Looking at the Skies in the Stone and Bronze Ages
(or in 2001)
Astronomy--the first “science”

- Oldest art/iconography
- Earliest extant written texts
- First natural phenomena seen as regular, quantifiable, & thus predictable
- Early attempts to ‘order’ heavens linked to social and religious needs
  - Annual calendar/seasons become important after invention of agriculture, ca. 8000 BCE
  - Earliest deities in many cultures were celestial
  - Earliest ‘specialists’ established to set calendar and to predict ‘dangerous’ events
The celestial sphere

- North Pole
- Horizon
- Celestial Equator
- Ecliptic = Path of Sun
- South Pole
- Autumnal Equinox
- Summer Solstice
- North
- South
- Sun
Naked-eye phenomena

- **Daily** E to W rotation of heavens
  - Pole, horizon, zenith, geographical latitude
  - Stars retain “fixed” positions

- **Annual** W to E motion of Sun
  - Ecliptic (or zodiac), equinoxes (vernal & autumnal), solstices (summer & winter), longitude, annual change in visibility of stars

- **Monthly** W to E motion of Moon
  - Latitude, lunar nodes, irregular eclipses

- **Long-term** precession of equinoxes
  - Drift of vernal equinox around zodiac, one circuit in 26,000 years
  - Tropical (back to equinox, 365.242d) vs. sidereal (back to same star, 365.256d) year
Conditions for eclipses

Condition for eclipses: Line of nodes must point toward Sun AND Moon must be either full or new.
Precession of equinoxes
Phenomena of Sun & Moon

- Tilting of ecliptic from celestial equator means that over the year:
  - Sun & Moon trace different arcs across sky in different seasons
  - Sun & Moon reach different maximal altitudes at noon
  - Sun & Moon rise and set at different points along the horizon
British Stone Age calendrical sites

- **Avebury**, largest stone circle in UK
  - 500 m in diameter, no known astronomical alignments, ca. -2600

- **Newgrange** circular stone mound
  - Aligned to winter equinox, ca. -2500

- **Stonehenge** (3 overlapping sites)
  - Earthwork ring & heel stone, ca. -2400
    - Center-Heel stone = summer solstice sunrise
    - Center-postholes = northernmost moonrise?
  - Earth mounds & four “station stones”
    - Station stones = moonrise points?
  - Ring of 30 sarson stones, 5 trilithons, ca. -2100
    - Alignments for max/min moonrise?
    - Aubery Holes as eclipse predictor (56-yr cycle)?
Avebury stone circle, c. -2600

No confirmed astronomical alignments

Largest stone circle in UK

Swindon stone, 65 tons
Newgrange, c. -2500

- 80 meters
- 97 kerbstones
- Winter solstice
Stonehenge, -3100 to -1600
Nebra disk, -1600 (Early Bronze Age)

- Found 1999, recovered for public 2002
- 32 cm in diameter, buried ritually with two bronze daggers
- 32 stars, not representational except for 7 in Pleiades
- Full and crescent moon
- Horizon arcs (82°) match max/min sunrise for Saxony
- Ship at bottom transports Sun at night
Nebra site
Origins of constellations

- Constellations before star names
- “Correlative thinking”
  - Lascaux cave paintings (-30,000)
  - Akkadian lion/bull (-1000)
  - Persepolis gate with lion/bull (-500)
  - First Greek constellations--Farnese globe (Roman copy, +100)
  - Ptolemy’s *Almagest* describes 48 constellations, ca. 1000 stars (+150)
Origins--zodiac constellations

- Constellations around ecliptic, 30°/sign
- All 12 “signs” first mentioned in Babylonian horoscope (-419)
- Pre-Babylonian origins as calendar “quartets” of signs?
  - Precession shifts equinoxes 1 sign in 2000 years
    - Gem/Vir/Sag/Pis (matriarchal in -6000)
    - Tau/Leo/Sco/Aqu (patriarchal in -4000)
    - Ari/Can/Lib/Cap (monotheism in -2000)
Gurshtein hypothesis, 1990

Gemini quartet -6000
- spring = twins
- summer = virgin
- fall = archer
- winter = fish

Taurus quartet -4000
- spring = bull
- summer = lion
- fall = spider
- winter = water carrier

Aries quartet -2000
- spring = ram
- summer = crab
- fall = balance
- winter = goat
Egyptian constellations

- Star images on tomb ceilings by -1500
  - Non-representational
  - Non-classical figures (hippopotamus)

- Decans = daily “star clocks” by -2500
  - 36 star groups each for 10° of zodiac, mark hourly risings
  - based on annual calendar of 360 days + 5 feast (epagomenal) days
Senmut tomb ceiling (-1534)

Decans
Constellations as phenomena

- Remain in “fixed” arrangements
- Rotate diurnally, rising E, setting W
- Shift in visibility through year as Sun moves backward through stars
- Shift in relation to vernal equinox because of precession; not known (i.e., mentioned in texts) until -300
Features of early astronomies

- Stars and major luminaries well-known in earliest religions and social orders
- Ordered by “correlative thinking”
- Regular motions of stars and major luminaries used for calendars & clocks
- Marking these motions required long-term attention by “experts”
- Wandering stars (planets) ordered later