AFP

Protests in Hong Kong

Why has a draft extradition bill sparked huge demonstrations? And are relations with China deteriorating?

STANLY JOHNY

The story so far: An extradition bill Hong Kong authorities had proposed triggered one of the largest protests in the city's history, escalating tensions between its pro-Beijing ruling elite and a defiant civil society. On Wednesday, hundreds of thousands of people assembled at the city's legislative council where lawmakers were supposed to debate the bill, leading to violent clashes between protesters and security personnel. Police fired tear gas and rubber bullets to disperse the crowd, which threw bricks and other objects in return. Following the unrest, lawmakers delayed the discussion, finally suspending the bill indefinitely on Saturday.

What is the extradition bill?
Hong Kong has seen several protests since it was handed over to China by the British colonialists in 1997. In 2003, then Chief Executive Tung Chee-hwa's attempt to pass stringent security legislation, which Beijing had pushed for, was successfully resisted by tens of thousands of protesters. In 2014, the city saw weeks-long protests against proposed changes in the electoral system, which came to be known as the Umbrella Movement. In the latest protest, the trigger has been the extradition bill which, if passed, would have allowed the city government to extradite any suspect to places with which Hong Kong does not have extradition accords. When Hong Kong's extradition agreements were finalised, mainland China and Taiwan were left out because those regions had fundamentally different criminal justice systems from that of the city. This "loophole", according to the Hong Kong government, allows suspected criminals to avoid trial elsewhere by taking refuge in the city. Hong Kong's current leader, Chief Executive Carrie Lam has said the bill would close the loophole so that suspects wanted elsewhere, including in mainland China, could be extradited. To argue that the law is urgently required, she cited the case of a Hong Kong man who is facing charges in Taiwan for murdering his girlfriend. The extradition plan applies to 37 crimes, including murder, sexual offences, abduction, drug peddling and corruption, with retroactive effect. The Chief Executive can decide on extradition requests on a case-by-case basis which would then be reviewed by the city's courts.

> Civil society groups and Hong Kong's pro-democracy activists say the bill would have allowed mainland China to deepen its influence over Hong Kong

Why is there opposition to the bill?
Civil society groups and Hong Kong's pro-democracy activists say the bill will allow mainland China to deepen its influence in Hong Kong. The relationship between China and Hong Kong is anything but smooth. When Hong Kong was handed over to China in 1997 by Britain, both sides agreed that the city would remain a semi autonomous region under the Basic Law, its mini-Constitution, for 50 years. The Basic Law provides people in Hong Kong more political freedoms than their counterparts in mainland China. There is a relatively free press, an unregulated Internet and a less-controlled judiciary in Hong Kong. Also, mainland authorities are not allowed to operate directly in Hong Kong. But Beijing has increasingly tried to exert its influence on the city in recent years, raising concerns of the city's pro-democracy groups which are largely Beijing-sceptics. There have been instances of China critics being abducted from Hong Kong with the city government doing nothing to resist such actions. Furthermore, the Hong Kong government itself has shown growing authoritarian tendencies in recent years. There have been instances of lawmakers being disqualified, activists banned from running for office, a political party prohibited and a foreign journalist expelled. So civil society groups are fighting two odds – growing instances of Beijing's meddling in Hong Kong's affairs and rising authoritarian traits of the city's rulers. They say the bill is another blow against the rights those in Hong Kong currently enjoy, noting that it would empower the city government to send critics of Beijing to the mainland where the criminal justice system is tightly controlled by the establishment. It will practically break the existing legal barriers between Hong Kong and mainland China that are guaranteed under the "One Country Two Systems" model, say the protesters.

What is next?
Ms. Lam had initially said she would not back off despite the protests. Evidently, she had the backing of Beijing as well. Two members of the Politburo Standing Committee of the Communist Party of China had publicly endorsed the bill, unlike in the past when Communist Party officials restrained themselves from commenting on the city's internal matters. But the protests, in which at least a million people, or one in seven residents of the city, participated, seem to have shaken the local government. After Wednesday's protests, there were calls for Ms. Lam to step down with critics slamming her for the heavy force used against the protesters. The protesters even called for a fresh sit-in on Sunday if the government did not withdraw the bill. Amid rising pressure, Ms. Lam said on Saturday that she was suspending the Bill indefinitely, handing a major victory to the protesters. While the government's U-turn could calm tensions for now, the crisis has exposed, once again, the growing distrust between the city's pro-Beijing authorities and its civil society.

In cricket, how does the DLS method work?

When and why was the DLS method or the Duckworth-Lewis-Stern method introduced in cricket to handle rain interruptions in one-day matches? What will its impact be on the ongoing ICC cricket World Cup?

SHREEDUTTA CHIDANANDA

The story so far: Rain has played spoilsport at the ongoing International Cricket Council (ICC) cricket World Cup England and Wales 2019, washing out a number of matches, including India's clash with New Zealand. As wet weather continues to affect games, the Duckworth-Lewis-Stern (DLS) method could come to feature prominently at the tournament.

What is the DLS?
The Duckworth-Lewis-Stern or DLS method (as it is now known) is a mathematical system employed to calculate target scores and reach outcomes in rain-shortened limited-overs matches. Devised by English statisticians Frank Duckworth and Tony Lewis and originally named after them, it was first used in 1997. Australian academic Steve Stern updated the formula, becoming its custodian ahead of the 2015 World Cup; his name was added to the title.

Why is it needed?
Having a reserve day in place for a limited-overs match and resuming proceedings the following morning would seem ideal, but logistical and scheduling challenges mean this is not always feasible. And so the game's administrators have for long laboured to find the fairest way of settling rain-affected one-dayers. When a match is interrupted by inclement weather, and one or both teams do not get their full quota of overs, an outcome has to be reached in the time available after resumption of play. What any calculation is doing is trying to adjust a target score according to the reduction in overs. Any number is an estimate: there is no one right answer. What the ICC has tried to do is arrive at a formula that takes into account as many parameters as possible and properly reflects the efforts of both teams. The DLS method, which has been updated a few times, is generally considered the most accurate system used in international cricket.

