

History of Engineering and Technology

Lecture 1: Engineering in the prehistoric era.



Prehistoric Engineering (~106 BP→~104 BP)



Prehistoric Engineering (~106 BP→~104 BP)

- Early Humans
- Invention of Tools
- Discovery of Fire
- Customs and Art
- Shelter and Migration
- Prehistory and Invention
- Prehistoric Engineering: Discovery of Devices

Prehistoric Engineering

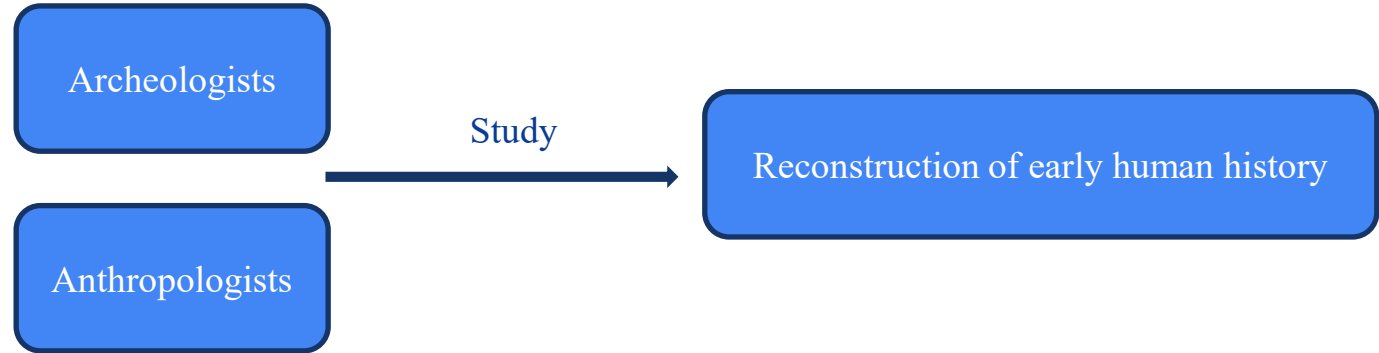


Primal Discovery of Devices



Early Humans

1- Early Humans



Anthropologists study the characteristics of past and present human communities through a variety of techniques they investigate and describe how different peoples of our world lived throughout history.

Archeologist عالم الآثار —a scientist who studies past peoples and cultures by excavating التنقيب and examining material remains as simple as an arrowpoint or as complex as the ruins أنقاض of a prehistoric village



Early Humans

Their work involves painstaking **مضنيًا** examination of a variety of earth's strata **طبقات الأرض** in search of rare skeletal **هيكلية** evidence and surviving artifacts **ومصنوعات يدوية**.

Detailed study of such **objects has yielded useful information** on the characterization and practices of Humans for the past million years.

Of particular interest is the available evidence suggestive of prehistoric makings of useful objects by humans, for therein one can recognize the primal stirrings of engineering, that is Prehistoric Engineering.



Early Humans

A widely publicized find corresponding to this prehistoric time occurred about 30 years ago in equatorial east Africa.

The subject, named *Lucy*, possessed a **brain volume of ~600 cm³** which may be **compared to ~1600 cm³ for modern humans.**

