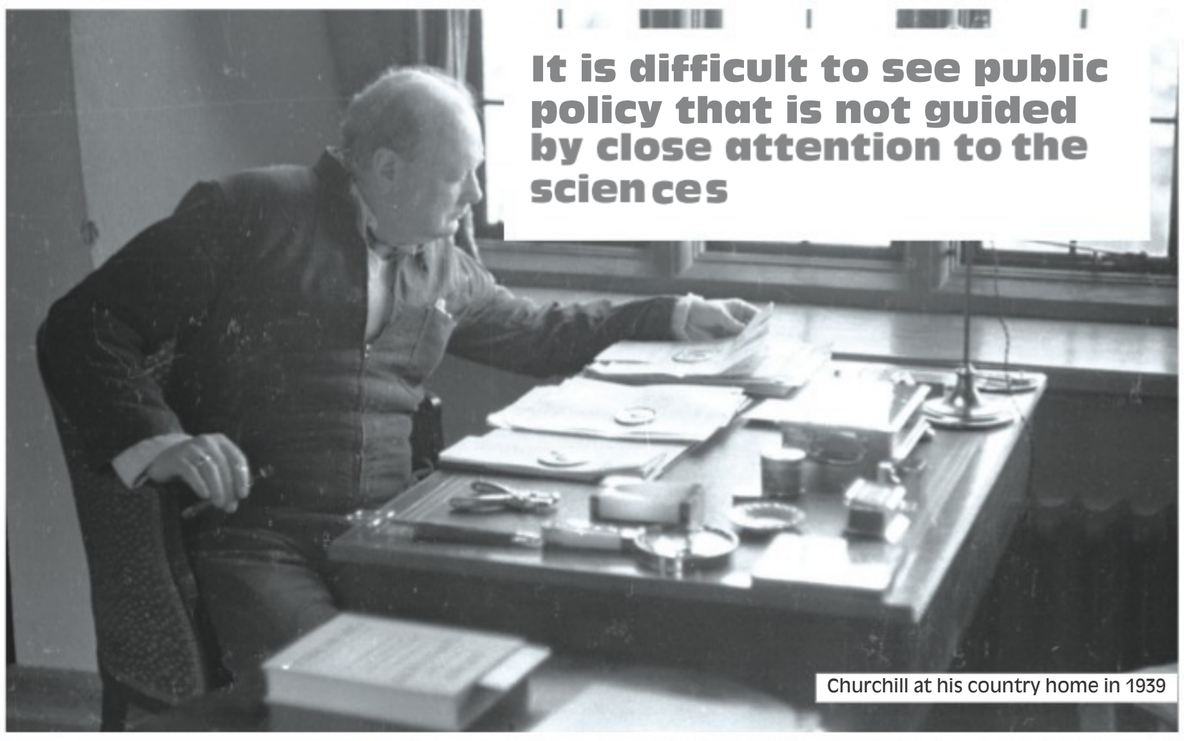
Making room for science



It is difficult to see public policy that is not guided by close attention to the sciences

Churchill at his country home in 1939

Mario Livio

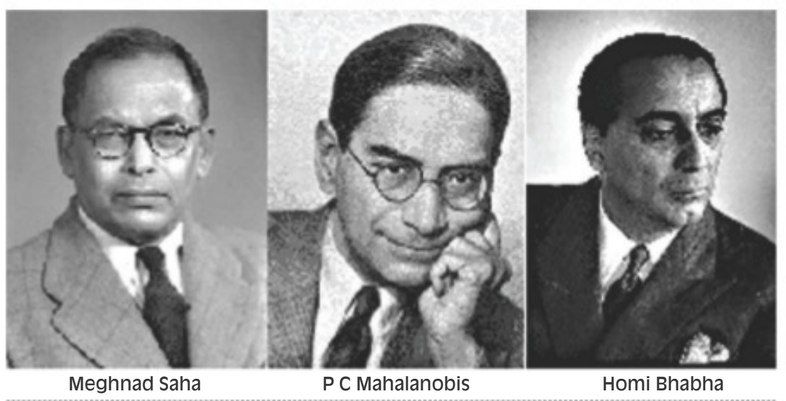
S ANANTHANARAYANAN

Winston Churchill, who led Britain during World War II, is remembered for his acute political acumen, statesmanship and dauntless courage. It would be news to many that he was also closely associated with the sciences.

Astrophysicist Mario Livio recently wrote a "comment" in the journal, Nature, where he chronicles Churchill's scholarship and his commitment to science. The article describes how Churchill wrote extensively on the most current scientific subjects of the times and, in 1940, was the first Prime Minister to appoint a formal science adviser to the government.