Why were older methods discarded?
When ODI cricket was first played, Average Run Rate (ARR) was used to calculate targets. Here, the chasing side simply had to match the opponent's run-rate. For example, if Team A scored 200 in 50 overs, at a run-rate of 4, and if Team B's innings was reduced to 30 overs, then the total to overcome would be 120. But this method did not take into account wickets lost, or the fact that it was easier to maintain a good run-rate over a lesser number of overs. So if Team A made 200 in 50 overs batting first and Team B was 100 for nine in 20 overs when rain ensured no further play was possible, the latter would be declared the winner. So the ARR method was inherently biased towards the team batting second.

Australia came up with an alternative to the ARR ahead of the 1992 Cricket World Cup, called the Most Productive Overs (MPO) method. This involved reducing the target by the number of runs scored by a team in its least productive overs, equal to the number of overs lost. For example, if Team A made 250 in 50 overs and Team B's innings was reduced to 30 overs, then the total to beat would be the total number of runs Team A scored in its highest scoring 30 overs. Here, Team B had genuine cause for complaint because the best 20 overs its bowlers had sent down were ignored. For argument's sake, if Team B had bowled 20 maiden overs and conceded 250 runs in the other 30 overs, then its 30-over target would still have been 251. So Team B was being penalised for bowling too many low-scoring overs. Clearly, this method tended to favour the side batting first.

Its flaws were famously highlighted during the 1992 World Cup semifinal between England and South Africa. Chasing England's 252, South Africa was 231 for six and needed 22 off 13 balls when rain stopped play for 12 minutes. Two overs were lost and so the two lowest-scoring overs – yielding one run in total – in the England innings were struck off. This meant that the target was reduced only by one, and South Africa had 21 runs to score off one ball (the scoreboard incorrectly flashed 22 that day). This farcical end to the game prompted the search for a better method.

> The DLS method sets targets (and decides outcomes) by calculating how many runs teams should score (and would have scored) if the resources available to both sides were equal

Years later, Duckworth told the BBC in an interview that this incident had inspired him to come up with a solution. He said, "I recall hearing [cricket journalist] Christopher Martin-Jenkins on radio saying 'surely someone, somewhere could come up with something better' and I soon realised that it was a mathematical problem that required a mathematical solution."

How does the DLS method work?
Neither the ARR nor the MPO methods were able to factor the match situation into their calculations, failing to take into account the wickets a team had left. The DLS method addresses this issue, considering both wickets and overs as resources and revising the target based on the availability of those resources. At the start of an innings, a team has 100% of its resources – 50 overs and 10 wickets – available. The DLS method expresses the balls and wickets remaining at any point as a percentage. How much is a wicket or a ball worth in percentage terms? This is calculated according to a formula which takes into account the scoring pattern in international matches, derived from analysis of data (ODI and T20, men and women) from a sliding four-year window. On the first of July every year, a new year's worth of data is added; so the DLS evolves as scoring trends do.

The rate at which resources deplete is not constant over the course of an innings: the curve is exponential, with that resource percentage falling faster as more wickets are lost and more balls are consumed.

The DLS methods sets targets (and decides outcomes) by calculating how many runs teams should score (and would have scored) if the resources available to both sides were equal. To calculate a target, the formula may simply be expressed thus: Team 2's par score = Team 1's score x (Team 2's resources/Team 1's resources). In international cricket, the resource values (which are not publicly available) are obtained from a computer programme.

The DLS method also allows for the fact that a team batting before a rain interruption would have batted differently had it known the game was going to be truncated. Of course, the weighting of wickets and overs is based on a formula, and there can be no universally perfect weightage, simply because the method cannot make qualitative measurements of individual batting abilities. It was long felt that under the D-L method, teams chasing big totals were better off keeping wickets in hand when rain was around the corner even if it meant scoring at a lower rate. Steve Stern felt he had improved on the D-L method in this regard by adjusting the formula to reflect changing realities in high-scoring ODIs and T20 matches.

An older version of the DL method (called the D-L Standard Edition), meant to be used where computers are not available, applies pre-calculated resource values off a chart. Where upward revisions are required (when the first innings is interrupted), a quantity called the G50 – the average total score in a 50-over innings – is used as reference. For matches involving ICC full member nations, G50 is currently fixed at 245. However, the Standard Edition is not used in international cricket.

Are there alternatives to the DLS method?
V. Jayadevan, an engineer from Kerala, devised an alternative in 2001, but it was never adopted by the ICC. The VJD method, as it is known, is used in Indian domestic cricket, though. Mr. Jayadevan has continually argued that the DLS method is statistically inconsistent and that his system produces superior results.

The match that spawned it

The second semifinal between England and South Africa in the 1992 World Cup became infamous for the "rain rule"; the scoreboard flashed an equation of 22 runs to win off one ball. This incident led to the formulation of the D-L method. A look at how different things would have been with the D-L method applied

As it happened

- England had scored 252/6 in 45 overs after which the game was stopped due to South Africa's poor bowling rate
- South Africa had to chase 253 in 45 overs
- South Africa had reached 231 at the end of 42.5 overs and needed 22 runs from the last 13 balls with four wickets in hand when rain stopped play for 12 minutes
- Two overs were lost and, as per the "rain rule", the two lowest-scoring overs – yielding one run in total – in the England innings were struck off. This meant that the target was reduced only by one, and South Africa had 21 runs to score off one ball (the scoreboard incorrectly flashed 22)

Compiled by Siddharth Rao T.

If D-L was in place

- The D-L method would have revised the target up from 253 as it takes into account the "percentage of resources left at disposal"
- The D-L uses a detailed chart ***(link: https://bit.ly/31sRq1P)*** to calculate this "resource percentage". The chart details the runs to be deducted or added to revise the target based on the wickets and overs remaining in play. The following steps describe the calculations involved in finding this revised target for the particular match

STEP 1: England had lost 6 wickets and five overs of the game. The D-L table takes these two figures into account and predicts that 15.5% of England's resource remained unused at the end of the first innings

STEP 2: Thus, 100% minus 15.5% gives us 84.5%, which is the resource actually used by England at the end of the first innings. This number is named R1

STEP 3: At the start of the second innings, South Africa had lost no wickets and five overs of the game. The D-L table pegs the resource remaining for the team as 95.5%. This number is named R2

