ANTH 3412 FALL 2012
SYLLABUS

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Lectures: T & TH 9:35-10:50 am 1957E St Room: 308

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On-line Access: This syllabus, introduction, other resources, notes for the classes, and some of the readings will be available on Blackboard at http://blackboard.gwu.edu.

Description

There is now very sound evidence that modern humans are more closely related to chimpanzees and bonobos than to any other living apes. This means that modern humans and extant chimps/bonobos must have evolved from a common ancestor exclusive to themselves; thereafter they became separate twigs or clades on the surface of the Tree of Life (TOL). The molecular differences between modern humans and chimps/bonobos can be used to calibrate the timing of that splitting point. These data suggest that the chimps/bonobo twig (a.k.a. the *Pan* clade) and the modern human twig (a.k.a. the *Homo* clade) (these and other terms are defined in the Wiley-Blackwell Encyclopedia of Human Evolution that will be on Blackboard) diverged between 5 and10 million years ago (Ma), and probably *c*.6 Ma. Thereafter, the two clades have evolved independently (although today chimps/bonobos are being threatened with extinction by the activities of modern humans).

Thus, the study of human evolution involves:

- understanding the evolutionary context and the circumstances surrounding the origin of the clade that includes modern humans;
- identifying from the fossil record the species that belong in that clade;
- reconstructing the morphology and behavior of those species;
- determining how they are related to each other and to modern humans;
- investigating the factors and influences (e.g., genetic, environmental) that shaped their evolution and
- reconstructing the origin(s) of modern human anatomy and behavior.

The study of the fossil evidence for human evolution is traditionally referred to as hominid paleontology. The word "hominid" comes from "Hominidae" the name of the Linnaean family within which modern humans (and the other fossil-only species included within the human clade) have traditionally been placed. However, because nearly all of the molecular

data support a particularly close relationship between *Homo sapiens* (the formal Linnaean name for modern humans) and the species of living chimpanzees and bonobos included within the genus *Pan*, this traditional terminology has been changed. Some researchers have suggested that the term Hominidae, and its informal version hominid, should be made more inclusive and be extended to embrace the great apes (i.e., the *Gorilla*, *Pan*, and *Pongo* clades) plus the *Homo* clade. Thus, another name needs to be found for *H. sapiens* and for the fossil species more closely related to it than to living *Pan* species. The solution we will use for this class is that if hominid is to be used as suggested above, then the species and genera more closely related to modern humans than to chimpanzees and bonobos should be recognized as a tribe (this is a taxonomic category below the level of the family and above the level of the genus) called the Hominini (the equivalent informal name is "hominin"). Thus, if researchers are confident a species is in the clade whose only living representatives are modern humans then it should be referred to as a *hominin*, not as a *hominid*. Therefore, in the "new" terminology (see Table 1 for the "old" and "new" taxonomies) this course concentrates on *hominin paleontology*. The study of the artifacts (e.g., stone and bone tools, drawn and carved images, early structures, evidence of decoration, etc.) made in prehistoric times is called prehistoric archeology. In the US the combined study of hominin paleontology and prehistoric archaeology is called *paleoanthropology*, human prehistory, or just *prehistory*.

This course concentrates on the fossil and to a lesser extent the molecular evidence, although it will refer to the archeological record when the latter can provide insights into hominin behavior. Because it will emphasize the importance of trying to reconstruct as much biology as possible from the fossil record it is most aptly described as a course in hominin paleobiology (or HPb).

Aims

The course HOMININ EVOLUTION aims to do the following:

- set out the scope of HPb (see the paragraph above);
- provide an introduction to the main analytical and research methods used in HPb;
- introduce the relevant fossil evidence and set out, as appropriate, its context (e.g., its geological age, paleoenvironmental context, etc.);
- review interpretations of the hominin fossil record, including a discussion of their strengths and weaknesses;
- provide a sound foundation for more advanced study and independent research within the area of HPb

Objectives

Through attendance at lectures and laboratory sessions, participation in discussions at both lectures and laboratory sessions, plus appropriate reading and independent study, diligent students should: -

- become familiar with the classes of evidence available to hominin paleobiologists;
- understand the limitations and inherent uncertainties of a historical science such as HPb;
- be able to discriminate between evidence and the interpretations placed on that evidence;
- be familiar with the important research questions within HPb;
- be sufficiently familiar with the anatomy of modern humans and with anatomical terminology so as to be able to understand and comprehend simple descriptions of hominin fossil evidence;
- be sufficiently familiar with the paleontological evidence and the relevant research methods to follow the arguments set out in reviews of the primary research literature, and
- be aware of the strengths and limitations of the main quantitative methods used in HPb research.

