publicity. It is perhaps the combination of modern molecular techniques and 'old-fashioned' archaeology that catches the interest of the scientific community and general public alike. This fascination sometimes clouds critical judgement. But this area of research, like all others, must meet with standards that ensure the authenticity and reproducibility of any given result. This has not always been so. Several of the most spectacular claims — such as the retrieval of DNA sequences from 15-million-year-old plant compression fossils³, from 80-million-year-old bones of putative dinosaur origin⁴ and from insects of up to 130 million years in age trapped in amber^{5–7} — could not be reproduced in any other than the original laboratories, and so are of limited value^{8–11}.

The relationship between Neanderthals and humans remains enigmatic, so the retrieval of Neanderthal DNA has been one of the major goals of researchers in the field of ancient DNA. The age of later Neanderthal populations is well within the range compatible with reliable retrieval of ancient DNA (such retrieval is possible from samples up to 100,000 years old). However, it appeared from several studies (for example, ref. 12) that the work done with ancient human remains was close to the technological limit of what is possible. This is mainly because of the difficulty of distinguishing target sequences from contaminating modern, in this case human, DNA (Box 1).

So it came as no surprise that the publication of the first successful retrieval of DNA from a Neanderthal, from the Feldhofer Cave in Germany², was greeted with caution. Although the paper was widely regarded as being of technically high quality, the remote possibility remained that the published sequence was an artefact or the result of contamination. The need for DNA sequences from a second, unrelated Neanderthal specimen was clear, as echoed in most reviews of that paper. And this is where the importance of the work of Ovchinnikov *et al.*¹ lies.

Ovchinnikov and colleagues sequenced Neanderthal mitochondrial DNA and found that it is closely related, but not identical, to that described previously. Like the first paper², the study of Ovchinnikov *et al.* is convincing in itself. The authors used all the state-of-the-art controls to monitor artefacts and contamination, including having the sequences verified by another laboratory. However, only the combination of the papers allows us to appreciate fully their individual worth. The identification of two Neanderthal DNA sequences, from different specimens found in locations far apart, that are closely related but not identical, rules out the possibility that either sequence is an artefact or the product of contamination. By verifying each other, the two papers provide the most reliable proof so far of the authenticity of ancient DNA sequences.

Can we learn anything from this new Neanderthal DNA sequence about the relationship between modern humans and Neanderthals? The new sequence shares with the Feldhofer one the same surprising feature: it is no more closely related to DNA from modern European populations than to sequences from any other modern human population. This argues against the idea that modern Europeans are at least partly of Neanderthal origin. Although the two sequences were taken from specimens at geographically distant locations, the number of differences between the sequences indicates that these two individuals were from a single gene pool. Furthermore, the variation between the two Neanderthal sequences is similar to that among modern humans.

Details of the Mezmaiskaya sequence also support the suggestion² that there was no contribution of the Neanderthals to the pool of mitochondrial genes in modern human populations. However, this does not exclude the possibility of a contribution of nuclear Neanderthal genes. Approximate quantification of the number of mitochondrial DNA molecules found in the Feldhofer Neanderthal ruled out any hope of recovering nuclear DNA from this specimen², but the apparently excellently preserved Mezmaiskaya specimen might yield values compatible with retrieval of nuclear DNA.

Having achieved DNA sequencing from members of geographically distant Neanderthal populations, it would be interesting to do the same for populations that are far apart on the timescale. A specimen dated closer to the upper time limit of Neanderthal distribution (about 230,000 years ago) would be a tempting choice for DNA retrieval.

The quality of the molecular data retrieved so far from Neanderthal specimens is compelling. If this is how research on ancient DNA is going to proceed, then we are truly on our way to Neanderthal population genetics.

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Daedalus

Direct illumination

The best monochromatic microwave sources are those efficient cavity-resonator valves, the klystron and the magnetron. The wavelength they emit is determined by the size of their cavity. These days, silicon microengineering can create and shape objects and cavities with dimensions around a wavelength of light. So Daedalus is now planning microklystrons and micro-magnetrons to generate bright monochromatic light.

It should be simple enough to form a proper cavity in silicon, and coat it with low-resistance metal to make it a good resonator. The main problem is making an electron beam fine enough to enter the cavity. A conventional cathode would be far too coarse. Fortunately, point sources for electron beams already exist, for field-ion and electron microscopes. With luck they could be formed by the same photofabrication used to make the cavity.

A single photoklystron would be a wonderful point source of light, but very feeble as a lamp. A DREADCO team is designing an array of many hundreds of photoklystrons sculpted on a single silicon wafer. Integrated circuitry on the same wafer will apply control and power voltages to the klystrons of the array. The whole thing will be sealed in an evacuated glass envelope from which the generated light can escape.

Integrated-circuit mass production is so cheap that the photoklystron lamp could well be competitive with its fluorescent and filament rivals. If the klystrons on the wafer were all different, so that each radiated its own frequency, the resulting lamp could be almost perfectly white, ideal for domestic illumination. Even better, it would be a cold white, with no infrared. And as a resonant device, the lamp should be highly efficient, far brighter per watt than its rivals.

If all the photoklystrons in the lamp were identical, it would be perfectly monochromatic, an ideal spectroscopic source. Like a conventional klystron, it could be tuned over a useful range by varying the voltage applied to its electrodes. A series of such klystron lamps could span the visible and infrared bands seamlessly, right out to the millimetre region. Physicists would at last be released from the inflexible, untunable grip of the laser.

David Jones

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