

Astronomy 330



This class (Lecture 19):
Cultural Evolution

Joshua Seiter
Jonah Wolff

Next Class:
Evolution of World View
Christine Fleener
Steven Wyatt

Music: *Intelligent Guy* – Butthole Surfers

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HW #3



- David Mayer:
<http://www.webpan.com/dsinclair/ufo.html>
- Sean Rohan:
http://www.ufoarea.com/events_illinoishist.html

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Presentations



- **Joshua Seiter:** [Black Hole](#)
- **Jonah Wolff:** [Colonizing Mars](#)

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Outline



- From intelligence to communication
- Will a civilization develop that has the appropriate **technology** and **worldview**?
- Requires knowledge of quantum mechanics and astronomy.

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Drake Equation

That's 0.77 intelligent systems/year

Frank Drake



$$N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

# of advanced civilizations we can contact in our Galaxy today	Star formation rate	Fraction of stars with planets	# of Earthlike planets per system	Fraction on which life arises	Fraction that evolve intelligence	Fraction that communicate	Lifetime of advanced civilizations
	15 stars/yr	0.5 systems/star	2.7 x 0.134 = 0.36 planets/system	0.95 life/planet	0.3 intel./life	comm./intel.	yrs/comm.

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Backdrop of Civilization



- Origin of modern H. sapiens is disputed, but the genetic and linguistic evidence points toward a spread of humans across Eurasia then the Americas.
- We share a common gene pool, but genetic drifts and selection for local environments created genetic differences among groups.
- These differences have little to do with the concept of race, which has been showed by genetic studies to be a meaningless concept.
- The greatest genetic and linguistic variations are found in Africa, supporting the “out of Africa” idea.



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<http://www.popular-science.net/img/out-of-africa.jpg>

Cultural Evolution



- Once humans spread across the globe, the primary method for evolutionary change shifted from biological to cultural evolution.
- Anatomically modern H. sapiens evolved 100,000 yrs ago, but the first modern behavior did not appear until 40,000 yrs ago– e.g. cave painting.
- Regardless, there has not been any significant biological evolution for the last 40,000 yrs– e.g. brain increase.



http://www.codcottage.freemove.co.uk/images/hand_castillo_spain.jpg

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Cultural Evolution



- The rest is cultural– from hunter-gathers to cell-phone-users.
- Cultural evolution was fast.
- Is cultural evolution needed for ET? Why would a ET culture try to communicate?
 - Capability (suitable technology) and interest (worldview?).



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Hunting and Gathering



- Until 10,000 years ago, H. Sapiens functioned completely as hunter-gathers.
- Small nomadic tribes with few possessions.
- Except for shortages, a fair and easy life
 - No midterms/finals
 - Only working about 4 hours a day
 - But, no way to create surpluses or free members for other roles.
 - When things go bad, they really go bad.



http://www.cnn.com/WORLD/9511/safrica_bushmen/

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Agriculture



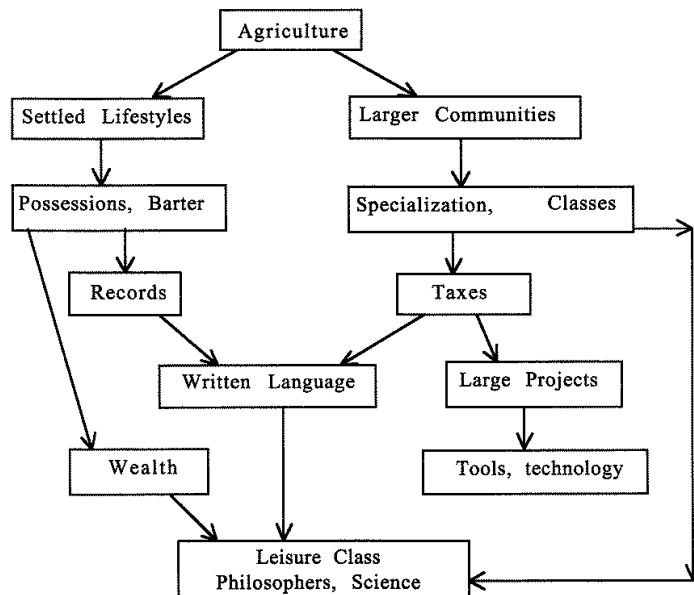
- Tribal societies– 100s of people into villages
- Due to agriculture, larger and larger communities and new societal organizations.
- Began about 10,000 yrs ago, around the dead sea.
 - Mixed hunting with harvesting of wild wheat and barley.
 - Storage, planting, and seed selection.
 - Mutant varieties took over and hunting decreased.
 - 1000 years later, animal domestication.
- Provided long-term settlements for cultural evolution, information, tools, and energy sources.

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<http://www.ffa.org/media/comm/index.html>

The Importance of Agriculture



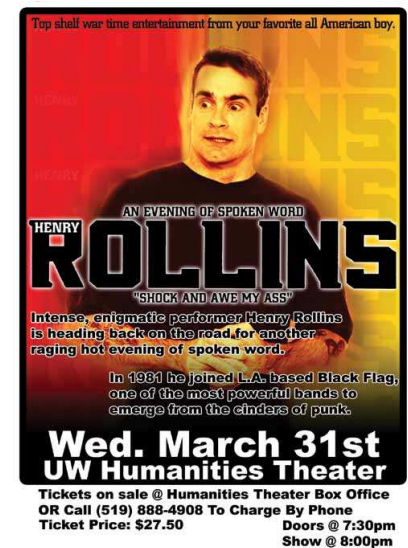
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Language and Information



- Limited size for brain, due to birth canal size, so limited bits of info.
- Need to develop **extra-somatic** (outside the body) information storage techniques.
- First method to store information from another person was spoken language.
- Crucial development.



