Noble prize in medicine

- The Nobel Prize for Physiology this year has been awarded to Svante Pääbo, Swedish geneticist, who pioneered the field of palaeogenomics, or the study of ancient hominins by extracting their DNA.
- The study of ancient humans has historically been limited to analysing their bone and objects around them such as weapons, utensils, tools and dwellings. Pääbo pioneered the use of DNA, the genetic blueprint present in all life, to examine questions about the relatedness of various ancient human species.
- He proved that Neanderthals, a cousin of the human species that evolved 1,00,000 years before humans, interbred with people and a fraction of their genes about 1-4% live on in those of European and Asian ancestry.

How can DNA be extracted from fossils?

- The challenge with extracting DNA from fossils is that it degrades fairly quickly and there is little usable material.
- Because such bones may have passed through several hands, the chances of it being contaminated by human as well as other bacterial DNA get higher
- DNA is concentrated in two different compartments within the cell: the nucleus and mitochondria, the latter being the powerhouse of the cell.
- Nuclear DNA stores most of the genetic information, while the much smaller mitochondrial genome is present in thousands of copies and therefore more retrievable.
- Pääbo's most important contribution is demonstrating that ancient DNA can be reliably extracted, analysed and compared with that of other humans and primates to examine what parts of our DNA make one distinctly human or Neanderthal.
- Comparative analyses with the human genome demonstrated that the most recent common ancestor of Neanderthals and Homo sapiens lived around 8, 00,000 years ago.

What are the implications of palaeogenomics?

- The study of ancient DNA provides an independent way to test theories of evolution and the relatedness of population groups.
- In 2018, an analysis of DNA extracted from skeletons at Haryana's Rakhigarhi reported to be a prominent Indus Valley civilisation site provoked an old debate about

the indigenousness of ancient Indian population.

- These fossils, about 4,500 years old, have better preserved DNA than those analysed in Pääbo's labs as they are about 10-times younger.
- The Rakhigarhi fossils showed that these Harappan denizens lacked ancestry from Central Asians or Iranian Farmers and stoked a debate on whether this proved or disproved 'Aryan migration.'
- Palaeogenomics also gives clues into disease. Researchers have analysed dental fossils to glean insights on dental infections.

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Noble price in physics

- Why were these three physicists chosen for the award?
- The prize has been given for experimental work in quantum entanglement, which Einstein referred to as 'spooky action at a distance'.
- John Clauser and Alain Aspect firmed up this concept, developing more and more complex experiments that demonstrated and established that entanglement was indeed a true characteristic of quantum mechanics.
- They did this by creating, processing and measuring what are called Bell pairs.
- Anton Zeilinger innovatively used entanglement and Bell pairs, both in research and in applications.
- These include quantum computation and quantum cryptography.

What is at the centre of the quantum revolution?

- Many of the concepts that were useful in visualising the movement of particles in the classical realm break down when applied to particles obeying quantum mechanics.
- For example, when a tennis ball is struck, we see that it traces out a definite path in space.
- The path it traces out is called a trajectory, and it is eminently possible to theoretically calculate the trajectory to any given accuracy.
- Simultaneously, there is no restriction on measuring the speed, or momentum of the ball at every point on the trajectory.
- Particles that fall into the quantum regime on the other hand electrons or photons, for example do not even possess a definite trajectory because they are not little hard spheres that we initially imagined them to be, but are weird, wavelike quantum objects.
- Because of this, there is a limit to how precisely you can measure the

position and momentum of these particles simultaneously.

- Many differences arise, starting from this fundamental difference.
- One important difference in the behaviour of quantum systems, when compared to classical bodies, is the concept of entanglement, which is at the heart of this year's Nobel Prize for physics.

What is the practical use of quantum mechanics?

- Electronic devices that we employ today use transistors that apply quantum mechanical ideas.
- Lasers have been built that apply the quantum properties of light.
- What is quantum entanglement? Does it have a classical counterpart?
- Quantum entanglement is a phenomenon by which a pair of particles, say photons, is allowed to exist in a shared state where they have complementary properties, such that by measuring the properties of one particle, you automatically know the properties of the other particle.
- This is true however far apart the two particles are, provided the entanglement is not broken. There is a trivial example of this from the classical domain.

