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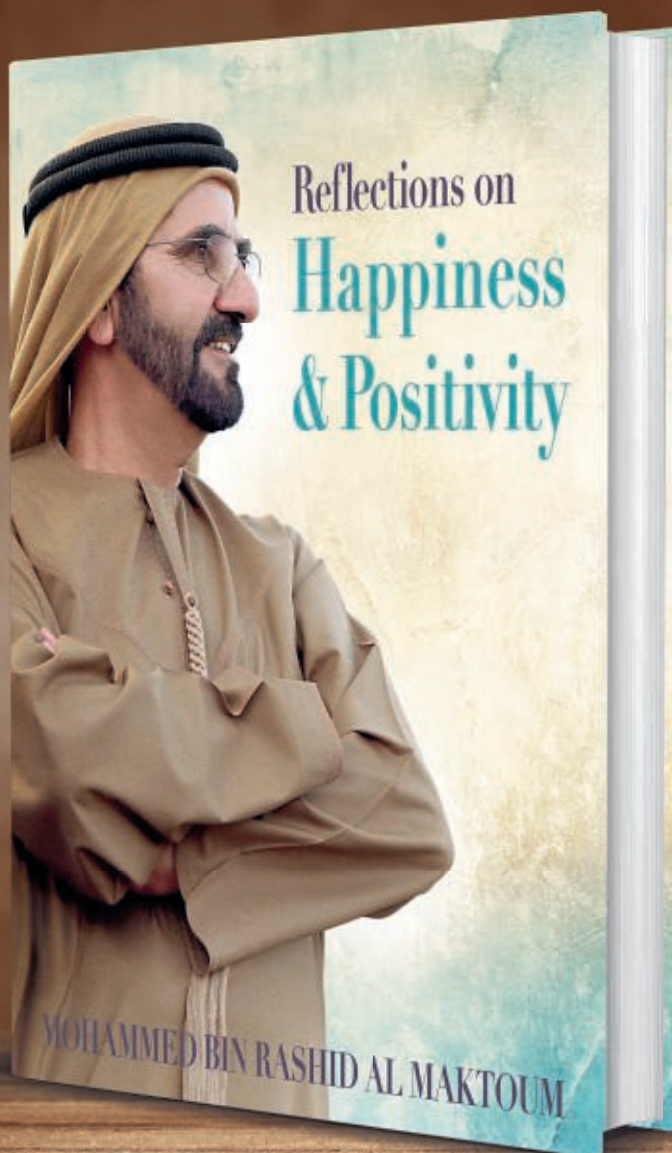
A MONTHLY MAGAZINE ON KNOWLEDGE AND DEVELOPMENT BY THE
MOHAMMED BIN RASHID AL MAKTOUM KNOWLEDGE FOUNDATION

APRIL 2017
ISSUE 28

#YearOfGiving

Pursuit of Happiness

The UAE Leads the Way



EMBATTLED BEES

WHY ARE THEY IN DECLINE?

VENOMS THAT HEAL

ANIMAL TOXINS THAT FIGHT PAIN

EXOPLANET HUNT

3,500 AND COUNTING



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FOREWORD

Dear readers,

The past month was focused on happiness, both on a national and international level. On March 4, His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, published his latest book *Reflections on Happiness and Positivity*. In its 24 chapters HH Sheikh Mohammed poses a different vision of administrative, developmental and civilized work based on positivity, confidence, and faith in citizens of the Arab World.

On March 20, the UAE celebrated International Happiness Day on the back of two important announcements. HH Sheikh Mohammed, in his capacity as Vice-President and Prime Minister of the UAE and Ruler of Dubai, announced the establishment of the World Happiness Council, which will focus on six key areas: health, education, environment, personal happiness, happy cities and community standards for happiness. The Council is also responsible for compiling an annual Global Happiness Report.

The second important announcement was that the UAE was ranked the happiest country in the Arab world for

the third consecutive year in the annual UN World Happiness Report 2017. The UAE, which ranked 21st globally, advanced seven places from last year. This proves that the country, under its wise leadership, is moving closer to its aim to become one of the top five happiest countries in the world under its Vision 2021 objectives. You can read more about the UAE's focus on happiness in our News section and The Pursuit of Happiness on page 12.

Sustainable economic development while looking after our natural resources is a key principle of any happiness index. However, humanity is impacting our planet as the decreasing number of bees and the identification of 208 new minerals – a direct result of human influence on the chemical make-up of Earth – proves.

We all know Earth is a finite resource, which is why the recent discovery of seven new planets – three of which orbit in the right temperature zone – makes for happy reading.

Jamal Bin Huwareb

CEO of Mohammed bin Rashid

Al Maktoum Knowledge Foundation



UAE Cabinet Launches National Strategy for Year of Giving



Following directives from His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE, the UAE Cabinet announced at an extraordinary meeting – held at the Wahat Al Karama memorial site in Abu Dhabi – that all the initiatives and projects under the Year of Giving will be dedicated to UAE martyrs in memory of their heroic deeds and in appreciation of their sacrifices.

His Highness President Sheikh Khalifa bin Zayed Al Nahyan said: “Our martyrs paid the ultimate sacrifice for our dear homeland, and their heroic deeds will live forever in the memory of the nation. Let us dedicate the greatest and noblest charitable efforts of the UAE and its people to those who gave their lives for this country. While keeping the memory of our martyrs and heroes alive, we seek to instill and sustain the habit of giving across the nation.”

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, said: “Dedicating the Year of Giving to the UAE martyrs is the greatest motivation to step up our efforts towards fulfilling its goals. The UAE was established in the spirit of giving and is led by people who love to give.”

HH Sheikh Mohammed hailed the National Strategy as a noble plan to sustain the charitable efforts of the UAE and its people. He stressed that everyone is a partner in this responsibility, and noted that in line with the UAE's history of giving, the strategy aims to build a sustainable practice of giving in the new generations. †

UAE Centennial 2071 Plan Revealed

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, has launched ‘UAE Centennial 2071’. This long-term government plan is based on a crucial keynote lecture given by His Highness Sheikh Mohamed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces.

The plan dissects the UAE of the future, in order to set future generations up for success and prosperity.

His Highness Sheikh Mohammed said, “Sheikh Mohammed bin Zayed's lecture has charted a path and laid the foundation for the future of the UAE. Our objective is for future generations in the UAE to live happier lives in a thriving environment with abundant opportunity, more connectivity and global influence.”

HH Sheikh Mohammed elaborated, “We have established a clear strategy for 2021; UAE Centennial goes beyond that, with a five-decade vision for future generations that provides the government with a clear roadmap for long-term development.”

He explained, “We must plant the seeds today for future generations to grow and prosper tomorrow. The world is rapidly changing, and we must equip our youth with the new tools, knowledge and skills needed to thrive in an ever-evolving environment.”

“Establishing a long-term strategy based on a vision for happy future generations will guarantee sustainable development and lasting joy for decades in our country,” he said.

UAE Centennial 2071 aims to prepare young Emiratis for the future to ensure prosperity, growth and the continuity of the UAE's values. This will create security and happiness, allowing future generations to excel and contribute to making the UAE the best country in the world.

The programme will focus on four main objectives. The first is to develop a flexible government with mindful leadership and a clear vision that prioritises the people and spreads positive messages. The second is to invest in education, focusing on advanced IT and establishing professionalism and ethics in educational institutions. The third is to establish a diversified, globally competitive economy, and the fourth is to consolidate the values of tolerance, social cohesion and respect in society within a comprehensive development plan to make the UAE the best country in the world. †

Focus on Happiness

The world needs a new approach for mankind to achieve happiness based on collaboration, integrated efforts and common denominators to promote positive values.

This was the view of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, at the launching of the World Happiness Council on the International Day of Happiness, which falls on March 20 every year. The Council, the first of its kind, conveys a positive message from the UAE to the world.

The Council serves as a think-tank that aims at helping governments to adopt happiness as standard for strategic planning, which will directly enhance the quality of life and welfare of people and help nations to overcome future challenges.

HH Sheikh Mohammed added that the UAE, under the leadership of His Highness President Sheikh Khalifa bin Zayed Al Nahyan, believes that the major responsibility of governments is to bring happiness to their people by enabling them to choose the tools and means and providing their nations with hope.

Two days earlier, on March 18, HH Sheikh Mohammed attended the “Journey of Happiness” held at the Dubai Water Canal. The one-day event was organised by the National Programme for Happiness and Positivity to mark the International Day of Happiness.

Minister of Cabinet Affairs and the Future, Mohammad Abdullah Al Gergawi; Minister of State for Happiness, Ohoud Khalfan Al Roumi; and Director General of the Dubai Protocol Department, Khalifa Saeed Sulaiman accompanied Sheikh Mohammed while touring the event’s venue. The event featured



educational, cultural and art activities that saw children, along with their families from various nationalities and cultural backgrounds, partake.

HH Sheikh Mohammad said: “I am happy to see these children along with their families and community members of all ages and different cultures interacting with the event and enjoying it, with smiles on their faces.”

Second Phase of Solar Park Inaugurated



The 200MW second phase of the Mohammed bin Rashid Al Maktoum Solar Park was inaugurated on 20 March by HH Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai

The Mohammed bin Rashid Al Maktoum Solar Park is one of the major projects that DEWA has implemented to boost the contribution of renewable energy to Dubai’s electricity grid. It is the largest single-site solar park in the world, based on the independent power producer (IPP) model, with a planned capacity of 1,000MW by 2020 and 5,000MW by 2030, with a total investment of \$13.61bn.

This phase can generate clean energy for 50,000 residences in Dubai, and will reduce 214,000 tonnes of carbon emissions annually. DEWA set a world record by obtaining the lowest price globally for the second phase of the solar park, at US\$5.6 cents per kilowatt hour. DEWA set another world record with the lowest recorded bid being US\$2.99 cents per kW/h for the 800MW third phase of the solar park.

Dubai also did its part for Earth Hour on 25 March, recording a reduction of 244MW in energy use, compared to 22MW last year. This resulted in offsetting 107 tonnes of carbon emissions compared to 11 tonnes last year.

The significant results achieved by Dubai indicate the importance of the rational use of energy and reducing Dubai’s carbon footprint to protect the environment and natural resources to achieve sustainable development.



MBRF wins government social media award

The Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) has won the Sharjah Award for Best Government Social Media Engagement in the GCC.

The announcement was made during the Sharjah Government Communication Award ceremony, which was organised by the International Government Communication Forum. The Forum itself was organised by the Sharjah Media Centre and ran from 22 to 23 March, under the patronage of His Highness Sheikh Dr Sultan bin Muhammad Al Qasimi, UAE Supreme Council Member and Ruler of Sharjah.

The award is especially important because it tracks government agencies' social media interactions with the public, keeping numerical records to measure their influence on the audience, as well as the positive impact they've had on those agencies' public image. It underlines MBRF's instrumental role in promoting the use of the Arabic language in the UAE and the region as a means to preserve Arab identity. The Foundation made great contributions in that regard, most notably with the "Bil Arabi" initiative, which has garnered unprecedented interactions from the UAE and the rest of the GCC.

His Excellency Jamal Bin Huwairb, CEO of MBRF, said: "Heeding the directives of MBRF's Chairman, His Highness Sheikh Ahmed bin Mohammed bin Rashid Al Maktoum, the Foundation has put forth one successful initiative after the



other to promote and preserve the Arabic language."

"Bil Arabi" is a landmark initiative when it comes to efforts looking to promote the use of the Arabic language on social media platforms," Bin Huwairb added. "Since its inception four years ago, the initiative has recorded unprecedented levels of public interaction and enthusiasm, inspiring people to communicate in their native Arabic. The Mohammed bin Rashid Al Maktoum Knowledge Foundation applauds all efforts that support the use of the Arabic language."

Meanwhile, Adel Farooq, Head of the "Bil Arabi" Team, noted that in 2016, the hashtag #Bil_Arabi trended among one billion users around the world on social media channels Facebook, Instagram, Snapchat and Twitter.✈



High-ranking Visit for MBRF at London Book Fair



His Highness Dr Sheikh Sultan Bin Mohammed Al Qasimi, Supreme Council Member and Ruler of Sharjah, visited the Mohammad Bin Rashid Al Maktoum Knowledge Foundation (MBRF) pavilion at the London Book Fair 2017, which ran from 14-16 March.

MBRF was participating at the fair, one of the publishing industry's most prominent exhibitions, under the auspices of Qindeel Printing, Publishing and Distribution.

Sulaiman Al Mazroui, UAE Ambassador to the UK, as well as

representatives from local and international media outlets, accompanied Dr Sheikh Sultan. Saif Al Mansouri, General Manager of MBRF Holding – which is the foundation's investment arm – received the delegation.

Al Mansouri presented the Ruler of Sharjah with a collection of Qindeel publications by renowned Arab authors, including Ali Afifi Ali Ghazi's new book, *Egyptian-Ottoman Conflict and the International Balance of Power in the 1930s*, which addresses the effects of that conflict on the balance of power in 1930s Europe, and its repercussions on the Near East.

Also in the collection was *Khawajas* and *Stories in the Arabian Desert* by Qasim Bin Khalaf Al Ruwais, which tells 22 stories of explorers from The Netherlands and Poland who travelled across the Arabian Peninsula and documented the stories of its people. †

MBRF launches 'reading convoy' to distribute books to remote Emirati Families

The Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) launched the 'reading convoy initiative to distribute bundles of books on various topics to Emirati families residing in remote areas of the country.

The 'convoy', which reflected MBRF's commitment to the UAE's 'month of reading' initiative, saw a delegation of the foundation's employees visit remote areas across the UAE from March 26 to 30, 2017.

During this time it visited areas including: Al Aweer, Al Habab, and Hatta in Dubai and Falaj Al-Mu'alla, Murbah, Qidfa', and Dafna in Umm Al-Qaiwin.

It also visited the Western Region and Zayed City in the Emirate of Abu Dhabi, in addition to Dibba Al-Fujairah.

His Excellency Jamal bin Huwairib, CEO of MBRF, said: "The Mohammed bin Rashid Al Maktoum Knowledge Foundation launched the 'reading convoy' initiative to support the National Reading Strategy, which designated the month of March as the annual 'month of reading'. The initiative is also part of the Foundation's efforts to honour the Year of Giving 2017, which was announced by His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the UAE, to promote social responsibility in the Emirates."