BW has written a commentary on most classes and these, plus a ppt presentation summarizing the content of each class, plus any suggested additional reading will be available on the Blackboard site.

Textbook

The course does not follow the sequence in any one textbook, but for each class BW has provided the page numbers of the relevant sections in each of three well-regarded textbooks.

The first of the three is *Reconstructing Human Origins* by Glenn C. Conroy (3nd edition 2007, Norton: New York and London) (ISBN 0-393-92590-0) hereafter referred to as "C". Glenn Conroy is a Professor at Washington University in St. Louis and a very experienced teacher and researcher. This is a sound presentation of the fossil evidence and its context. The new edition is more up-to-date than "K" or "L&F" and it is probably the book of choice for those students who are mainly interested in the hominin fossil record.

The second book is the *Principles of Human Evolution* by Roger Lewin and Robert Foley (2nd edition 2004, Blackwell: Malden, MA and Oxford) (ISBN: 0-632-04704-6), hereafter referred to as "L&F". Rob Foley is a Professor of Anthropology at The University of Cambridge and Roger Lewin is an experienced and knowledgeable science writer. This is an up-to-date survey of human evolution that stresses the theory and the comparative context. It complements BW's emphasis on the fossil record.

The third option is the *The Human Career* by Richard Klein (3rd edition 2009, The University of Chicago Press: Chicago) (ISBN: 978-0-226-43965-5), hereafter referred to as "K". Richard Klein is a Professor at Stanford University. He specializes in archeology but he is very well-informed about the hominin fossil record. As you will see when you go to the library or bookstore "K" is a large book and some sections contain more than you need. At the time of its publication, "K" was commendably up to date, but it does not deal with several recent important discoveries and re-interpretations. If you are as interested in

Archeology as you are in Hominin Paleobiology, then this is the book for you, but if you decide to use this book you will have to pay particular attention to the readings for each class.

Other non-textbooks students might consider looking at are: -

An Introduction to Human Evolutionary Anatomy by Leslie Aiello and Christopher Dean (1990, Academic Press: London) (ISBN 0-12-04559-9)
This is more detailed than you need, but despite its age it will be indispensable if you continue with more advanced human evolution courses.

Encyclopedia of Human Evolution (2nd Ed.) edited by Eric Delson, Ian Tattersall, John Van Couvering and Alison Brooks (2000, Garland Publishing: New York) (ISBN 0-8153-1696-8)
Well-worth getting if you intend to continue with human evolution.

The Fossil Trail: How we know what we think we know about human evolution by Ian Tattersall (2008, Oxford University Press: New York) (ISBN-13: 978-0195367669)
This is a history of fossil discoveries. It is well written, and Ian Tattersall's acute observations of, and experience with, the hominin fossil record make the book more authoritative than most popular summaries of hominin evolution.

Getting Here: The story of human evolution by W.W. Howells. (1993 Compass Press: Washington, DC) (ISBN 0-929-59011-2) W.W. (Bill) Howells was the doyen of hominin paleontology and for many years was the senior Anthropology Professor at Harvard. He wrote with enviable clarity (he is the grandson of Dean Howells) and with a style that helps and encourages people to understand difficult topics and concepts. It is an excellent, if now inevitably dated, overview of human evolution.

Readings

In addition to the relevant sections of the three textbooks for many classes students will be directed to specific reading assignments. These have been carefully selected so as not to burden you with impossibly long reading lists. However, you *will* be expected to have read and be familiar with the few readings that are prescribed; your examinations will assume you have read them. Lists of "further reading" will be provided for those who wish to read about topics in more depth.

