

When fair winds stop blowing



While the role of the variability of rainfall and the proneness to drought in the region are recognised, the fall of the Neo-Assyrians has so far been considered to be predominantly the result of politics and war. The fact that there are scant records of climate during the time, while there are ample historical and archeological records, has turned the spotlight away from the role that climate may have played, the paper says.

As a departure, the present study takes a closer look at an accurate proxy for rainfall, which has been discovered in the heart of the region, to arrive at data, well resolved in time, of rainfall and moisture levels right through 4,000 years. "These data provide a climatic context for the rise, expansion, and ultimately the collapse of the Assyrian Empire during the mid-to-late seventh century BCE. Our data also permit us to place the recent multi-year droughts and a near-century-long drying trend over the eastern Mediterranean and Middle East region in the broader context of the region's hydroclimate variability during the past four millennia," the paper says.

The data was collected from Kuna Ba Cave (shown by a white star in the map), in the foothills of the Zagros Mountains, western Iraq. The Kuna Ba (or 'hole in the wind') Cave is part of a system which includes caves where skeletons of Neanderthals were found. The Kuna Ba Cave contains a large, cavernous interior full of hanging structures, like stalactites, or stalagmites, made of minerals deposited by dripping water from the roof.

The paper says, "The vegetation above and surrounding the cave is sparse mostly consisting of grasses and shrubs. The soil cover is thin, less than one metre deep, and the total earth above the cave is less than 15 metres". Rainwater is thus able to seep through and drips from the roof of the cave. Over years and centuries, the structure and content of the mineral deposits have formed a record of the quantity of rain as well as the composition of the water that seeped down to the cave.

This record of water and rainfall reveals that the first part of the three centuries when the Neo-Assyrians flourished was the best-watered period in all the 4,000 years for which the record exists. The rainfall, the record shows, in some periods, was 15 to 30 per cent higher than what it has been in modern times. This extended period, about 200 years of plentiful water, clearly made for good crops, a robust economy and supported military conquest.

And then, the record shows that towards the end of the three-century period, there was a series of extended droughts, and, despite the system of canals that was in existence, the mega dry spells spelt doom for the agriculture-based economy. The state policy being one of expansion and filling urban centres with population, often by force, the financial crunch gave teeth to the forces of opposition, leading to revolt, military losses and rapid disintegration of the empire. "These data provide a climatic context for the rise, expansion, and ultimately the collapse of the Assyrian Empire during the mid-to-late seventh century BCE," the paper says.

In the current crisis of global warming, the effects of climate change would not stay local, as in the Assyrian empire, but would spread out in the economy of today's connected world. The most affluent societies may be the most badly affected and there may be a reversal of the pecking order.

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PLUS POINTS

Prevention works best



A dentist's drill might not be the best way to tackle tooth decay in children's teeth, a new study has concluded. Findings from a major dental trial suggest that preventing tooth decay from occurring in the first place is the most effective way for parents to help avoid pain and infection from decay in their children's teeth.

A three-year study comparing three different treatment options for tooth decay in children's teeth, led by dentists from the University of Sheffield School of Clinical Dentistry and the Universities of Dundee, Newcastle, Cardiff, Queen Mary University of London and Leeds, has found no evidence to suggest that conventional fillings are more effective in stopping pain and infection from tooth decay in primary teeth, than sealing decay into teeth, or using prevention techniques alone.

The FICTION trial, the largest of its kind to date, also found that 450 children who took part in the study experienced tooth decay and pain, regardless of which kind of dental treatment they received. During the study, more than 1,140 children between the ages of three and seven with visible tooth decay were recruited by dentists working in one of 72 dental clinics throughout the country. One of three treatment approaches was then chosen randomly for each child's dental care for the duration of the trial, which was up to three years.