"The 'reading convoy' reaches out to Emirati families in remote areas across the country and offers them 'knowledge



bundles' to educate all members of the family. The initiative also promotes volunteer work among our own employees, who are personally delivering these bundles to the families," he added.

More than 3,000 bundles were earmarked for distribution, and the foundation worked to widen the area covered by the initiative in order to reach more villages and cities across the UAE.

The initiative promotes reading in the UAE and distributes the foundation's publications to all segments of society, which include international bestsellers translated into Arabic. †



Reading Rank Overall: 9th
Total Reading Time Per Year: 43 hours
2016 Sample Size: 17,561
Number of Arab Countries Sampled: 22

The Arab Reading Index (ARI) was first released in 2016 and aims to provide an objective assessment of the state of reading in the Arab region

under the wider vision of the Arab Knowledge Index. As reading is the basic tool in knowledge acquisition, exchange, and dissemination this assessment is of primary importance. The Arab Reading Index focuses mainly on reading within the more general knowledge development concept, emphasising the role of reading as a tool for enlightenment and empowerment.



63%

EXTENT OF
READING



53%

ACCESS AND
AVAILABILITY

Reading matter
sourced from



43 hrs

Average of total
reading (annual)



55%

Family



65%

School



39%

Society



AVERAGE TOTAL
READING HOURS
(ANNUAL)

Made up of



24 hrs

Electronic
documents



21 hrs

Printed documents



24 hrs

Work related



17 hrs

Not work related



57%

PERSONAL
ATTRIBUTES



96%

Skills and abilities



57%

Motivation



66%

Attitudes



AVERAGE
NUMBER
OF BOOKS
READ

ابت

14

In Arabic

أ

8

In foreign languages



7

Work related



11

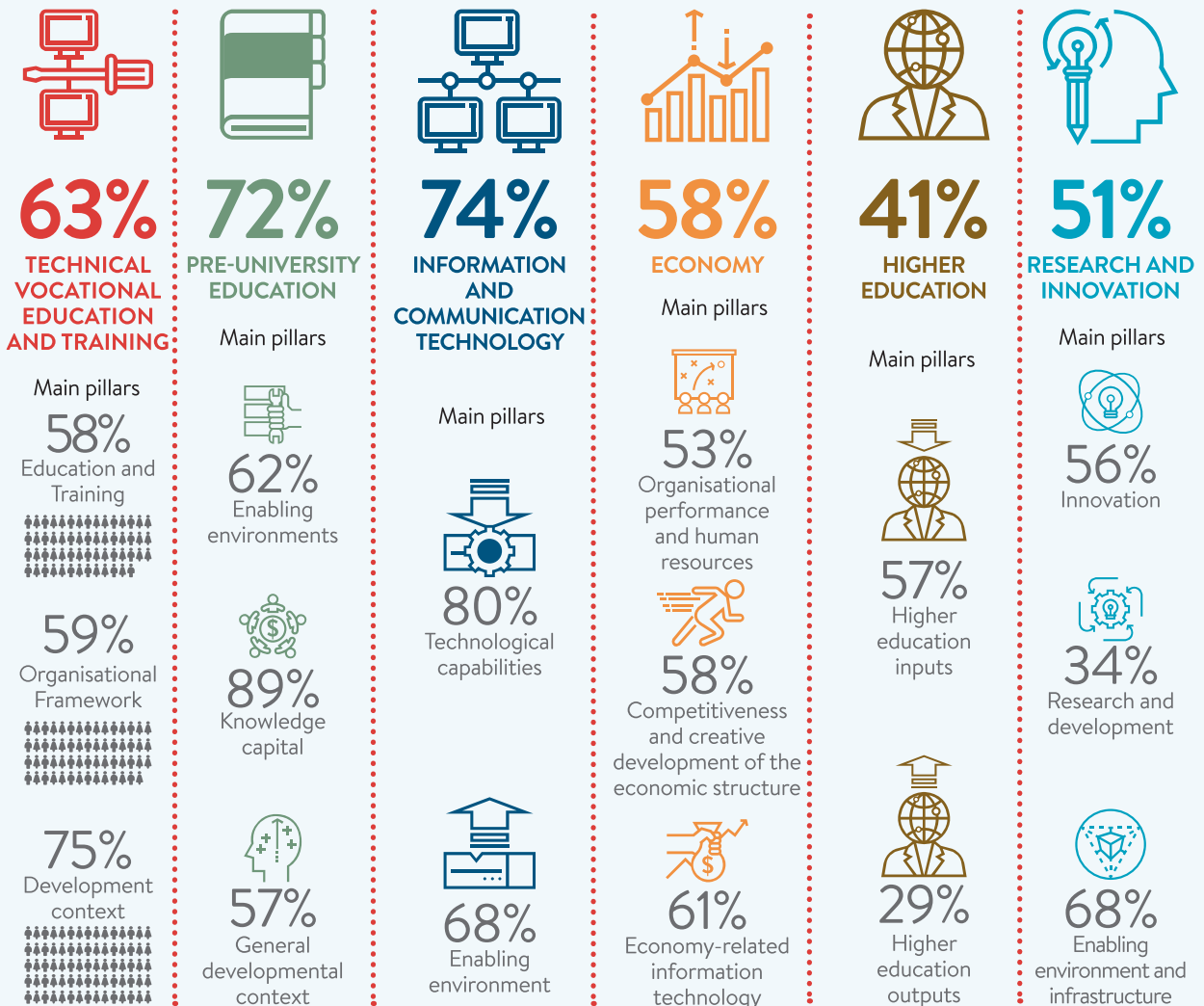
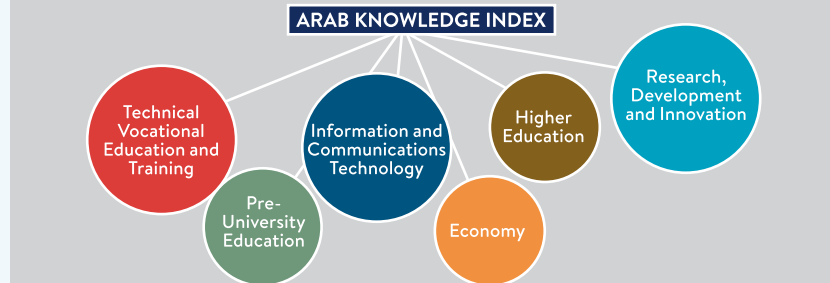
Not work related

The Arab Reading Index is done in partnership by the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

Number of Arab Countries
Sampled: 22

The Index, which was initially launched at 2015's Knowledge Summit, monitors the status of knowledge in 22 Arab countries to help decision makers, experts and researchers to implement development policies and identify knowledge gaps.

THE SIX MAIN SECTORAL INDICES OF THE ARAB KNOWLEDGE INDEX



The Arab Knowledge Index is a joint initiative between the Mohammed bin Rashid Al Maktoum Knowledge Foundation (MBRF) and the United Nations Development Programme (UNDP).

THE PURSUIT OF HAPPINESS

The UAE has embraced happiness as a core principle of government policy both on a national and international level.



Happiness is making headlines in the UAE for all the right reasons, and March 2017 was a particularly good month in that regard.

The positive start to the month was heralded by His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, publishing his latest book *Reflections on Happiness and Positivity* on March 4. In its 24 chapters, HH Sheikh Mohammed posed a different vision of administrative, developmental and civilized work based on positivity, confidence, and faith in citizens of the Arab World. The first chapter poses the question “Why Happiness?” HH Sheikh Mohammed starts the book by conceding, “It is a question repeated many times, especially during the last few years of the lifetime of the government. Why focus on happiness?”

He noted that to answer this question, he had always asked himself a simple, yet deep question that made the answer “not easy”.

“What is my true role as a leader? What is my main job? Is it to manage a government?” He then adds that a government should go beyond enforcing policies and rules and providing society with the basics of

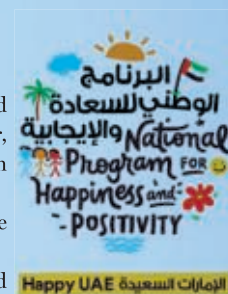
life such as health, education, living and infrastructure. “Can’t we have a bigger, deeper and a more inspiring role than that?” he asks.

The answer is a resounding “yes” as the events of March 20 proved.

On that day the UAE celebrated International Happiness Day, which was highlighted by the establishment of the World Happiness Council by His Highness Sheikh Mohammed Bin Rashid Al Maktoum in his capacity as Vice-President and Prime Minister of the UAE and Ruler of Dubai.

The World Happiness Council was the result of debates on happiness that were part of the 5th edition of the World Government Summit held in February in Dubai. Headed by Columbia University Professor Jeffrey Sachs, the 12-member Council will focus on six key areas: health, education, environment, personal happiness, happy cities and community standards for happiness, each with its own sub-council chaired by a different member of the team.

The Council is also responsible for compiling an annual Global Happiness Report, highlighting



Reflections on Happiness and Positivity sold 20,000 copies in Arabic within 24 hours.

international practices and achievements with regards to happiness and happiness research. The Council will convene twice a year, once during the Global Dialogue for Happiness of the World Government Summit, while the second will be held in New York during meetings of the UN General Assembly.

HH Sheikh Mohammed said on the occasion that the UAE has been founded on the principles of giving, happiness, development, and tolerance to civilisations, cultures and peoples of the world. "We want to help the international community with its ongoing efforts to make this world a better place."

The UAE's leadership in this regard was highlighted by the fact that March 20 was also the day that the annual UN World Happiness Report 2017 was released. It was a further cause for celebration as the UAE was ranked the happiest country in the Arab world for the third consecutive year. The UAE, which ranked 21st globally, advanced seven places from last year. The survey measures happiness levels using six measures including gross domestic product



per capita, life expectancy, support from relatives or friends, charitable giving, freedom to make life choices and perceived levels of government and corporate corruption.

Commenting on the report, HH Sheikh Mohammed tweeted: "The UAE came first in the Arab world for the third consecutive year and the Emirati people are ranked 21st as the happiest people in the world. We are also ranked first globally regarding the satisfaction of residents from other countries.

"According to the report, the UAE ranks first globally in terms of its people's good health and

is the second globally in terms of satisfaction with economy and fourth globally in terms of comfort. It also comes in the second place globally in terms of trust in the future of its economy and fourth globally in terms of satisfaction with living standards," HH Sheikh Mohammed said.

This rise in the ranking reflects the UAE's aim to become one of the top five happiest countries in the world under its Vision 2021 objectives, and reflects the positive impact of various initiatives taken in this regard.

Dubai launched its own "Happiness Index" in

UAE AMONG TOP 10 COUNTRIES IN 21 INDICATORS

01

- Satisfaction with efforts to preserve the environment
- Being healthy to perform daily activities
- Convenience of city for people from different countries to live in

02

- Satisfaction with roads and highways
- Satisfaction with economic conditions
- Economic Confidence Index (evaluation of economic conditions today and in the future)

03

- Belief that city economic conditions are getting better
- Belief that national economic conditions are getting better

04

- Belief that children in the country are treated with respect
- Satisfaction with availability of quality healthcare
- Feeling well-rested
- Satisfaction with city of living
- Satisfaction with standard of living

05

- Feeling that standard of living is getting better
- Satisfaction with freedom to make life choices
- Satisfaction with life after five years

06

- Satisfaction with household income

07

- Satisfaction with public transport system

09

- Satisfaction with children's opportunity to learn and grow

10

- Helping strangers
- People trusted with respect

References: Gallup World Poll 2016

2014, which was designed to help the city make policy that improved the well being of its residents in immaterial ways. This system is based on touch-screen terminals placed in public buildings where passersby are encouraged to leave feedback.

However, the pursuit of happiness really took off with the appointment of Ohoud Al Roumi as Minister of Happiness in February 2016 to help “align and drive government policy to create social good and satisfaction.” Before being appointed as Minister of Happiness she had worked in HH Sheikh Mohammed’s team for the past 13 years. Al Roumi said that during this time happiness and positivity has been the work style within the UAE Government’s team, which was the main factor moving the country forward.

This was made clear in March 2016 when a national 100-day happiness plan was approved by HH Sheikh Mohammed which featured several initiatives spread across three areas: happiness in government policies, programmes and services; promotion of positivity and happiness as a lifestyle in the community; and development of benchmarks and ways to measure happiness.

This was followed in 2016 by the rolling out of Happiness Centres that are designed to help residents improve their satisfaction by offering easy access to birth certificates, medical reports and other information.

Instituting happiness as policy was further underlined when His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai and Chairman of Dubai Executive Council,

launched the ‘Government Policies Guide’ in March this year.

This comprehensive guide that outlines the policymaking process aims to support decision-making processes and achieve the objectives of Dubai Plan 2021. The guide also underlined that government policymaking was based on enhancing the happiness and welfare of individuals and society.

HH Sheikh Hamdan said that the concept of happiness has become a source of pride for Emirati society and he noted it seeks to make the achievement of happiness a key driver of its operations to ensure it becomes a reality in society.

“Enhancing happiness is the government’s main role, and we want Dubai Government to come up with plans to ensure happiness in society through innovative policies, services and programmes. Happiness is the compass of Dubai Plan 2021, and we have been working over the last few years to measure it in different sections of society. It is the main indicator that will demonstrate the success of our plans,” Sheikh Hamdan said.

The UAE isn’t the first country to adopt a national happiness campaign. In the 1970s, Bhutan started keeping track of a Gross National Happiness Index, a system of measuring personal joy akin to how economists might judge a country’s financial health. Venezuela has also experimented with formal happiness tracking.

However, what is clear from the UAE’s approach is that happiness is a holistic concept enshrined in government policy on a national and international level, and that is truly unprecedented. ♪

Ohoud Al Roumi became the world’s first Minister of Happiness in February 2016.

