GETTING A NEW HIGH

HKUST PRESIDENT TONY CHAN STARTED OUT INQUISITIVE. NOW, HE'S TRYING TO START A FIRE IN HONG KONG THAT WILL SPUR NEW TECHNOLOGY, NEW START-UPS, AND NEW BUSINESSES.

STORY **RYAN SWIFT**
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"Give me a lever long enough and a fulcrum on which to place it, and I shall move the world." Thus said Archimedes, the Greek philosopher and scientist of antiquity. Whether it is truly a quote from Archimedes, however, is almost beside the point. For the quote concerns more than just a simple point about physics and leverage; it's also about the potential of science and technology to reshape the world of *people*.

Upon meeting Hong Kong University of Science Technology (HKUST) president Tony Chan, you can feel the idea behind that historical quote resonating in this man. Chan exudes energy and excitement. And he's keen to talk: about himself, his career and achievements (there are many), the nature of science, philosophy, business and – perhaps most of all – his beloved university.

One particular subject he loves coming back to is DJI, the drone-building company now based in Shenzhen that was started in 2006 by a young HKUST alumnus, Frank Wang. DJI is now recognised as the world leader in the manufacturing of civilian drones. A recent round of investment funding would value the company at US$10 billion, according to *Forbes*. Should that funding go through, Wang would become one of China's newest billionaires.

It's that kind of success story that Chan is eager to see replicated. Students need heroes and role models, after all.

THE SCIENCE PERSONALITY

If you were to see Chan when he was a child, you might not have guessed that he'd go on to become a leading mathematician. He grew up in what was once the quarry of Shau Kei Wan, where his father – the only person in the village with a university-level education – tended to the rock-crushing machine. "My father was an engineer and I grew up with machines," Chan says. "When I was 10, I already knew how to drive a stick-shift."

That kind of parental influence was a rarity in a place where people toiled with their hands. "There was no running water [at home], no TV. Twice a day, they would blow up the mountain, so I learned to live with explosions," he says.

Another noise that caught Chan's attention amid the explosions was the sound of airplanes. Shau Kei Wan was under the old flight path of Kai Tak airport, and the old airliners of the early 1960s would be powering up as they ascended over his home.

Chan excelled at maths and

CHAN SEES THE GROWING IMPORTANCE OF DATA SCIENCE AS A WAY FOR HIS RELATIVELY YOUNG UNIVERSITY TO OUTFLANK MUCH OLDER AND MORE ESTABLISHED INSTITUTIONS
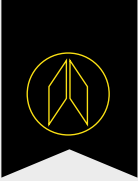
physics, finding math problems particularly easy to handle. One day, during his time at Queen's College, he was presented with a magazine which featured a story on Richard Feynman and Murray Gell-Mann, two physicist collaborators and rivals, working at the California Institute of Technology (Caltech). This was a revelation for Chan. "Everyone had heard of MIT [the Massachusetts Institute of Technology], but nobody had heard of Caltech," he says.

Chan was intrigued by what he discovered of the now legendary Feynman. "He was such a colourful person ... You can still buy his lecture notes today."

Chan recounts the many facets to Feynman beyond the physics – he was an accomplished drummer, scribbled drawings while in topless bars, and was keenly interested in Mayan culture. There is debate about who was the greater physicist, but although Gell-Mann was instrumental in developing the language behind particle physics, he remains largely unknown outside the realm of scientific academia. Feynman, with his intuitive style of

explanation, won a wider fame for himself that has endured long after his death in 1988.

"The lecture notes are different from anything you've read; it's not a rigid way of teaching physics – [Feynman] gives you the intuition, he tries to explain. And *then* he writes down the equations. I was captivated by his way of explaining. So I said I have to go to this place," Chan recalls. "I was captivated by Feynman, and I wanted to become a physicist."

RAREFIED ENVIRONMENT

Caltech remains a rarefied environment to this day. Chan estimates that only about 200 students enter each year, compared to 2,000 admitted annually by HKUST and the 1,000 freshmen admitted to MIT. "It's tiny, but you hear about it [Caltech] because it is an elite, special school. When I applied, I didn't know that, but it was a very special place. There were so many Nobel Laureates walking around," Chan recalls. At HKUST, the student-teacher ratio is around 15 to one, whereas at Caltech, it's more likely two, or even one to one, he says.