Livio is an Israeli-American astrophysicist and is well known for his many books that bring fundamental ideas in science and mathematics within the reach of ordinary readers. What prompted Livio to write about Churchill is the rediscovery, in 2016, of an article on the possibility of extra-terrestrial life, by Churchill. Churchill, back in 1939, discusses the topic much in the same scientific idiom of the current quest for exoplanets. Despite Churchill's fine credentials as a follower of the sciences, the quality of the article came as a surprise, Livio says.

Churchill was passionate about science and technology. "Aged 22, while stationed with the British Army in India in 1896, he read Darwin's On the Origin of Species and a primer on physics," Livio writes. Later, in the 1920s and 30s, Churchill wrote popular science essays in newspapers and magazines. Nuclear power itself was just a concept in 1932 and became something of a reality only by 1942. But Churchill, even in 1931, in an article in The Strand Magazine, had described nuclear fusion power, "If the hydrogen atoms in a pound of water could be prevailed upon to combine together and form helium, they would suffice to drive a thousand-horsepower engine for a whole year," he wrote.



Meghnad Saha P C Mahalanobis Homi Bhabha

Churchill was in regular contact with Bernard Lowell, the celebrated radio astronomer, later first director of the Jordell Bank observatory, and the physicist Frederick Lindemann, whom Churchill appointed as his principal scientific adviser. These associations surely influenced Churchill in the strong support that he extended to the development of radar and the British nuclear programme. Lindemann helped set up a "statistical branch" of the government, with systematic collection and analyses of data from a variety of sources. Economic information, like the status of the nation's food supplies, or the tonnage of shipping being handled, became accurately and rapidly available. A branch of the Imperial War Rooms, a London museum, has records of bar charts that compared bomb tonnage dropped by Germany on Britain with that dropped by the Allies on Germany each month, testimony to the value placed of statistics, with the active participation of the Prime Minister, in directing the war effort.

Livio refers to an exchange between Churchill and Air Chief Marshall Arthur "Bomber" Harris, over the use of statistics to combat the German U-Boats. Air Chief Marshall Harris, who preferred "sustained area bombing" to the government policy of "strategic and targeted bombing", asked, "Are we fighting this war with weapons or slide rules?". "Let's try the slide rule," Churchill is reported to have replied.

"The science-friendly environment that Churchill created in the United Kingdom through government funding of laboratories, telescopes and technology development spawned post-war discoveries and inventions in fields from molecular genetics to X-ray crystallography," Livio says in the essay.

Let us return to Churchill's article on extra-terrestrial life. The article was penned, Livio says, perhaps for London's News of the World, a Sunday newspaper, in 1939. Churchill revised it slightly in the 1950s, but left it with Emery Reves, his publisher. Reves' wife, Wendy, passed the manuscript on to the US National Churchill Museum archives in the 1980s. It may be only in 2016, when Time Riley became the director, that the article shown to Livio, who may be its first commentator.

Churchill, in the article, reasons that the chief characteristic of life is the ability to reproduce. Although viruses share this ability, Churchill decides to focus on "comparatively highly-organised life", presumably multicellular life. Next, he reasons that "all living things of the type we know require water". Although there can be life that depends on other substances, the bases that we have lead us first to look for water, and then for water in liquid form.

This leads Churchill to reason that heavenly bodies that support life must have surface temperature "between a few degrees of frost and the boiling point of water". This is possible on the earth, he explains, because of how far it is from the sun, which leads us on to the kind of planets of other suns that we need to look for, if we can hope to find signs of life on them. Churchill also examines the question of how massive a planet needs to be, given how hot it is, so that it can retain its atmosphere. And he concludes that a large fraction of extrasolar planets "will be the right size to keep on their surface water and possibly an atmosphere of some sort" and some will be "at the proper distance from their parent sun to maintain a suitable temperature".

Churchill, that political leader, statesman and man of letters, back in 1939, when England was on the point of going to war, penned an article on a subject that included most and may have surpassed some parts of known science, at a level that said all that there is even 78 years later. "At a time when a number of today's politicians shun science", Livio concludes, "I find it moving to recall a leader who engaged with it so profoundly."

Closer home, independent India started with the scientist, Meghnad Saha, serving as a Member of Parliament and with the support, for statistics and planning, of the legendary Prasantra Chandra Mahalanobis. And about the same time the audacity of Homi Bhabha who conceived a full-fledged atomic energy programme for a country that was struggling to get on its feet, found support from Jawaharlal Nehru, then Prime Minister.