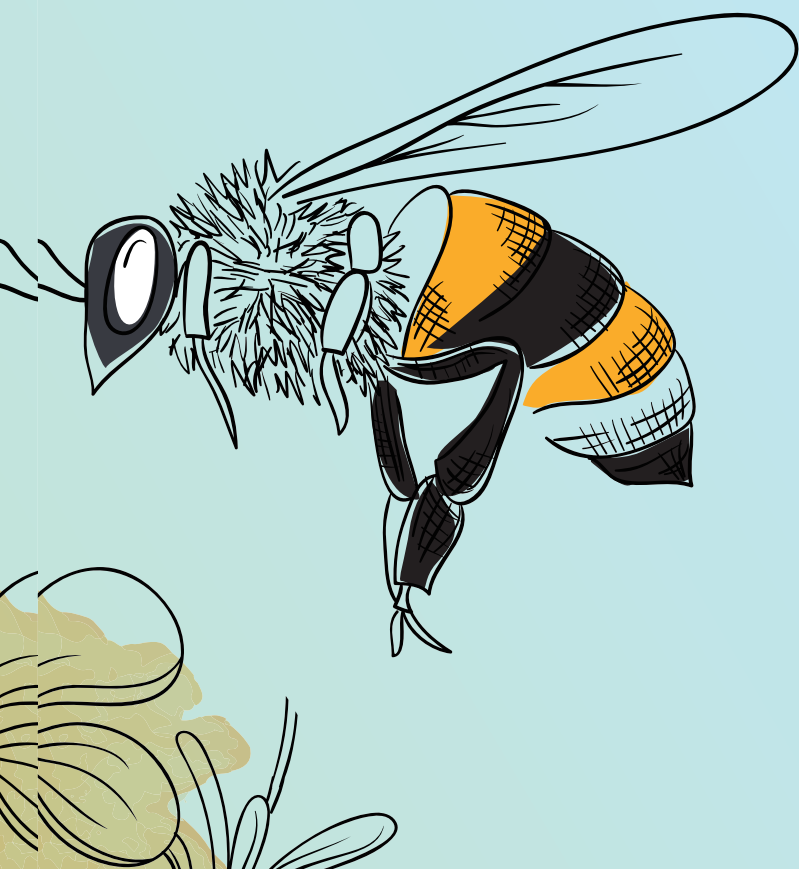


THE EMBATTLED

BEE



Bees are a vital ecological linchpin. The extinction of bees would not only be a tragic loss to the natural world but could signal difficulties for civilisation itself.



It is evident that apiarists love their bees. The dedicated beekeeper becomes attuned to their bees' behaviour and fondly attached to them. It must be a shocking moment when a busy and healthy hive is suddenly found almost empty, save for an abandoned queen and a handful of weakened but loyal worker bees. The rest of the community that forms the super-organism is gone and presumed dead.

This scene is played out all around the world as global bee numbers are reported to be in serious decline. This worrying claim is contested by some scientists and experts, as well as by the giant agricultural firms that produce the pesticides implicated in affecting bees. Yet numerous governmental and independent reports clearly present a growing body of evidence that leaves little doubt that bees are desperately beleaguered.

Bees have been around for over 50 million years and humans have a vital symbiotic relationship with them. Throughout the ages we have been drawn to them for numerous reasons, such as harvesting honey and the natural antiseptic propolis from their colonies, but it is for the service of pollination that we so crucially rely on bees.

The United Nations estimates that of the 100 crop species responsible for providing 90 per cent of food worldwide, 71 are dependent on bee pollination. Albert Einstein is often misquoted as having said, "If the bee disappeared off the surface of the globe then man would only have four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man."

Roughly 70 per cent of quotes on the internet are incorrectly attributed, but it's not who said it but the veracity of the assertion that counts here. It is an overstatement that humans would soon follow bees into extinction. However, if the human race allows the 20,000 species of bees to become imperilled to the point of borderline extinction, forcing us to use alternative means of pollination such as mechanical drones, then our world will be a poorer place.

In the UK and the USA alone, bees represent huge economic value. Bees contribute an estimated annual sum of £651 million to the British economy through their pollination





Above: In Provence, France, bees are used to pollinate the famous lavender fields.

Above right: Bees need pollen from a variety of plants to thrive.



services. The dollar value of plants pollinated by bees in North America each year is a whopping \$265 billion. In February 2017, the US Center for Biological Diversity (a non-profit conservation organisation with more than 1.2 million members dedicated to the protection of endangered species) published the landmark report 'Pollinators in Peril – a systematic status review of North American and Hawaiian native bees'. The report states over 700 North American bee species are headed toward extinction.

Kelsey Kopeck, a native pollinator researcher at the Center and author of the study says, "The evidence is overwhelming that hundreds of the native bees we depend on for ecosystem stability, as well as pollination services worth billions of dollars, are spiralling toward extinction. It's a quiet but staggering crisis unfolding right under our noses that illuminates the unacceptably high cost of our careless addiction to pesticides and monoculture farming".

The evidence has been building over time. In May 2013, the conclusion of a massive Department of Agriculture (USDA) report was that, "The survivorship of honeybee colonies is too low for us to be confident in our ability to meet the pollination demands of US agricultural crops". A bleak forecast that was followed in early 2015 with the White House releasing its first National Strategy to Promote the Health of Honey Bees

and Other Pollinators – a 64-page policy framework for saving the nation's bees, butterflies and other pollinating animals. So far though, the worrying losses have not been reversed.

A further 2015 report from a United Nations group called the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) found that populations of bee species are declining by 37 per cent, with nine per cent of butterfly and bee populations facing extinction. The report adds that in some places in Europe more than 40 per cent of bee species may be threatened.

There is no one singular cause for this potentially catastrophic spectre but rather multiple and interacting causes of death, which grouped together were coined Colony Collapse Disorder (CCD) in 2006. CCD syndrome covers habitat loss, the adverse effects of pollution and climate change, diseases caused by invasive species such as Varroa mites and other pathogens, and the use of chemicals in intensive farming.

Bees need a varied diet of different pollens in order to become strong and healthy workers and the prevalence of monocultures means a disturbing lack of diversity that provides little or no food for bees, creating a green dessert. The combination of a restricted diet, climate change factors such as unusually hot summers and exceedingly cold winters, the stresses of being





Bee swarms when the old queen leaves with around 60 per cent of the worker bees to form a new colony.



Top: A beekeeper checks his hives after they were transported to pollinate crops.

Above: The Varroa mite is destroying bee colonies.

transported great distances on trucks to pollinate agricultural zones, together with the particularly pernicious ravages of mites, pesticides, insecticides, fungicides, viruses and other potential causes of CCD, means that global honeybee colonies are in real jeopardy.

Of all the natural enemies that embattle the honey bee, the Varroa destructor parasitic mite is the greatest threat worldwide. The mite invades the developing bee offspring and sucks its bodily fluids while it's growing, weakening it considerably. When the new-born bee emerges from its cell the mites spread and take over the whole hive and colony. If that wasn't enough, the Varroa mites infect bees with viruses causing birth defects such as useless wings. Despite extensive research, effective

control measures have not yet managed to suppress the mite, which has become resistant to several commonly used chemicals to combat it.

Of the man-made threats facing bees, much attention has been paid to Neonicotinoids. Known in short as "Neonics", these insecticides were introduced in the early 1990s as an alternative to chemicals such as the infamously noxious DDT.

Neonics attack insect's nervous systems and they are the most widely used insecticides in the world with global sales in the billions. The neonics are not sprayed onto crops but instead coat the seeds and then infuse the plants as they grow. When collecting pollen a bee will either take in a lethal dose and suffer convulsions and die immediately, or a sub-lethal dose will attack the brain function and render the bee unable to navigate back to its hive, causing it to become lost and die away from the colony. If a bee does manage to make it back to the hive, the toxins can accumulate over time and potentially kill the whole colony.

With billions of dollars to be made in delaying the restriction of neonics it is not surprising the chemical industry is at odds with those factions producing research and evidence for the list of damaging effects. The giant agricultural firms with a vested interest in neonics fund opposing reports that claim low toxicity for bees and pronounce neonics safe for use.





Above: Beekeeper working among the rapeseed flowers fields of Luoping in Yunnan, China.

There are also conflicting stances within the scientific and academic community. Professor Francis Ratnieks from the Laboratory of Apiculture and Social Insects at the University of Sussex spoke to *Flashes* from Brazil where he was studying bees. Contrary to the many warnings about the plight of bees, Ratnieks says, "Although the media is full of reports of the declines of bees, the number of honey bee colonies in the world is actually increasing and there are now more honey bees on Earth than at any time in the past. The biggest challenges faced by honey bees are diseases and lack of forage".

Ratnieks adds, "Bees are not doing worse than other types of wildlife, and probably better than most." As Ratnieks seems unconcerned about the dangers facing bees, it begs the question – why is there such an abundance of reports, papers, articles, books and documentary films that all widely describe the decline of bees and highlight the catastrophic ramifications that will follow?

Ratnieks relies bluntly, "Death sells... the media reporting of threats to bees is dire as they only report one side".

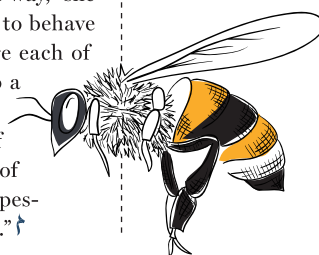
What is inarguable is that CCD has serious implications for the worldwide ecology and economy. If bees were to die out, alternative forms of pollination will be necessary. Ejjiro Miyako, a researcher at Japan's

National Institute of Advanced Industrial Science and Technology, has developed a \$100 mini-drone comprising ionic liquid gel and horse hair to collect and transfer pollen between plants.

Unsurprisingly, not everyone is convinced. Marla Spivak, a MacArthur Fellow and entomologist at the University of Minnesota says, "There are one million acres of almond trees in California. Every flower needs to be pollinated to set the nut. Two million colonies of bees are trucked in to pollinate the almonds, and each colony has between ten and twenty thousand foragers. How many robots would be needed?"

Such a solution would clearly be too expensive to be effective, but it does highlight the importance of protecting the biodiversity we still have left rather than plan for plastic replacements.

Spivak advocates individuals planting bee-friendly flowers as a cheap and effective viable solution. "The beauty of helping bees this way," she concludes, "is that every one of us needs to behave a little bit more like a bee society, where each of our individual actions can contribute to a grand solution, an emergent property, that's much greater than the mere sum of our individual actions. Let the small act of planting flowers and keeping them free of pesticides be the driver of large-scale change."†



THE ECONOMICS OF MAKING MONEY

Cashless transactions may be more common in the modern age but coins and notes are still an essential element of everyday life. That's why mints around the world are still cashing in.

Whether it really makes the world go around or not, it is indisputable that humans have an incredibly strong attachment to and dependence on money. Coins and currency are an enduringly pivotal part of human societies all around the planet.

The first coins were minted around 610-600 BC by King Alyattes in Sardis, Lydia – an ancient kingdom in Anatolia – now present-day western Turkey. A natural alchemy of gold and silver formed the material of these coins, known as electrum. A strict weight-standard was used for electrum coins and just as we save our coins today, so too did those early adopters. The 1904-05 British Museum excavations of the Temple of Artemis at Ephesus – one of the Seven Wonders of the Ancient World – unearthed the first ever known hoard of electrum coins – 19 coins saved in a small pot and buried alongside another 74 coins in the foundations of the temple.

The compulsion to collect coins hasn't waned but strange things start to occur when the face value and

the commodity value of currency begins to blur. At the end of the 1980s in Bolivia, inflation ran out of control so much that low denomination coins became practically worthless. Using a public phone box could cost around 40 thousand pesos. Yet the payphones only accepted 50-peso coins. This created the bizarre situation where a 50-peso coin became worth around 50,000 pesos to someone who needed to make a call.

Another anecdote shared on the forums of numismatists – aficionados and collectors of coins – relates the incident of an aluminium coin in Israel that was once so worthless that US\$200 worth of them would contain enough aluminium to build a commercial airplane.

In the present day, anomalies still occur. The face value of a 2014 American Gold Eagle is \$50, but you could sell the coin for approximately \$1,400. Conversely, a US dollar coin has a face value of \$1, yet its metal content would actually only be worth about 10 cents if melted down. >



COST OF PRODUCTION

\$1 AND \$2

5.4

cents per note

\$5

11.5

cents per note

\$10

10.9

cents per note

\$20

12.2

cents per note

\$50

19.4

cents per note

\$100

15.5

cents per note

Source: Federal Reserve

"A penny saved is a penny earned", said Benjamin Franklin, one of the most famous statesmen of the American Revolution. His simple message was that saving money is an essential way of building wealth and attaining financial success. Franklin, before he became such a giant figure in American history, was the founder and proprietor of a printing shop and today graces the largest currency note printed by the US Treasury – the \$100 bill. The Federal Reserve is purported to make over \$99 profit on every "Benjamin" they print, and this is the difference in production cost and face value known as seigniorage profit. Amongst other revenue streams, such as commemorative coins or producing money for other countries, the seigniorage profit funds the minting body.

The same used to be true of coins, but with fluctuating commodity prices on the metals used for minting coins and the rate of inflation, things can quickly get complex and confounding. As metals such as copper, zinc and bronze and the specific alloys used for coins become more expensive, making money can sometimes become unprofitable.

For example, after the Soviet Union collapsed in the 1990s, the resulting inflation quickly led to rouble coins becoming worth less than their metal content, so they were exported by the container load to Europe and melted down.

In 2007, millions of Indian rupee coins were being melted down and turned into razorblades, causing a severe coin shortage. The trick was that a one-rupee coin melted down was enough to make five to seven razorblades that fetched around 35 rupees. As a result the metal content of the coin was scaled down.

In 2014, *Forbes* reported that the US Mint was finding it harder to be penny wise as the metal used to make coins was getting costlier. Aside from the cost of the metal the report stated that: "making a penny is now around 1.6 cents, leading to losses over the year of some \$55 million from the process of making pennies." This adds a new dimension to Ralph Waldo Emerson's famous quote, "Money often costs too much".

While a coin's face value is easy to determine, calculating its actual worth requires a greater knowledge of several key factors, such as its melt value (the base worth of the metal contained in the coin) the historic importance, aesthetic elements, the Mint year, the condition, rarity and collectability of the coin.

For example, a pre-1965 Washington quarter could be easily squandered by someone



oblivious to the fact that such a coin is 90 per cent silver and therefore worth a lot more than its face value. A similar situation began in 1982 when the US penny switched over to zinc base metal. Coin hoarders began hedging their bets and acquiring as many copper cent pieces as possible as one cent pieces became worth roughly two cents. Thirty-five years later such collectors stand to make 100 per cent gains on their stash. However, the United States government banned the melting or mass exportation of one-cent coins in 2007. Out of an estimated 140 billion total US pennies there could be as much as \$1.5 billion worth of copper pennies in circulation. If the melt ban is ever lifted, the penny hoarders will be able to cash in their small fortunes.