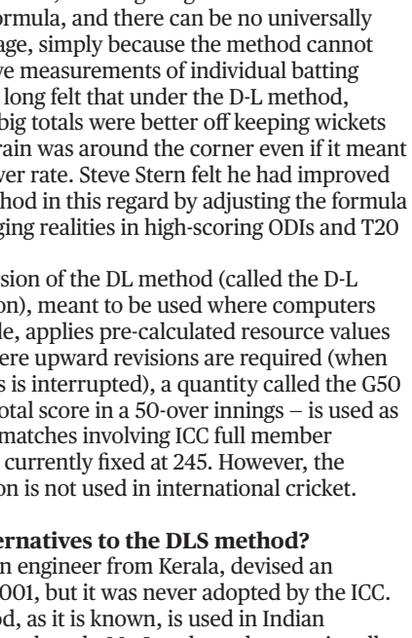
STEP 4: In order to calculate the revised target, the D-L method uses the average score at the end of 50 overs in the first innings in all One Day Internationals at that point of time. In 1992 the average score was 225. This figure is named G50

STEP 5: The numbers are used in the following equation

Set target + G50 x (R2 - R1) = Revised target

In this case

- 253 + 225 x (0.955 -0.845) = 278 (rounded-off)
- Thus, instead of chasing 253 in 45 overs, South Africa would have started the chase requiring 278 runs
- Thereafter, every time there was an interruption due to rain, the target would have been revised using the same formula



Why does Assam need more Foreigners Tribunals?

As the NRC drive reaches its final stage, the Central government has sanctioned more tribunals. How will they work?

VIJAITA SINGH & RAHUL KARMAKAR

The story so far: Foreigners Tribunals, unique to Assam, are in the news as the final list of the National Register of Citizens (NRC) is to be published by July 31, on the directions of the Supreme Court. The Registrar General & Census Commissioner, India, under the Union Home Ministry, published the final draft list of the NRC on July 30, 2018 to segregate Indian citizens living in Assam from those who had illegally entered the State from Bangladesh after March 25, 1971. Nearly 40 lakh people were excluded from the final draft. In the course of the year, 36 lakh people filed claims against the exclusion; the remaining four lakh did not apply. To give a proper hearing to those excluded from the final list and to handle the influx of applications, the Ministry of Home Affairs sanctioned 1,000 additional tribunals. Of these, 400 will come up in the next one month before the final publication of the list.

How many tribunals are there?
Assam at present has 100 Foreigners Tribunals across the State. According to the State's Home Department, there were initially 11 Illegal Migrants (Determination) Tribunals (IMDT). These were converted to tribunals after the Supreme Court scrapped the Illegal Migrants (Determination by Tribunals) Act, 1983 in 2005. The State government established another 21 tribunals that year. Four more were added in 2009 and the remaining 64 were established in 2014 for disposal of cases that were piling up in the tribunals.

Who runs the tribunals?
Each tribunal is like a quasi-judicial set-up. It's headed by a member appointed under the Foreigners Tribunal Act, 1941 and Foreigners (Tribunal) Order, 1984 as in the guidelines issued by the government from time to time. A member can be a retired judicial officer of the Assam Judicial Service, a retired civil servant not below the rank of Secretary and Additional Secretary with judicial experience, or a practising advocate not below the age of 35 years and with at least seven years of practice. The member is also required to have a fair knowledge of the official languages of Assam (Assamese, Bengali, Bodo and English) and the State's historical background giving rise to the foreigners' issue.

An advertisement by the Gauhati High Court on June 10 for preparing a panel of 221 tribunal members says the appointment of each member for a year may be extended on "need basis" subject to their attainment of 67 years. A retired judge or civil servant appointed as a tribunal member is entitled to a pay package similar to what he or she drew at the time of superannuation besides allowances; the current salary for an advocate is ₹85,000 per month plus allowances.

PTI

Why was 2005 a watershed year?
Cases of suspected foreigners used to be handled by the IMDTs under the IMDT Act that the Indira Gandhi government passed in 1983 during the peak of the Assam agitation seeking ejection of people staying illegally in the State. The system changed after the Supreme Court struck down the IMDT Act in July 2005 after hearing a petition by the present Assam Chief Minister Sarbananda Sonowal, who was an Asom Gana Parishad leader then. The IMDT Act – applicable only in Assam while the detection of foreigners was done under the Foreigners Act, 1946 elsewhere in India – was said to provide special protection against undue harassment to the 'minorities' affected by the Assam Agitation. The burden of proving citizenship or otherwise under the IMDT Act rested on the accuser living within a 3 km radius of the accused and the police, and not on the accused as required by the Foreigners Act. The Supreme Court , while scrapping the IMDT Act in 2005, echoed the indigenous organisations and the Assam government's observation that the Act "has created the biggest hurdle and is the main impediment or barrier in the identification and deportation of illegal migrants".

How do the tribunals work?
The Assam Police Border Organisation, a wing of the State police tasked with detecting foreigners, readies the cases for the tribunals to decide who is a foreigner and who is not. The government allegedly gives the border police a monthly target to detect people of suspect citizenship and these cases are referred to the tribunals. Several judgments have been contested with Gautam Soren, a tribunal member in central Assam's Morigaon district observing in August 2017 that foreigners' cases "have assumed the form of industry as each and every person involved" have been "trying to mint money by any means". The Morigaon tribunal also noted that the "unfair practices involved turn Indians into foreigners and foreigners into Indians on the basis of fake or duplicate documents." A few days ago, the All Assam Minority Students' Union said the border police and tribunals were "foreigner-making factories" and "officials have orders to harass the religious and linguistic minorities".

What is the amended Foreigners (Tribunals) Amendment Order, 2019 that has replaced the 1964 one?
The Ministry of Home Affairs amended the Foreigners (Tribunals) Order, 1964 which empowers district magistrates in all States and Union Territories to set up tribunals. Earlier, such powers to constitute tribunals was vested with the Central government alone. The Ministry clarified that the amendment laid down the modalities for the tribunals in case of appeals made by persons not satisfied with the outcome of claims and objections filed against the NRC. The Ministry said the amendment also provides for reference by district magistrates to the tribunal for its opinion as to whether the appellant is a "foreigner" or not. "Since the Foreigners Tribunals have been established only in Assam and in no other State of the country, this amendment is going to be relevant only to Assam at present," the Ministry has said.

