La Niña and global warming

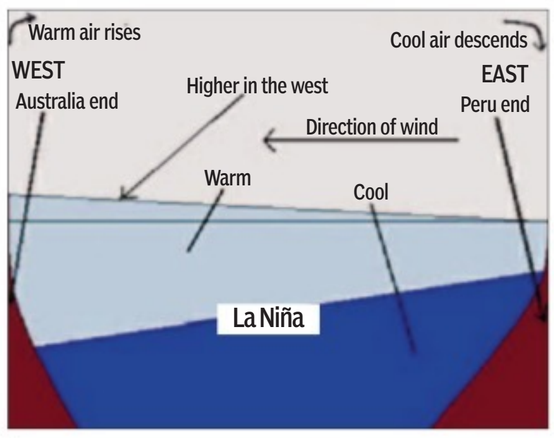
THE HEAT IS GETTING STOWED IN THE INDIAN OCEAN, WRITES
S ANANTHANARAYANAN

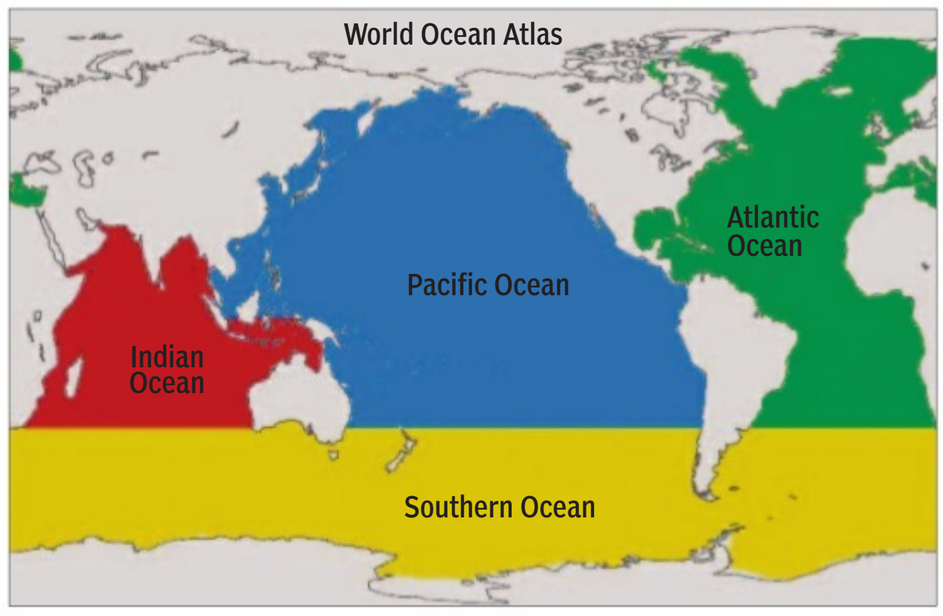
Despite global inaction to contain the emission of greenhouse gases and even the sizeable rise in the level of emissions during the last decade, it is seen that there has been nearly no increase in the earth's surface temperature. But scientists have warned that this is no reason to think matters are under control. The reason the ambient temperature has not been rising is that in the last decade the deep sea, which is cool and has great heat capacity, has been absorbing global heat.

Sang-Ki Lee, Wonsun Park, Molly O Baringer, Arnold L Gordon, Bruce Huber and Yanyun Liu of Miami, the University of Columbia and Kiel, Germany, in their letter in the journal *Nature Geoscience*, describe how a persistent *reverse El Niño* effect results in the surface of the Pacific Ocean cooling down and absorbing heat from the atmosphere. As there is no evidence of the surface of the ocean getting warmer, the team has searched and found that the heat is being passed on to the Indian Ocean, which keeps the heat in its upper 700 metres.

The El Niño effect is the phenomenon of the eastern side, that is the South America side, of the Pacific Ocean, which is normally cool and dry, getting warm and humid with rain, while the western side, which is the warm Australia side, gets cooler than it usually is. In normal years, the Peruvian coast of South America is cool and the sea near Australia is warm. The air over Australia gets warmed and rises, while trade winds blow westward from the Peruvian end. The westward winds over the ocean cause the water to shore up at the western end. The weight of higher water (it is higher by about one metre) near Australia causes cooler, nutrition-rich, deeper water to "well up" at the Peru end, where the weather stays dry and there is great fishing.

