

Galileo's damage control

The scientist considered prudence the better part of valour while dealing with Papal orthodoxy

By ANANTHANARAYANAN

What may be considered a crucial step for humans to become scientific beings was beset by resistance from bigotry. This was when humans, by observation and contemplation, discovered that the Earth moved around the Sun, although the senses showed us to be quite still, while it was the Sun that was in motion. This one step, which emphasised objectivity, in opposition to what was perceived, showed thinking as a way to understand nature and weakened the hold of belief in the supernatural.

The opposition of the church to Galileo, for teaching the heliocentric system of Copernicus, is legendary. The journal, *Nature*, carries a report that an "original letter — long thought lost — in which Galileo Galilei first set down his arguments against the church's doctrine that the Sun orbits the Earth has been discovered in a mislaid library catalogue in London." The letter bears corrections, which suggest that Galileo had realised the harm that it was doing and decided to tone down his insistence on a view, not in keeping with Papal approval.

The nature of the cosmos had been first described by Ptolemy, of the second century BCE. Ptolemy placed the Earth at the centre of the universe and the stars in spheres that encircled the Earth. The movement of the planets was accounted for by circles that moved within circles, a complicated picture, but one that served the ends of navigation and the church calendar, after a fashion. Nicolaus Copernicus was not satisfied with the recourse the theory took to the "caprice" or the "humour" of planets to explain inaccuracies in forecasts. And he committed himself to a lifetime of observation. The data that he collected only revealed more shortcomings in Ptolemaic ideas and finally pointed to the conclusion that the Sun was stationary and the Earth and the planets moved around the Sun in circles.

Copernicus first spent many years in confirming his findings with more observations and tests of events forecast. And then many years before he published his findings, for fear of



opposition, from fellow scientists as well as from the church. From scientists because the teachings of Ptolemy had held sway for 15 centuries! And from the church as the Book of Genesis implied the Earth was at the centre.

Copernicus's book was finally published in 1543. It was not particularly well received and Copernicus' ideas were even reviled for many decades. Tycho Brahe, of Denmark, who was born in 1546, spent a lifetime, till 1601, in collecting vast and more accurate data. Even when his successor, Johannes Kepler, used the data to prove sophisticated mathematical patterns in planetary motion, there was resistance, and his results, published in the early 1600s, took decades to be accepted. Galileo, born in 1564, in Pisa, made an early mark as a scientist and became a professor of mathematics in the University of Pisa at the age of 25. This, as also his fine work, was resented by many. He discovered the principle of the pendulum and did important work on the effect of gravity in accelerating falling objects. He had, in fact, discovered the laws of motion, except that mathematics was still not developed for the laws to be put down.

And he discovered the fact that the apparent speed of an object depended on the speed of the observer. This had the dangerous implication, in respect of cosmology, that we could not say the Earth was not in rapid motion simply because we do not feel that we are moving. Those, and other ideas, made things difficult in Pisa and Galileo moved to Padua, where there was greater intellectual freedom.

In the early 1600s, the books of Copernicus became available. And so did the newly invented telescope. Galileo ground his own glass lenses and improved on the current designs. With his own telescope, he made observations of the moon and the planets. What the telescope revealed was literally eye-opening. What Copernicus and Kepler had divined from charts and calculation, Galileo could see. The telescope showed that the planets were globes, and he saw the phases of Venus and the moons of Jupiter. At about the same time, Galileo decided to move back from Padua to Pisa. While Padua was in an independent province under Venice, Pisa was subject to the influence of Papal authority. The Catholic Church had created a process called the Inquisition where allegations of beliefs that were contrary to the Bible could be inquired into. The Inquisition launched an enquiry into the utterances and writings of Galileo.

The church, at the time, held that the Bible taught that the Earth was at the centre of creation. Galileo was found to have actively supported and taught the views of Copernicus and the Inquisition held Galileo culpable. It was thanks to his good standing in circles of influence that he was only ordered to desist thereafter from holding or teaching a Sun-centric cosmology. Galileo did lie low for some time, but his conviction, and the belief that the truth did not contradict the Bible, which never intended to make an assertion in astronomy, overcame his prudence and in 1632, he published a satirical work that demolished the



Galileo at the Inquisition, where it is believed, he said before recanting, "But still, it moves" about the Earth being in motion around the Sun.



