THIS WEEK

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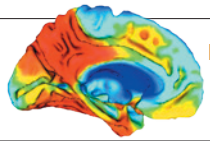

INSIDE VIEW Imaging technique shows ageing protein **p.143**

Food processing

A recreation of how early humans managed to eat a diet of meat hundreds of thousands of years before they had fire to cook it with, shows an ingenious use of tools to cut down on chewing time.

You are what you eat. Not only that, but you are what your ancestors ate, when they ate it, and what they did to it first. One of the many peculiarities that set humans apart from other animals is that eating is more than just stuffing something into our mouths.

True, the human diet is astonishingly eclectic, but this wide range is tempered by elaborate preparation. No other animal, for example, exposes prospective food items to prolonged heating, a habit we call 'cooking'. It's now generally thought that cooking was central to the evolution of modern humans, prompting a massive reduction in tooth size and chewing muscles, alongside a marked increase in available nutrients, more time to spend doing other things besides chewing, and even an expansion of the brain.

There is — as always — a catch. Cooking requires fire, and there is scant evidence for the regular use of fire before around 500,000 years ago. *Homo erectus*, the first hominin to even begin to approach modern humans in stature, brain size and masticatory apparatus, appeared around 1.5 million years earlier than that. *Homo erectus* was a regular carnivore, a habit that has stayed with us and is believed to be necessary to our modern diet (see *Nature* **531,** S12–S13; 2016).

How did *H. erectus* manage to consume meat without cooking it? As Katherine Zink and Daniel Lieberman explore in a paper online in *Nature* (see http://dx.doi.org/10.1038/nature16990), raw meat is tough and practically impossible to break down into swallowable pieces just by chewing it. Side orders of roots and tubers can be crunched, but only if you are prepared to put in the hours. A lot of hours. About 40,000 chews a day, which, at a ruminative rate of 1 chew per second, adds up to 11 hours. That's almost a whole day gone, just chewing. That's no issue for many baseball players or football managers, perhaps, but *H. erectus* had better things to do.

The new study squares the circle by showing that tools equivalent to knives, mortars and pestles entered the kitchen a long time before the oven. Stone tools date back to at least 3.3 million years ago (S. Harmand *et al. Nature* **521,** 310–315; 2015). A freshly struck flake of stone makes short work of slicing raw meat into morsels, and a lump of rock can be used to pound roots and tubers into a paste.

Work with people today has put numbers on these gains. When meat is sliced and roots are pounded, a prehistoric diet of 2,000 kilocalories per day (one-third raw goat and two-thirds raw yams, carrots and beets) can be achieved with 2.5 million fewer chews a year than if the items are unprocessed. That's an entire month spent not chewing — presumably enough to explain the reduction in tooth size and masticatory muscle mass of *H. erectus* compared with earlier, more masticatory species, as well as the increase in brain size allowed by the release of more nutrients. And what does one do with one's mouth when not chewing? One talks a lot, of course. Preferably to other people.

Our ancestors probably also ate fruits and berries, fish and shellfish, nuts, bone marrow, liver and brains, all of which are highly nutritious. But some of those foods need a deal of slicing and pounding to get at. Nuts have hard shells, as do shellfish, by definition; marrow and brains require (there is no delicate way to put this) the smashing of bones and skulls. Many animals are known to use simple tools to acquire food of that sort. But the release of nutrients from muscle by an animal with teeth more suitable for crushing than slicing required the application of some early food technology.

"Raw meat is tough and practically impossible to break down into swallowable pieces just by chewing it."

Cooking, when it came, enabled yet more efficient nutrient release, and provided other benefits such as the killing of any harmful parasites that raw meat might contain, as well as the gathering of sociable people round a hearth to swap gossip, watch celebrity chefs on TV and share pictures of their cats on the Internet, if only as a way of using up all that time not spent chewing the fat. But cooking did not start this. It merely accelerated a culinary tradition already millions of years old. ■

Who ordered that?

An unexpected data signal that could change everything has particle physicists salivating.

Physicists at the Large Hadron Collider (LHC), the giant particle-physics experiment near Geneva, Switzerland, have searched for many possible subatomic particles and novel phenomena. They have tried to recreate dark matter, reveal extra dimensions of and collapse matter into microscopic black holes.

But the possibility of an electrically neutral particle that is four times heavier than the top quark — the current heaviest — and that could decay into pairs of photons has apparently never crossed anybody's mind. No theorist has ever predicted that such a particle should exist. No experiment has ever been designed to look for one.

So when, on 15 December last year, two separate teams at the LHC independently reported hints of such a particle (see *Nature* http://doi.org/bc4t; 2015), the reaction of many experts was similar to that of US physicist Isidor Isaac Rabi when the muon, a heavier relative of the electron, was discovered in 1936: "Who ordered that?"

If the particle exists, the implications would be enormous. Precisely because it is so unexpected, it could be the most important discovery in particle physics since quarks — the elementary constituents of protons and neutrons — were confirmed to exist in the 1970s. Perhaps it would be the biggest deal since the muon itself.

The evidence so far is scant, however. It amounts to a few too many