The world and the country are now facing challenges that only great inventiveness and the best use of resources would enable us to overcome. We also need great objectivity to recognise priorities and make correct choices — having hard science as a guide may never have been more important.

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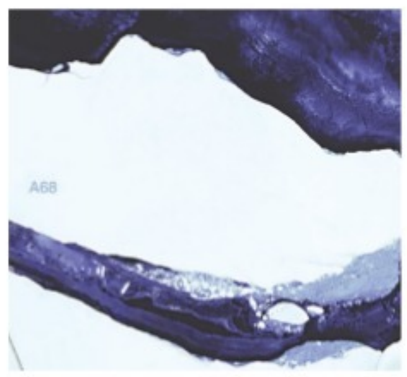
PLUS POINTS

Opinions divided



A massive iceberg four times the size of London has started to drift out to sea from Antarctica, new satellite images have revealed. When the A68 berg broke off from the Larsen C ice shelf, it was unclear what would happen.

Icebergs can remain in place for decades, depending on sea currents and the topography of the seabed. However, the vast slab of ice now appears to be on the move.

At about 5,800 sq km and a trillion tonnes, A68 is one of the largest icebergs ever known, although it is only about half the size of the record-holder, which broke off the Ross Ice Shelf in 2000.

Professor Stef Lhermitte, of Delft University in the Netherlands, posted some of the latest satellite images on Twitter, saying, "After some initial back-and-forth movement, Larsen C's iceberg A68 seems on drift now." And he added that the iceberg "continues to drift", tweeting an image showing the latest position on Saturday and comparing that to a picture taken on Wednesday. If these were too small to track on satellite, they could pose a significant risk to vessels.

Scientists have said it does not appear that global warming played a role in the calving of the iceberg. Dr Natalie Robinson, a marine physicist at New Zealand's National Institute of Water and Atmospheric Research, said it was "a 'normal', if relatively large, calving event" and "very different from the collapse of its neighbouring ice shelves".

However, another expert, Professor Nancy Bertler, of the Antarctic Research Centre at Victoria University of Wellington, said global warming and the hole in the ozone layer had caused the sudden break-up of "numerous ice shelves" in the region "some of which have been shown to have existed for 10,000 years or more".

The independent

It's a gas

Onions make us teary because a reaction in the bulb releases a chemical called lachrymatory factor that irritates our eyes. Peeling an onion won't make your eyes water. But if you chop, cut or crush one — boohoo! The onion's cells break open, allowing two normally separated substances to combine.

Linked together like pieces of a puzzle, they become a potent chemical weapon. "It turns into a gas. It hits your eyes, and then it hits the sensory nerves in your eyes and causes them to tear up," said Josie Silvaroli, an undergraduate at Case Western Reserve University in Ohio who helped describe the process in a paper published in the journal *ACS Chemical Biology*.

Lachrymatory factor evolved as a defence mechanism, protecting onions against microbes and animals. Damaging an onion causes it to ramp up its defences — as cells break, the chemical reaction is unlocked.

Inside the intact cells of an onion, a molecule called sulfenic acid precursor floats around the watery filler like a napping human in a lazy river. Also in that cytoplasm are little sacs called vacuoles, containing a protein called alliinase, which is like a little drill sergeant of the process. "One has not seen the other, but if you damage the cells, they can now meet and make these reactions," said Marcin Golczak, a biochemist at Case Western Reserve and the study's main investigator.

Can you avoid the onion feelies? In Japan, scientists engineered a tearless onion. But it lacks that signature onion flavour.

With regular onions, there are options — chuck your onion in the fridge before cutting or submerge it in water while chopping. These, however, will alter the flavour.

Unfortunately, it seems there is no simple way to avoid it. For the love of onions, sometimes you just have to cry.

The straits times/ann

A matter of pride and joy

Cassini's 20-year Saturn mission was one of the most ambitious space operations ever

JOHN VON RADOWITZ

Cassini will long be remembered as one of the most ambitious and successful space missions ever undertaken.

First there was the sheer distance involved. The 22ft long spacecraft, launched from Cape Canaveral, Florida, in 1997, took seven years to reach Saturn after a journey of two billion miles that involved fleeting visits to Venus, Earth and Jupiter. Each fly-by provided a gravitational "kick" that boosted Cassini's speed to more than 42,500mph and helped the probe on its way.

Another challenge was communicating with and controlling an unmanned robot so far out in the outer solar system. Saturn is on average 890 million miles from Earth, and it takes around 83 minutes for radio waves to cross that distance at the speed of light.