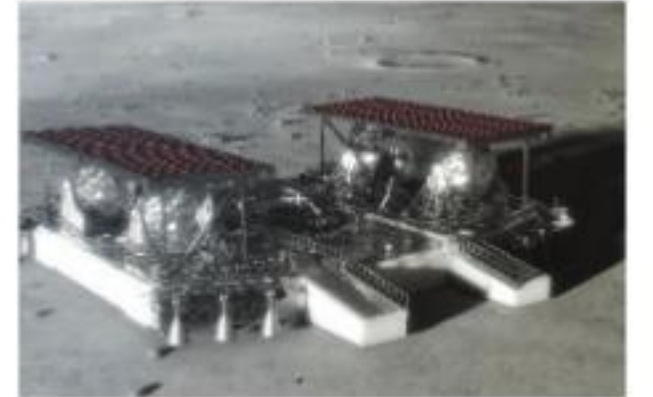
The first approach avoided placing any fillings and aimed to prevent new decay by reducing sugar intake, ensuring twice daily brushing with fluoridated toothpaste, application of fluoride varnish and placing of fissure sealants on the first permanent molar (back) teeth.

The second option involved drilling out tooth decay, which was based upon what has been considered the standard "drill and fill" practice for more than 50 years together with preventive treatments. And the third treatment strategy was a minimally invasive approach where tooth decay was sealed in under a metal crown or a filling to stop it progressing together with preventive treatments.

The main trial findings, published in the *Journal of Dental Research* found no evidence to suggest that any of the treatment strategies were better than another in terms of making a difference in children's experience of pain or infection, quality of life or dental anxiety between groups. All three different ways of treating decay were acceptable to children, parents and dental professionals.

Professor Nicola Innes, chair of paediatric dentistry at the University of Dundee and lead author on the paper, said, "Our study shows that each way of treating decay worked to a similar level but that children who get tooth decay at a young age have a high chance of experiencing toothache and abscesses regardless of the way the dentist manages the decay. What is absolutely clear is that the best way to manage tooth decay is not by drilling it out or sealing it in — it's by preventing it in the first place."

Back on the Moon



Nasa has revealed a version of the lunar lander that could one day help get astronauts to the Moon. The space agency hopes to send its first people back to the Moon in decades — and the first woman ever — in 2024.

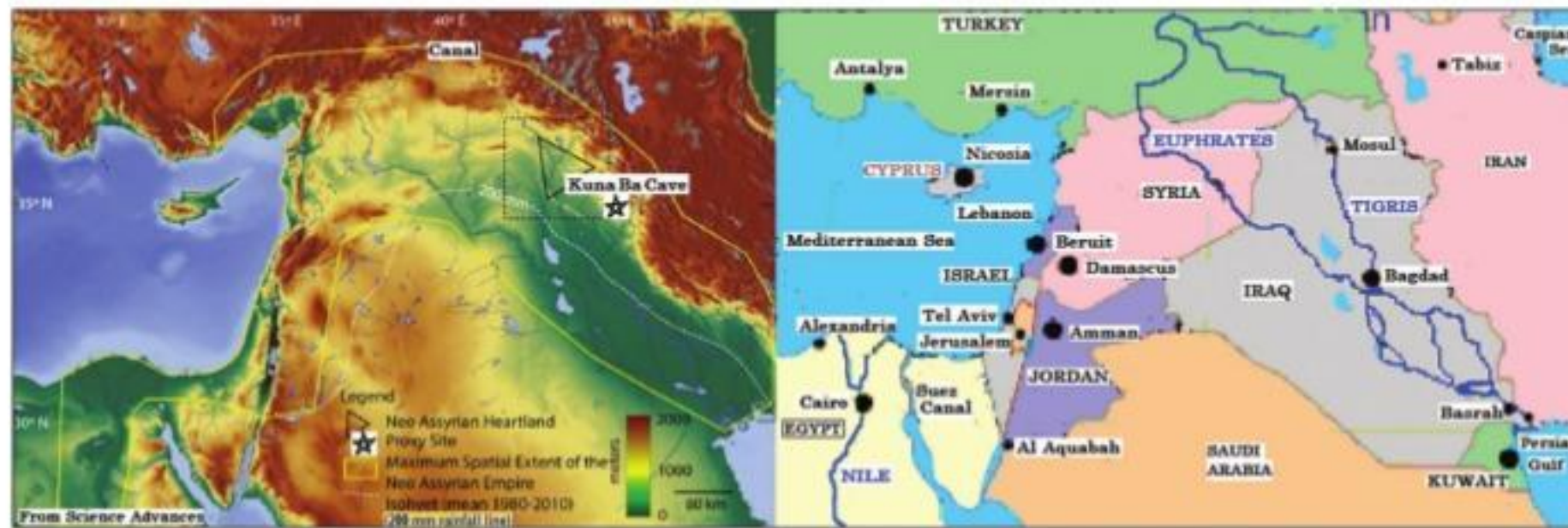
The newly-unveiled concept spacecraft, which it said is a "pallet lander concept" could carry a 300km rover and other payload that would allow it to explore the Moon's polar regions.