What was the work done by the laureates?

- John Clauser and Alain Aspect devised sophisticated experiments to test the above cases and establish through Bell's inequality, that entanglement was indeed a consequence of quantum physics.
- The third laureate Anton Zeilinger and his group used the phenomenon of entanglement to perform what is called quantum teleportation. This is a way of conveying information from one place to another without the actual transport of material.

Where does the work find use in practical applications?

- The work of the three laureates can help in developing quantum technologies of the future, for example, quantum cryptography, and precise timekeeping as is done in atomic clocks.

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Australia set goal to prevent extinction

- Australia sets goal to prevent new wildlife extinctions
- Australia's government has set the goal of preventing new extinctions of native wildlife, and conserving at least 30% of its land mass by 2030.

- More mammal species have gone extinct in Australia than on any other continent, and over 1,900 Australian species are listed as threatened.
- The government's 10-year threatened-species plan will prioritise the protection of 110 species.
- The commitment to zero extinction is commendable but there is still no clarity on how the plan will protect non-priority species.

THE HINDU

Heat wave forecasting

- Heatwave is a period of unusually hot weather with above normal temperatures that typically last three or more days.
- In India, heatwaves are generally experienced during March-June.
- On an average, two-three heatwave events are expected every season.
- Heatwaves are predominantly observed over two areas, central and northwest India and another over coastal Andhra Pradesh and Odisha, supported by favourable atmospheric conditions.
- Total duration of heatwaves has increased by about three days during the last 30 years and a further increase of 12-18 days is expected by 2060.
- In future climate, heatwaves will be spread to new areas including southern parts of India.
- Climate change is causing heatwaves more frequently, and they are much stronger and can last for more day.
- Caused fatalities Heatwaves have multiple and cascading impact on human health, ecosystems, agriculture, energy, water, and economy.
- The recent 2022 heatwave in India and Pakistan in March-April made devastating impacts. It is estimated to have led at least 90 deaths across India and Pakistan.
- It also triggered an extreme Glacial Lake Outburst Flood in northern Pakistan.
- Adaptation to heatwaves can be effective to minimise the negative impacts, by developing a comprehensive heat response plan that includes early warnings, awareness rising and technology intervention.
- India has now a strong national framework for heat action plans involving the India Meteorological Department (IMD), the National and State disaster management authorities, and local bodies.
- Early warning systems are an integral part of this heat action plan.
- Heatwaves are caused by large scale atmospheric circulation anomalies

like high pressure areas, upper-tropospheric, jet streams, etc.

- The global forcing like the El Nino/Southern Oscillation (ENSO) and the Indian Ocean modulate the frequency and duration of Indian heatwaves.
- Heatwave can be further accentuated by local effects like depleted soil moisture and enhanced sensible heat flux.
- Under the National Monsoon Mission, the Ministry of Earth Sciences (MoES) had established an advanced prediction system for early warnings of heatwaves.
- IMD has the capability to predict the genesis, duration and intensity of heatwave events with reasonable accuracy up to four-five days in advance.
- Scientific Reports by the scientists at the Indian Institute of Tropical Meteorology (IITM), Pune, has shown that heatwave genesis and duration in India can be predicted with good skill up to two weeks in advance.
- In another recent study published in the International Journal of Climatology of the Royal Meteorological Society last month, scientists from IMD, IITM and MoES have documented for the first time that Indian heat waves can be predicted even one season in advance.
- They used 37 years (1981-2017) of hindcasts from the Monsoon Mission Coupled Climate Forecast Model (MMCFS) to document that seasonal predictions of frequency and duration of Indian heat waves during April June are very useful.
- We have an end to-end seamless prediction system to predict heat waves in all time scales, from short-range to seasonal.
- The seasonal forecast will provide an outlook or probability of frequency and duration of heatwaves, one season in advance.
- This early outlook can be further strengthened using the extended range (two weeks) and short range (four-five days) forecasts for more focused region wise response strategies.

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