> The Assam Police Border Organisation, a wing of the State police tasked with detecting foreigners, readies the cases for the tribunals to decide who is a foreigner and who is not

The amended order also empowers individuals to approach the tribunals. Earlier, only the State administration could move the tribunal against an illegal foreigner. It also says that the final order of the tribunal shall be given within a period of "one hundred and twenty days (four months from the date of production of the records".

CAPSULE

Origin of gold
Heavy metals found on earth, such as gold and platinum, probably originated in a supernova explosion, new research from University of Guelph, Canada, claims. Challenging the earlier theories involving colliding blackholes or neutron stars, the study points towards the relatively rare collapsors, which are a heavy-element rich supernova explosion of stars about 30 times as massive as the sun.

Rings around Saturn
Analysing the data given by Cassini probe during its last rendezvous with Saturn, several groups have published their findings in *Science*. Saturn has five small moons located in and around its rings. These accrete ring material and have distinct shapes. The rings are much younger than the planet, giving clues and placing constraints on models of how they formed.

JNCASR finds key protein conferring radiation sensitivity in cancer cells

The immediate medical implication of the finding will be in the treatment of certain cancer patients

R. PRASAD

Researchers at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, have unravelled the molecular mechanism by which autophagy pathway (a pathway recycles unnecessary or dysfunctional cell components) that gets enhanced leading to human cells becoming resistant to radiation. The immediate medical implication of the finding will be in treatment of certain cancer patients. The JNCASR research team led by Tapas K. Kundu from the Molecular Biology and Genetics Unit discovered that absence or downregulation of a particular protein – positive co-activator 4 (PC4) – is responsible for enhanced autophagy.

Mystery unravelled: This is the first time any study has shown that genome organisation is directly responsible for autophagy regulation in cells, say Sweta Sikder (left), Tapas Kundu and Ravi Manjithaya.

DNA damage

When a cell experiences stress, its DNA gets damaged. Cells with damaged DNA can either die or can activate the autophagy pathway and recycle the damaged cell components and survive. Lack of PC4 protein leads to irregular nuclear shape and defects in chromosome distribution in daughter cells. However, these changes do not lead to cell death but enhanced autophagy. The increased level of autophagy allow cells to withstand the stress caused by gamma radiation.

"What we found was that cells despite several defects upon PC4 downregulation not only did not die, they actually displayed increased proliferation. This was not expected," says Sweta Sikder from JNCASR and first author of a paper published in *FEBS Journal*. "When the cells lacking PC4 protein were exposed to gamma radiation for 24 hours, there was greater induction of autophagy. This observation suggests that gamma radiation further triggers the induction of autophagy in the cells, thus allowing cells to survive the effects of radiation."

Studies have shown that in some cancers, resistance to gamma radiation is achieved through enhanced autophagy. So, the team set to investigate if autophagy was indeed enhanced in the cells where the PC4 protein is absent or downregulated. "We did observe enhanced autophagy in the cells that had depleted levels of PC4 protein. We now know how the cells survived gamma radiation," says Ravi Manjithaya from JNCASR and one of the authors of the paper.

Validation

To validate increased autophagy in cells that had depleted PC4, the researchers used inhibitors of autophagy pathway. "The inhibitors reduced autophagy and the cells that lacked PC4 protein started to die when exposed to gamma radiation," says Prof. Kundu, who is currently the Director of CSIR-Central Drug Research Institute, Lucknow. The team also silenced the gene responsible for autophagy induction to revalidate the findings. Even in this case, the proliferation rate reduced drastically.

The final validation was by restoring (or rescuing) the protein expression in the PC4 knockdown cells. When the PC4 protein was restored to normal levels, autophagy reduced. The team thus confirmed that in cells with depleted PC4 protein the autophagy is enhanced making the cells not only to survive but to also proliferate at an increased rate and also become resistant to gamma radiation.

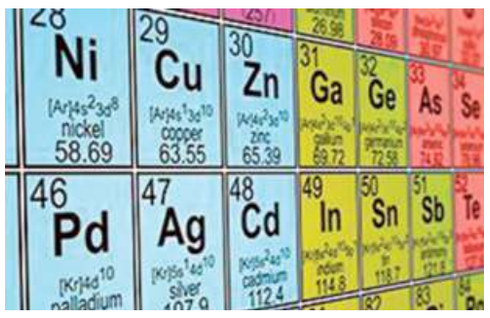
"This is the first time any study has shown that genome organisation is directly responsible for autophagy regulation in cells," says Prof. Kundu.

"We found that in cancers cells that are relatively less malignant, the PC4 level is normal and autophagy is low. But in such cells, if the PC4 is depleted then the cells become highly aggressive," explains Prof. Kundu. "And if you inhibit the autophagy in such cells, the proliferation comes down."

Implications

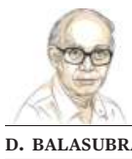
Explaining the possible medical implication of their study, Prof. Kundu says that in some cancers the autophagy gets enhanced. And this is seen only in the cancer cells and not in normal cells of the cancer patients suggesting that future cancer therapies may involve supplementation with autophagy inhibitors.

"In the present study, we generated a stable PC4 knockdown cell line for screening autophagy inhibitors. We are in the process of licensing the cell line," Prof. Kundu says.



An ode to Mendeleev and his periodic table of elements

The periodic table symbolises the logical cogency, principled rationality of all science



SPEAKING OF SCIENCE

D. BALASUBRAMANIAN

Mankind has known materials such as gold, silver, mercury, iron, phosphorous, sulphur and others since antiquity. Alchemists tried making gold out of "base" metals – with no success. But we had to wait until the English school teacher John Dalton who in 1808 came up with his "new system of chemical philosophy", where he proposed that chemical elements are made of atoms; any given element is made entirely of one kind of atom and that each atom has a characteristic weight; chemical reactions occur when atoms of different elements interact with one another. Dalton and Thomas Thomson from England and Berzelius from Europe defined the weight of a hydrogen atom as one, and the atomic weights of other elements were measured using this standard. By the 1860s, the atomic weights of a large number of elements were published.