Across the ocean in the UK, there is something of a scramble to find, sell and spend the long serving one pound coin as it is due to become worthless by the end of 2017. Piggy banks, sofas, drawers, old bags and car ashtrays are being scoured up and down the country to find the old coins before they cease to be legal tender. According to government estimates, there are around £433 million pounds' worth of one pound coins stashed or languishing wherever they lie.

Brits are also on the hunt for any rare and collectable examples of the round pound coin before it is replaced by a new 12-sided model, which was unveiled by the chancellor



in March 2017. Demand is high and some coins are currently fetching around £35 on popular auction websites.

The UK's Royal Mint is a grand historical institution. One of the most influential scientists of all time, Sir Isaac Newton, was Master of the Mint from 1699 until his death in 1727. He was tasked with improving the accuracy and integrity of coins and also sought to prevent counterfeiting – a crime punishable by death at the time.

The Royal Mint has been making coins for 1,100 years and is the world's leading export mint, making coins and medals for an average of 60 countries every year. The plant in South Wales, which has 900 employees and runs 24/7, is guarded by the Ministry of Defence and produces five billion coins per year. It is incredibly effective at making money – physically and actually – and in 2015 it generated revenues of nearly £260 million and recorded an operating profit of £11.4 million. The Treasury owns the Mint and pays a dividend of £4 million to the government each year, with the remaining profits reinvested into the business.

The healthy profits are bolstered by the facility producing over two billion coins for 29 other countries and through the sale of commemorative coins struck and sold to mark events such as the 50th anniversary of Winston Churchill's death, the centenary of WWI and the 800th anniversary of the Magna Carta. The new £9 million museum and visitor experience that opened its doors in 2016 will continue to add to the coffers.

When things go to plan there is great wealth in making money. The United Arab Emirates is no

stranger to smart financial innovations and the country looks set to benefit from its own newly inaugurated money making plant. Historically, UAE Dirhams (which have been used since 1973) were printed by companies in the UK and France, while Dirham coins are produced by the Royal Canadian Mint. However, in March 2017, His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, officially inspected the UAE's first banknote printing plant at Khalifa Industrial Zone Abu Dhabi and unveiled a commemorative plaque to mark the official inauguration of the banknote printing company.

The plant is operated by Oumolat Security Printing, which stated that it “aspires to become the premium choice of central banks for any banknote related matters, including production, consultancy, planning of security upgrades to existing banknote designs, provision of conceptual design ideas and conceiving of new security features and concepts”.

His Highness Sheikh Mansour bin Zayed Al Nahyan, Deputy Prime Minister of the UAE and Minister of Presidential Affairs, presented Sheikh Mohammed with the first Dhs1,000 note, bearing the number 1, which is definitely a collectible that will one day exceed its face value.

Theories and predictions of cashless societies may abound but most countries around the world, even the most modern and progressive, show no signs of moving away from real notes and coins any time soon. ↑

Above (L-R):

Blank coins that have been produced at the Royal Mint are sorted before being sent to be stamped in the coin press.

A pressman inspects the press that prints serial numbers on USD 20 bills at the US Bureau of Engraving.

The Royal Mint produces a new £20 silver coin, made to commemorate the First World War.

INDIA'S LESSER-KNOWN HERITAGE SITES

With 35 World Heritage Sites listed by UNESCO, India ranks 7th globally. Many are instantly recognizable such as the Taj Mahal, while others are less known. Twenty-seven sites are of cultural importance and eight are of natural importance.





RANI KI VAV, PATAN, GUJARAT

Built in the 3rd millennium BC in the memory of the kings, it's an explicit example of fine Ancient Indian architecture. It was declared as a UNESCO World Heritage site in 2014, owing to its architectural marvel and splendour. Rani-ki-vav is well known for its stepped corridors, sculptures and stone carvings in the well.



ROCK SHELTERS OF BHIMBETKA, MADHYA PRADESH

Declared a Unesco World Heritage Site in 2003, the Rock Shelters of Bhimbetka is the place where the earliest traces of human life on the Indian subcontinent was discovered. They're located at the foothills of the Vindhya Mountains in the Deccan Plateau and are an archaeological site for the Mesolithic period (more than 100,000 years ago).





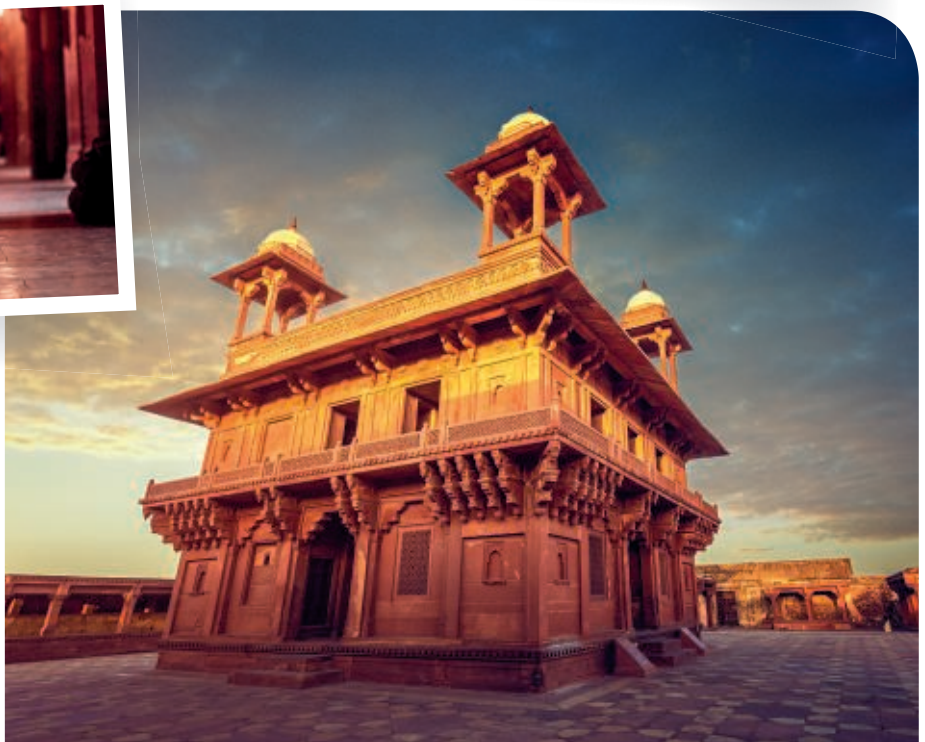
NANDA DEVI AND VALLEY OF FLOWERS NATIONAL PARKS, UTTARAKHAND

Nanda Devi is the highest mountain peak of Uttarakhand and the highest mountain of India. The Valley of Flowers is a National Park near Nanda Devi peak, which is home to more than 600 species of flora and over 520 species of fauna.



FATEHPUR SIKRI, UTTAR PRADESH

Fatehpur Sikri constitutes of four main Monuments. The Jama Masjid, The Buland Darwaza which is the greatest door of Asia made of a specific wood imported from Australia, Panch Mahal or Jada Bai ka Mahal, which is also considered as the origin place of the Navaratnas. It also contained the Diwan-e-khas and Diwan-e-aam.





QUTUB MINAR AND ITS MONUMENTS, NEW DELHI

The Qutub Minar was built in 1193 by the first Muslim ruler of Delhi, Qutub-ud-din Aibak of the Mamluk Dynasty, after defeat of Delhi's last Hindu Kingdom. The Qutub Minar is one of the several other buildings located within the Qutub complex, and it occupies the centre stage mainly due to its height. It is 73 metres tall and has a diameter of 15 metre at the base and 2.5 m at the top.



GROUP OF MONUMENTS AT PATTADAKAL, KARNATAKA

It is famous for its Chalukya style of architecture that originated in Aihole and blended with the Nagara and Dravidian styles of architecture. It is at Pattadakal that all the Chalukya kings were coronated and was the capital of the Chalukyas as well. The Sangameswara Temple is part of the former capital Kisuvolal.



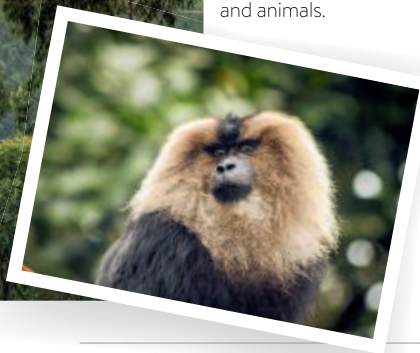
MOUNTAIN RAILWAYS OF INDIA

The mountain railways of India comprise of the Darjeeling Himalayan Railway (pictured), the Nilgiri Mountain Railway and the Kalka-Shimla Railway. Built during the 19th and early 20th century, these engineering marvels were a bold and ingenious solution to the problem of connectivity in the rugged mountains and a gem in the heritage of India.



WESTERN GHATS

The Western Ghats or the Sahyadri mountain ranges lies along the western coast of the Indian Peninsula. The hills cover a 160,000 square kilometre area. The forests along the Western Ghats are home to about 325 species of flora and fauna, which includes endangered, rare and critically endangered species of plants and animals.





MINERAL EXPLOSION

The discovery of 208 new minerals that have developed in the past 250 years illustrates the human impact on Earth.

The Earth is about 4.54 billion years old according to radiometric dating. During this time our planet has undergone numerous changes from the beginning of life to mass extinctions, which geologists, palaeontologists and other Earth scientists divide into chronological dates using the geological time scale (GTS) that relates geological strata to time.

Lately, some scientists have proposed labelling the current time period the Anthropocene to reflect the influence that humans are having on the planet, such as climate change, altering ecosystems or a loss of biodiversity. The exact starting point of the Anthropocene is still being debated, but many scientists say it started on July 16, 1945, when humans detonated the first atomic bomb, which left a powerful chemical marker in the geological record that's detectable with radioactive isotopes.

The Anthropocene Working Group met in Oslo in April 2016 to consolidate evidence supporting

the argument for the Anthropocene as a true geologic epoch. Should the International Commission on Stratigraphy approve the recommendation, the proposal to adopt the term will have to be ratified by the International Union of Geological Sciences before its formal adoption as part of the geologic time scale. Regardless of whether it is officially adopted, the Anthropocene is already in popular use as evidence of the human impact on Earth keeps mounting.

The latest bit of evidence is the identification of 208 new minerals that are a result of human influence on the chemical make-up of Earth. That might not sound like a lot, but the new minerals account for nearly four per cent of the 5224 minerals formally recognised by the International Mineralogical Association.

The anthropogenic minerals were identified in a paper published in *American Mineralogist*.



Above: The sandstone at Petra in Jordan shows different layers of sandstone and minerals.

Above centre: Deformed bands of a banded iron formation.

Below: Robert Hazen is a mineral expert at the Carnegie Institution's Geophysical Laboratory.



Carnegie's Robert Hazen, who co-wrote the paper with Edward Grew of the University of Maine, and Marcus Origlieri and Robert Downs of the University of Arizona, says this development of new minerals is unprecedented.

"It took over two billion years for combinations of elements to meet naturally on Earth at a specific location, depth and temperature, and to form into the more than 5,200 minerals officially recognised today. Within that collection are 208 produced directly or indirectly by human activities, mostly since the mid-1700s, and we believe that others continue to be formed at that same relatively blazing pace. To imagine 250 years relative to two billion years, that's the difference between the blink of an eye and one month."

To figure out when the minerals first appeared, the team of scientists went through geological databases, looking for the time when each officially recognised mineral first appeared in the geological record.

To be defined as a mineral, compounds must meet a fairly narrow band of criteria: they're inorganic, chemically distinct, often arranged as crystals and, most importantly, naturally occurring. This means that rocks, comprised of various minerals and compounds, don't qualify, and things made by humans, such as synthetic gemstones, pure silicon or exotic metallic alloys, are also excluded. Although the International Mineralogical Association currently recognises 5,224 minerals, it is believed there could be as many as 7,000.

Hazen, who is a research scientist at the Carnegie Institution of Washington's Geophysical Laboratory, divides the Earth's history into six great ages of minerals

formation. At first, only magmatic rocks and minerals existed on the cooling crust of the young Earth. When tectonic activity started on the early Earth, metamorphic minerals started to form. After oceans formed, sedimentary rocks were deposited.

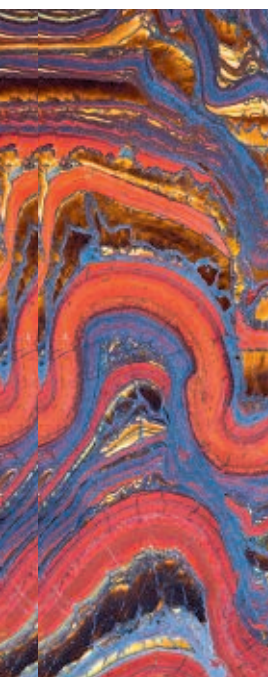
The big mineral explosion came 1.3 to 2.3 billion years ago. At this time the first photosynthetic microorganisms evolved the ability to split water and carbon dioxide, releasing free oxygen into the sea and atmosphere. Reacting with other elements, oxygen formed over 2,000 new oxides and minerals, adding to the 2,000 previously occurring minerals. The evolution of higher life forms and plants and new chemical reactions added further minerals over the next millions of years. Geologists label such a sharp increase or decrease in the number of mineral species as 'punctuation events'.

Today, minerals still form by erosion and chemical weathering of older minerals and rocks. However, the 208 previously non-existent minerals that have appeared in the last 250 years reflect a major speeding up of this process and are a by-product of human activities.

Most of these modern minerals form through chemical reactions between the natural world and human infrastructure, such as mines, quarries and industrial complexes.

"Many are associated with mining," explains Edward Grue, a mineralogist and petrologist from the University of Maine, who collaborated with Hazen on the paper. "Mining disturbs the environment under the Earth, or the Earth's surface," he says, "and that disturbance makes for an environment where new minerals can





form. Some of them have been dated from the Bronze Age, but for the most part they are much newer.”