BW is the editor of the *Wiley-Blackwell Encyclopedia of Human Evolution* and Jennifer Baker was the Assistant Executive Editor (2011 Wiley-Blackwell, Oxford) (ISBN 978-1-4051-5510-6) and he will upload pdfs of W-BEHE1 onto Blackboard. BW is presently working with some colleagues to develop a more concise (and affordable!) dictionary version of W-BEHE1 for students.

Assessment

This is broken down into *five* components.

MCQ/SAs

Two of the components are Multiple-Choice/Short Answer examinations; one will be held during class times, and the second will be in place of the 'final exam'. The first one is designed to help students judge whether they are making progress with the goals of the class, and to give them examples of the types of factual information they will be expected to be familiar with. The first will cover Classes 1-9; the second will concentrate on Classes12-30, but may include material from Classes1-9.

Anatomy Quiz

The third component of the assessment is the Anatomy Quiz (which is LAB 3), which will test your knowledge of the skeletal anatomy that is relevant to hominin evolution.

Writing

Two of the five assessment components are writing exercises.

The first of these, which contributes 30% of the overall grade for the course, consists of the write-ups of the laboratory sessions. These are done throughout the semester. CK will tell you what is expected for these write-ups, and near the end of the semester BW will confer with CK and decide on a final letter grade for this component.

The second of the two writing components, which also contributes 30% of the overall grade for the course, is a written summary of a hominin species taxon; you may combine with no more than two other students to do this. You should write as if you were preparing notes for your classmates and it should be written at the same level as BW's notes for the course. You should prepare a list of the specimens included within that taxon and provide detailed information about the first and last appearance of that taxon. The description should not exceed 3000 words.

You must let CK know which taxon you have selected **by 5pm on 11/12** at the latest; it will be "first come, first served" in the sense that the earlier you do this the more choice of taxon you will have. You must send CK a double-spaced draft of your summary **by 5pm on 11/26 at the latest**; CK will go through these with you. A double-spaced copy of the final version for grading in Times (12 pt font) must be in CK's inbox **by 5pm on 12/10 at the latest**. Please note that the taxon summaries must be headed 'ANTH_3412_FALL_2012: TAXON_SUMMARY_BY A N OTHER.' Please note that submissions *in any other format or using any other heading will not be graded.*

Extra credit will be given to students who are at least one week in advance of each of the three deadlines.

BW in collaboration with CK will moderate the overall grade on the basis of the contribution each student has made to discussion in the lectures and in the laboratory sessions. Usually this will be used to increase a student's grade; only in exceptional circumstances will it be used to reduce a grade.

The components of the Class grade are summarized below: -

Anatomy Quiz	**5%**
First MCQ Assessment	**10%**
Second MCQ Assessment	**20%**
Hominin species summary	**35%**
Lab reports	**30%**

Meeting

BW likes to meet all of the students individually for *c*.20-30'. Please arrange to do this in the first four weeks of the semester. Please note that students who fail to make contact with BW to make these arrangements in the first three weeks of the semester will *not* be eligible for any extra credits.

Table 1: 'Old' and 'New' Taxonomies

A traditional pre-molecular taxonomy of higher primates. Extinct only taxa are in bold.

Superfamily Hominoidea (hominoids)

Family Hylobatidae (hylobatids)
Genus *Hylobates*
Family Pongidae (pongids)
Genus *Pongo*
Genus *Gorilla*
Genus *Pan*
Family Hominidae (hominids)
Subfamily Australopithecinae (australopithecines)
Genus *Ardipithecus*
Genus *Australopithecus*
Genus *Kenyanthropus*
Genus *Orrorin*
Genus *Paranthropus*
Genus *Sahelanthropus*
Subfamily Homininae (hominines)
Genus *Homo*

A taxonomy of higher primates that recognizes the close genetic links between *Pan* and *Homo*. Extinct only taxa are in bold type.

