Molecular Egyptology

Mummified human DNA cloned

from J.S. Jones

ON page 644 of this issue, Svante Pääbo reports the remarkable extraction and cloning of DNA from an Egyptian mummy[1]. One clone contains a 3.4 kilobase segment of DNA that has been preserved for more than two millenia. Although only one out of 23 mummies has yet produced clonable DNA, the yield from this individual approaches five per cent of that obtainable from fresh human material. Preliminary though it is, the report opens up some fascinating possibilities for future work on human evolution and archaeology.

'Fossil genes' have been identified before now: ancient snails buried in prehistoric English earthworks retain their shell colour and banding patterns[2], and comparisons of skeletal variants in living and extinct mice have been used to establish the origins of some Scottish mouse populations[3]. Even mummies retain enough of their blood group substances to allow the kinship of family groups to be confirmed serologically[4] and, on the basis of hair characters, an unidentified royal mummy from the New Kingdom has been shown to be the mother of the heretic pharaoh Akhenaton[5].

Valuable as such specific data may be, there is much more potential information in DNA sequences. The human genome possesses hundreds of thousands of genetic polymorphisms at the DNA level. Some regions (which involve variations in the number of copies of repeated sequences not dissimilar to the *Alu* sequence, to which the mummy 3.4 kilobase clone is closely related) are hypervariable[6] and can provide particularly precise estimates of human kinship and population relatedness. If these polymorphisms can be detected in mummies, we may answer some important questions about the world of our ancestors.

Information on DNA sequences is uniquely suited for tracing population movements: knowledge of the geographical distribution of point mutations in some senses provides no more than single letters in a population's genetic identity, while the ordered sequence of bases provided by its DNA haplotype gives the genetic surname itself. Thus, information on DNA sequences closely linked to the sickle-cell haemoglobin polymorphism has recently been used to establish the relationships between living populations in different parts of Africa[7]. Sickle-cell populations from Senegal and Benin differ considerably in their sickle-cell haplotype; but populations from North Africa have the same haplotype as the Nigerians. This is strong evidence that the sickle-cell mutation has arisen several times, but that the northern sickling populations originated by migration from West Africa.

Information of this kind from mummies might tell us something about population movements in ancient Africa. Ancient Egypt is thought to have been occupied by a number of distinct populations, and it is certainly the case that some dynasties of Pharaohs were drawn from foreign populations that invaded the Nile Valley. Perhaps it would be possible to test the claim of the Coptic Christians of modern Egypt to be the lineal descendants of the ancients (who disappeared from the Nile Valley under successive waves of invasion by Syrians, Greeks, Romans, Byzantines and Arabs).

DNA sequences are also useful in studying patterns of kinship and paternity within local populations. There is considerable controversy among Egyptologists about the relatedness of groups of mummies from particular sites, and there is clear potential for DNA work here. Ancient records suggest that in the 18th Dynasty, the Egyptian royal family practised incest between brother and sister or father and daughter for at least eight generations: information on their mummified DNA sequences might tell us to what extent this royal exclusivity was successful. Incest in Egypt was designed to preserve the blood line of a deity. There is something intriguing about the possiblity of learning the genotype of a god.

Mummies are not unique to Egypt: preserved humans have been found in Peru, Japan, Australasia and Europe. There is the potential here to answer some larger questions abut human evolution. What is the relationship between the native Australians and the rest of the world; were there indeed two separate invasions of Australia, as often claimed? Do the genotypes of mummified Europeans accord with the suggestion that geographical patterns of gene-frequency change in modern Europeans reflect an invasion from the East that occurred as a result of the development of agriculture? Mr Average, as defined by the population nearest the global mean for a large number of enzyme and blood-group loci, lives in the Middle East[8]: would the patterns of change in mummified humans support the idea of worldwide spread from the Middle East? An answer to any of these questions would be of extraordinary interest.

Finally, it is important to understand that Pääbo has *not* done: we cannot of course reconstitute a functional gene (let alone a living individual) from this short repeated sequence. One American newspaper reported the recent cloning of mitochondrial DNA from a specimen of the extinct quagga[9] as "US Scientists Clone Dinosaurs to Fight on after Nuclear War", and probably there will be similar sensational accounts of mummy DNA. Molecular biology rarely lives up to its headlines, but the interaction of DNA technology and archaeology may open a new phase in our understanding of human history. □

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Archaeoastronomy

Halley's comet in Babylonia

from C.B.F. Walker

IN August 1984, Halley's comet was unexpectedly discovered in the British Museum or, to be more precise, on some Babylonian tablets in the museum's archives. That discovery, reported by F.R. Stephenson, K.K.C. Yau and H. Hunger on page 587 of this issue, will be exciting both for eager Halley watchers and for historians of science. It represents the first significant addition to our knowledge of the past history of the comet since the French publication of Chinese observations in 1846. It fills an important gap in the historical record, since no other account of the return of the comet in 164 BC survives. Remarkably, it also proves that the Babylonian astronomers kept records of such accuracy that we can now make a clear choice between current theories of the comet's path in antiquity.

What were the Babylonians doing recording comets? The beginnings of astronomy in Mesopotamia probably go back to the third millennium BC, when the Sumerians gave the planets and principal constellations their names but, apart from simple tables of the length of daylight and the rising and setting of constellations, almost all the early texts are concerned with astrology rather than astronomy. Writing in about AD 150, the Greek astronomer Ptolemy notes that the earliest observations available to him date from the time of the Babylonian king Nabonassar (Nabu-nasir, 747-734 BC). Although contemporary texts do not survive, later Babylonian texts also suggest that the practice of keeping a regular official record on the movements