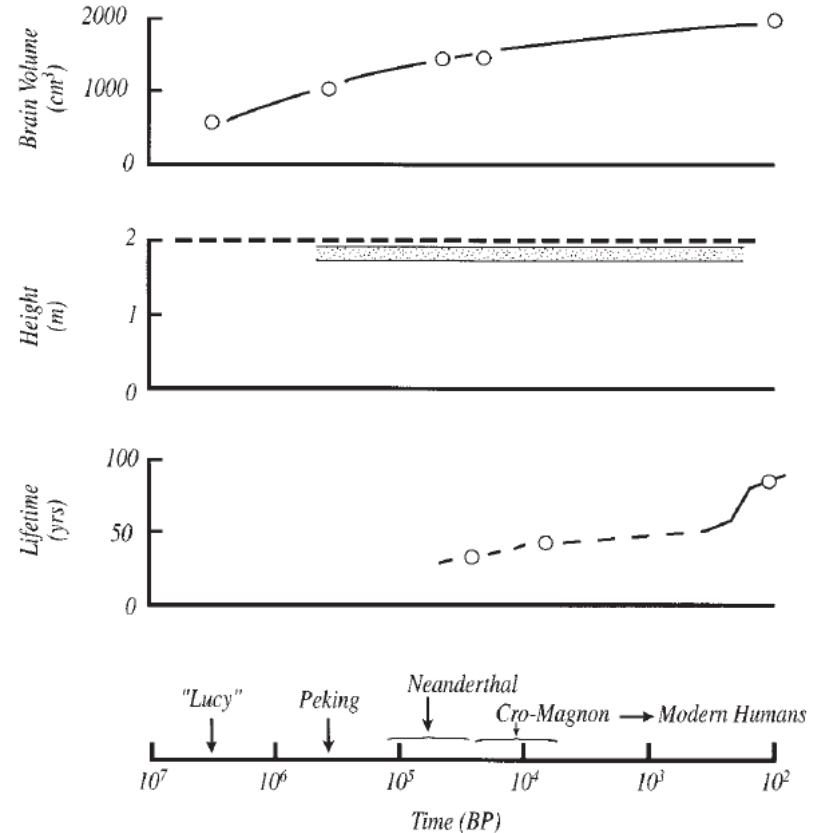
Peking Man, estimated to have lived about **500,000 BP**, was short with a sloping forehead and a brain volume of about 1000 cm³. Chipped stones and ashes from that site suggest that both stone tools and fire making were known to this early cave dweller ساكن الكهف .

Neanderthal Man, This human species existed between about **300,000 BP and 30,000 BP**, was stocky ممتلئ الجسم , also with a sloping forehead and possessed a brain volume of **~1400 cm³**.



Early Humans

Summary characterization of some average features associated with early and contemporary humans الأوائل والمعاصرين . Note the substantial increase in brain volume with time and that average height appears to be largely time invariant. Increased mean lifetime has been significant in recent times for reason of changes in sanitary installations and improvements in health care.



Early Humans

Cro-Magnon is a general term for European early modern humans.

- The next sequential prehistoric human to be noted is Cro-Magnon Man.
- ❖ Its skeletons were first found in the mid 1800s in the Cro-Magnon hills of southwestern France and subsequently throughout the World.
- ❖ Dated to an initial appearance of about 30,000 BP, contemporary human الإنسان المعاصر features of vertical forehead and brain volume had by then evolved.
- ❖ Artistic skills had also emerged as evidenced by the still observable wall paintings in ancient caves.
- ❖ Cro-Magnon people are generally viewed as our oldest anatomically similar ancestors أسلافنا المتشابهين من الناحية التشريحية.

Invention of Tools

2- Invention of Tools

Anthropologists argue that there are fundamental human needs, like nutrition, security, hygiene, and social interaction, which exist regardless of cultural context. Even basic human-made tools are created to fulfill these needs.

materials → creativity → devices

The earliest humans started utilizing twigs اغصان to enhance their search for edible roots جذور صالحة للأكل , supplementing the actions of their fingertips.

After some time, they likely found that their foraging البحث عن الطعام could be enhanced with specific twigs and further improved by chewing the ends of the twigs to create a suitable point.

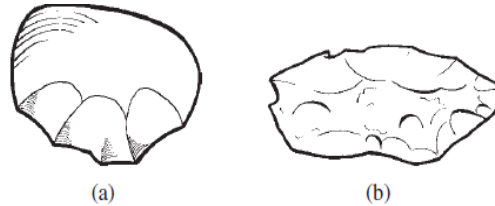
$N(t) \{wood\} \rightarrow E(t) \{chewed\ point\} \rightarrow D(t) \{wood\ tool\}$



Invention of Tools

The earliest stone tools were chopping tools, typically consisting of a grapefruit-sized smooth stone knocked off تم تقطيعه using a harder stone or even hardwood

With time, these stone tools were selectively **chipped to be useful for a variety of purposes** such as **shaping wood**, **cutting carcasses** جثث, **cleaning hides** قطع الجلود, and **boring holes in hide** حفر جلود or **wood**. Thus, by the application of primitive engineering skills, early humans could expand their activities as an aid to survival and begin to explore and control their world.