Superfamily Hominoidea (hominoids)
Family Hylobatidae (hylobatids)
Genus *Hylobates*
Family Hominidae (hominids)
Subfamily Ponginae
Genus *Pongo* (pongines)
Subfamily Gorillinae
Genus *Gorilla* (gorillines)
Subfamily Homininae (hominines)
Tribe Panini
Genus *Pan* (panins)
Tribe Hominini (hominins)
Subtribe Australopithecina (possible or archaic hominins)
Genus *Ardipithecus*
Genus *Australopithecus*
Genus *Kenyanthropus*
Genus *Orrorin*
Genus *Paranthropus*
Genus *Sahelanthropus*
Subtribe Hominina (hominans)
Genus *Homo*

Class 1: 'Introduction and outline of the course'
(C pp. 3-10; L&F pp. 3-45; K pp.725-751)

This session will explain how fossil evidence is "interrogated" so that it yields as much information as possible, consider examples of how new fossil finds are published and explain the role that scientific journals of various categories play in hominin paleobiology.

SECTION 1: HOMININ EVOLUTION: CONTEXT

Class 2: 'Evolutionary context of *Homo sapiens*: comparative studies'
(C pp. 130-137; L&F pp. 116-125, 196-204; K pp. 94-96)

What evidence is available to determine which, if any, of the living primates is more closely related to modern humans than any other? This class will explore the classes of evidence that can be used to explore the relationships among living organisms and it will suggest that the majority of that evidence points to modern humans being more closely related to chimpanzees and bonobos than to any other living primate. Thus, although chimpanzees are often thought of as just a smaller version of the gorilla, the former is more closely related to modern humans than it is to the gorilla. We will also discuss what implications this evidence has for using classical morphology as an indicator of phylogenetic relationships within the hominin clade.

Class 3: 'Names and what they mean: I. Taxonomy and systematics'
(C pp. 93-108; L&F pp. 101-104; K pp. 9-18; 71-75)

Systems and conventions are essential for any science. Think of how difficult physics and chemistry would be if there were no conventions about notation and there was no periodic table or how difficult it would be if *iTunes* or your local supermarket had no system for listing the tunes etc. available or for displaying the goods for sale (e.g., in the case of the latter they stacked corn flour next to grapefruit juice and wine next to kitchen cleaners).

The convention we use to classify living things is the one devised by Linnaeus. However, when he devised the scheme the only organisms he had in mind were living ones. How easily can it be applied to extinct animals, when all we know about them comes from the sparse fossil record? Can a fossil species be recognized and defined in the same way as a living species? How well, if at all, can criteria such as reproductive isolation be inferred from the fossil record? What criteria should be used to identify species in the fossil record?

Class 4: 'Names and what they mean: II. Terminology of human evolutionary anatomy'
(C pp. 10-22; K pp. 65-94)

In order to study human evolution students must acquire a working knowledge of both anatomical terminology and the reference points used in studies that involve measuring fossils and comparative collections. This class will review the history of anatomical research and will explain the origin of the terms used in anatomy and hominin paleobiology. Learning human evolutionary anatomy requires one to be able to recognize anatomical elements and understand, and be able to use, a precise anatomical vocabulary.

Class 5: 'Overview of the hominin fossil record'

The hominin fossil record can be broken up finely into many exclusive categories or more coarsely into inclusive taxa or even more inclusive grades. This class sets out the case for recognizing six grades around and within the hominin clade.

Class 6: 'Reconstructing the past: I. Time and context'
(C pp. 67-86; L&F pp. 55-72, 84-94; K pp. 19-64)

The context of the hominin fossil record (e.g., age, climate, habitat) is important for its interpretation. What methods are used to date fossils? What roles, if any, did changes in global and regional climates play in determining the course of hominin evolution? How do scientists obtain information about past climates? What can be inferred about the habitats the early hominins lived in from fossil evidence and other evidence? What other animal groups co-exist with fossil hominins? Can the changes and trends observed in their evolution help interpret the hominin fossil record?

Class 7: 'Reconstructing the past: II. Phylogeny'
(L&F pp. 103-116; K pp. 9-16)

Once the fossil record has been resolved into species the next task is to understand how those species are related. Was there just a single hominin lineage or did it break up into several lineages each with its own particular morphological signature? This problem has been addressed apparently successfully at higher taxonomic levels (i.e., the relationships among inclusive taxonomic groups within major groupings such as birds and reptiles) by a method called cladistics, also known as phylogenetic analysis. But how successful is cladistics at determining the phylogenetic significance of the relatively subtle differences among hominin species especially when the early hominin fossil record is sparse and largely restricted to skulls and teeth?

