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Early human use of fire

Handling of fire has become something we take for granted today. Humans use it in a variety of ways, and it has become a constant, always available companion. We rely on and are dependent on it. Even if, in our modern society, fire is often hidden from view, almost all the achievements of the industrial age are based on it: metals, glass, plastics, ceramics, power generation, combustion engines, and rocket propulsion. Without the power of fire, our civilization would not exist in this form. Its use was a qualitative leap for our ancestors, and control over it marks a clear boundary between animals and humans. No other distinguishing criterion achieves this exclusivity in the discussion about our delineation from animals. The manipulation and creation of fire is an exclusively human trait that has become universal within our *Homo* species. The ability to control fire is a crucial trait of human culture and has likely influenced both the physical and cultural development of our lineage. Fire has fundamentally changed our relationship with the world. But when did humans begin to use fire, and what are the many advantages of this cultural innovation?

The benefits of fire for those who were brave enough to harness it are many. The use of fire as a heat source extended the natural range of humans and made it possible for them to colonize more northern latitudes and higher altitudes. For the first time, fire also provided an effective deterrent against dangerous predators and enabled hominins to occupy caves and drive away other competing cave dwellers such as hyenas and bears. The smoke also kept annoying flies and swarming mosquitos away. Fire also provided comfort as it was an effective way of clearing sleeping areas of the parasites that lived in the old grass beds. *Fig. 2*

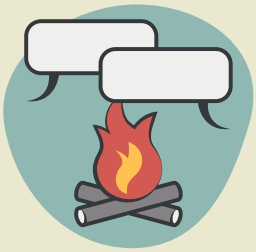
1 The control of fire has become something we take for granted today.

Source of heat

Preservation of food through smoke

Hunting and cultivating the landscape

Cooking



Communication

Smoke as protection against mosquitos

Light source

Protection from predators

Cleaning of sleeping places using heat

Technical improvement

As a further advantage, fire brought light into the darkness and thus lengthened the day. It provided light for working and kept warm in the cool night. The extra time gained in this way could be used for social interaction, exchange of information, and creative processes. In general, the social component of fire as a central spot for coming together was certainly important. In addition to the social nature of eating together, working around a fire led to an expansion of communication and solidarity within the group, and encouraged cultural and technological advances. Sitting around the fire in the evenings, during and after meals, and the associated exchange of stories and experiences strengthened memories, imagination, and empathy for the thoughts of others. The use of fire surely also led to a closer social structure within the groups since, in addition to the technical challenges, it was also necessary to organize a regular supply of fuel to keep the fires burning.

The use of fire also facilitated technical improvements and innovations. By applying fire (and heat), it was possible to improve the material properties of wood and stone. Through heating (tempering), some rocks became easier to split, making it easier to produce certain tools; wooden lance tips could be hardened by fire. Later, it became possible to manufacture completely new materials such as birch pitch, which was used as an adhesive. Fire was often useful during hunting. With its help, it was possible to create panic among prey animals or corner them so that they could be hunted more easily. It could also be used to cultivate the landscape and thus promote the growth of preferred edible plants for prey species or the hominins themselves. Heat and smoke preserved food through drying and smoking, respectively. This is still of great importance for hunting societies today, to preserve food as a reserve for hard times and thus compensate for bad hunts.

However, the ability to cook food was probably the most important advantage of using fire and is viewed by many scientists as a decisive step in human evolution. Cooking with fire significantly expanded the range of foods that hominins could consume. The heat decomposed poisonous substances in plant foods and eliminated parasites. Fire also resulted in several energetic advantages: the reduced digestive effort when consuming cooked food as opposed to raw food led to a significant reduction in expended energy and time (more on this in the article by Bruch/Hahn in this volume).

2 The many advantages of using fire.

The long road to using fire

Imagine, what were the first steps in harnessing fire? Using fire does not necessarily mean being able to produce it. In general, the process can be summarized in the following steps: 1. Getting used to natural fire, 2. Using fire, 3. Maintaining fire, and 4. Producing fire. In the beginning, it was certainly necessary to overcome the initial reflex to escape or run away when confronted with a natural fire that was ignited through a lightning strike, volcanic activity, or, more rarely, by the spontaneous combustion of coal, oil shale, or other concentrations of organic plant matter. Like today's chimpanzees, early humans developed the ability to face a burning landscape calmly without panic. The next insights included recognizing and making use of the positive consequences of fire, i.e., after a bushfire, such as the easier acquisition of formerly hidden fruits, seeds, or tubers, as well as (lightly cooked) small animals that perished in the fire. In addition, the reduced vegetation cover caused by bushfires made locomotion and the early detection of dangerous predators easier. This passive use of fire probably eventually led to active use. Initially, a naturally burning fire was fed with additional fuel to artificially prolong its presence at the site of origin so that one could warm oneself or cook something. This likely evolved into the ability to transport fire from its place of origin to another location. Eventually, people discovered, probably through a combination of lucky chance and experimentation, that they could make fire themselves whenever and wherever they wanted. This mastery gave early humans profound freedom to control their environment, cook their food, and produce new materials at will. It is generally assumed that these transitions took place in landscapes in which lightning-related fires prevailed or in zones of long-term active volcanism (for example the African Rift Valley). It is possible, that life in fire-prone environments led to an adaptation in hominins that eventually taught them to use fire to their advantage.