<http://www.feds.uwaterloo.ca/posters/henryrollins.jpg>

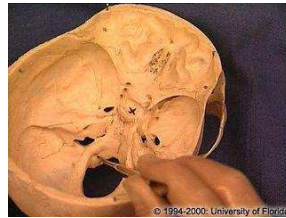
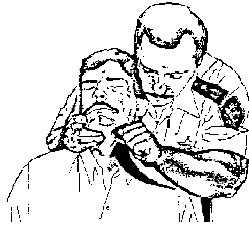
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Language and Dis-Information

- But the origins of language are not well understood– no fossils.
- Probably in hunting parties for large prey.
- The control of the tongue is through the hypoglossal canal (hole) in the skull. In humans it is twice as large as chimps.
- First arose about 400,000 yrs ago in Australopithecines.

Hypoglossal Nerve



<http://members.aol.com/paroleinfo/PRESSURE.HTM>

<http://imc.gsm.com/integrated/haonline/haonline/ha/imgs/00000/3000/600/3604.jpg>

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The Language Gene?

- FOXP2 was identified recently.
 - A severe speech and language disorder that affects almost half the members of a large family.
 - They are unable to produce the fine movements with the tongue and lips that are necessary to speak clearly.
- Human FOXP2 differs from chimp FOXP2 by only two amino acids, mouse by only 3, and zebra finch by only 7.
- Recent research shows that Neanderthal version is identical to ours. Maybe speech happened soon after chimp/hominid split?



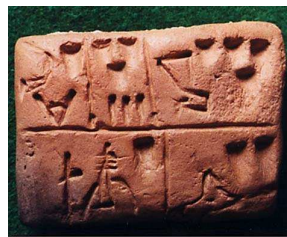
http://news.bbc.co.uk/nolpda/ukfs_news/hi/newsid_6146000/6146908.stm

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Writing

- Oral language is clearly limited.
- Development of written language provided a powerful, new source of info storage.
- Earliest appearance was in Sumer– present day Iraq (8500 BCE).



MS 3008
Account of commodities, Sumer, ca. 3200 BC.
The earliest continuous writing known

<http://www.nb.no/baser/schoyen/4/4.4/441.html>

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Writing

- Probably started from economic need– barter or receipts.
- Common by 3000 BCE.
- Written records of taxes and a ruling class– the rise of civilization.
- Move from symbols to syllabic language developed by 1500 BCE.



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Account of commodities, Sumer, ca. 3200 BC.
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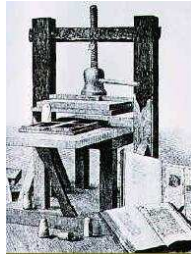
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Extrasomatic Storage Leaps



- Printing press (1456) – number of books jumped from 10,000 to 10 million in 50 yrs.
- Telegraph (1844)
- Radio (1895)
- Television (1936)
- Computers (1950s)
- Internet (1970s)
 - Huge extrasomatic storage: Well above brain storage



Does all of this increase the “intelligence” of our species?

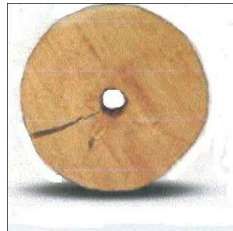
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From Rocks to Metal



- Stone tools (silicates) started with H. habilis about 2 Myrs ago.
- Agriculture developed at the end of the stone age.
- First pottery (still silicates) around 7000 BCE.
- First metal (copper) in 6500 BCE, mostly ornamentation.
- The wheel was invented in 6500 BCE.



<http://www.angelfire.com/country/veneti/images/OldestWheel.jpg>

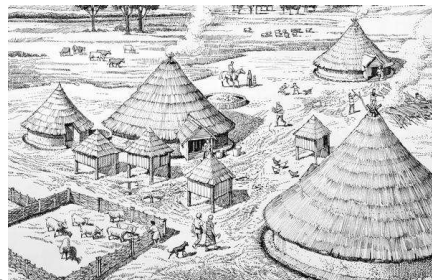
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From Rocks to Metal



- Copper tools in 4000 BCE.
- Animal drawn vehicles & sailboats in 3300 BCE.
- Bronze (copper and tin) tools in 2800-1000 BCE (the Bronze age).
- Iron first showed up in 1500 BCE.



http://www.museumoflondon.org.uk/MOLsite/learning/who_are_you/teachers/images/citizenship/iron_age_settlement_no192.jpg

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From Rocks, to Metal, to Rocks



- Next real step was developing energy sources.
- The industrial revolution.
- Modern technology based on electronics, crucial to our ability to communicate with ET.



<http://www.learnhistory.org.uk/cpp/industrial-revolution-children-labor.jpg>

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From Rocks, to Metal, to Rocks

- Transistor in 1948.
- Microchip in 1959.
- We went back to rocks— silicon!
We are arguably in the “silicon age”.
- This implies knowledge of electromagnetisms and quantum mechanics.