Examples of earliest ingenious devices: (a) hand-held stone chopping tool, and (b) cutting and scraping stone tool. The act of making such prehistoric tools is now known as *stone knapping*.



Invention of Tools

A closer examination of the evolution of the works of these prehistoric stone-age tool makers also suggests a primitive instance of engineering synthesis: a sharp-edged elongated flaked stone tool could be tied with animal sinew **عصب** to a sturdy wooden pole thereby forming a lance or a spear **رمح**.

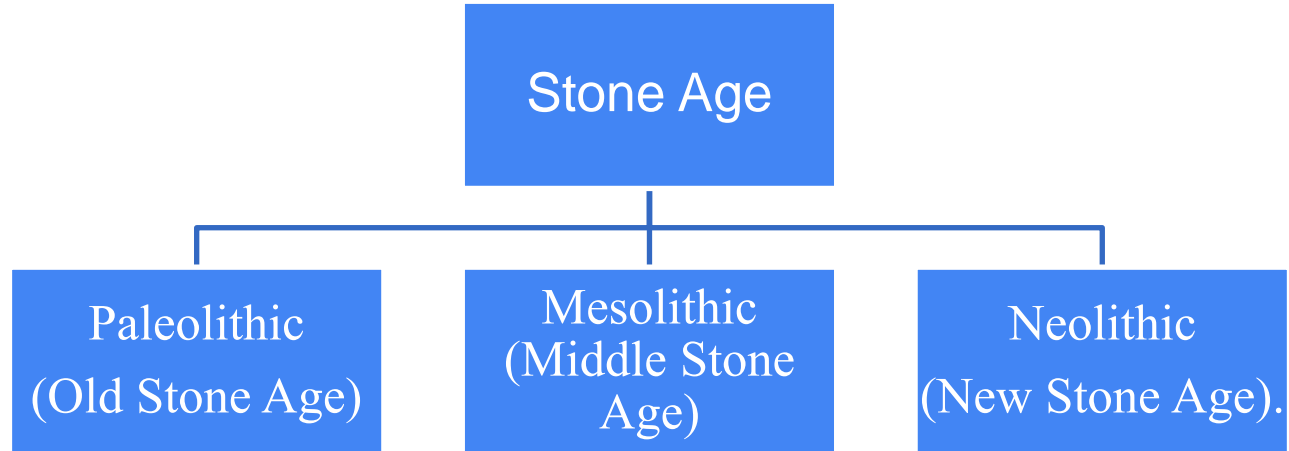


Similarly, a stone chopping tool could be fixed to a short wooden club thereby forming an axe or hammer. Prehistoric humans thus discovered that something new and ingenious **عبقري** could be made by a suitable combination of something old according to the primal progression

$$N(t) \begin{Bmatrix} \text{wood} \\ \text{stone} \\ \text{sinew} \end{Bmatrix} \rightarrow E(t) \begin{Bmatrix} \text{selecting} \\ \text{fitting} \\ \text{binding} \end{Bmatrix} \rightarrow D(t) \begin{Bmatrix} \text{spear} \\ \text{lance} \\ \text{hammer} \end{Bmatrix}.$$



Invention of Tools



Invention of Tools

Prehistoric people also learned how to keep animal hide from perishing الهلاك.

They used sharp stone scrapers to remove the decomposable قابلة للتحلل material from the inside.

Then, leaving the hide for sun drying would produce hard material suitable for walls and roofs; however, these early crafters الحرفيين also discovered that soaking fresh hide in various solutions with subsequent kneading نقع الجلد الطازج or **chewing and treatment with fats could make hide sufficiently soft for clothing.** في محاليل مختلفة ثم عجنه



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Discovery of Fire

3- Discovery of Fire

The discovery of a means to produce and transport fire at will is widely viewed as a most historic achievement of Stone Age humans.

Peking Man may well have been among the first to establish the practice of using fire, for in the immediate vicinity المنطقة المجاورة where the skeletal remains were found there exist campfire ashes

once fire has been naturally started — by lightning or lava flow — it could have been sustained and transported by burning wood sticks and preservation of embers الحفاظ على الجمر.