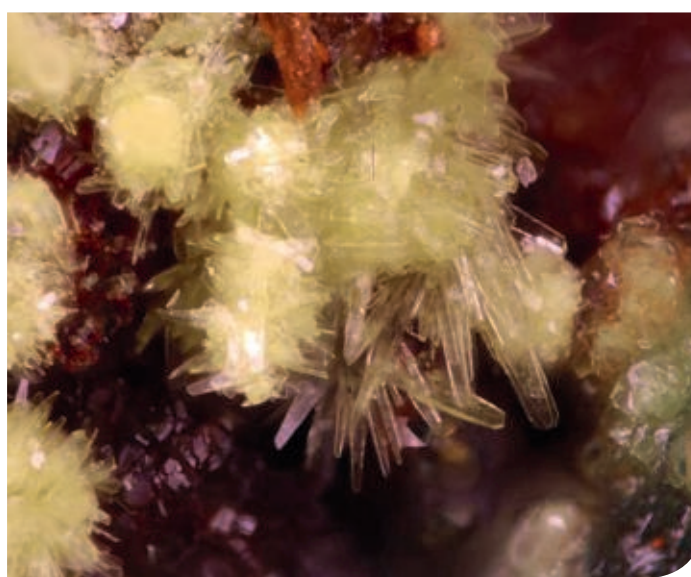
Others minerals have popped up in geothermal pipes, and some have been found in archaeological digs, such as several from a Hellenistic period shipwreck off the coast of Tunisia. The minerals are called things like Jurbanite, Wroewolfeite, Zdeněkite and Pharmacolite, and many bear the name of the scientist who found them.

Landfills are especially promising for the formation of new minerals as they contain a complex mixture of carbon from plastic, silicon and other metals from electronic waste, and acids and chemicals from leaking batteries.

“There are probably all sorts of things forming as a result of old silicon chips or batteries,” says Hazen. “TVs have all these exotic phosphors they use, and magnets and all sorts of high-tech materials. When you start hydrating and oxidizing them, you’re going to start finding a lot of exotic new materials.”

Over time, landfills will be involved in tectonic movements and under heat, pressure or other natural conditions the sites will act as ‘furnaces’ for the creation of new minerals. Also, other human rubbish has the potential to become part of Earth’s geological record. Plastiglomerate is a new type of rock formed by burning plastic trash along the coasts of Hawaii. The melting plastic incorporates the pebbles of lava-rocks found on the beach, forming a never before seen type of conglomerate.

“Simply put, we live in an era of unparalleled inorganic compound diversification,” says Hazen “Indeed, if the Great Oxidation eons ago was a ‘punctuation event’



in Earth’s history, the rapid and extensive geological impact of the Anthropocene is an exclamation mark. There is nothing like it in Earth’s history.”

In geological terms, the distinctive things we find in them define different periods of Earth’s history. According to Hazen, the new minerals would tell future geologists that something was different about this layer formed during the Anthropocene.

It is a sobering thought that these newly created minerals will very likely outlive the civilization that created them, as they will be preserved for billions of years in the sedimentary record. ↑

Above:
Leószilárdite
was found in old
uranium mines.

Top: Many of
the new minerals are
forming in mines.



THE HUNT FOR EXOPLANETS

Until 1995, we knew of just the nine planets that orbit our own sun. With the launch of NASA's Kepler space telescope in 2009, the exoplanet population exploded to nearly 5,000.

Moving to another planet could be much closer to reality than previously thought thanks to NASA's discovery of the Trappist-1 system in February this year. Thirty-nine light years from Earth, the Trappist-1 System contains seven Earth-sized worlds orbiting a dwarf star. Of the seven planets, three orbit in the 'Goldilocks' zone where temperatures are suited to the existence of liquid oceans. If these planets have liquid water, then they are very likely to have some form of life too. The idea that we may have cosmic company, and in such close proximity to Earth, has made Trappist-1 one of the most exciting finds of the 21st century. Astronomers are hailing the discovery as an "accelerated leap forward" in the search for extraterrestrial life.

The discovery of Trappist-1 is indeed groundbreaking – there is no other known star system that contains such a large number of Earth-sized, rocky planets and with temperatures conducive to life. In the words of Thomas Zurbuchen, associate administrator of NASA's Science Mission Directorate, "This discovery could be a significant piece in the puzzle of finding habitable environments, places that are conducive to life. Answering the question 'are we alone' is a top science priority and finding so many planets like these for the first time in the habitable zone is a remarkable step forward toward that goal. This gives us a hint that finding a second Earth is not a matter of 'if', but 'when'."

Man's hunt for exoplanets is not a new one, neither is his curiosity to find alien life. Take for instance the expeditions to Mars. Although the Mars Express and Odysseys Orbiters found evidence of methane and hydrogen in the red planet's atmosphere and the Spirit

and Opportunity Rovers showed that Mars once had liquid water, there has been no conclusive evidence to say that life existed on it. But even if extraterrestrial life exists, astronomers suggest we reign in our imagination. Space explorers and researchers are not expecting to bump into aliens on the new planets. The most likely kind of life to be found there are bacteria and other small micro-organisms similar to the ones that we have found in extreme environments on Earth, such as frozen lakes, hot springs and thermal vents.

THE RUSH FOR EXOPLANETS

Exoplanets are planets that orbit stars other than our sun. The first exoplanet was discovered in 1988. Since then over 5,000 exoplanets have been detected, sparking greater interest in the possibility of extraterrestrial life. However, of these, only three are thought to have conditions that can sustain life. This makes the discovery of Trappist-1 and its three 'habitable' planets even more crucial. According to Zurbuchen, we are experiencing a 'gold rush' in the hunt for exoplanets.

The search for and discovery of exoplanets has spiked exponentially thanks to the availability of advanced telescopes and other cosmic scanning equipment. NASA's Kepler space telescope, launched in 2009, alone has spotted 4,706 possible exoplanets. Trappist-1 was spotted by NASA's Spitzer space telescope. Together with several ground-based telescopes, Spitzer yielded enough data for the research team to precisely measure the sizes of the seven planets and develop first estimates of the masses of six of them, allowing their density to be estimated.





Top and above: The James Webb Space Telescope will have 18 large mirrors when completed, enabling it to analyze the atmospheres of exoplanets.

Long before the Kepler and Spitzer telescopes came along the scientific community relied on the iconic Hubble, the world's first space telescope, to send back images of the universe to Earth. Its elevated perspective and advanced optics allow it to peer further away than any ground-based optics are able to see.

NASA is now using the Hubble to screen the Trappist-1 system. Hubble has already indicated that the planets in Trappist-1 are rocky and not gaseous. Kepler is also focused on Trappist-1, making measurements of the star's minuscule changes in brightness due to transiting planets. The data gleaned by these telescopes will allow astronomers to refine the properties of the known planets, as well as search for additional planets in the system.

THE WORLD'S LARGEST SPACE TELESCOPE

For investigators, Trappist-1 is the best target yet for studying the atmospheres of potentially habitable, Earth-size worlds. Despite their advanced features, Spitzer, Hubble, and Kepler cannot capture the data required to determine if Trappist-1's planets are

habitable or not. Astronomers will have to wait for the launch of NASA's James Webb Space Telescope (JWST) in 2018 to acquire this data.

"If these planets have atmospheres, the James Webb Space Telescope will be the key to unlocking their secrets," said Doug Hudgins, Exoplanet Program Scientist at NASA Headquarters in Washington. "In the meantime, NASA's missions like Spitzer, Hubble, and Kepler are following up on these planets." NASA's current telescopes cannot analyse the atmospheres of the new planets, something the Webb can do with much ease and accuracy. Once the chemical fingerprints of water, methane, oxygen, ozone, temperature and surface pressure are detected, astronomers will be able to accurately assess their habitability.

The Webb telescope has been under construction for nearly two decades and is the world's largest-ever space telescope. Seven times the size of the Hubble, JWST has 18 large mirrors that will collect infrared light, sheltered behind a tennis-court-size sun shield. The telescope's powerful infrared view will be able to pierce through obscuring cosmic dust to reveal the universe's first galaxies and detect newly forming planetary systems.

The actual launch period of JWST in 2018 will be one of the most critical waiting times for astronomers. The full telescope, with a 21.3-foot (6.5 metres) mirror assembly, is too large to launch fully extended,



so the telescope will be carefully furled during launch and will be unfolded over the course of two weeks once it is in space. Next, its sunshield will be extended and the telescope will be given time to cool down. The whole process will take around six months, after which the Webb telescope will be ready to unveil the universe's mysteries.

JWST is poised to bring in a major revolution for the space sciences. Right from the first luminous

glows after the Big Bang to the formation of solar systems and detecting exoplanets – JWST's massive size and several innovative technologies will give man an insight into space like never before.

And while NASA gears up for the launch of its James Webb Space Telescope, exoplanet hunters are getting ready for a whole new era of discovering Earth-like worlds and maybe even extra terrestrial life. †

Above: The exoplanets of the Trappist-1 system in comparison to our solar system's planets.

EXOPLANETS IN THE CONSERVATIVE HABITABLE ZONE			
Object	Star	Period (days)	Distance (ly)
Earth	Sun	365.24	—
Proxima Centauri b	Proxima Centauri	11.186	4.22
Gliese 667 Cc	Gliese 667 C	28.143 ± 0.029	23.62
Kepler-442b	Kepler-442	112.3053	1291.6
Kepler-452b	Kepler-452	384.8	1402
Wolf 1061c	Wolf 1061	179	13.8
Kepler-1229b	Kepler-1229	86.8	769
Kapteyn b*	Kapteyn	48.6	13
Kepler-62f	Kepler-62	267.291	1200
Kepler-186f	Kepler-186	129.9459	561
GJ 273b*	Luyten's Star	18.650	12.36
TRAPPIST-1e	TRAPPIST-1	6.1	39
TRAPPIST-1f	TRAPPIST-1	9.2	39
TRAPPIST-1g	TRAPPIST-1	12.4	39

VENOMS THAT HEAL

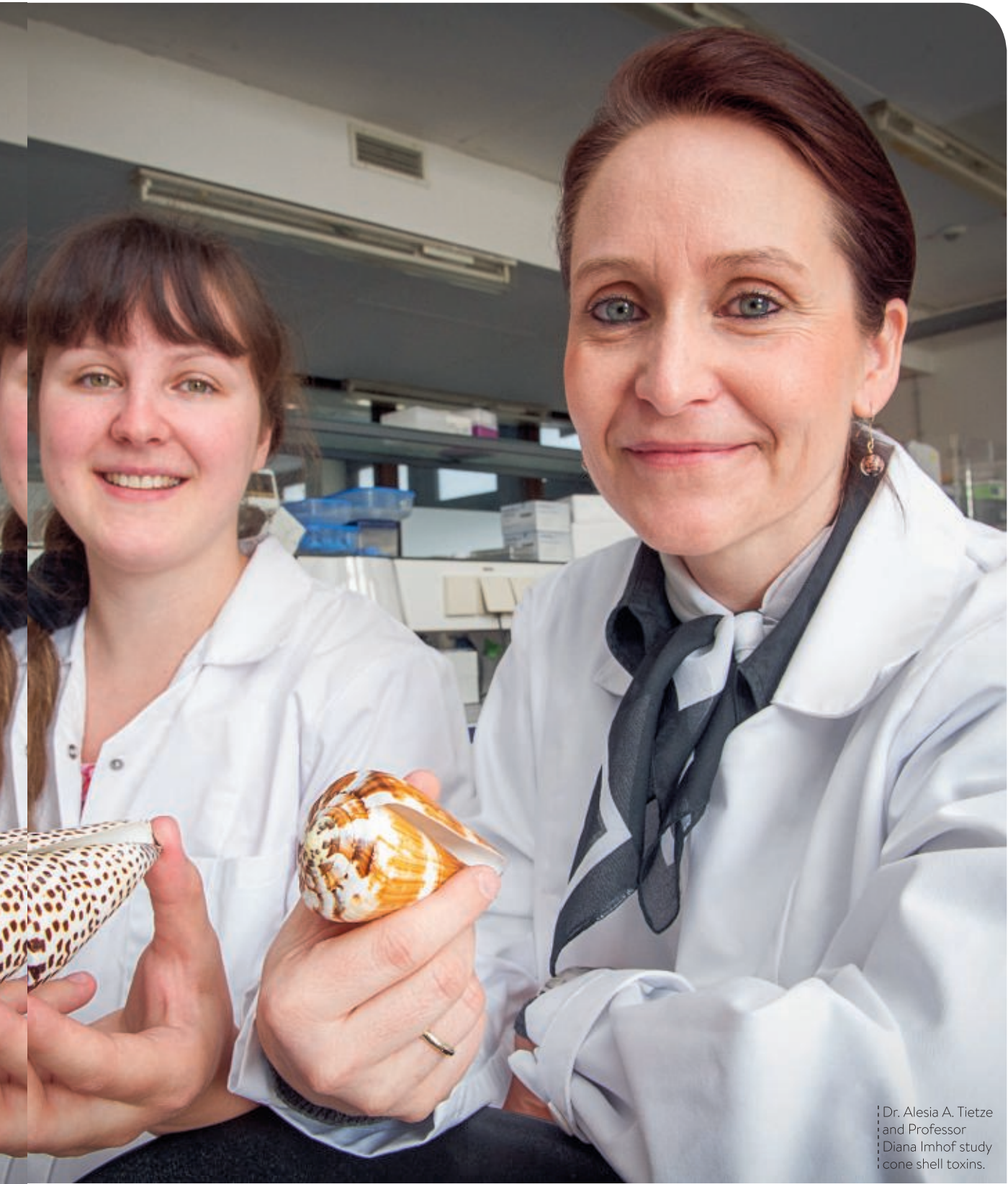
It seems counter intuitive, but there is great potential in animal poisons to give rise to the next generation of painkillers.

According to Professor Glenn King, deadly spiders, centipedes and scorpions could actually help mankind make the perfect painkiller. King, a biochemist and researcher at the University of Queensland spends much of his time studying the neurotoxins that allow these dreaded creatures to paralyse and eventually kill their prey. When an animal is stung with their venom, the toxins in it shut down a 'channel' in the animal's neuron network, killing it. King believes this same mechanism could provide relief to chronic pain sufferers – the neurotoxins in the venom can be used to block the channels that carry pain signals to the brain.

King's experiments are born from the desire to eliminate human dependence on opioid-based painkillers. Although these alleviate pain, they also pose the risks of addiction and drug tolerance where the drug loses efficacy after prolonged use. Opioid-based medications are also recognised as the primary source of fatal overdoses in the United States of America with nearly 71 per cent of deaths related to pharmaceutical overdoses in 2013 caused due to prescription opioid pain relievers. In this regard, animal toxins are much safer. They can alleviate chronic pain without the risk of inducing tolerance or addiction as they target parts of the nervous system outside the brain.