But every once in a few years ocean currents bring warm water to the eastern coast. This blocks the trade wind and the "up welling", and ruins the fishing, but there is warmth and moisture and luxurious vegetation in parts that are normally arid and bare. As this usually happens around Christmas time, the phenomenon is likened to the arrival of baby Jesus and has been named *El Niño*, or the (Holy) Little One.





And conversely, every once in a few, usually alternating with El Niño, is the opposite, when the weather around Peru is really cool and dry and this other extreme is called *La Niña*, which also means the little one, but with the gender changed.

La Niña & the atmosphere

The mean temperature of the atmosphere is a result of warming by the sun from above and by radiation from the earth or the sea from below. Now when the surface of the sea becomes unusually cool, as during La Niña, the sea does not radiate towards the atmosphere and this loses heat and cools down. The warm and cool spells in the Pacific alternate every few years, but since the beginning of this century there has been an unusually long spell of La Niña conditions. The surface of the Pacific Ocean has thus been cool for all these years and this is the reason that the lower atmosphere has been losing heat and the rise in global warming has not been readily apparent.

San Ki Lee and colleagues worked out the arithmetic of how heat is distributed among the earth's oceans, or the Global Heat Budget, with the help of the World Ocean Atlas. This is a display of the major ocean basins — the Atlantic, Pacific and Indian Oceans — separated by land masses, and the Southern Ocean below. The record of the annual addition to Oceanic Heat Content, or the OHC_{700}, which is the heat content in the upper 700 metres, is shown (see table) in terms of a unit that indicates the relative value.

The figures show that while there has been an increase of the global heat content, there is net reduction in the Pacific and Atlantic Oceans, with increase in the Southern Ocean and sharp increase in the Indian Ocean. Independent studies have shown that the Atlantic and Southern Oceans had a major inflow of heat, the effect not being visible in OHC_{700} of the Atlantic because heat has been transferred to the deep ocean, below 700 metres. But the anomaly remains of the Pacific Ocean, despite the high intake in the eastern Pacific, and the rise in the Indian Oceans, and this formed the subject of the scientists' study.

Horizontal flow

The study used a global general circulation model and simulated heat transport processes to correspond to the observed changes. The simulations correctly reflect the increased heat uptake, globally, on account of increased man-made addition to greenhouse gas content of the atmosphere, speeding up, and also checked by greater radiation by the warmer sea in the last decade. The Indian Ocean also has low heat intake during the earlier period and a sharp increase after the turn of the century.

These changes are reflected by the simulations, but the detailed heat budget analyses show that the warming of the Indian Ocean is not on account of surface heating but is a result of horizontal flows. Further analysis shows that the heat intake was from the Pacific Ocean via the passage to the Indian Ocean through the Indonesian archipelago. And this intake more than compensated the increased loss of heat during the period from the Indian Ocean to the Southern Ocean.

These changes are mirrored in the changes in the Pacific Ocean. There was great increase in the heat input on account of the sustained La Niña conditions, but this did not lead to a rise in surface temperature, rather the contrary, which would be a feature of La Niña because of the loss of heat to the Indian Ocean.

The study shows the Indian Ocean area as important in global ocean heat distribution and underlines the need to understand the mechanisms at work. An outcome of better understanding may be to know whether the heat stored in the Indian Ocean may be returned to the atmosphere once the La Niña conditions in the Pacific relax, or if it may get sequestered in the deep sea.

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Period	Global Ocean	Indian Ocean	Pacific Ocean	Atlantic Ocean	Southern Ocean
1971-2000	2.8	- 0.2	0.9	1.3	0.6
2003-2012	2.9	2.1	- 0.4	- 0.3	1.5

What throws the switch?

CURRENT studies indicate that when warm water collects in the west (that is, eastern Australia), heat is transported north by ocean currents and also to the atmosphere by evaporation. Natural flows then deliver the excess heat to the eastern Pacific (that is near Peru), setting off El Niño. The effect is, hence, that the tropical Pacific Ocean loses heat during El Niño and gains it during La Niña.