The copy of Galileo's letter

Earth-centric model.

That was provocation indeed, and the Inquisition came down heavily. While there are records and conjectures, it is clear that Galileo did not make a fair showing and he was sentenced never to leave the premises of his house. This too was a concession because he had agreed to publicly disown the heliocentric theory.

The records of Galileo's submission to the Inquisition suggest that he tried energetically to defend himself. He repeatedly asked them to look through his telescope and see for themselves, but, it seems, in vain. And there is on record a letter, in very powerful language, clearly of no avail before judges whose minds were made up about what was heresy, and were there only to prove that it had been committed. There are, however, copies of another letter, in a softened tone, which was believed to be a later ver-

sion, which Galileo had written with the object of winning over the tribunal. It has been suggested that this was the letter that Galileo wrote and the strident version was a creation of his enemies to show him in a worse light. The original letter may be in the secret vault of the Vatican and there has only been conjecture.

The original of the strongly worded letter had never been found till the remarkable letter in the archives of the Royal Society. A catalogue error in the date of the letter led to its being ignored for 250 years. But it was spotted by a scholar, and yes, it is the original letter, with corrections in Galileo's own hand, to show that he had himself redone the letter as a measure of damage control.

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PLUS POINTS

Similar response



Scientists have found that giving the popular party drug MDMA to octopuses makes the normally reclusive creatures highly sociable. When humans take the illegal substance — commonly known as ecstasy — they experience euphoria and closeness to others, effects that have made it popular among revellers at nightclubs and festivals.

Even though they are separated from humans by 500 million years of evolution, the new research suggests that octopuses experience very similar effects. The unusual study was conducted by scientists in an attempt to understand the ancient brain mechanisms that control social behaviour in animals. Octopuses are widely known to be intelligent animals, capable of outwitting prey and solving complex puzzles, but their brains are totally alien when compared to our own.

The question before scientists was whether these creatures, which normally live a solitary existence, would show any distinctive behaviour changes associated with an ecstasy user. To find out, they placed eight subjects in baths containing MDMA for 10 minutes before placing them in specialised chambers in which they had the choice of interacting with plastic action figures or other octopuses in cages.

Subjects under the influence of the drug spent more time with other octopuses, and during this time they engaged in a lot of close physical contact. The scientists noted that this contact did not appear aggressive in nature.

The results of this study, published in the scientific journal *Current Biology*, suggest there are deep evolutionary connections between human behaviour and that of octopuses.

"What our studies suggest is that certain brain chemicals, or neurotransmitters, that send signals between neurons required for these social behaviours are evolutionarily conserved," explained Gul Dolen, a neuroscientist at the Johns Hopkins University School of Medicine, US, who led the experiments.

Dolen's genetic analysis of the California two-spot octopus, an animal widely used in scientific laboratories, revealed that its brain had the molecular components required to sense MDMA. In particular, these marine invertebrates share the same genes that control how brain cells bind with serotonin — a chemical that controls mood.

Nevertheless, the researchers said the paper was only the first step into this very new area of research, and said the results must be confirmed by further experiments before the octopus becomes a new laboratory model for the human brain.

The Independent

Pioneer no more



Charles Kuen Kao, a scientist awarded the Nobel Prize for physics in 2009 for his work on fibre optics, passed away in Hong Kong on Sunday at the age of 84. Kao pioneered the development and use of fibre optics technology, bringing revolutionary changes to modern telecommunication technology, said Carrie Lam, chief executive of China's Hong Kong Special Administrative Region.

Kao was diagnosed with Alzheimer's disease in 2004. Despite this, he, together with his wife, created the Charles K Kao Foundation for Alzheimer's Disease in 2010 to help other patients and raise public awareness about the disease, she said.