There are potentially 20 million distinct venom toxins, each with their own targets and effects that have yet to be explored. What's intriguing is that venom often targets the same molecules that medicines target to treat disease, "fitting into them like keys into locks." Out of the fewer than 1,000 venom toxins that have been analysed by researchers so far, about a dozen medications have been developed and brought to market. The potential remains huge however. More than 1,000 fish species are venomous, for example, but they are still largely unexplored by science. ➤





Dr. Alesia A. Tietze
and Professor
Diana Imhof study
cone shell toxins.



Above: More than a dozen peptides have been isolated from the Gila monster's neurotoxic venom.

TOXINS TO KILL PAIN

When there is damage to any of the cells in the human body, the cells alert the brain to the threat by releasing a small sodium-ion charge through a pore in the cell membrane called voltage-gated sodium channel 1.7, or Nav 1.7. Blocking the functioning of Nav 1.7 can keep people pain free. A geneticist named Geoffrey Woods discovered this in 2006 and since then researchers and pharmaceutical companies have been racing to find an antibody that inhibits the functioning of sodium channel 1.7. King wants to achieve this by using peptides isolated from venom.

The human body has nine sodium channels that perform a variety of functions. Researchers have to ensure that the substances used to block Nav 1.7 do not block the other channels. For instance, if the 1.7 blocking painkiller also blocks channel 1.5, the patient would die of heart failure.

Venom-based peptides show the promise of overcoming this hurdle too. Made up of short chains of amino acids, they are better at being selective of which channel to block and have the ability to turn off only one particular sodium channel.

PREFERRED POISONS

However, not just any venomous creature will do to create sodium channel blockers. Snake and reptile venoms cannot be used since they destroy the red blood cells and target the cardiovascular system. Only venoms with neurotoxins can help. "Spiders have proved to be the best so far," says King who has studied nearly 300 different arachnid venoms. He believes that a useful and selective peptide is sure to be found in them. Centipede venom also contains a potential 1.7 blocker but the bigger size of spiders makes them more viable for research.

The idea of using animal venom to alleviate pain is not a new one. For millennia, the Chinese have made use of the medicinal properties of scorpion venom for chronic pain and a host of other ailments. In the 1970s, researchers at the University of Utah discovered that certain components of cone snail venom – conotoxins – targeted voltage-gated calcium channels, which, like sodium channels, handle communication between pain-sensing neurons and the brain. By 2004, drug companies had developed painkillers using conotoxins. But these drugs had dose-limiting side effects and could be applied only through injections into the spinal cord limiting their use as mainstream painkillers. Researchers are now trying to create drugs based on conotoxins that can be taken orally.

Poison dart frogs in Central and South America are toxic enough to kill. However, one particular type of poison dart frog may prove to be beneficial. It is called the phantasmal poison frog (*Epipedobates tricolor*) and is found in Ecuador. This tiny frog produces a toxin called epibatidine. In the wild this toxin targets the nervous system, causing paralysis and even death. It was Dr John Daly in the 1970's who

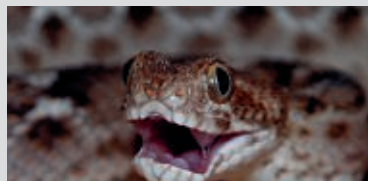


VENOM-BASED MEDICINE



Brazilian arrowhead viper

Its venom was once used on the tips of arrow heads, today it is used to help treat high blood pressure. In 1981, captopril became the first venom-based drug approved by the US Food and Drug Administration (FDA).



Saw-scaled viper

This viper's venom was used to create the myocardial infarction drug tirofiban. Viper venom is known to prevent blood from clotting, which is useful for anticoagulant drugs.



Gila monster

Its venom was used to create the type 2 diabetes drug exenatide.



discovered that the secretions worked as a powerful pain reliever at very small doses. It chemically resembles nicotine and is 200 times more powerful than the opioid Morphine. What makes it extraordinary however is that it lacks the ability to cause addiction. Research is still underway, as it may take seven to 25 years from the time a toxin is identified to the time a new drug is brought to market.

For biochemist George Miljanich, saxitoxin, made by bacteria found in the algae that cause toxic red tides, may be the ultimate pain killer. Although saxitoxin causes paralytic shellfish poisoning in humans, it also binds to six out of the nine sodium-channel subtypes. For him, the challenge is to narrow down

the selectivity to Nav 1.7 only. According to Miljanich, a viable alternative to opioids that could work against all pain syndromes could arrive in the next three to four years.

All these researchers are united by one thought: Mother Nature is a wonderful, productive source of drugs. Even if engineered components of venom don't become drugs themselves, they are extremely useful in pointing out potential new targets. Science can devise ways to prevent pain only when it has an in-depth understanding of what causes pain. And in the long run, the animal venoms offer a tool kit for understanding what happens when people have severe pain. ↑

Above: Pain is transmitted by the Nav 1.7 channel, which is targeted by some animal toxins.

Above left: There are potentially 20 million distinct venom toxins, of which fewer than 1,000 have been analysed.



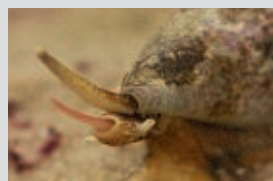
Death-stalker scorpion

Its venom is being used in trials to help locate tumours during surgery.



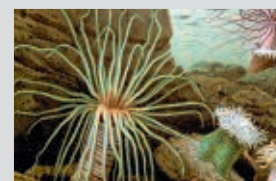
Fire-bellied toad

Venom from the fire-bellied toad is being used to develop drugs that help with imaging and identifying prostate cancer.



Venomous marine snails

Venom from the cone snail was used to make the drug ziconotide, which is used to treat chronic pain.



Sea anemones

Toxins from these sea creatures are being used to create medications to treat autoimmune diseases.

THE FUEL-EFFICIENCY QUEST

The latest generation of jet engines promise fuel savings of up to 20 per cent, but it is becoming increasingly difficult to realise improvements.

The biggest single factor that determines an airline's profitability is the price of jet fuel, which is why the industry is demanding more fuel-efficient aircraft. The second factor is that fuel-efficient aircraft produce less carbon dioxide (CO₂), which is a greenhouse gas implicated in global warming.

The commercial aviation industry emits 705 million metric tons of carbon dioxide annually. While that represents only about two per cent of global carbon emissions, there is evidence that the greenhouse gases in jet fuel have a larger effect on the atmosphere as they are released at high altitude. With legislation looming on the horizon that will penalize high CO₂ emitters, the demand for more fuel-efficient commercial jets is continuously rising.

There are three main ways an aircraft can be made more fuel efficient. The first is aerodynamics, where aircraft with a lower drag coefficient need less thrust. The second is reducing weight, which is why manufacturers such as Boeing and Airbus are using more composite materials. The third factor depends on the fuel-efficiency of the jet engines.

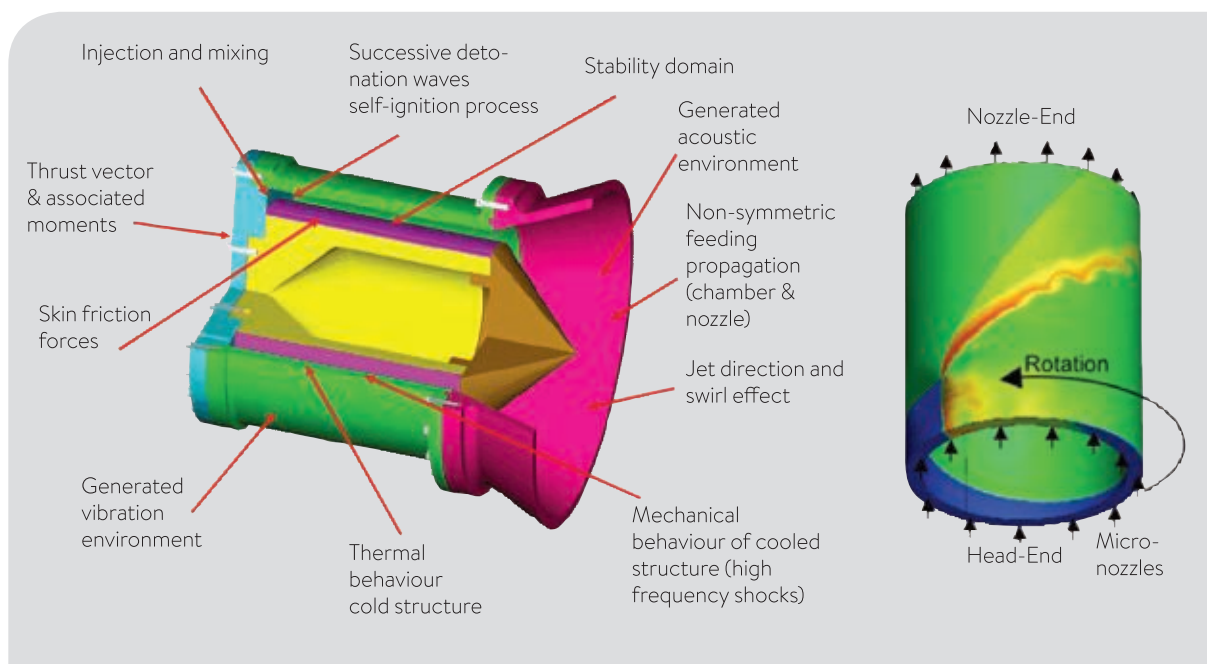
Before World War II, jet engines primarily existed in labs. Great Britain's Frank Whittle, who registered a patent for the turbojet engine in 1930, is credited with its invention. However, Hans von Ohain of Germany built the first fully operational jet aircraft in 1939. His design led to the ME 262, the only jet fighter to fly in combat during World War II. However, due to its high fuel consumption it spent most of its time on the ground, a problem that also plagued Britain's first jet fighter, the Gloster Meteor.

The British shared Whittle's technology with the US, allowing General Electric (GE) to build engines for America's first fighter jet, the Bell XP59. The British continued to develop new turbojet engines from Whittle's design with Rolls-Royce, which is still a major engine supplier today, at the forefront.

The surrender of Germany in 1945 revealed substantial wartime research, which GE and Pratt & Whitney, another American engine-builder, incorporated together with ongoing research on both sides of the Atlantic.







Above: Illustration of a Continuously Rotating Detonation Engine.

Below middle: The ME262 was the first jet fighter to see combat.

In 1948 Pratt & Whitney resolved the high fuel consumption dilemma by combining two engines into one. The engine included two compressors, each of which rotated independently, with the inner one giving high compression for better performance. Each compressor drew power from its own turbine. This resulted in the J57 turbojet engine that was extensively used in the first commercial jet airliners such as the Boeing 707 and the Douglas DC-8.

The next breakthrough was the turbofan jet engine that went into service in the early 1960s. In a turbojet all the air taken in passes through the turbine (through the combustion chamber), while in a turbofan some of that air bypasses the turbine, giving high thrust at low speed, which results in better runway performance. For reasons of fuel economy, and also of reduced noise, almost all of today's jet airliners are powered by high-bypass turbofans as they are the most efficient engines from about 500 to 1,000 km/h, the speed at which most commercial aircraft operate.

Most studies conclude that jet engines have improved their fuel efficiency by between 45 to 55 per cent since 1960. During periods of rapid improvement such as the 1980s, fuel efficiency improved by 2.6 per cent annually due to the aggressive adoption of new technologies and efficient aircraft design principles. In contrast, little net improvement was seen during the 1970s.

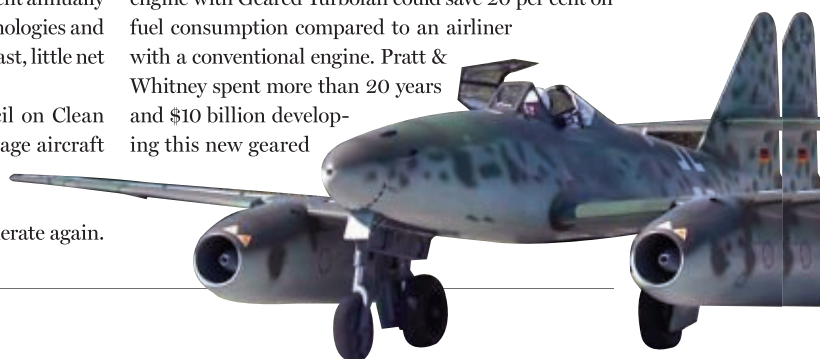
According to the International Council on Clean Transportation (ICAO) reductions in average aircraft fuel burn slowed noticeably after 1990 and largely halted around 2000. After 2010, average fuel efficiency began to accelerate again.

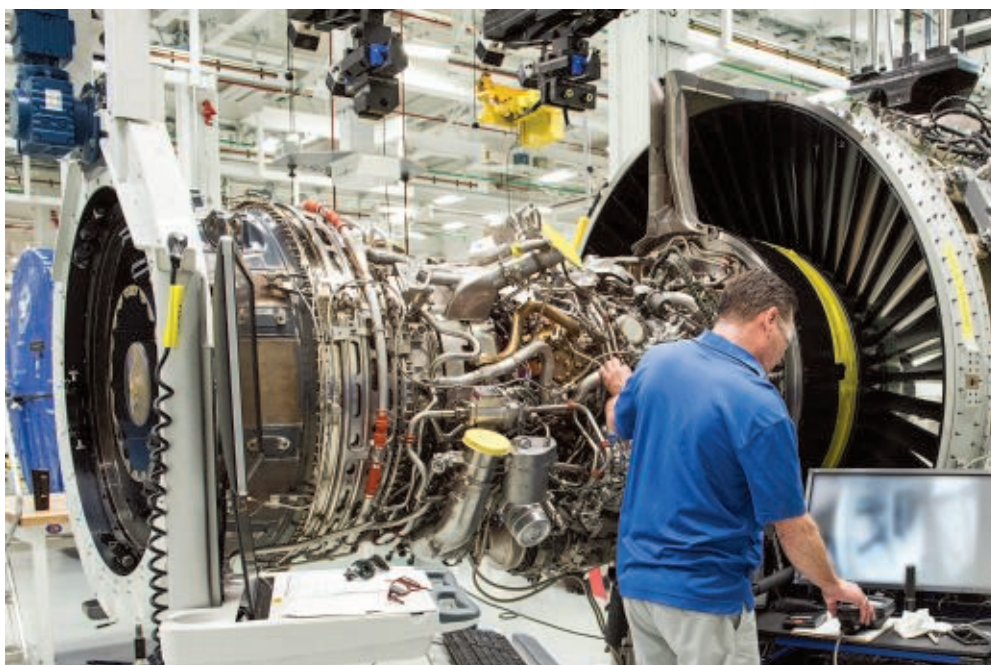
According to estimates by the ICAO there is the potential for a 40 per cent improvement in fuel efficiency for new single-aisle and small twin-aisle aircraft in 2020 relative to 2000 levels. Engines across the line have become better: The unit on the new Boeing 737 Max is twice as efficient as the one on the 737 New Generation introduced in 1998.