The question that captured the minds of chemists at that time was: is there any pattern or logic that one can derive by looking at the similarity in the properties of certain classes of atoms (say, lithium, sodium and potassium) on one hand, and their atomic weights on the other? Johann Dobereiner of Germany in 1817 found that, if he took a triad of elements with similar properties, the atomic weight of the middle element is roughly midway between those of the other two [e.g., sodium with atomic weight 23 is midway between lithium (3) and potassium (39), or bromine (80) between chlorine (35) and iodine (127)]. And in 1865, the English chemist John Newlands stated his "law of octaves": if elements are arranged in increasing atomic weight order, those with similar properties occur after each interval of seven elements (for example, lithium and sodium, or carbon and silicon), much as the notes in music.

It was against this background that we meet Professor Dimitri Mendeleev at St. Petersburg, Russia, in 1865. Not satisfied with existing text books, he wrote his own. In doing so, he had to organise the elements and arrange them in a logical order. Dr Tom Siegfried writes in ScienceNews on 9-1-2019 that Mendeleev wrote each of the 69 then known elements with their properties on a note card, arranged the cards in vertical columns from lower to higher atomic weights, and found that elements arranged according to the size of their atomic weights show clear periodic properties, and more importantly "the size of the atomic weight determines the nature of the elements". He presented this discovery before the Russian Chemical Society on March 1, 1869. The periodic table was born. (Incidentally, Siegfried's lucid essay: "How the periodic table went from a sketch to an enduring masterpiece", mentioned above, is a free access article, highly recommended for reading).

Predictive power

This periodic table of Mendeleev not only confirmed the works of Dobereiner and Newlands (that every eighth element in the table resembles the first), but could go further. Given this repetition rule, he could predict that an element (he named it eka-silicon) will be discovered which will resemble silicon and have an atomic weight of 72. Sure enough it was found in 1886, and was named germanium. Likewise, his prediction of eka-aluminium too came true; gallium discovered in 1875 had all properties predicted by Mendeleev. Siegfried writes: "His [Mendeleev's] table finished the transformation of chemical science from the medieval magical mysticism of alchemy to the realm of modern scientific rigor. The periodic table symbolizes not merely the constituents of matter, but the logical cogency and principled rationality of all science."

While Dalton and Mendeleev believed that the atom is the ultimate indivisible particle of an element, modern physics, by the turn of the century, showed that atoms themselves are made up of a central nucleus, inside which "protons" (with a single positive charge and weighing that of a hydrogen atom) and often also of "neutrons" (no charge but mass of a hydrogen atom) reside, and "electrons" (of negligible mass, but a single negative charge) spinning around the nucleus at various well-defined orbits of increasing radius, somewhat akin to the sun and its planets. This idea enabled chemists to arrange elements in such atomic models, and in orbits of increasing levels corresponding to the atomic number (protons in the nucleus). The electrons in the outermost orbits in an atom govern the chemical properties of the element.

Note that orbits arranged in increasing well-defined levels. This periodicity indeed concurs with Mendeleev's periodic table arrangement and its predictions. In a sense, Mendeleev was "prescient." This was his grand plan to arrange elements, whose 150th year we celebrate in 2019.

A poetic tribute to the Periodic Table has been written by Dr. Alok K. R. Paul, Principal Scientist at the Central Electrochemical Research Institute, Chennai Unit. This "ode to the periodic table" can be accessed at https://euroscientist.com/ode-to-the-periodic-table/. Read it and enjoy it!

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Clues from crickets: Can temperature influence our body clock?

Circadian machinery of crickets shows both drosophila and mammal-like traits

ASWATHI PACHA

Cricket, the tiny insect, is not just good at making spooky noises at night; it has now helped researchers understand more about the body's sleep-wake cycle or the circadian rhythm.

The team from Okayama University in Japan and Indian Institute of Science Education and Research (IISER) Thiruvananthapuram, looked at how changes in atmospheric temperature can affect the behaviour and molecular mechanism of the clock genes.

Studying crickets: It helped us understand the diversification of insect clocks and how it has evolved across the animal kingdom, says.Nisha Kannan (sitting).

Dark environment

They locked up a few adult crickets in a totally dark environment and exposed the insects to 30 degree C for 12 hours and 25 degree C for the remaining 12 hours. They found that the activity of the insects increased when the temperature dropped. In fact, the activity started one hour before the transition period. "The insects being nocturnal perceived the drop in temperature as evening setting and started its activity," explains Nisha N Kannan from IISER Thiruvananthapuram and first author of the paper published in *Zoological Science*.

Till now, drosophila or fruit fly has been considered as a model organism and have been used in many studies. So why cricket? According to Dr. Nisha, the circadian machinery of crickets shows both drosophila and mammal-like traits. "Studying crickets would help us understand the diversification of insect clocks and how it has evolved across the kingdom," she says.

The team also studied the clock genes – period, timeless, cryptochrome2 and cycle – to see if the temperature changes altered them.

Optical lobe

The team looked at the optical lobe of the cricket to decode whether the change in activity is mediated through the expression levels of the clock genes. "In drosophila, the body clock control is in the brain scattered across 150 neurons and in humans, we have the suprachiasmatic nucleus region in the brain composed of thousands of neurons that control our circadian rhythm. Similarly, in crickets, it has been found that the optical lobe (located in the anterior segment of the brain), which receives the visual information from the retina, houses the clock controls," adds Dr. Nisha.

Changes were seen in the period and timeless mRNA expression indicating these are the initial clock gene components that respond to changes in the external environmental temperature.

The case of mammals

Will this hold true for humans? In mammals, in addition to the master clock present in the brain, peripheral circadian clocks too operate, which means that the cells and tissues throughout our body have their own individual clocks.

Dr. Nisha explains that this peripheral circadian clock can be affected by temperature changes but our master clock in the brain is resistant to temperature changes.

Our brain has evolved to even override the peripheral circadian clock, so, fortunately, temperature changes (unless very extreme) cannot affect our body clock.

NIT Rourkela: Converting fruit waste to ethanol

Marine bacteria isolated from Digha and Shankarpur waters were used

GREESHMA P

With finite supply of combustible and natural energy sources, there is a demand for alternative energy sources. This has led to increased focus on biofuels. Now, researchers from the Department of Biotechnology and Medical Engineering at the National Institute of Technology (NIT) Rourkela, Odisha, have discovered a marine bacterial strain (*Citrobacter* species) that can produce ethanol directly from fruit waste.

Tolerant strains

The *Citrobacter* species was isolated from the marine water near Digha and Shankarpur seashore of West Bengal. Ten strains were found to be highly tolerant to ethanol. The strains were tested with various waste materials including kitchen, paper, fruit and garden waste for their ability to produce ethanol.