MARKING MALIGNANCY

TUMOR SUPPRESSOR GENES ARE THOSE WHOSE LOSS OR INACTIVATION CAN LEAD TO CANCER, SAYS **TAPAN KUMAR MAITRA**

In contrast to oncogenes, whose presence can induce cancer formation, the loss or inactivation of tumor suppressor genes can also lead to the disease. As the name implies, the normal function of such genes is to restrain cell proliferation. In other words, tumor suppressor genes act as brakes on the process of cell proliferation whereas oncogenes function as accelerators of cell proliferation. Of the roughly 30,000 genes in human cells, only a few dozen exhibit the properties of tumor suppressors, and since losing the function of just one of these genes may cause cancer, each must perform an extremely important function.

The first indication that cells contain genes whose loss can lead to cancer came from experiments in which normal cells were fused with cancer ones. Based on our current understanding of oncogenes, you might expect that the hybrid cells created by fusing cancer cells with normal cells would have acquired oncogenes from the original cancer cell and would therefore exhibit uncontrolled growth, just like a cancer cell. In fact, this is not what happens. The fusion of cancer cells with normal cells almost always yields hybrid cells that behave like the normal parent and do not form tumors. Such results, first reported in the late 1960s, provided the earliest evidence that normal cells contain genes that can suppress tumor growth and re-establish normal growth behaviour.

Although fusing cancer cells with normal cells generally yields hybrid cells that lack the ability to form tumors, this does not mean these cells are normal. When they are allowed to grow for extended periods in culture, the hybrid cells often revert to the malignant, uncontrolled behaviour of the original cancer cells. Reversion to malignant behaviour is associated with the loss of certain chromosomes, suggesting that these particular chromosomes contain genes that had been suppressing the ability to form tumors. Such observations eventually led to the naming of the lost genes as "tumor suppressor genes".

As long as hybrid cells retain both sets of original chromosomes — that is, chromosomes derived from both cancer cells and normal cells — the ability to form tumors is suppressed. Tumor suppression is even observed when the original cancer cells possess an oncogene, such as a mutant *RAS* gene, that is actively expressed in the hybrid cells. This means tumor suppressor genes located in the chromosomes of normal cells can overcome the effects of a *RAS* oncogene present in a cancer cell chromosome. The ability to form tumors only reappears after the hybrid cell loses a chromosome containing a critical tumor suppressor gene.

Although cell fusion experiments provided the initial evidence for the existence of tumor suppressor genes, identifying these genes is no simple task. By definition, the existence of a tumor suppressor gene only becomes evident after its function has been lost. How do scientists go about finding something whose very existence is unknown until it disappears?

One approach involves families that are at high risk for developing cancer. While most cancers are known to be environmentally triggered, about 10-20 per cent of the cases can be traced to inherited gene defects. When it is said that such cancers are hereditary, this does not mean people actually inherit cancer. What can be inherited, however, is an increased *susceptibility* to developing cancer. The reason for the increased risk is usually an inherited defect in a tumor suppressor gene.