The next generation of more fuel-efficient jet engines started entering service last year, but they followed two different approaches.

The Leap 1a engine developed by CFM International, a joint company between GE and Safran Aircraft Engines (France), is using the conventional turbofan architecture. It uses lightweight composite materials, such as carbon fibre fan blades, to achieve energy efficiency gains in the region of 15 per cent. The engine also has some of the first FAA-approved 3D-printed components. For example, the Leap 1a engine's combustion chamber uses 19 3D printed fuel nozzles that are up to 25 per cent lighter than the originals. The first Airbus A321neo equipped with the LEAP engine is due to be delivered later this year.

Pratt & Whitney says its new PurePower PW1000G engine with Geared Turbofan could save 20 per cent on fuel consumption compared to an airliner with a conventional engine. Pratt & Whitney spent more than 20 years and \$10 billion developing this new geared





Left: General Electric's PurePower turbofan engine is the first to use a gearbox to improve fuel efficiency.

turbofan engine, which use larger fans (up to 205 centimetres in diameter on the A320neo) and a gearbox to make the fans rotate more slowly than the internal turbine that drives them, making them more efficient than traditional engines. This marks a radical break from existing technology and the first PurePower PW1000G engines had some teething problems, which have now been rectified. The new engines are also being deployed on different versions of Airbus's A320neo.

The Leap represents "the ultimate refinement of the traditional turbofan engine," says aviation analyst Richard Aboulafia, vice president for analysis at the Teal Group. The two directions for the world's leading makers of jet engines contrast sharply: "Typically new engine designs are different flavours of vanilla," Aboulafia says. "This is the biggest diversion in propulsion philosophy that we've ever seen with two competing engines."

Still, it is becoming increasingly difficult to wring more fuel efficiency out of turbofan engines by increasing air compression, as the cost and complexity of that approach is making it harder to realise improvements. What is needed is a totally new approach.

One such approach, which several companies and research institutions are currently studying, is called the Continuously Rotating Detonation Engine (CDRE). Essentially, this works by creating a series of small detonations and using the supersonic wave that a detonation generates to keep combustion going continuously.

Theoretically, a rotating detonation turbojet engine can produce a large effective thrust at a low-pressure ratio. This will reduce the number

of compressors in conventional turbine engines and minimise the demanding requirements of the turbine manufacturing process.

If the system works, it would require up to 25 per cent less fuel to get the engine moving and keep it moving. And even with less fuel the engine would also theoretically produce significantly more energy. This would not only be good news for aviation, but also power stations and shipping.

"The trick of the engine is containing the detonation, making it stable, and having it operate at conditions you want," says Anthony Dean, head of combustion systems at General Electric's Global Research Center in New York. "Will it operate well, will it be durable, can it have low emissions, and what fuel can I burn with such an engine? We're in the middle of the science phase."

The US military, which is working together with scientists at GE and other companies, is now in the middle of a \$62 million programme aimed at building the first full-scale demonstration of one version of the technology. Yet many challenges still remain, especially building engines that are strong enough to withstand the detonations. That's easier to do for stationary applications like power plants, where the weight of the engine isn't much of an issue. But detonation engines for airplanes might require new materials and impeccable engineering.

Narendra Joshi, advanced technology leader for propulsion technologies at GE, explains: "The detonation is like a hammer blow. You have to be careful where that hammer blow goes." If it goes in the right direction, it will make the aviation sector greener and more profitable. ↑



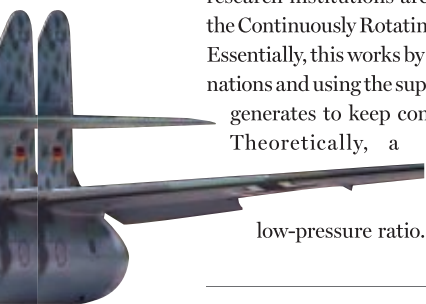
LEAP ENGINES

15%

LOWER FUEL
CONSUMPTION AND
CO₂ EMISSIONS

50%

REDUCTION IN
NO_x EMISSIONS



UNLOCKING THE BLOCKCHAIN

In 2016, His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai and Chairman of the Executive Council of Dubai, announced ambitious plans for Dubai to become “the first government in the world to execute all its transactions using blockchain technology by 2020”. We take a look at what blockchain is and how it works.

Starting this month, hundreds of employees from Dubai’s government, semi-government and private organisations will attend workshops in the use of blockchain technology. The training sessions are in line with the emirate’s plans to become paperless by 2020. The shift to Blockchain – an online encrypted database – is expected to improve the delivery of basic government services and save over 25 million productivity hours per year.

Dubai Land Department, Dubai Municipality, Dubai Electricity and Water Authority (DEWA) and the Department of Naturalisation and Residency (DNRD) plan to launch their blockchain pilot projects by 2018. In the meanwhile, Dubai Customs, Dubai Trade and government-owned ICT firm Dutech are already working with IBM on blockchain ledger projects.

“This effort will position Dubai as the pre-eminent blockchain-powered government,” said Wesam Lootah, the Chief Executive of Smart Dubai Government Establishment. Smart Dubai is designing and building a shared Blockchain platform in conjunction with IBM and ConsenSys for both government entities and private companies to use to pilot and implement such projects.

With this commitment to leadership in blockchain, the government launched a number of initiatives that make Dubai fertile ground for breakthrough and transformative technologies, including the highly selective Dubai Future Accelerators programme.

The Accelerators elicited a staggering response, with over 2,000 companies from 73 countries competing for 35 places. Since then, the first batch of companies in the Accelerators have had an unprecedentedly high success rate of 64 per cent.

Blockchain Virtual GovHack was the largest virtual blockchain hackathon in history, with 1,011 participants of 41 nationalities working on 131 projects. It offered \$140,000 in prizes for government

technology pioneers with the best ideas for blockchain-enabled solutions to global challenges. “The Blockchain Virtual Gov Hack, which is part of the World GovTechioneers Race, has received a high uptake from across the globe, reflecting the great international interest in developing government work through utilising latest technologies to serve societies,” said Hessa Essa Buhumaid, Assistant Director General for Government Services and Pioneership at the UAE’s Ministry of Cabinet Affairs and The Future.

WHAT IS BLOCKCHAIN?

Blockchain is a type of distributed ledger or decentralised database that keeps records of digital transactions. Instead of having a central administrator such as banks, governments and accountants, a distributed ledger has a network of replicated databases, synchronised via the internet and visible to anyone within the network. Blockchain networks can be private with restricted membership, or public and therefore accessible to any person in the world.

Each time a digital transaction is carried out, it is recorded in a cryptographically protected block. The transaction is then broadcast to the entire network of users. The transaction will be complete only when it is validated by miners – special members in the network with high levels of computing knowledge. The miners compete with each other to validate the transaction by solving complex coded problems. The first miner to solve the problem and validate the block receives a reward, such as digital currency. The validated block of transactions is time stamped and linked to the previous transaction by the same user in a linear, chronological order. These recorded transactions become part of an ever growing, unchangeable and encrypted ledger that can be viewed by anyone with the proper access. The ‘ledger’ is stored across a network of computers using cloud computing technology.

Mohammed Shael Al Saadi, CEO of Strategic Affairs at Department of Economic Development, says blockchain will improve government services.



New blocks of validated transactions are linked to older blocks, making a chain of blocks that show every transaction made in the history of that blockchain. The entire chain is continually updated so that every ledger in the network is identical, giving each member the ability to prove who owns what at any given time.

TRUST PROTOCOL

The blockchain is the first native digital medium for peer to peer value exchange. Its protocol establishes the rules – in the form of globally distributed computations and heavy duty encryption – that ensure the integrity of the data traded among billions of devices without going through a trusted third party. Trust is hard-coded into the platform. This is why a blockchain can also be called the Trust Protocol. It acts as a ledger of accounts, a database, a notary, a sentry, and clearing house, all by consensus.

The blockchain is also completely transparent and incorruptible. Digital information can only be distributed across a blockchain network but cannot be copied or even hacked. If someone wanted to hack into a particular block in a blockchain, the hacker would not only need to hack into that specific block, but all of the proceeding blocks going back the entire history of that blockchain. He would also have to hack every ledger in the network, which could run into millions, simultaneously.

Blockchains enable the digitisation of assets, causing a fundamental paradigm shift: we are moving from the internet of information, where we can instantly view, exchange and communicate information to the internet of value, where we can instantly exchange assets. It is creating a new global economy where trust is established not by central intermediaries but through consensus and complex computer code.

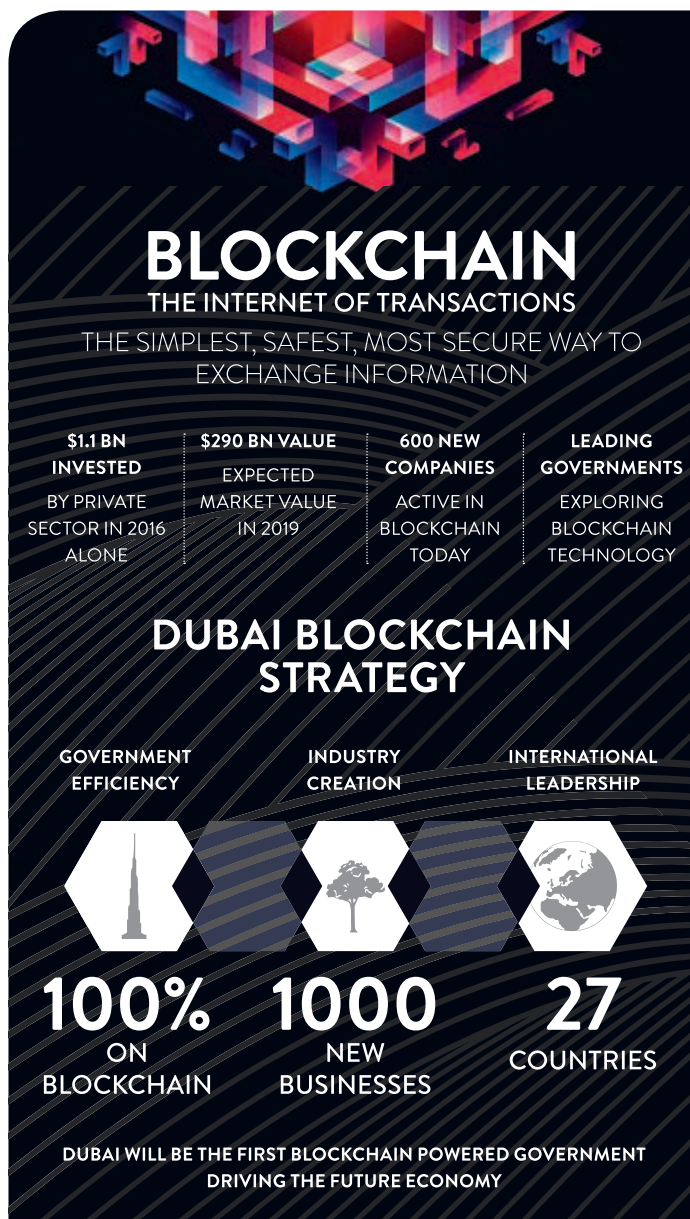
WHERE CAN BLOCKCHAINS BE USED?

Although commonly associated with the digital currency Bitcoin and money transfers, blockchain technology has many other applications. From electronic voting, smart contracts and digitally recorded property assets to patient health records management and proof of ownership for digital content, blockchains can be used in a variety of areas.

Dubai's blockchain strategy is based on three themes – efficiency, creating new specialised sectors and achieving global leadership. The Government of Dubai wants to shift 100 per cent of government transactions to a blockchain network by 2020, encouraging paperless transactions. The move will not only improve efficiency but will also cut almost 100 million paper transactions annually. Apart from the environmental benefits, the 25 million work hours required in handling paper documents

will be eliminated boosting employee productivity. The shift to the blockchain network will create thousands of jobs as there will be a need for companies that provide expertise on blockchains and its related services.

"Blockchain is still a very nascent technology," said Dr Aisha bin Bishr, the Director General of Smart Dubai Office, speaking on the sidelines of a Smart Dubai press conference in Dubai in March. "We're taking the responsibility here in Dubai to make sure that we shape this nascent technology and make it happen in a way that really suits the city's needs."



CULTURE SHOCK

Best-selling author Leila Aboulela has experienced the challenges immigrants face, a fact that is compassionately reflected in many of her books.

The Emirates Airline Festival of Literature has a special place in Leila Aboulela's heart. She attended the first one in 2009 as a member of the audience while living in Dubai. Since then, she has seen the festival's profile and ambition grow, reflecting in many ways her writing career. This year was her second visit as a renowned author and star attraction. "Every time I go, it's bigger, the programme is more varied and there are more Arab writers," she says.

Aboulela, who was born 1964 in Cairo to an Egyptian mother and a Sudanese

father, has a wide world view that stems both from her African/Muslim roots and the fact that she has lived in many different places – Egypt, Khartoum in Sudan, Jakarta, Dubai, Abu Dhabi, London and Aberdeen. It was in Scotland in 1990 that her writing career started when she found herself surrounded by the cold granite of Aberdeen with a two-week-old baby, a four-year-old son and her husband working offshore in the oil industry.

"I think the shock made me a writer," says Aboulela referring to her sense of







Top: Aboulela's third book, *Lyrics Alley*, won the Scottish Book Awards.

cultural and geographical displacement. "I needed to express myself. I was 24 years old and stuck in a strange place, with two boisterous little boys, and my husband was working offshore on the oilrigs. It was a life for which I wasn't prepared. Most of the day I was stuck at home and opportunities to meet or interact with like-minded people were limited. Reading has always been an important part of my life and writing felt like a natural extension. So I joined an evening Creative Writing Class and found welcome and support."