In a technical paper explaining its work, Nasa says the mid-sized lander was designed to be simple and affordable — though it admits that the lander is not intended to survive the lunar night. It would travel aboard a commercial launch vehicle in order to reach the moon.

Nasa wants to establish a "sustainable human presence on the moon by 2028" in a bid to discover new scientific discoveries and demonstrate new technological advancements, with the help of private companies to build a lunar economy.

The Independent

Findings show that the decline of a mighty empire was caused by climate change



5 MINUTE HANARY HANAN

The largest empire of the ancient world was the Neo-Assyrian — an Iron Age civilisation that flourished for three centuries from 911 to 609 BCE. This was in Mesopotamia, the Tigris-Euphrates floodplain in Western Asia, where we now have most of Iraq, Kuwait, and parts of Syria and Turkey. After its peak of success in 670 BCE, however, the empire rapidly declined, and in 60 years, ceased to exist as an independent state.

Scholars have attributed the disintegration to political reasons, ambitious expansion, uprisings and civil wars, and alliances formed by hostile Iranian, Persian and Babylonian power centres. Ashish Sinha, Gayatri Kathayat, Harvey Weiss, Hanying Li,

Hai Cheng, Justin Reuter, Adam W Schneider, Max Berkelhammer, Selim F Adali, Lowell D Stott, R Lawrence Edwards from California State University, at Carson, Yale University, Universities of Minnesota, Colorado, Illinois, of Southern California, in the US, University of Ankara and Xi'an Jiaotong University, Xi'an, China, however, report in the journal, *Science Advances*, that the root cause of the decline may have been quite different.

They identify a two century-long period of ample rainfall, in comparison to the preceding 4,000 years, as the reason for the rapid rise of the empire from 911 BCE. And then, a century of mega-droughts, lasting decades at a time, that wrecked economic havoc and led to the sharp decline in the seventh century BCE.

The paper explains, in its supplement, that the Neo-Assyrian state arose with the revival of what remained of the earlier, middle Assyrian Kingdom, which had gone into decline two centuries before. It is recorded that the earlier regime had collapsed as a result of severe regional drought, which had the twin effect of weakening the state and driving neighbouring tribes to carry out foraging raids. However, the Assyrians, who had scattered, regrouped in 934 BCE and regained their lost territory. The state soon began to flourish and over the next two centuries, "became the dominant power in West Asia and the Eastern Mediterranean."

The map shows the extent of the area of influence, from the area that is now Turkey in the north, the borders

of present-day Egypt in the west and eastwards as far as what we know as the Persian Gulf and western Iran.