Chan was good at maths, but ultimately decided he was no Feynman; he didn't have the ability to see or explain physical phenomenon in the same way. Venturing into engineering, Chan got a master's degree in aeronautical engineering, partly because of his continued fascination with flight. During this time, he discovered the work that computers were then doing in understanding aerodynamics. Today, of course, most airplanes are designed using complicated software, but back then, wind tunnels and trial and error were still commonplace.

This introduction to the world of computers, at a time when they were still mysterious and largely

ABOVE
Tony Chan obtained a master's degree in aeronautical engineering in Caltech, later receiving his PhD in computer science from Stanford University.

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>
> — Tony Chan, HKUST president

unknown to humanity, was thrilling. The field was so new that Caltech didn't have a dedicated department for it, so Chan had to move to Stanford, where a computer science department had been set up by a former Caltech professor.

When Chan joined, the department was just 10 years old. But he found the newness of the field and the risks people were taking alluring. "We were pioneers," he says. "No one could have predicted then how much computers would now run everything."

Of Chan's class of 20 doctoral students in 1973, none had undergraduate degrees in computer science. More surprisingly, says Chan, none of the professors had degrees in computer science.

"These were all professors of mathematics, linguistics, psychology, electrical engineering – they were all excellent in their own fields and they could see this new thing coming," says Chan. What brought these nascent computer scientists together in 1973 was the vision of artificial intelligence. "That was their dream – they were already thinking about that."

That so many disciplines were coming together to create a new thing was something Chan relished. And though he recites what's arguably the scientific pecking order – mathematicians, then physicists, chemists and biologists – he also notes how disciplines are coming together as never before: in data science, biology in the form of genomics, and so on. In his view, the next *truly* big thing, like computer science in the 1970s, will come about from a mixing of disciplines.

THE ALLURE OF IDEAS

Today, Chan sees a similar "computer science" moment in fields such as data science and genetics, both of which he is keen to have HKUST embrace. Ever competitive, he sees the growing importance of data science as a way for his relatively young university to outflank much older and more established institutions.

He cites the fact that when the Institute of Electrical and Electronics Engineers (IEEE), the world's largest association of technical engineers, decided to publish a new journal about big data, they looked to Yang Qiang, the head of HKUST's computer science and engineering department, to be editor-in-chief. This, Chan says, was both a proud moment and an emblematic one.

"If you think about this region – China, Hong Kong, Asia – we are poised to make a big advance compared to the rest of the world. [Data science] is a new field, so the playing field is more level, if you are starting out."

He adds that it will be in Asia that tremendous amounts of data are generated, due to the fact that Asia's population is higher than in any other continent, giving more opportunities for data firms such as Tencent to develop new techniques and ideas.

To that end, Chan says HKUST is preparing to launch a data science research institute "in the next year or two".

Establishing such an institute may also be a part of Chan's effort to move HKUST up the global ranks of the world's top universities. Becoming known for top-level education and having world-beating graduates is a key part of that. The university's drive

up the ranks has been impressive. In the *Times Higher Education* rankings of the top 100 universities under 50 years old, HKUST has been in the top five since 2012, falling just behind Switzerland's École Polytechnique Fédérale de Lausanne, Pohang University of Science and Technology (South Korea) and the Korean Advanced Institute of Science and Technology (South Korea).

Since HKUST's founding in 1991, it has benefited from land grants (its scenic location in Sai Kung was originally a British army barracks) and grants from the Hong Kong Jockey Club and billionaire Lee Shau-kee.

Chan emphasises the hiring policy of HKUST as a key factor. Professor Woo Chia-wei, who was the founding president of HKUST, aimed to build Asia's first research-oriented university, modelled along the lines of Germany's Humboldt University, which had inspired institutions including MIT. To that end, every professor who was hired for the fledgling university had to have a PhD, and had to be able to teach, do research and do technology transfer. "First-rate people will bring in first-rate people, but if you hire second-rate people, it will bring in third-rate people," Chan quotes Woo as saying.

The 2015 *Times Higher Education* ranking of the top 100 universities under 50 years old puts HKUST at the top of the world in terms of research (other categories were citations, teaching, international outlook and industry income). Gaining higher placements in rankings includes an element of public perception, as the editors of the *Times Higher Education* index acknowledge. It also rests on the achievements of its graduates. In
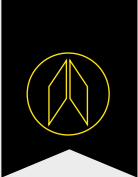
this, Chan is supremely confident. He reckons also that as Asia becomes ever more prominent in the global economy, top-ranked professors and researchers will consider coming to HKUST or other Asian institutes.