By her own admission, Aboulela had a very "Westernised" upbringing growing up in Khartoum. She attended the Khartoum American School and the Sisters' School, a private Catholic High School, where she learned English and read books such as *Little House on the Prairie* and *Little Women*. She later attended the University of

Khartoum and graduated in 1985 with a degree in Statistics. In 1987, Aboulela studied at the London School of Economics where she was awarded a M.Sc. and an MPhil degree in Statistics.

Her move to Britain resulted in the themes of faith, disruption and displacement that run through much of her writing. It was in London that religion asserted itself. "My faith was started off by my grandmother and mother and so I always saw it as a very private, personal thing," she says. "At the same time, they were very progressive. My grandmother studied medicine in the Forties, which was very rare in Egypt, and my mother was a university professor. In Britain you can do what you like, so being religious is one of the things that I chose".

Displacement, disruption and struggling with assimilation hit her after moving to Scotland. "I

thought to myself, I'm an immigrant. What's that going to be like?" says Aboulela. The answer, to borrow a phrase from one of her novels, was 'a maze of culture shocks'.

"I was always very aware of the differences between people. When I came to Britain, I was interested in life around me. Fiction provided me the space to explore the conflict between an old life and a new life, and I found it really interesting that immigrants I met didn't really talk about these things," she says. "They wanted to forget they were in a new place and instead tried to recreate familiar conditions from the old country. There was a lot of denial going on."

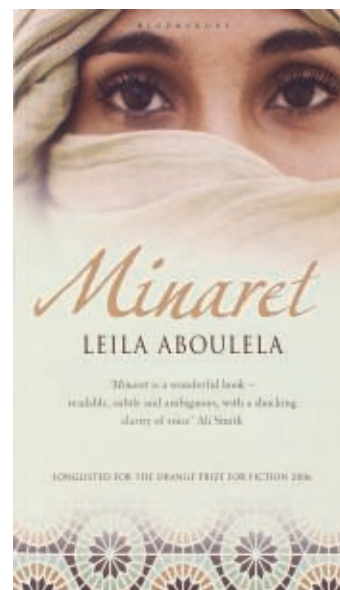
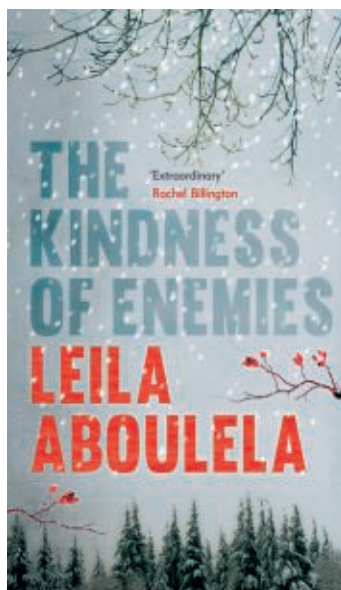
These experiences provided fertile ground for her writing. Her first book, *The Translator*, was nominated for the Orange Prize for Fiction. 'The Museum', a short story from her compilation *Coloured Lights*, won her the first ever Caine Prize for African Writing. It was followed by *Minaret* in 2005, which was nominated for the Orange Prize and the IMPAC Dublin Award. Her third novel, *Lyrics Alley*, appeared in 2011 and was the Fiction Winner of the Scottish Book Awards and was shortlisted for the Commonwealth Writers Prize – Europe and South East Asia. Her most recent release is *The Kindness of Enemies*, which was published in 2015. Besides her novels, she also frequently writes for radio.

The experience of moving towards religion and being a stranger in a strange land was reflected to some extent by the character Najwa in *Minaret*. "There is this sense of alienation, that there is only you and God. That's what religion teaches, that life is a temporary thing which is going to dissolve one day." For Aboulela, a personal, religious identity provides more stability than national identity. "I can carry [religion] with me wherever I go, whereas the other things can easily be taken away from me."

Aboulela is often asked why she writes in English, although she is a fluent Arabic speaker. "I was educated in English and I always read in English," she says. When she is writing dialogue however, she hears it in Arabic in her head and translating it into English as she writes.

However, Aboulela doesn't care much for categorisation. She has been labelled a British-Muslim writer, a Scottish-Arab writer, as well as an African-Muslim author. The category that many settle on is Sudanese-British.

"I don't want to be labeled or tagged as a Muslim writer; I want to be seen just as a writer," explains Aboulela. "But at the same time, when I get appreciated by Muslims themselves, it's nice,



because then it feels that they are saying to me, "Yes, you are authentic, you are part of the community, you know what you're talking about." It's good to have this recognition, but it does sort of constrict you. And certainly, in terms of literary circles in Sudan, they don't like me having this tag of "Muslim writer"; they think that that's not an appropriate label. So I have mixed feelings about it, but I don't mind it too much, because I think there's truth in it, and so I don't feel very strongly against it." However, Aboulela points out "My characters are not role-model Muslims, but they struggle to make their choices using 'Muslim logic'."

After all these years of moving around, how does she categorise herself? "My children think of themselves as British, and they make me feel British when I'm with them. And when I'm in America, I become really British." With her books having being translated into 14 languages, another label could be that she is a voice of multiculturalism. As Aboulela says, she "creates dialogue among peoples and generations."

Top: Displacement, disruption and struggling with assimilation feature in many of her books.





MAPPING THE WORLD

During the Islamic Golden Age scholars compiled their extensive geographical knowledge into books and created amazingly accurate maps.

“I saw the Rusiyyah when they had arrived on their trading expedition and had disembarked at the River Atil,” wrote the 10th century traveller Ahmed ibn Fadlan. “I have never seen more perfect physiques. The man wears a cloak with which he covers one half of his body, leaving one of his arms uncovered. Every one of them carries an axe, a sword and a dagger and is never without all of that which we have mentioned.”

Very little is known about Ibn Fadlan but he left behind one of the most remarkable documents of the Viking Age. He described a world of slave girls and Frankish swords, and a people who were, to him, completely strange. Most famously, he witnessed and recorded in detail the funeral of a chieftain of the Volga Vikings (the Rusiyyah) and the sacrifice of a slave girl.

An expert in Islamic jurisprudence, Ibn Fadlan had been sent as part of a delegation to the king of the Bulgars by the Abbasid Caliph of Baghdad in 921. It took them almost a year to reach their destination, travelling north through what is now Turkmenistan, past the Aral Sea and into the frozen lands north of the Caspian Sea. He chronicled the “violence of the cold” and encountered the Oghuz Turks, who lived as nomads between the Caspian Sea and the Ural Mountains, before heading northwest between the Ural and Volga rivers. Eventually the delegation reached the land of the Bulgars, where Ibn Fadlan presented the king with a letter from the Caliph al-Muqtadir, as well as gifts of perfume, cloth and pearls.

Ibn Fadlan was indicative of a new age of Arab discovery and learning that was encouraged by the Abbasid caliphs of Baghdad during the Islamic Golden Age. Geographers, travellers, chroniclers and cartographers expanded Arab and Muslim knowledge of the world, recording what they had seen and heard and mapping the world in works such as Muhammad ibn Musa al-Khwarizmi’s *Kitāb sūrat al-Ard* (Book on the Appearance of the Earth).

The fact that we know of Ibn Fadlan at all is primarily down to the 12th century geographer Yaqut al-Hamawi, who included an incomplete version of Ibn Fadlan’s journal in his *Mu’jam al-Buldan*





Above: The Arab caliphs commissioned scholars to make maps for them.

Below: Muhammad al-Idrisi created a famous map of the known world called the *Tabula Rogeriana* in 1154.



(*Dictionary of Countries*). A fuller version was discovered in 1923 (in a manuscript found in the Astane Quds Museum in Iran), but a complete version of Ibn Fadlan's travels has yet to be found.

Early Arab cartographers were primarily geographers and occasionally astronomers. Indeed, cartography was a by-product of both disciplines, with many Muslim scholars writing geographical compendiums that described the towns, cities, rivers, seas and peoples of various parts of the known world. Among them were the 9th century polymath Abu Hanifa Dina-wari, who wrote his own *Mu'jam al-Buldan* (*Dictionary of Countries*), and the 10th century Persian explorer and geographer Ahmad ibn Rustah, who wrote the *Book of Precious Records* and, like Ibn Fadlan, visited the Rus-yyah in what is now Russia.

Yet despite the practical knowledge of travellers and scholars such as Ibn Rustah and Ibn Fadlan, the content and presentation of maps created by early Islamic cartographers was not impacted by that knowledge.

"Arabic maps were designed to serve as illustrations to texts, and like their Western medieval counterparts, none can be used as a practical guide to location," wrote the editors John Block Friedman and Kristen Mossler Figg in *Trade, Travel, and Exploration in the Middle Ages*. "Although a few authors give instructions for map production and some texts describe maps, cartography

never became an independent branch of science in the Arab world. Indeed, the massive factual knowledge accumulated by Muslim travellers and geographers on places as distant as Ireland and the British Isles was never translated into cartographic detail, even though extensive narratives existed."

Just as Islamic astronomers had inherited Greek astronomer and geographer Ptolemy's *Almagest* – a mathematical and astronomical work detailing the motions of the stars, the sun, the moon and the five known planets at that time – so geographers inherited his *Geography*. A treatise on cartography, *Geography* was a compilation of the geographical knowledge of the 2nd-century Roman Empire and helped stimulate an interest in the discipline across the Islamic world.

That interest was encouraged by the seventh Abbassid Caliph, Al-Ma'mun, who reigned from 813 until his death in 833. He commissioned scholars to re-measure the distance on the surface of the Earth corresponding to one degree of celestial meridian, resulting in the refinement of the definition of the Arab mile, and ordered the production of a huge map of the world, which has since been lost.

"Al-Ma'mun's map, however, is likely to have been prompted as much by a political motive as by a purely scholarly one, since various early rulers (Sassanid, Fatimid, and Sicilian Norman) were said to have had



similar maps constructed to show that they ruled everything in the world that mattered,” wrote Gerald Tibbetts in *The History of Cartography*, edited by JB Harley and David Woodward. “This map has not survived. The only knowledge we have of it comes from a number of contradictory references in the works of later authors.”

Many of the geographers and cartographers employed by Al-Ma'mun were scholars in the House of Wisdom, including Al-Khwarizmi, whose *Book on the Appearance of the Earth* was essentially a major reworking of Ptolemy's *Geography*. Completed in 833 and accompanied by four (now lost) maps, it gave the latitudes and longitudes for 2,402 localities, corrected Ptolemy's overestimate for the length of the Mediterranean Sea, and depicted the Atlantic and Indian Oceans as open bodies of water, not land-locked seas as Ptolemy had done. It was also arranged according to the Greek system of climates (aqālīm), and included contemporary data as well as knowledge from other Muslim scholars.

“Most Arab writers divided the inhabitable part of the world into horizontal bands known as ‘climata’ or climates (aqalim), of which there were seven,” wrote Tibbetts. “In this they followed the Greek tradition that permeated later Syriac and Byzantine writings, although Ptolemy himself produced twenty-four climates based on the length of the shadow of the gnomon

[the part of a sundial that casts a shadow] or on the length of the midsummer day.”

Most maps of the age depicted ‘south’ at the top and ‘north’ at the bottom and would be considered upside down today. They also frequently featured the Mountain of the Moon, considered to be the source of the Nile, and placed Mecca at the centre.

This Greco-Muslim depiction of the world was one of two main schools of early Islamic cartography, both of which date from the 9th and 10th centuries. The second was centred on the work of Persian mathematician, physician, psychologist and geographer Abu Zayd al-Balkhi, who favoured terrestrial mapping centred on the Islamic world. The maps of the Balkhi school were defined by political, not longitudinal boundaries, with distances between locations equalised (think London Underground map) and only verticals, horizontals, 90-degree angles and arcs used to depict shape and form.

It was the Greco-Muslim tradition, however, that persisted and found its greatest exponent in Muhammad al-Idrisi. Born in Ceuta (now a Spanish enclave off the coast of Morocco), Al-Idrisi lived in Palermo, Sicily, at the court of King Roger II, for whom he created *The Book of Pleasant Journeys into Faraway Lands* in 1154. More commonly known as the Tabula Rogeriana, it is both a description of the world and a world map, and is regarded as the apogee of Arab exploration and geography.

Above: A Western map based on the Tabula Rogeriana.



Above: Close-up detail of the Tabula Rogeriana, which was published in *The Book of Pleasant Journeys into Faraway Lands*.

“Al-Idrisi’s wealth of geographical information was unsurpassed anywhere in the world during his lifetime, and his work is the pinnacle of medieval Arab and Muslim cartography,” wrote Friedman and Figg. “In essence, he adopted Ptolemy’s map of the world and superimposed on it an enormous amount of new information gathered from books and travellers. Especially valuable are the data on Asia and Europe. Al-Idrisi’s maps give the first realistic representation of northern Europe by an Islamic scholar.”

The most accurate world map for the next 300 years, the Tabula Rogeriana presented the world as a sphere and included 70 maps alongside exhaustive descriptions of the physical, cultural, political and socio-economic conditions of each region. It also calculated the circumference of the world to be 37,000 kilometres – an error of less than 10 per cent – and hinted at the concept of gravity.

Understandably, the Tabula Rogeriana’s significance in the history of cartography is considerable.

So too is that of the recently-discovered *Kitāb Gharāḥ bib al-funūn wa-mulah al-uyūn*, known simply as the Book of Curiosities.

An illustrated manuscript of a hitherto unknown Arabic cosmographical treatise, the Book of Curiosities was bought by the Bodleian Library in 2002 and was completely unknown to scholars prior to its sale at a London auction in 2000. The copy of an anonymous work compiled in Egypt during the first half of the 11th century, the manuscript was probably made in the late 12th or early 13th century and contains a remarkable series of early maps and astronomical diagrams, most of which are unparalleled in any Greek, Latin or Arabic material known to be preserved today.

As Emilie Savage-Smith of Oxford’s Oriental Institute told *The Times*: “It is a missing link in the history of cartography between late antiquity and the medieval times. The discovery of this manuscript demonstrates the large extent to which the Middle East has contributed to our shared intellectual history.”†



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