What about the evidence?

The earliest evidence suggested for the use of fire by early humans is not archeological but physiological. It is postulated that eating easily digestible cooked food may have been responsible for the shortening of the human intestine and thus the redirection of the calories saved during digestion into the brain, which ultimately led to an increase in brain size as documented in the fossil record with the appearance of *Homo erectus* from around 1.9 million years ago. However, the extra calories needed for larger brains could just as easily come from high-energy bone marrow. At this time, hominins had already mastered the ability to break open skulls and long bones of their prey with large stones to reach the precious bone marrow.

3 Important sites with early fire use in Africa and the Middle East with an age between 1.5 million and 125,000 years.

The earliest archeological evidence of fire use in the form of thermally altered sediments, stone artifacts, or bones was discovered in Africa. The oldest evidence is 1.5 million years old and comes from Koobi Fora in Kenya. Other sites include Chesowanja in Kenya and Gadeb in Ethiopia, as well as the one-million-year-old cave sites Swartkrans and Wonderwerk in South Africa, where an analysis of the sediments has shown that the burned bones were certainly not caused by bush fires, and the site Olorgesailie in Kenya. The oldest evidence for something resembling a stove on which food was cooked is around 790,000 years old and comes from the Gesher Benot Ya'akov site in Israel. Possibly similarly old evidence for the use of fire was discovered in the Zhoukoudian Cave in China. From 400,000 years ago, evidence for use of fire increased significantly. Clear evidence of the production of fire is circa 30,000 years old, yet newly discovered traces on Neanderthal stone tools have also been interpreted as an indication for the early production of fire.

Further reading

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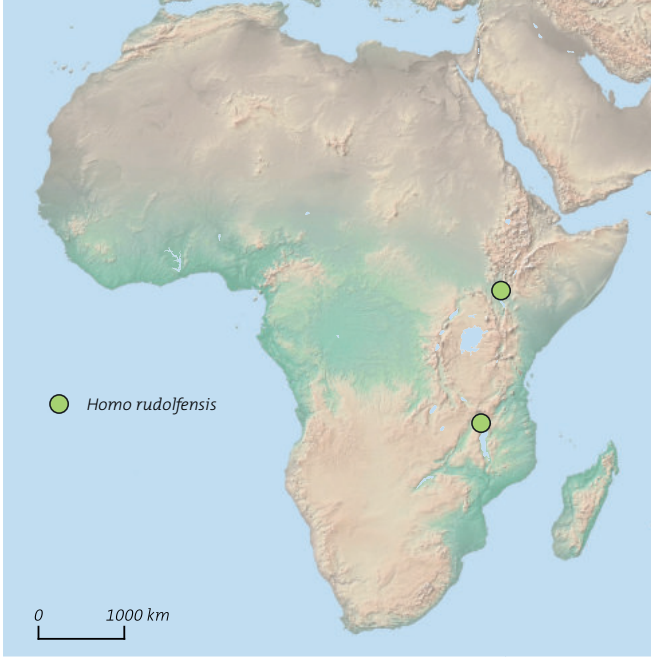
Homo rudolfensis

Profile



Discovery

The first fossil of *Homo rudolfensis* was discovered by Bernard Ngeneo in 1972 near Lake Turkana. It was a badly fragmented skull.

Sites

Kenya: Koobi-Fora-Formation.

Malawi: Uraha.

Finds

Multiple preserved skulls, lower jaw bone, teeth, thigh bone without articular surfaces, upper portion of a lower arm bone, pelvic bones, shin bone.

Age

2.5–1.8 million years.

Brain size

750–752 cm^3.

Characteristics

Homo rudolfensis is the oldest species of the genus *Homo*. The shapes of their leg and pelvic bones indicate that they probably walked bipedally more often and longer than any other species before them. The slightly curved shape of their teeth is also very similar to younger *Homo* species. It is estimated that they were 1.5 m tall and weighed between 45 and 50 kg. The proportion of plants in their diet was large. They mainly ate leaves, seeds, and fruits from trees. While *Homo rudolfensis* is believed to have been able to make and use tools, no tools have yet been found that are directly associated with them.

Facial reconstruction

Skull KNM-ER 1470
from Koobi Fora, Kenya

Lower jaw UR 501 from Uraha, Malawi