Fire may have also been started by friction on hardwood to produce heat or by sparking between hard stone and flint, and the associated use of kindling such as wood chips and dry grass.



Discovery of Fire

Control of fire affected early humans in most profound ways. Among those to be noted in particular are the following:

(a) Protection

All animals seek to avoid fire so that burning sticks and campfires can fend off predator attacks صد هجمات الحيوانات المفترسة.

(b) Nutrition

Many foods are difficult to digest raw هضمها نيئة (e.g. raw vegetables, meats, ...) but may be rendered edible تصبح صالحه للاكل upon heating; heat also destroys bacteria البكتيريا.

(c) Range

The transport of fire enabled Stone Age people to migrate from tropical Africa to colder climates of northern Europe and Asia.

(d) Community

One may well image that evening campfires provided a suitable social environment for story telling. Hence, control of fire may have directly contributed to the formation of human expression and the establishment of mythical tales and legends. ساهمت بشكل مباشر في تكوين التعبير الإنساني وتأسيس الحكايات والأساطير الأسطورية.

Customs and Art

4- Customs and Art

Three particular practices seem to have emerged in these prehistoric times:

(a) *Burial*

Some graves contain human skeletons aligned in a sunrise/sunset direction, implying therefore some specific beliefs associated with natural phenomena.

(b) *Hunting*

Stone pits حفر حجرية have been found containing mostly bear skulls, suggesting the first practice of collecting trophies associated with successful hunts.

(c) *Stampeding*

Identification of piles of ibex bones at the base of cliffs and bottoms of wide crevices قاعدة المنحدرات وقيعان الشقوق الواسعة indicates the prehistoric practice of stampeding animals for food supplies تدافع الحيوانات للحصول على الإمدادات الغذائية.



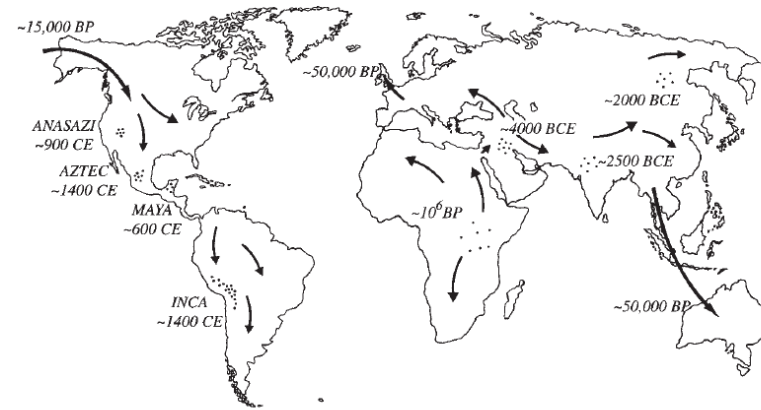
Shelter and Migration

5- Shelter and Migration

Humans of the Prehistoric era were initially foragers **الباحثين عن الطعام** and subsequently hunters. For reasons of survival, they followed seasonal plant growth patterns and migrating herds of animals.

In tropical zones **المناطق الاستوائية**, shelter was provided by caves and overhanging cliffs.

Migration of early humans from their apparent primary-source region of equatorial east Africa proceeded to the Middle East and from there to Europe and Asia.



Prehistoric making of devices spread by global migrations (→). Approximate dates for early population centers are indicated (•••).



Shelter and Migration

During the last **ice age**, reduced oceanic distances opened land bridges and island-hopping pathways for migration from Asia to Australia as well as from Europe to England, both about 50,000 BP.

Similarly, from about 30,000 BP to about 15,000 BP, various bands of hunters followed game and crossed from Asia to North America along the land bridge in the Bering Strait region thus establishing—or contributing to—human occupation of North and South America.

Subsequent melting of the polar ice caps raised the sea level by about 100 m thereby tending to isolate these nomads البدو on continents and island of various sizes.



Prehistory and Invention

6- Prehistory and Invention

Stone tools of the Prehistoric era appear to have many independent inventors because similar tools have been found in various distant regions.