SHENZHEN VS HONG KONG

As well as being a proud intellectual, Chan doesn't shy away from the business side of his job – in fact, he embraces it. Connecting business with groundbreaking research is, he says, part of the original mission of HKUST. It is the reason why the school developed a top-level business education department, as did MIT. The Kellogg-HKUST EMBA programme ranked number one globally until 2014, when it slipped to number two.

Reaching out to the Hong Kong business community is high up on Chan's to-do list. He points to an HKUST luncheon series that was launched in October 2011 called "Science for Lunch", in which faculty members present the results of their research to an invited group of businessmen at the Hong Kong Club. These monthly talks are done "without the math", yet in such a way as to impart essential ideas with simple explanations – much as Feynman might have done. A talk in March reviewed the research of HKUST faculty on the possibilities of "flexible" concrete.

"We had one professor, who was a former classmate of [German Chancellor Angela Merkel] who developed a device to detect whether you were going to have a heart attack. Another professor was studying Chinese medicine using biochemistry. These companies all came and wanted to talk about how to invest," Chan says.

When General Electric's vice-chairman, John Rice, relocated to Hong Kong four years ago,

Chan says that Rice was in his office within the week. Nothing in particular has come from that meeting, Chan says, though GE did build a research lab in Shanghai, and HKUST's provost, who used to be an engineer with GE, has been to visit.

That GE set up shop in Shanghai may have been disappointing to Chan, though he betrays no regret. Where he does show some regret is the case of DJI's Frank Wang, who formed his company while still at HKUST. "When he wanted to move beyond prototypes, he had to go to Shenzhen. He wanted to have his headquarters in Hong Kong, but he didn't quite get the government support."

Shenzhen's drive to become China's Silicon Valley is now getting widespread attention. It's the homegrown tech billionaires such as Wang who have fuelled interest in the Shenzhen stock market. Chan acknowledges this, noting that business and political leaders in Shenzhen decided long ago that they wanted to advance beyond low-

wage manufacturing and thus take a bigger slice of the profit margin from new tech products.

HKUST has a presence in Shenzhen, with the city government giving land for the HKUST Shenzhen Research Institute, which was established in 2001. The institute has received some funding from the mainland, according to Chan, but that only goes to the Shenzhen institute, which conducts research as well as some classes. But Chan doesn't want to expand too far there, reckoning that HKUST has to focus on maintaining and improving standards at the Hong Kong campus.

R&D HUB

Furthermore, Chan says that research and development is already starting to take root in Hong Kong, citing Huawei, Beijing Genomics Institute (now BGI), Lenovo and TCL as examples of companies that have set up R&D labs in the city. Chan is quite optimistic about the strengths of

Hong Kong to develop as an R&D hub, which he sees as the basis of new industries and profitability for the city. Rule of law and wide-ranging freedoms, low taxes and a strong education system are all part of the environment that leads to more ideas and, ultimately, more money.

Chan is also a big advocate of a Hong Kong top-level strategy for the development of science and research. He quickly runs through US strategic initiatives to advance in this field, noting

that Hong Kong could benefit from a similar way of thinking. He is definitely in favour of the proposed Innovation and Technology Bureau (though he concedes he is biased). But he also says that Hong Kong needs partnerships with the mainland. "In terms of big science, Hong Kong has to partner with Shenzhen," he says.

Students also need passion for research and science. Right now, Chan feels there is still too much parental pressure on kids to

succeed at finance, accounting or law, instead of science.

DJI is now providing scholarships to HKUST students. A young drone pilot, who is helping with our story's photo shoot, is attending HKUST thanks to one of these scholarships, and it's clearly his intention to work in engineering, perhaps starting his own world-beating company one day. Chan, sitting on his professor's sofa, can only rejoice at the prospect of another technology hero entering the market. Ⓐ

Chan – Vese Active Contour Without Edges

$$\min_{c_1, c_2, \varphi} \mu \int_\Omega |\nabla H(\varphi)| + \int_\Omega |u_0 - c_1|^2 H(\varphi) \, dx \, dy + \int_\Omega |u_0 - c_2|^2 (1 - H(\varphi)) \, dx \, dy$$

Conformal Brain Mapping

$$\min_{f: M \to N} \int_M \|\nabla_m f\|^2 \, dM$$

ABOVE
Two of Tony Chan's equations, developed to help computer imaging.

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