Ground controllers could not give Cassini "real time" instructions and instead relied on extensive pre-programming. Complex sequences of commands were written for large blocks of time lasting hours, days or even weeks, which were encoded in radio signals beamed to the craft. In addition, the probe's computer "brain" automatically kept it safe and stable and responded to problems requiring immediate action.

This illustration shows Cassini above Saturn's northern hemisphere

That far from the sun, Cassini's power had to come from a small plutonium-fuelled nuclear reactor rather than the familiar solar panels seen on many space probes. The scientists wanted to get their money's worth from the £2.9 billion mission and so packed Cassini with instruments, leading to comparisons with a multi-purpose Swiss army knife.

Cassini also carried a small lander called Huygens, supplied by the European Space Agency, whose descent to the surface of Saturn's giant moon Titan made headlines around the world and marked the highpoint of the mission. In January 2005, the tiny Huygens probe parachuted down through Titan's thick nitrogen and methane atmosphere and landed on a pebble-strewn surface with the consistency of wet sand.

It was the first successful landing made on a world in the outer solar system. The images Huygens sent back showed startling Earth-like features similar to rivers and shorelines. These and other pictures from orbiting Cassini confirmed that Titan has lakes, rivers and seas filled not with water, but liquid methane and ethane.

Cassini carried a total of 12 instruments, several of which were wholly or partly contributed by UK scientists. They provided the probe's senses for studying the dust, gas and magnetic fields around Saturn and its moons as well as capturing optical and radar images at visible and invisible wavelengths. Together the instruments delivered a wealth of data that scientists will be analysing for a long time to come.

One of Cassini's chief discoveries was a global watery ocean beneath the icy surface of Saturn's moon Enceladus. Gravity measurements suggested an ocean some six miles deep below an ice shell 19 to 25 miles thick. The ocean could explain the appearance of water spray geysers bursting out of fractures at the moon's South Pole.

Scientists believe that, like the similar sub-surface ocean on Jupiter's moon Europa, the vast reservoir of water under the ice of Enceladus could harbour life. Cassini also added to Saturn's large collection of known moons, more than 60 of which have been counted with confirmed orbits.

Six named moons were identified by the probe, Methone, Pallene, Polydeuces, Daphnis, Anthe, and Aegaeon. A seventh unnamed "moonlet" was found embedded in Saturn's B ring. Cassini's detailed studies of Saturn's famous rings, which are made from particles of ice and rocky debris, shed new light on the creation of moons and planets.

The probe observed propeller-like formations within the dynamic ring system, and the appearance of a small icy object on the edge of the rings that may mark the birth of a new moon. In addition, the mission solved the 300-year-old mystery of Saturn's two-tone moon Iapetus, which has one face that is light and another that is dark.

Scientists discovered that as it orbits Saturn, Iapetus picks up dark reddish dust on its leading side. Water cannot freeze on the darker half of the moon, which absorbs more heat, but forms a bright frosty covering on the lighter hemisphere.

Cassini also investigated giant storms on Saturn and spotted raging hurricanes at both poles, and has identified unusual natural radio waves from inside the planet whose origin is still uncertain.

The independent

What a way to go

This image shows Cassini's "farewell portrait", depicting the intriguing moon Enceladus rising above Saturn's surface. Soon after, the craft plunged into the latter planet, destroying itself.

Scientists say that the craft's fiery end was emotional, bringing both sadness and joy. But it was also important, allowing Cassini to see the planet in far more detail than ever before, and send back what it found. For now, scientists are just pleased that the mission - and its ending - went so well. The last messages and information were received here long after the craft had been destroyed, because it takes so long for that information to travel.

"The Cassini operations team did an absolutely stellar job guiding the spacecraft to its noble end," said Earl Maize, Cassini project manager at the Jet Propulsion Laboratory. "From designing the trajectory seven years ago, to navigating through the 22 nail-biting plunges between Saturn and its rings, this is a crack shot group of scientists and engineers that scripted a fitting end to a great mission. What a way to go. Truly a blaze of glory!"

Scientists now hope to pick through that information and find even more about how the planet formed and changed over time. Its last moments allowed it to have a taste of Saturn's mysterious atmosphere - that same atmosphere that would go on to destroy the craft, and disperse what was left over the planet's surface.

"This is the final chapter of an amazing mission, but it's also a new beginning," said Thomas Zurbuchen, associate administrator for Nasa's science mission directorate at Nasa headquarters in Washington. "Cassini's discovery of ocean worlds at Titan and Enceladus changed everything, shaking our views to the core about surprising places to search for potential life beyond Earth."