History records that fissures in the Neo-Assyrian armour began to show in 705 BCE, when the Assyrians suffered a military defeat against a less powerful opponent and the king was killed. His successors still carried the standard forward and the early seventh century BCE saw major civil engineering work, a 100 km network of canals and aqueducts, to sustain expanding borders. But foes proved intractable, there was discontent and rebellion and by the end of the century, the state fell before an alliance of what became the Neo-Babylonian Empire and a powerful state in the mountains of central western Iran.

Multi-cellular replication

A new organism created by the process of nuclear transplantation is said to be a clone of the organism from which the original nucleus was taken

TAPAN KUMAR MAITRA

The fact that a multi-cellular plant or animal may need to produce hundreds of different cell types using a single genome underscores the difficulty of explaining eukaryotic gene regulation entirely in terms of known prokaryotic mechanisms — elephants are not just large *E. coli* after all! If we are to have a thorough understanding of gene regulation in eukaryotic cells, we must approach the topic from a eukaryotic perspective.

The pattern of genes being expressed in any given eukaryotic cell is ultimately reflected in the spectrum of functional gene products — usually protein molecules but in some cases RNA — produced by that cell. The overall pattern is the culmination of controls exerted at several different levels — the flow of genetic information from genomic DNA in the nucleus to functional proteins in the cytoplasm (many, but not all, of these control points are applicable to prokaryotes as well).

There are five main levels at which control might be exerted, the genome, transcription, RNA processing and export from nucleus to cytoplasm, translation, and post-transla-

tional events. Regulatory mechanisms in the last three categories are all examples of post-transcriptional control, a term that encompasses a wide variety of different processes.

The first level of control is exerted at the level of the overall genome. In multicellular plants and animals, each specialised cell type expresses only a small fraction of the total number of genes contained within the genome. Yet almost all of the cells in each organism (other than the haploid sperm and eggs) still contain the same exact, complete set of genes.

For animals, early evidence that even highly specialised cells carry a full complement of genes was provided by John Gurdon and his colleagues. In studies with *Xenopus laevis*, the African clawed frog, they transplanted nuclei from differentiated tadpole cells into unfertilised eggs that had been deprived of their own nuclei. Although the frequency of success was low, some eggs containing transplanted nuclei gave rise to viable, swimming tadpoles.