Stone Age people made tools for personal use only as the need arose فقط عند الحاجة and these were subsequently discarded; hence the reason for many stone chipped tools found at habitation sites. With stones generally plentiful and their production simple, there was no need to be burdened by always carrying them around.

Furthermore, among the more than 10^6 stone tools from the Prehistoric era are on deposit in museums, there exist some **rare and incomplete tools made from vegetable and animal matter.**

These suggest the bow made from wood or bone and strung with animal sinew عصب. Additionally, variously shaped hooks and harpoon points الخطافات ورؤوس الحربة made from bone were also fashioned for various purposes.

Prehistoric engineers were indeed adept in the application of available natural materials for useful purposes.



Prehistoric Engineering: Discovery of Devices

7- Prehistoric Engineering: Discovery of Devices

With stone available in nature $N(t)$ by simple collection and then by process of percussion, the engineers of the day $E(t)$ created ingenious devices $D(t)$ for their own personal use as the need arose. Prehistoric Engineering may hence be well characterized by the engineering primal progression thereby representing the profound discovery of the making of devices.

$$N(t) \rightarrow E(t) \rightarrow D(t)$$

$$N(t) \{wood\} \rightarrow E(t) \{chewed\ point\} \rightarrow D(t) \{wood\ tool\}$$

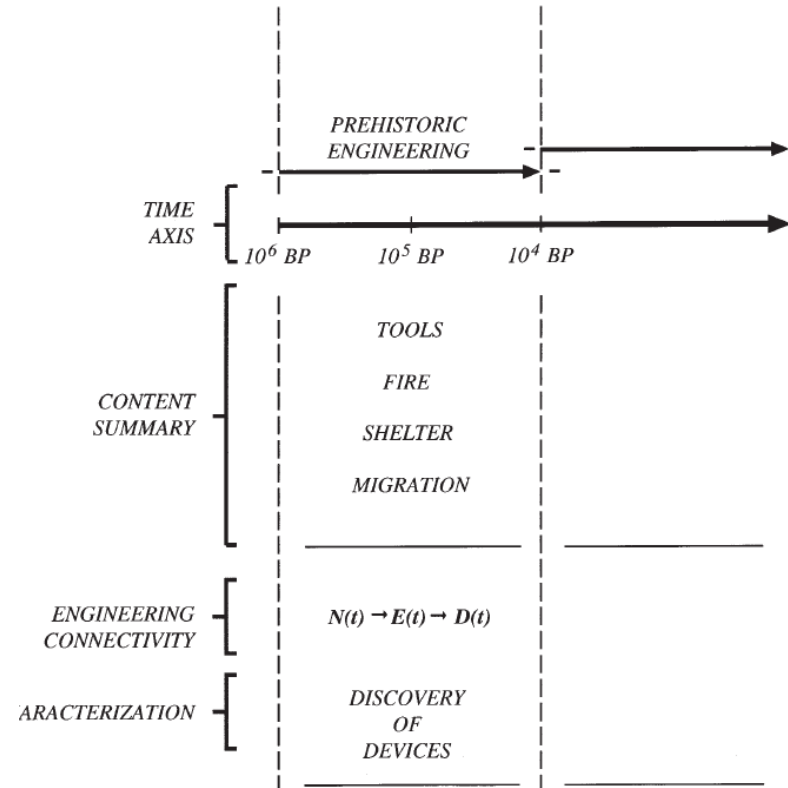
$$N(t) \begin{Bmatrix} wood \\ stone \\ sinew \end{Bmatrix} \rightarrow E(t) \begin{Bmatrix} selecting \\ fitting \\ binding \end{Bmatrix} \rightarrow D(t) \begin{Bmatrix} spear \\ lance \\ hammer \end{Bmatrix}.$$



Prehistoric Engineering: Discovery of Devices

Time axis illustration of Prehistoric Engineering ($\sim 10^6$ BP \rightarrow $\sim 10^4$ BP). The several characterizations here introduced for this period of time in the Content Summary take on the form of a column vector; note, however, that the components are not independent.

EVOLUTION OF ENGINEERING



Prehistoric Engineering (~106 BP→~104 BP)

Thank you !