"We wanted a more eco-friendly and cost-efficient method apart from the usual fermentation processes for the production of bioethanol," says Angana Sarkar from NIT Rourkela, the corresponding author of the paper published in the journal *Process Safety and Environment Protection*.

Of the ten ethanol-resistant strains screened, a particular species (*Citrobacter* sp. E4) was found to directly convert fruit waste into ethanol without any pretreatment.

The waste material was powdered to enhance bacterial activity and thereby reduce the time taken to produce ethanol. The powdered waste along with the bacterial strain and mineral salts required for its growth were introduced into the bioreactor. Under optimum temperature (33.2°C) and optimum pH (7.1), a maximum output of 0.30g of ethanol was obtained from 1g of fruit waste. It took over 24 hours to convert waste into ethanol.

Due to the high sugar content, fruit waste was found to be the most favourable, whereas paper waste was the least favourable due to the presence of cellulosic substances. The researchers note that this method is environment-friendly, sustainable and cost-efficient.

The species was further tested and found to be non-pathogenic and antibiotic-resistant against cephalosporin and ampicillin, to name a few.

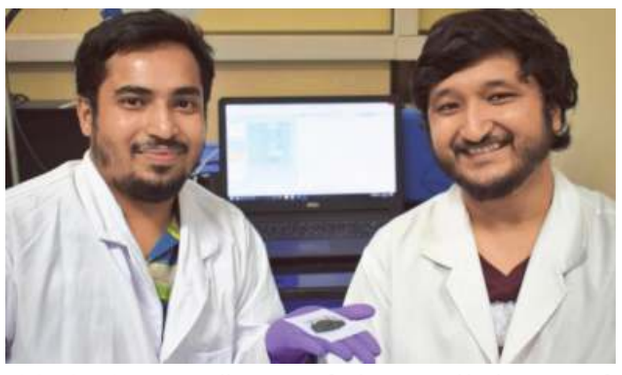
The species could be easily cultured under laboratory conditions. "We are trying to genetically modify the species to increase the amount of ethanol produced," adds Dr. Sarkar.

Novel selenium-graphene catalyst for fuel cells

This catalyst provides a cheap and effective alternative to platinum which is often used in fuel cells

SHUBASHREE DESIKAN

Modern energy technology, for example fuel cells which are used commercially in hydrogen fuel-based cars, require good catalysts that are efficient as well as cost-effective. Now, a multi-institutional team from India has developed a selenium-graphene-based catalyst which is more efficient, costs less and also remains stable for longer than the usual platinum based catalysts. The institutes involved in the work are: Tata Institute of Fundamental Research, Hyderabad (TIFR-H), University of Hyderabad and Indian Institute of Science Education and Research (IISER) Thiruvananthapuram. The research has been published in the journal *ACS: Applied Energy Materials*.



Right chemistry: A small amount of selenium and high amount of graphene, treated right, presented the group with a useful and cheap catalyst.

Normally, fuel cells use expensive platinum-like elements. "These expensive metal-based technologies perform excellently for initial few cycles, but then get degraded in performance due to many reasons," explains T.N. Narayanan of TIFR-H, the corresponding author. As a result, there is a need to change this part of the fuel cell routinely.

The oxygen reduction reaction is a key step in the functioning of the fuel cell. Graphene by itself is a "poor" catalyst of this reaction. In the sense that it involves reduction of oxygen in two steps, each of which consume two electrons. This is not very useful either for fuel cells or metal-air batteries.

Platinum is often used to catalyse this reaction. As a substitute, the group developed the catalyst with selenium and graphene. "Graphene modified with selenium atoms in very low amounts can perform like platinum in a demonstrated reaction," Dr. Narayanan clarifies.

While neither selenium nor graphene can do the trick by themselves, the combination works efficiently. "When you do the right chemistry together with small amount of selenium with high amount of carbon containing graphene, you end up with a very useful catalyst, which is very cheap too," he adds.

Poisoning-resistant

Methanol fuel cells, a common form of fuel cell used, suffer from a "poisoning" effect. This is a part of the process where the methanol reaches the negative electrode and coats it, so that the electrode becomes ineffective after some cycles. This is especially problematic when expensive catalysts like platinum are used, as they often are. "We found that the catalyst we have developed has a high tolerance [to poisoning] while platinum got affected," says Dr Narayanan.

The concept of single-atom catalyst - that category into which this catalyst falls - is not new. But earlier concepts had used heavy metals such as platinum, palladium and gold. Using selenium is a novel idea mooted by this group.

"Such direct water converting oxygen reduction reaction catalyst has enormous applications in other fields too, such as metal-air battery. It is ongoing research for the development of high energy density devices in batteries. This will be far better than the existing lithium ion-based battery," he says.

THE HINDU PHOTO ARCHIVES

Wodehouse, undistilled

SAUMYA BALASUBRAMANIAN

I was reading a short story by P.G. Wodehouse on the train. These are the times when I'm possibly mistaken for a lunatic. My seat shudders with unconcealed mirth. I giggle, laugh and sometimes wipe away tears of laughter, while the world is going about the stern business of earning a living.

He is one of my favourite authors, and after every few books that make me mope around the world pondering on the wretchedness and seriousness of life, I turn to a PGW book to remind myself that tomfoolery is a virtue to be celebrated. His turns of phrase, his romping joy, will suffice to set me straight.

When I read his autobiography, *Over Seventy*, a few years ago, I could see that the septuagenarian viewed his own life pretty much the same way he came across in his writing: sunny and delightful. In his own words, he simply lacked the life required for a gripping autobiography because one needs some level of suffering to bung into the thing. "My father was plain as rice pudding and everyone in school understood me perfectly," he wrote. So, it must have been particularly jarring to the man when he was treated as an untouchable in his own country.

Wodehouse had his head in books and led a sheltered life. Whether it was Blandings Castle, or Jeeves rescuing his young master, his thoughts were almost always occupied with love and the stirrings of the idiotic. Known as 'Plum' to his friends, he had a villa in France. Plum and his wife were unfortunately there when the German troops stormed France, and he was taken prisoner at the beginning of the Second World War.

