，人們普遍認為病因來自壓力和不良的飲食習慣。可是在1982年，巴里·詹士·馬歇爾教授和他的同事，羅賓·沃倫醫生證明這是錯誤的，並成功識別出消化性潰瘍和胃癌的真正病因—幽門螺旋桿菌，為此，他們榮獲2005年諾貝爾生理學獎。

受到護士母親的薰陶，馬歇爾教授在童年的時候已經對解剖學，生理學和生物學有所接觸。1975年，他在西澳大學取得醫學和外科學士學位後，便在伊麗莎白二世醫療中心的查理斯蓋爾德納醫院開始實習和任職內科的住院醫生。他在1978年開展其專科醫生訓練並於1979年獲委派到皇家珀斯醫院任職專科住院醫生。在馬歇爾教授受訓的第三年，在進行臨床研究項目的時候結識了當時為病理學家的羅賓·沃倫醫生，他們開始共同研究螺旋形微生物。

當馬歇爾教授認識了一直都在研究胃部的彎曲細菌的羅賓·沃倫醫生後，便對細菌在胃部疾病中的作用產生興趣。他們翻查了提到胃部細菌的醫學文獻，多次培育胃部螺旋形細菌，卻每每失敗而回。幸好，在1982年復活節週末的時候，他們聽任細菌留在培養皿中，終於成功得到了生長緩慢的胃部螺旋形細菌。此病原體現在被稱為幽門螺旋桿菌，是一種和產琥珀酸沃廉菌有密切關係的彎曲細菌，而產琥珀酸沃廉菌則生存在四個牛胃之中的其中一個胃。

雖然有此發現，但馬歇爾教授的研究在科學界遇到無數的批評和懷疑。壓力迫使他利用感染動物來證明他的理論正確，可是多次嘗試也並未成功。這是因為幽門螺旋桿菌已經完全適應了人類胃部的生活環境，而不同動物的胃部是不一樣的。馬歇爾教授竭力要證明幽門螺旋桿菌的致病作用，唯有自己喝下培育的幽門螺桿菌。之後幾日，他感到病情嚴重，出現噁心、嘔吐和疲憊等症狀，而且有消化性潰瘍的初期病徵。他的胃部活組織檢查確認他成功感染自己並得到了消化性潰瘍。更重要的是，他能夠利用抗生素來治癒自己。

縱使這個驚人的發現引起極大迴響，仍然有人對此存疑，不相信細菌能在胃部如此極度酸性的環境下生存，加上壓力乃胃潰瘍的發病成因的理論根深蒂固，使得他的理論遭到質疑。馬歇爾教授解釋，每日碰到的平常壓力對潰瘍的影響極微，只有創傷性壓力，例如因交通事故所造成嚴重受傷，才能引起一些「壓力性潰瘍」。儘管如此，馬歇爾教授處方抗生素後，卻能輕易治療所有消化性潰瘍患者。直至得到美國國家衛生研究院的支持，醫學界才終於被說服了，他的研究徹底改革了整個治療消化性潰瘍的過程。

除了發現了幽門螺旋桿菌外，馬歇爾教授也著手發展幽門螺桿菌呼氣測試以供診斷之用。他現在正在幽門螺桿菌研究實驗室致力研究幽門螺桿菌的流行病學、基因組學和其診斷療法，並希望利用幽門螺旋桿菌作疫苗載體。馬歇爾教授憑著信念和決心力排眾議，他的故事不但改變了世人如何治療消化性潰瘍，還改變了人們一貫秉持舊有思想的態度，使科學界更容易接受新的想法。

科學就是要抱持著懷疑的態度不停反思!

Full interview with Prof Marshall available on our website. 請在我們的網站閱讀完整的採訪。

http://sciencefocus.ust.hk/interview

Failure – The Essential Stage to Becoming an Outstanding Scientist: Henry Tye

By Kwan Shu Tse 謝鈞澍

> *The most important quality of success is the ability to face failure courageously and learn from it.*

A piece of inspiring and enlightening wisdom imparted to me by Prof. Henry Tye, Director of HKUST Jockey Club Institute for Advanced Study (IAS). His heartfelt enthusiasm and optimism in the promotion of scientific research in Hong Kong and Asia was apparent throughout the interview.

Prof. Henry Tye was born in Shanghai, raised in Hong Kong, and completed his secondary school studies in La Salle College. He developed a keen interest in physics in secondary school, and decided to further his studies in physics after graduation. During this period, Hong Kong was still a British colony and he felt that the social development of Hong Kong was hindered. Subsequently, he went on to obtain a bachelor's degree in science from the California Institute of Technology in 1970, and received his PhD in Physics from the Massachusetts Institute of Technology(MIT) in 1974. Before joining HKUST as the Director of IAS in 2011, he held the position of Horace White Professor of Physics at Cornell University since 1987. His research interest includes theoretical particle physics, string theory and cosmology.

Modeled on the internationally renowned Institute for Advanced Study at Princeton, the IAS was founded in 2005 by the former president of HKUST, Prof. Paul Chu. The mission of IAS is to promote scientific research in HKUST, Hong Kong and Asia, and become a premier research center. Currently, there are four directions of development: recruiting international outstanding scientists to lead research teams; promoting interdisciplinary collaboration of local, national and international researchers; holding distinguished lectures, workshops, programs and conferences regularly, and in-depth study of specific research topics.