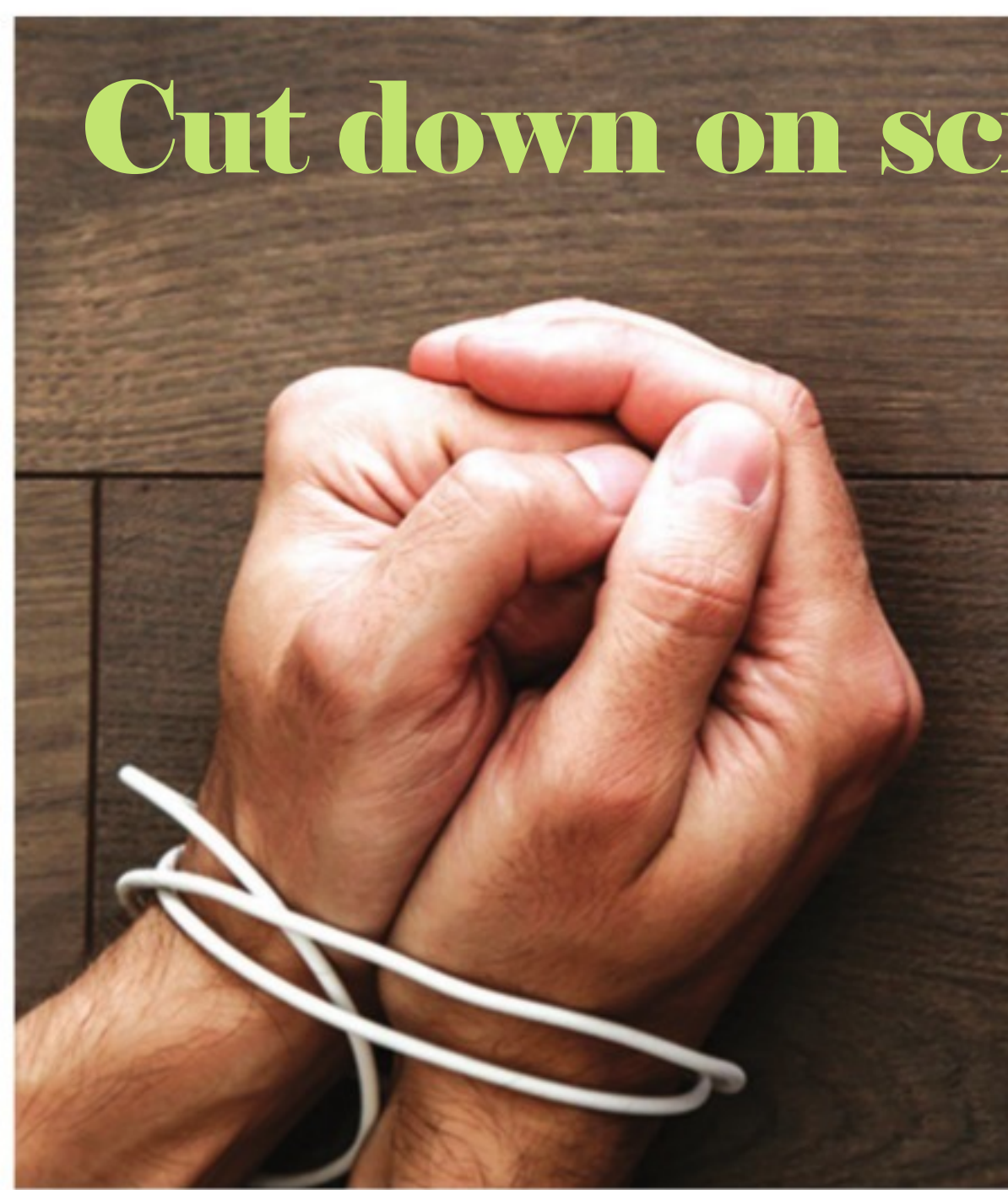
His impeccable strive for excellence in science and technology led to his ground-breaking accomplishments in the area of fibre optics, which brought forth the development of the Internet and opened a new page in the history of telecommunications, Rocky Tuan, vice-chancellor and president of the Chinese University of Hong Kong said.

Born in Shanghai in 1933, Prof Kao moved to Hong Kong in 1948. He studied at the University of London where he obtained his Bachelor of Science degree and his PhD in electrical engineering.