The Germans released him after 42 weeks, when he was nearing 60, as they seldom kept foreign internees beyond the age of 60. Through an old Hollywood friend of his, they sought to use him to make humorous broadcasts about his internment, and he naively did so. He had a trusting nature devoid of malice of any kind, and was incapable of seeing political propaganda for what it was. Though he suffered immensely during his internment - he had lost around 60 pounds, and "looked like something the carrion crow had brought in", he did not quite realise the extent of evil and genocide that was happening inside War-time Germany. He simply intended to let his readers know that he was alive and well.

That back-fired, however, and the author went from beloved to detested in his native United Kingdom. People were looking for a scapegoat and he fit the bill. Sadly, he became his own Bertie Wooster but with no Jeeves to help.

Some time after the Second World War ended, PGW was asked by a journalist whether he hated the Germans for what they put him through. To which the author supposedly replied, elegantly smoking his pipe, "I do not hate in the plural."

A truly astounding statement. It was this statement of 'not hating in the plural' that I sought out to find when I read the books: *P.G. Wodehouse: A Life in Letters* and *Wodehouse at War*, but I could find no reference to the actual statement. What I found instead was a man who was not only possibly the world's funniest author, but was also the most hardworking, shy, kind and gentle person, who magnanimously shared with the world the gift of his sunny mind.

I read the text of all five of his broadcasts from Germany in their entirety, and to my equally naive mind there is nothing in there that could be seen as treason. It shows how war and malice can take any inane thing and wring it out of shape and proportion. What is real and what is fake when power is involved?

He was finally knighted in January 1975. He died the following month, on February 14, 1975, aged 93.

I am immensely grateful to the dear author, even if that means the 'prim and proper' crowd of the world lifts eyebrows and look away uncomfortably when I laugh. I cannot say it better than Stephen Fry does on the personal influence of P.G. Wodehouse: "He taught me something about good nature. It is enough to be benign, to be gentle, to be funny, to be kind."

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GIFTS GALORE
but some very special

There are some things that have a life of their own, whose goodness is perennial

ANUSHA SINGH

In 2002, I was ready to step out of Ambala for the national capital city of Delhi. As I packed my bags to begin the new phase of my life at Lady Shri Ram College for Women, my father gave me two gifts.

The first was his pocket-size Oxford English Dictionary that had been his companion since his student days at the Military School in Belgaum. He taught himself new words from it every day. There was a time when he knew every single word in that dictionary! He learnt it all because he realised early on that a good vocabulary was an asset, and you must acquire one if you can. And that's exactly what he did.

He then passed on this lovely rendition of the English language to me on the occasion of my new life as an independent woman, away from the warm snuggle of my parents' cocoon. On Sundays, as I lay on my bed in my hostel room on the campus reading non-fiction works, I easily looked up words in the pocket dictionary beside me. Slightly tattered and yellowing, its pages effused a warm and musty fragrance, ever welcoming and tender. I was surprised to find there most of the words that I looked up. Whenever I didn't, I had to reluctantly abandon my comfortable position, lift the heavy Merriam Webster's dictionary on my side table and flip through its crisp white pages, rather soulless and cold. Even today, the pocket dictionary holds pride of place in my writing nook. It symbolises my father's will to learn, to grow, and his relentless capacity to work hard on becoming the best version of himself, right from his adolescent days. It inspires me to keep alive the hummingbird in my soul and actively sharpen my interests and skills.

The second gift was his good old transistor radio. Black and bulky with a thick handle at the top, this old but sturdy and fully functional device gave grandfatherly vibes, warm and reliable. I often placed it atop my wooden foldable table in the centre of my room, tuned into an FM channel, and worked on my course assignments while listening to melodies and storytelling of a bygone era. On some days, the transistor played a therapeutic role too! Whenever I came to my room annoyed about something, silly stuff mostly, I looked at it and imagined it telling me, "Be stable and sincere *beta*, and everything will fall into place."

ILLUSTRATION: J.A. PREMKUMAR

In today's times when one company has launched an easy-to-carry transistor with pre-recorded songs, one can only imagine the beauty of the original black one, of authentic yesteryear vintage.

When I look back, I recollect that there were so many other gifts and things that my parents gave me during my shift to the hostel. For instance, on the day of my admission, they took me window-shopping and picked up a stylish red top from a high-end showroom. I liked it a lot and wore it frequently.

Similarly, there were other such things. But when I think of them today almost two decades later, there is nothing that I really carry with me, physically or emotionally. Despite being 'valuable,' they turned out to be eminently forgettable and ephemeral. Just as many other materialistic things in life are. Seemingly important then, they invoke negligible joy years later.

But when it comes to the pocket dictionary and the transistor, they are living organisms. They are invaluable. Things whose worth cannot be measured, despite the price that the market calculates, despite the worth that other people attach to it. Things that have a life of their own. Things whose goodness is perennial. The literary and the symbolic. I believe that's what makes those two gifts my most prized possessions of all.

Thank you father, for giving me 'wealth' that is so meaningful and thoughtful. I hold them in my heart and in my mind today, and always will.

www.anushasingh.in

A cup of coffee or a jar of thoughts

Everyone has some baggage, but it is important to loosen it a little

SEEMA GHISINGH

Today as I sat down with my morning cup of coffee, suddenly I realised how we felt yesterday does not bother your present. Trust me, yesterday I was all broken, felt like nothing was going right, everything was falling apart, and the whole day was spent like that. But today it's a bit different. I'm more energetic, I have things I want to finish today, or maybe it's because of the weather. The weather is killing, early in the morning you will see the sun shining so bright. Not that I don't like sunshine mornings, but I am more of a gloomy-day kind. I don't know, but gloomy days bring more energy in me. I know it's hard to believe, but that's how my body works.

So today over a cup of coffee I just realised that if we want to be happy or contented with our life, we have to really start appreciating what we have. I know this is not rocket science, this thing you hear from everyone, "appreciate what you have". You remember how the parents (or most of the parents) always told us that "when we were of your age we had no facilities like this", or "we have walked miles to go to school", and so on. Believe me, guys, every parent has used this phrase. I'm not saying they are lying or just fooling us. Trust me, I appreciate what they have done for us and I believe they have gone the extra mile for their kids even when they could have said 'no'. Not just me, almost every child appreciates what parents have done for him or her, but we are just a bit shy to tell them we love them and want to do anything for them.