When it comes to the current status and future prospects of scientific research in Hong Kong, Prof. Tye unabashedly admits that government funding is inadequate. Singapore, for instance, dedicates much higher GDP per capita to research funding when compared with Hong Kong. While the three economic pillars in Hong Kong, finance, logistics and tourism, are easily influenced by external factors, scientific research is less so, making it a safe avenue for government resource investment. Hong Kong's relatively conservative society may also be a factor that contributes to the lack of adventurous spirit in research.

> *If there were companies willing to support Charles Kao in the research on optical fiber, Hong Kong may have been dubbed the original birth place of optical fibre.*

Prof. Tye believes that this dearth in enthusiasm may also suppress students' passion toward and scientific research, with the stigmatism that a career path in research may be unfruitful or uncertain.

The negative opinion associated with scientific research is largely untrue, because as with any career path, success does not come easily and the ability to face hardships and failures are essential qualities. Prof. Tye advocates that possessing and maintaining a positive attitude can be developed through experience. That is not to say that failure should be embraced. A successful researcher, as much as possible, should weigh out all the factors that may affect project completion before making a go or no-go decision. However, a professional decision can only be made when one possesses strong observation skills, creativity and a broadened horizon, none of which are acquirable alone through books or lessons. "You can search the web if you don't know the materials written on the books, but critical thinking and analytical power can only be cultivated through experience." It is vital to maintain a positive and healthy attitude towards failure.

失敗—成就優秀科學家之路

戴自海教授

「能夠勇於面對失敗，懂得從失敗中學習才是最重要的！」

聽到戴自海院長口中這句話，可謂令人茅塞頓開，有如當頭棒喝。我們非常榮幸可以邀請到香港科技大學賽馬會高等研究院（下稱科大高研院）院長戴自海教授親自接受訪問。言談間可以感覺到他對香港科研發展抱著樂觀的態度，同時希望能夠為推動香港和亞洲的科研發展出一分力。

戴自海教授出生於上海，之後移居香港，入讀喇沙書院。中學時期的他已經對物理學產生濃厚興趣，希望畢業後可以繼續修讀物理。可是，由於香港當時屬於英國殖民地，戴自海教授深感社會發展受到窒礙，因此畢業後便毅然離開香港，到美國升學。他於1970年在美國加州理工學院取得理學士學位，並於1974年在美國麻省理工學院完成物理學博士課程。自1987年起出任美國康乃爾大學賀瑞斯．維特物理學教授，直至2011年加入科大高研院出任院長，研究領域包括粒子物理、弦理論和宇宙學。

科大高研院由前校長朱經武教授於2005年創立，彷效美國普林斯頓研究院，希望提升科大、香港、甚至亞洲的科研水準，成為亞洲科研中心。現時科大高研院有四大發展方向：邀請外國高水準科學家帶領研究；促進本地、國內和國外研究人員作跨學科合作；定期舉辦講座、工作坊、論壇、會議和就特定課題作深入研習。

談到香港的科研狀況和前景，戴自海教授認為相比其他亞洲國家，政府投資在科研的經費太少。以新加坡為例，投資在科研的資金佔人均本地生產總值的比率遠高於香港。而且香港的三大經濟支柱，金融、物流和旅遊都極受外圍因素影響；科研受這方面影響較少，安全性較高，適合政府投放資源。他又指出香港社會相對保守，不敢冒險，因而失去了很多機遇。

保守的心態使很多學生認為讀科學和做研究沒有前途，壓抑了他們對科研的熱忱。

「假如當年有公司投資高錕研究光纖，香港現在已經成為光纖之都了。」

其實有許多與科研相關的負面意見是不確的。從事科研與其他行業一樣，不易取得成功，所以必須要懂得面對失敗。他認為要透過磨練和失敗，才能培育正確的心態，這並不是說要刻意求敗。一個成功的研究員要懂得評估所有對項目進度有影響的因素，然後決定應否開展項目。要判斷準確，必須要有一定觀察力、創造力和見識，這些元素都不能在書本和課堂上學到。正如戴自海教授所言：「假如看不懂課本上的東西可以到網上搜尋，但思考力和分析力則需要經過歷練才能夠培養。」下次，當你遇到挫敗時，何不抱著正面態度，從容面對呢？

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***香港科技大學高等研究院*將驅動跨學科與跨院校的協作項目，與全國學界、工商界、社會團體及政府機構建立緊密的伙伴關係。**

Test Yourself! 測一測

Which of the following materials exhibits the strongest tensile strength?
以下哪一種材料具有最高的抗拉強度？

a. **Spider silk 蜘蛛絲**
b. **Human hair 人類頭髮**
c. **Piano wire 鋼琴線**
d. **bamboo 竹**

The rarest element in the world is known to be Astatine. How many grams of Astatine are currently estimated to be present on Earth?
世界上最稀有的化學元素是砹。大約在地球上估算有多少克的砹？

a. **10 grams 10 克**
b. **28 grams 28 克**
c. **57 grams 57 克**
d. **122 grams 122 克**

For detailed answers and explanations, please visit our website.
想了解更多，請參觀我們的網站
http://sciencefocus.ust.hk

Answers 答案：a, b, a, 091

Which of the following types of cells have no nucleus?
以下哪一類細胞不含有細胞核？

a. **Mature Red blood cells 成熟的紅血球**
b. **Nerve cells 神經細胞**
c. **Epithelial (skin) cells 上皮細胞**
d. **Adipocyte (fat) cells 脂肪細胞**

What are the values of * based on the pattern?**
根據以上數字模式，* 代表著什麼數字？**

7 2 8 9 8 4 3 8
3 7 4 1 9 0 7 1
2 1 1 0 2 7 1 7
2 0 3 * * * 1 6

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