- expensive tissue
- *H. erectus* 1.8–0.4 mya
  - Africa = *H. ergaster*
  - Asia = *H. erectus*
  - Europe = *H. antecessor*
- key sites
  - Nariokotome 1.6 mya; Java, 1.6-1.8 mya; Dmanisi 1.8-1.6 mya; Erk-el-Akhmar 1.7-2.0 mya; Longgupo 2.0 mya (?)
- Migration v. Dispersal
  - climate & dispersal
- expensive tissue
- corridor through the Sahara
- *H. erectus* 1.8–0.4 mya
- Africa = *H. ergaster*
- Asia = *H. erectus*
- Europe = *H. antecessor*

Expensive Tissue Hypothesis and Feedback

- Bipedalism
- Stone Technology
- Big Brain
- Language (organizational tool)
- Animal Protein & Fat

- evolutionary cascade
- neotony & social learning

- Migration v. Dispersal
- climate & dispersal

- *H. ergaster* (*erectus*)
  - anatomy
    - thick brow ridges
    - low sloping forehead and long skull
    - wide skull base
    - brain size 700-1100 ml
    - modern post-cranial skeleton
  - Nariokotome Boy, 1.56 mya
  - West Turkana, Kenya

- *H. ergaster* (erectus)
  - KNM-ER 3733 1.75 mya
  - Range: 1.8–0.6 mya

- *H. heidelbergensis* (H. antecessor)
  - Atapuerca 400 ka
  - Range: 0.8–0.2 mya

- *H. erectus*; “Peiking Man” 0.5-0.2 mya
  - Range: 1.8–0.2 ka
**H. erectus**

**Key Asian sites**

- **Mojokerto**
- **Sangiran** 1.6-1.8 mya
- **Longgupo (?)**
- **Lantian/Gongwanling Nihewan** 1-1.2 mya

**West Asia**

- **Dmanisi, Republic of Georgia**
  - hominid mandible, cranial fossils and Oldowan-like tools
  - Ar-Ar date of ca. 1.8-1.6 mya

**Homo ergaster (?)**

- **West Asia**
  - **Erk-el-Akham 1.7-2.0 mya**
  - paleomagnetic dates
  - Oldowan-like tools
  - ‘Ubeidiya ca. 1.4 – 1.0 mya
  - K-Ar dates & biostratigraphy
  - Oldowan/Acheulian-like tools

**Central Europe** 730,000

- **Omanisi 1.6 mya**
- **Zhoukoudian 500,000**
- **Sangiran 1.6 - 1.8 mya**
- **Foomb Fora 1.8 mya**

**Map of key sites in Asia**

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*Note: The image contains a map of key sites in Asia, highlighting the distribution of Homo erectus and Homo ergaster sites.*
fossils from Dmanisi, Georgia ca. 1.8-1.6 mya

resembles…
Homo ergaster

Europe
- Gran Dolina, Atapuerca, Spain
  - crude stone tools and various hominid fossils >780 ka (paleomagnetic)
- H. heidelbergensis
  - H. antecessor
  - ancestor of neanderthals?

distribution of sites suggest a dispersal event shortly after appearance of H. ergaster 1.8 mya

process of dispersal
- dispersal =
  - unintentional geographic relocation of individuals from a population
  - commonly associated with reproductive cycle and population growth
    - individuals expand into new areas to avoid competition with natal groups
  - ultimate geographic destination determined largely by extrinsic factors (barriers and corridors)
- migration =
  - intentional geographic relocation of a population
Causes of dispersal in *H. erectus*

- Climatic and environmental change
- New biological adaptations
- New cultural adaptations

- climate change
  - climate has fluctuated between extremes of cold-dry glacials, and warm-wet interglacial more than 20 times in past 2 ma
  - organisms try to keep pace with these changes by shifting their spatial distributions to where they feel “comfortable” (optimal habitats)

- why only after 1.8 mya?
  - something must be biologically different about *H. ergaster!*
    - bigger body size → bigger home range size
    - more efficient bipedalism → walk longer distances
    - better heat regulation → less tied to water sources
something different about behavior

Acheulian Industrial Complex
- 1.65–0.15 mya
- Africa, West Asia & Europe
- greater control of tool manufacture → greater control of environment?
- tool function?
- hand-axes did it???

East Asia and other areas lack hand axes!

life in temperate environments...
- controlled use of fire?
  - Swartkrans, 1.7 mya
  - Zhoukoudian (?) 500 ka
  - regular increase in habitual use after 400 ka

cooperation and language
- bigger brains → better management of social relationships
  - e.g., reputations and history of social relationships
  - cooperation necessary to live in highly-variable, unpredictable temperate climates
A Further Evolutionary Cascade

1. big brain + small birth canal = neoteny
2. neoteny $\rightarrow$ greater infant dependence for survival
3. greater infant dependence $\rightarrow$ longer & stronger social bonds
4. longer & stronger social bonds $\rightarrow$ enhanced cooperation & dependence on social learning (i.e., culture)