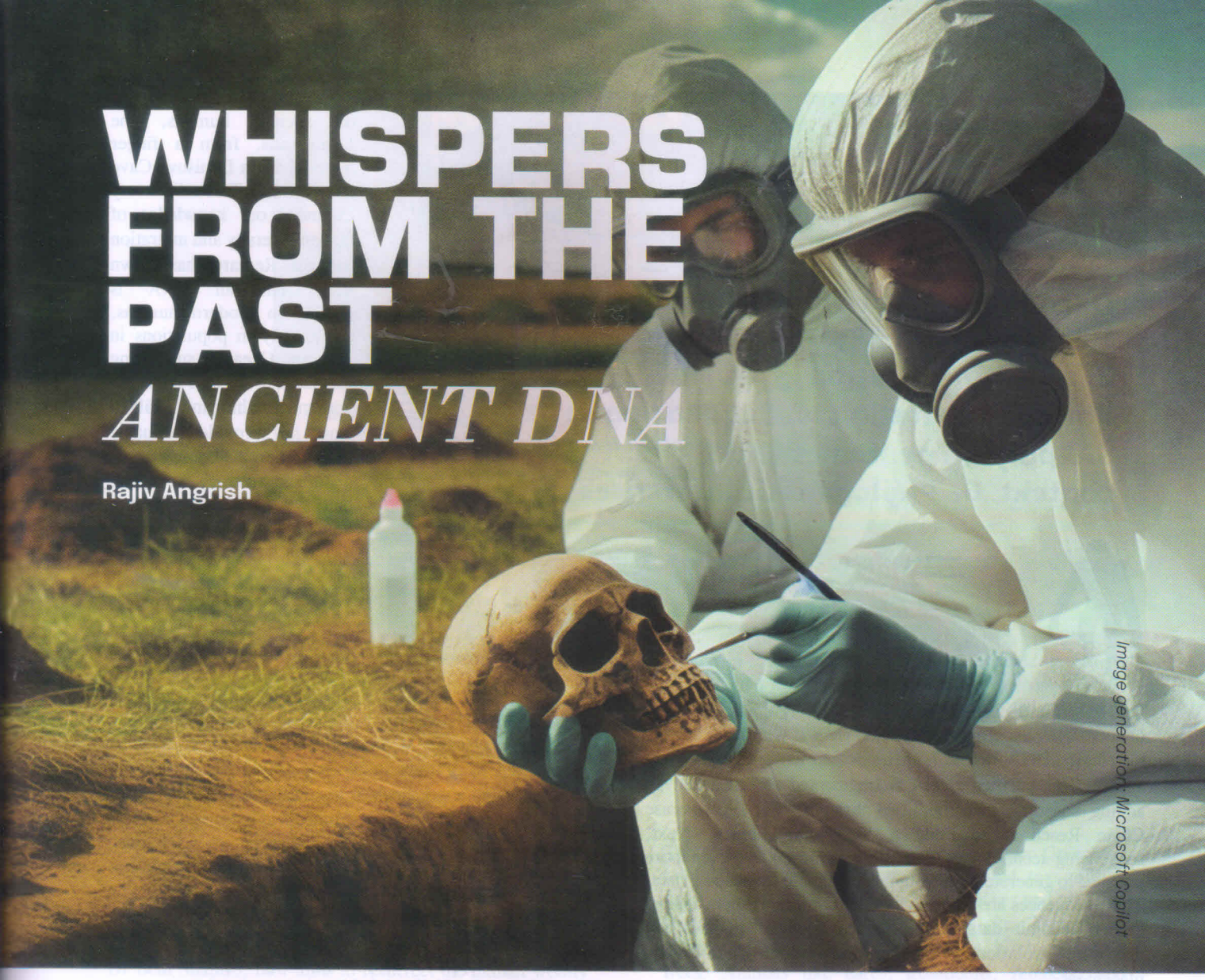
WHISPERS FROM THE PAST

ANCIENT DNA

Rajiv Angrish



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THE study of ancient DNA (aDNA) has revolutionised our understanding of the past like never before. aDNA refers to genetic material extracted from the remains of ancient organisms, such as bones, teeth, or sedimentary deposits that may be thousands to hundreds of thousands of years old. Research in aDNA plays a significant role in understanding the evolution, migration, and interactions of humans, animals, plants, and microbes.

After an organism dies, its DNA begins to break down as cellular enzymes and microbes degrade it. In rare conditions — like freezing, very dry places, or places with no oxygen — this process slows down or stops. Hard fossil remains like bones and teeth often house aDNA. It can also survive naked in sediments such as lake beds, caves, or permafrost when it is termed as sedimentary-aDNA. Under ideal freezing conditions (–5°C), aDNA has a half-life of about 521 years — that is, every 521 years, roughly half of the DNA bonds break. In warmer settings, chemical decay speeds up, and the half-life becomes significantly shorter. Among the most remarkable recoveries of viable aDNA are the 1.2-million-year-old samples from frozen woolly mammoths and the groundbreaking discovery of 2-million-year-old aDNA preserved in Greenland sediments — both setting records for aDNA survival.

Diverse aDNA Types

aDNA includes nuclear, mitochondrial, and plastid DNA, each offering unique insights. Nuclear DNA, inherited from both parents, is comprehensive but more prone to degradation. Mitochondrial DNA, maternally inherited, is more stable due to its smaller size and circular structure, aiding in studying maternal lineages. Plastid DNA, similar to mitochondrial DNA, provides information on plant evolution and agriculture. Additionally, ancient prokaryotic genomes reveal insights into early microbial life. However, RNA, being fragile, is rarely preserved in ancient specimens.

Analysing Ancient DNA (aDNA)

Sampling aDNA requires extreme care to prevent environmental DNA contamination, so researchers wear protective suits, use sterilised tools, and seal samples in secure containers, while laboratories rely on HEPA filters and