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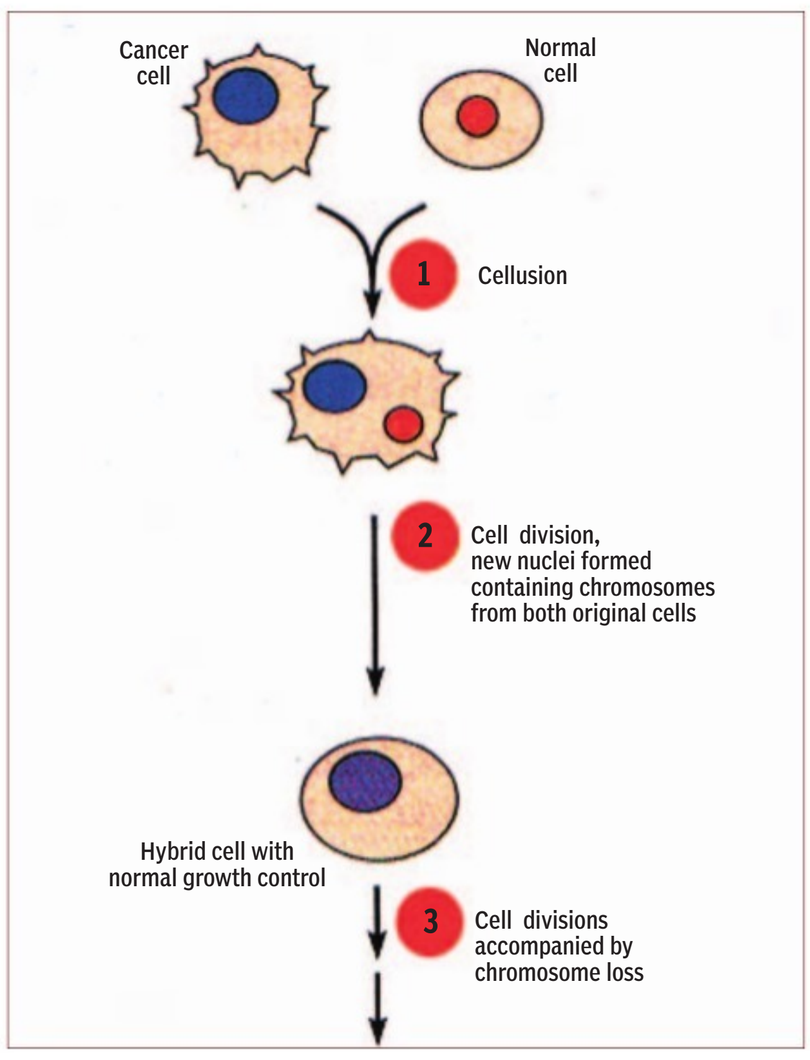


When cancer cells are fused with normal cells, the resulting hybrid cells do not initially form tumors. After they proliferate for extended periods in culture, the hybrid cells usually revert to the uncontrolled, tumor-forming behaviour of the original cancer cells. This reversion is accompanied by the loss of chromosomes containing tumor suppressor genes.

Evolution of social bees

SCIENTISTS REVEAL THAT THE ONE KEY FEATURE IS AN ELABORATION OF GENE REGULATION CAPACITY, WRITES **RUTH WILLIAMS**

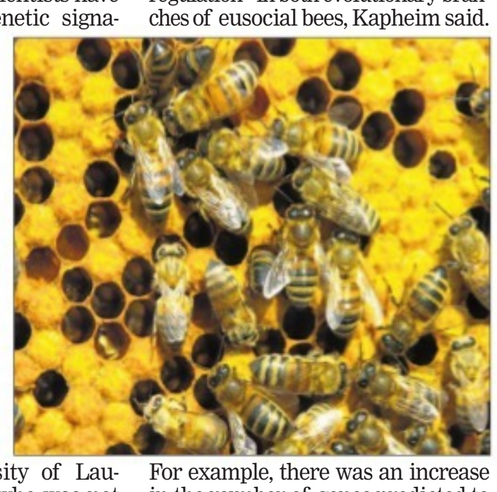
Some bees are solitary, some live in small groups and some in colonies that number many thousands of individuals and having studied the genomes of 10 species that represent these different living arrangements scientists have now identified the genetic signatures of communal living. The results, published on 14 May in *Science* reveal that one key feature of increased sociality is an elaboration of gene regulation capacity.

"This comparative analysis shows several clear changes associated with the evolution of the two eusocial groups of bees (including) changes in the regulation of gene expression," said evolutionary ecologist Laurent Keller of the University of Lausanne in Switzerland, who was not involved in the work. "Bees are highly social and we are highly social… so it's interesting to see what the mechanisms are that lead to the evolution of such a complex system."

A key feature of eusociality is the confinement of reproduction to select individuals — such as the queen in the case of bees. The switch from solitary living to eusociality, much like the transition from unicellular to multicellular organisms, "is one of the major transitions in evolution," said Karen Kapheim of Utah State University, who led the study. Indeed, some eusocial groups have even been referred to as super-organisms, she said, "because they function like a multi-cellular organism where the queen could be thought of as a gamete… and the workers are the body, or the non-reproductive parts of the organism".

And much like gene expression increases or decreases across different cell types in multi-cellular organisms, some researchers have predicted that the evolution of eusociality would require a species to increase its capacity to regulate genes in individuals. To investigate whether this is indeed the case, Kapheim and her colleagues analysed the genome sequences of 10 bee species: three that lived solitary lives and seven social species that represented two independent ancestral origins, as well as differing degrees of eusociality.