ILLUSTRATION: SATWIK GADE

Patience is the key

However, sometimes the waves are just against your ship and the ship is not even in your control. What to do then? Most people will say, "Have patience, it will soon work out for you", and I believe one should have patience. But is it really that easy to have such patience?

When things are going south, nothing is working out, you are running out of money, family pressure, aaah! Trust me, you feel like shouting, you want to shout, shout at anything or at anyone without even thinking about the repercussions. And then the final nail. You went to Facebook to distract yourself, and boom! your friend is getting married or getting engaged or going on a vacation, posting all kinds of pictures, looking happy, enjoying. And we start to feel why we don't have such good times. Trust me, it's hard.

But is that real life? Do you really think real life is a vacation? No, right. Stop feeling bad for yourself. I believe in this, and trust me, it comes out true for me always.

If you are having a bad day or time today, then definitely tomorrow will be good. If you are having a tough year, next year will definitely be prosperous for you. So do well what comes today. If you're having the worst day, think about the next day, which will be better. I do believe hard work is the key to success, but I also believe that believing that a good time will come soon leads you to success faster.

I also don't have a perfect life. I have my own doubts, my problems, my fears, my responsibilities, my anxieties, my fear of losing out on people and also the fear of missing out. So everyone has his or her own baggage, but it is important to loosen the baggage a little. A small girl weighing 30 kg cannot carry a bag of 30 kg. Likewise, we should also know what are the things we really want to carry, or can carry. If we start worrying about all the things, we won't be able to conquer even one thing.

So do not worry much about life, worry only about things that are in your control. We are not gods, we do not have control over everything. So let's just be humans and do the best we can today. And soon you will also be posting your vacation or happy picture on Facebook only if you want it.

No amount of pictures can actually measure the happiness; it is what you think that is happiness. For me it's what Poh says in Kung Fu Panda: 'Inner Peace'.

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The caged life

SAI SPANDANA

The saga of the IIT-JEE Advanced, 2019 is over. Now amid all the gala I tell you the tale of an aspirant looming in the narrow and anxiety-ridden lanes of Kota, Rajasthan...

The clock has been ticking. I live in delusion, each tick producing a throb in my ears, every second taking away a hue of innocence from my face, leaving overtones of jealousy and sheer contempt.

Events and occasions fly past me leaving no marks of nostalgia or memories, except the loving voice of my *aama* (mother) which coos gently in my ears. I mature into a new person every day, but itching for my lost innocence. My hands crave to feel the mud as my nose longs for the smell of village sand. My brain is now immune to the myriad books I studied, but my heart sobs.

The nights never end as I walk down the aisle to cherish a hot soothing cup of cutting chai. Gobs of memories flush my cheeks as I wait. The hue of my skin erodes as I sip and witness the silence of the night.

I am stained by marks caused by the deplorable scores which have become a part of my psyche. An uncanny feeling whizzes past me as I feel that the year is going to be malevolent.

My brain is set into a frenzy as we get calibrated like the degree marks of a thermometer, the lower degrees being shunned and the upper degrees hogging the limelight.

Offbeat shades paint our hearts as we unravel the days wondering what is in store for us. The tough ones are able to spin the idea of living an exuberant life into reality, which dances around their soul, adding fuel to their inner fire.

Sultry days parch my throat amidst the never-ending battle between my sweating and my tears. You get to see numerous diamonds, which create sparkle from the torrid rays. Yet you also see stones that try to emulate the North Star.

There is a constant battle between my soul and brain as *appa* calls me every week. Frankly, for me my primrose path is to make a spectacle of my achievements in front of my parents.

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At a certain age, in the company of seniors

It may be a group forever complaining of aches and pains, but high on empathy and understanding

D.V. GURUPRASAD

I used to travel alone, getting great thrill doing things on my own. All that changed when I turned 65. Citing instances of people falling sick or even kicking the bucket in foreign lands, an uncle who attended my birthday bash advised me that from then on I should stop being a lone wolf. Joining him, the others warned of lurking criminals and terrorists. Catching the virus quickly, my children declared that henceforth I would travel with their mother, only in a group tour. Softening the blow, they announced a trip to China as my birthday gift.

Within hours of landing in Shanghai on a special tour for seniors, I realised that all the histrionics I had learnt in school would not help me to communicate. Pointing out that we were lucky to be accompanied by an English-speaking Chinese guide, my wife wondered what would have happened had I travelled there alone. She was proved right when I was refused boarding passes in airports because of a mismatch between my name as spelt in my passport and in my air ticket. But for our Chinese guide, I would probably be in a Chinese prison now.

I would always be the first in our group to finish sightseeing. But being part of a group forever complaining of aches and pains, the wait for others to finish was usually long. In Xian, I decided to utilise the waiting period by sleeping in our bus. When I went in search of our bus in the parking lot, all buses and drivers looked alike and I was lost. Looking for something familiar, I located our bus, purely by being nosey – it was the only one emanating the strong smell of pain-killing sprays.

African proverb: 'If you want to go fast, go alone; if you want to go far, go together'

Waiting in the bus without air-conditioning had made me angry and I took it out on my wife for forcing me to join the group tour. She politely said I should be thanking my stars for learning to be patient, a virtue I had lacked since birth. She also wondered how despite being a top officer, I had not yet imbibed the management lesson of being a team member. I shut my eyes and mouth.

Sudden, ecstatic cries of the group made me open my eyes.

Our guide had sprung a surprise by taking us to a parlour to get us 'Chinese foot massage'. When the old frayed muscles and tissues of the seniors got the Chinese touch, the feeling was divine. After learning that the massage was complimentary, the joy was double. Would I have gone for a massage had I travelled alone, wondered my wife. I smirked.

Soon the tour was over. Waiting to board our aircraft on our return journey, I realised I had packed my medicine kit in my checked-in luggage. Missing drugs for my gastric problem made me panic. Realising my predicament, several group members rushed out to help popping their hands with a variety of drugs to choose from. After all, being of the same age, almost everyone had similar ailments.

As I thanked them, my wife recited an old African proverb, 'If you want to go fast, go alone; if you want to go far, go together'.

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The controller-in-chief has a lot on his platter, but he takes it in his stride and braces for more
P.V. IYER

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RANA PREET GILL

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