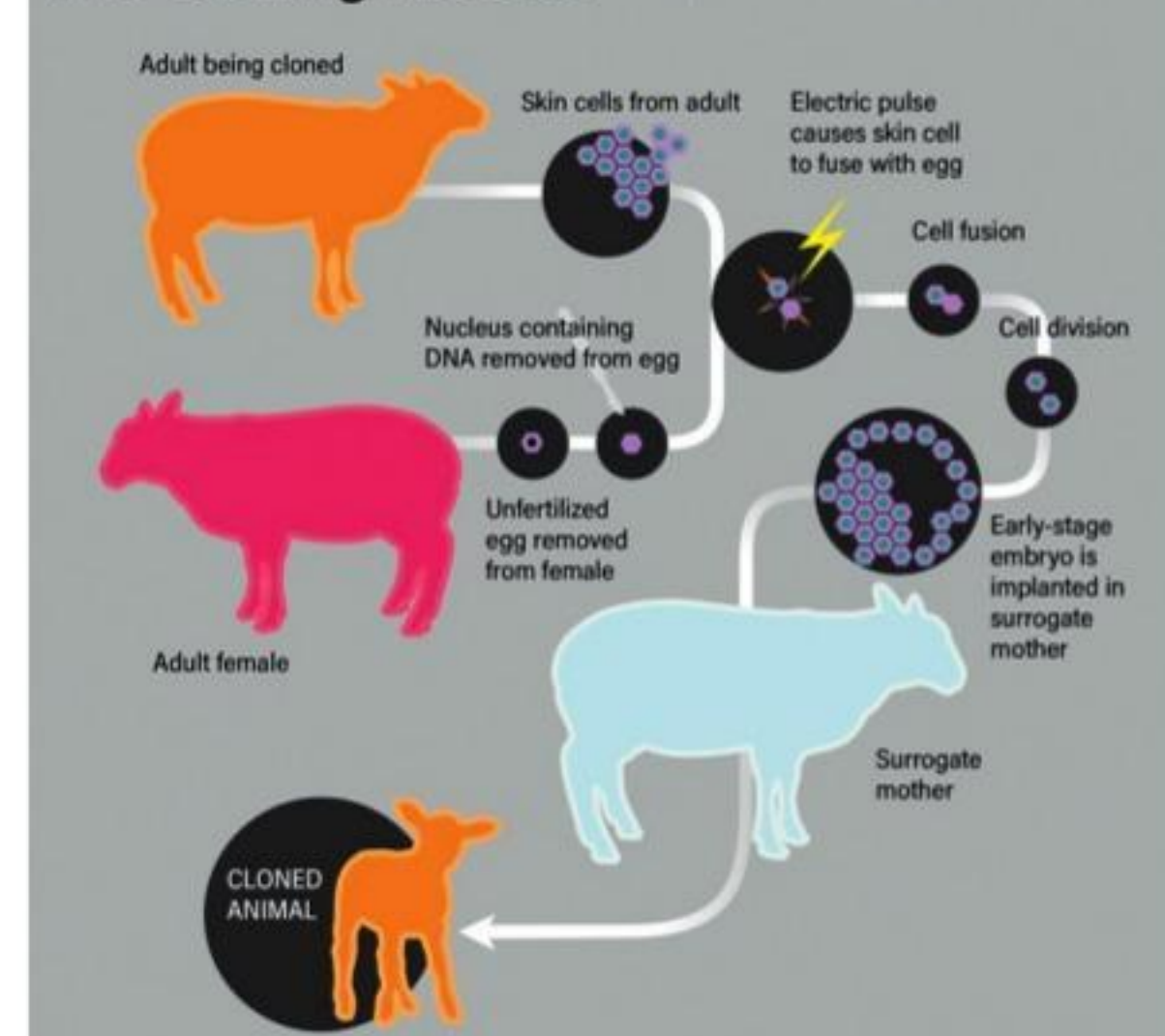
A new organism created by this process of nuclear transplantation is said to be a clone of the organism from which the original nucleus was taken, since the cells of the new organism all contain nuclear DNA derived from cells of the original

organism. The results of these studies indicated that nuclei taken from differentiated cells can direct the development of an entire new organism. Such a nucleus is therefore said to be totipotent — it contains the complete set of genes needed to create a new organism of the same type as the organism from which the nucleus was taken.

An especially dramatic example of animal cloning was reported in 1997, when Ian Wilmut and his colleagues in Scotland made newspaper headlines by reporting the birth of a cloned lamb, Dolly — the first animal ever cloned from a cell derived from an adult. Dolly was born from a sheep egg whose original nucleus had been replaced by a nucleus taken from a single cell of an adult sheep. Similar techniques have subsequently been used to clone animals of several other species, including the cow, mouse, goat, pig, rabbit, and cat. Cloning is a remarkable feat that raises numerous questions about the future applications of such technology.

The ability to produce entire new organisms using genetic information derived from single differentiated cells has also been demonstrated in plants. In an approach pioneered by Frederick Steward, new plants can be created by mitotic division of differ-

The Cloning Process



entiated cells that have been removed from mature plants. For example, you can take a piece of carrot, cut it into small fragments, and isolate cells that are then placed on a nutrient medium and grown in a test tube. Single cells isolated under these conditions eventually grow into complete carrot plants with normal roots, shoots, and leaves.

Thus the nuclei of differentiated plant cells do not require transplantation into an egg to express totipotency. Expression of totipotency is trig-

gered simply by freeing the cells from their normal contacts with neighbouring cells. This method for creating plant clones is of great commercial interest because it provides a reliable way of reproducing agricultural plant strains that exhibit desirable genetic traits without the genetic variability inherent in sexual reproduction.

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