The results revealed a "clear pattern of increased potential for gene regulation" in both evolutionary branches of eusocial bees, Kapheim said.



For example, there was an increase in the number of genes predicted to be methylated (a form of epigenetic regulation) and an increase in the number of transcription factor binding sites in the promoters of genes — particularly those that appeared to be linked to the evolution of eusociality. "The study suggests that there has been an increase in the complexity of gene regulation with increased social complexity," said insect sociogenomics researcher Amy Toth of Iowa State University, who was not involved in the work.

But perhaps the most surprising result, said Kapheim, was that "the independent transitions that we studied really seemed to be independent… We don't see a whole lot of evidence for convergent evolution." That is, although the overall genomic signatures of eusociality were similar irrespective of origin, the genes involved were different. For the purpose of making comparisons, she chose species that were either solitary or eusocial, but across the 20,000 or more species of bees (and indeed, across all animal taxa), sociality is a continuum, she said. "There's all kinds of variation in social behaviour… and I think we're now going to have to dig in and start filling in those gaps."

THE SCIENTIST

PLUS POINTS

According to the study, Aquarius and Pisces would be the zodiac signs most associated with celebrity.

Star sign status

Your month of birth could affect whether or not you become a celebrity, according to one academic study. The implication is that astrological signs could indicate how likely a person is to be successful. While the study — carried out by Dr Mark Hamilton from the University of Connecticut and published in the journal *Comprehensive Psychology* — concludes that "distant star clusters do not exert mystical effects on earthly events", it does suggest that astrological signs may be a guide to potential celebrity.

Dr Hamilton conducted a statistical analysis of the birth months of 300 celebrities drawn from public life, literature, science, art and sports and found that they tended to have birth dates clustered around the period December to March. In astrological terms, the celebrity signs would be Aquarius and Pisces.

The study's main conclusion is that "relative age" — the time a child is born relative to when their classmates were born — is a major factor determining how successful someone will become. It suggests those born near the beginning of the school year — and so older, relative to their classmates — are more likely to be successful.

Earlier studies, including one by Dr Jeremy Genovese of Cleveland State University, to which Dr Hamilton's paper is a response, had ruled out a link between celebrity status and the signs of the zodiac.

ALEXANDER SEHMER/THE INDEPENDENT

Unpolished goodness

It might be hard to believe today but there was a time when men in Tamil Nadu wanting to marry had to win the trust of the girl's family by either controlling a charging bull or lifting a heavy boulder. Since the task demanded a high dose of instant energy, the girl's family would feed the aspiring son-in-law a red rice variety called *mapilai samba*, which means son-in-law rice, before the feat. The tradition went out of fashion with time. And so did the healthy rice variety.

Mapilai samba is one of the many varieties of red and black medicinal rice in Tamil Nadu that are hardly grown today because of the commercial demand for polished white rice. As a result, rice consumption in the state has witnessed a steady drop despite the availability of several healthier options. However, some farmer groups near Chennai are trying to revive these indigenous rice varieties and are growing *karunguravai*, *kavuni*, *mapilai samba* and *kullakar* varieties, each known for its unique health value, taste and cooking techniques.

T Thirunarayanan of Traditional Medicine and Research, a Chennai-based NGO, says there are surprising parallels between what Siddha medicinal tradition of South India, one of the oldest medicinal traditions known to humankind, has to say about these rice varieties and the findings of modern science.

APARNA PALLAVI/CSE-DOWN TO EARTH FEATURE SERVICE

Insect plague

An insect that sucks the sap out of cactus plants has been experimented with in East Africa to contain the spread of an invasive cactus species that threatens local grazing areas. The cochineal bug, known as *dudu* in Swahili, for biological control has been released on farmland in Kenya's Laikipia region, which is used by the Maasai for livestock herding. The trial showed that the bug feeds exclusively on the *Opuntia stricta cactus*, better known as prickly pear, which has invaded grasslands and drives out local plants used to feed cattle.

The Maasai community in Laikipia partnered with the Centre for Agriculture Biosciences International to conduct the trial.

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