The Strait Times

Cut down on screen time

Using one's phone in moderation might be the answer to being a little happier



By JEAN TWENGE

We'd all like to be a little happier. The problem is that much of what determines happiness is outside of our control. Some of us are genetically predisposed to see the world through rose-coloured glasses, while others have a generally negative outlook. Bad things happen, to us and in the world. People can be unkind and jobs can be tedious. But we do have some control over how we spend our leisure time. That's one reason why it's worth asking, which leisure time activities are linked to happiness, and which aren't.

In a new analysis of one million US teens, my co-authors and I looked at how teens were spending their free time and which activities correlated with happiness, and which didn't.

We wanted to see if changes in the way teens spend their free time might partially explain a startling drop in teens' happiness after 2012 — and

perhaps the decline in adults' happiness since 2000 as well.

A possible culprit emerges

In our study, we analysed data from a nationally representative survey of eighth, 10th and 12th graders that's been conducted annually since 1991.

Every year, teens are asked about their general happiness, in addition to how they spend their time. We found that teens who spent more time seeing their friends in person, exercising, playing sports, attending religious services, reading or even doing homework were happier. However, teens who spent more time on the Internet, playing computer games, on social media, texting, using video chat or watching TV were less happy.

In other words, every activity that didn't involve a screen was linked to more happiness, and every activity that involved a screen was linked to less happiness. The differences were considerable — teens who spent more

than five hours a day online were twice as likely to be unhappy as those who spent less than an hour a day.

Of course, it might be that unhappy people seek out screen activities. However, a growing number of studies show that most of the causation goes from screen use to unhappiness, not the other way around.

In one experiment, people who were randomly assigned to give up Facebook for a week ended that time happier, less lonely and less depressed than those who continued to use Facebook. In another study, young adults required to give up Facebook for their jobs were happier than those who kept their accounts. In addition, several longitudinal studies show that screen time leads to unhappiness but unhappiness doesn't lead to more screen time. If you wanted to give advice based on this research, it would be very simple — put down your phone or tablet and go do something — just about anything — else.

It's not just teens

These links between happiness and time use are worrying news, as the current generation of teens (whom I call "iGen" in my book of the same name) spends more time with screens than any previous generation. Time spent online doubled between 2006 and 2016, and 82 per cent of 12th graders now use social media every day (up from 51 per cent in 2008).

Sure enough, teens' happiness suddenly plummeted after 2012 (the year when the majority of Americans owned smartphones). So did teens' self-esteem and their satisfaction with their lives, especially their satisfaction with their friends, the amount of fun they were having, and their lives as a whole. These declines in well-being mirror other studies finding sharp increases in mental health issues among iGen, including depressive symptoms, major depression, self-

harm and suicide. Especially compared to the optimistic and almost relentlessly positive millennials, iGen is markedly less self-assured and more depressed.

A similar trend might be occurring for adults — my co-authors and I previously found that adults over age 30 were less happy than they were 15 years ago, and that adults were having sex less frequently. There may be many reasons for these trends but adults are also spending more time with screens than they used to. That might mean less face-to-face time with other people, including with their sexual partners. The result — less sex and less happiness.

Although both teen and adult happiness dropped during the years of high unemployment amid the Great Recession (2008-2010), happiness didn't rebound in the years after 2012 when the economy was doing progressively better. Instead, happiness continued to decline as the economy improved, making it unlikely that economic cycles were to blame for lower happiness after 2012.

Growing income inequality could play a role, especially for adults. But if so, one would expect that happiness would have been dropping continuously since the 1980s, when income inequality began to grow. Instead, happiness began to decline around 2000 for adults and around 2012 for teens. Nevertheless, it's possible that concerns about the job market and income inequality reached a tipping point in the early 2000s. Somewhat surprisingly, we found that teens who didn't use digital media at all were actually a little less happy than those who used digital media a little bit (less than an hour a day). Happiness was then steadily lower with more hours of use. Thus, the happiest teens were those who used digital media, but for a limited amount of time.

The answer, then, is not to give up technology entirely. Instead, the solution is a familiar adage — everything in moderation. Use your phone for all the cool things it's good for. And then set it down and go do something else.

You might be happier for it.

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