Classes 8 and 9: 'Fossils and their analysis: I and II.'
(C pp. 63-67; L&F pp. 94-100*)*

What do fossils consist of? Why are some parts of the skeleton better represented in the fossil record than others? Are fossils an unbiased, or a biased, sample of past populations and faunas? How can an irregular object, such as a tooth or a skull, be converted into qualitative or quantitative data suitable for scientific analysis?

Class 10: REVIEW OF SECTION 1: TOPICS CHOSEN BY THE CLASS.

Class 11: MCQ/SA ASSESSMENT OF SECTION 1.

Class 12: 'Hominin origins: contenders for the title of "earliest" hominin'
(C pp. 207-209, 235-238; L&F pp. 204-254; K pp. Chapter 4)

If most mutations are assumed to be neutral and DNA differences are calibrated in one way or another then the DNA differences between modern humans and chimpanzees suggest that the common ancestor of these two groups would have been living between about 8 and 5 Ma and most likely *c.*6 Ma. What kind of animal was the common ancestor of later hominins? It was unlikely to have been like modern apes. Discoveries made at Aramis in Ethiopia in the 1990s were not only very old - close to 4.4 Ma - but they also displayed an

intriguing mixture of features, some that formerly had been regarded as indicative of either *Australopithecus*, others indicative of living and fossil apes and yet others that were novel, either individually or in combination. In this session we review what is known of the material that has now been allocated to a new genus as *Ardipithecus ramidus*. Subsequent discoveries at localities older than Aramis in Ethiopia referred to *Ardipithecus kadabba*, and at the Kenyan site of Lukeino referred to *Orrorin tugenensis*, have also been cited as evidence that the hominin fossil record can be traced back to *c*.5.7 and 6 Ma, respectively. Fossils dating to *c*.7 Ma discovered at a site called Toros-Menalla in Central Africa and referred to *Sahelanthropus tchadensis* have also been put forward as a possible hominin ancestor. How certain can we be that *any* of these discoveries have sampled creatures more closely related to modern humans than to chimpanzees? Could they be ancestors of living chimpanzees or belong to an archaic 'proto-hominin' group with no direct link to either living chimpanzees or modern humans? Have recent additional discoveries and analyses of these taxa provided any enlightenment?

Class 13: 'Archaic hominins: early evidence from East and Central Africa'
(C pp. 238-248, 217-225; L&F pp. 255-272; K pp. Chapter 4)

Discoveries in East Africa, most of them made over the past two decades, together with material from a site in Central Africa, make up the evidence for at least one, and perhaps several, species of *Australopithecus*. The best known of these is *Australopithecus afarensis*. There is as good a fossil record for this species as for any early hominin and thus it offers an opportunity to investigate it using the principles and methods presented in previous classes. How well is its fossil record dated? How well can it be characterized in terms of its functional capabilities? How different are males and females? Does it display any evolutionary trends through time? Can its paleohabitat be determined with any precision? How do the other East and Central African archaic hominins, *Australopithecus anamensis* and *Australopithecus garhi*, and *Australopithecus bahrelghazali* respectively, differ from *Au. afarensis*? Why did researchers decide to erect a new genus, *Kenyanthropus*, to accommodate recent discoveries from Kenya? How does the new taxon differ from taxa included in *Australopithecus*? What are the relationships of *Au. garhi*?

Class 14: 'Archaic hominins: evidence from southern Africa'
(C pp. 185-192; L&F pp. 255-283; K pp. 131-155)

The first archaic hominin was not discovered in East Africa but at the Taungs (now called Taung) Limeworks, which is 75 miles north of Kimberley in what is now part of South Africa. It was found in 1924 and in the following year in a letter to the journal *Nature* Raymond Dart attributed the child's skull from Taung to a new species and genus, *Australopithecus africanus.* Comparable finds at Sterkfontein and at Makapansgat were initially attributed to different genera and species but they were later included within *Au. africanus*, as were hominins more recently recovered from Gladysvale and Malapa. Fossils with slightly larger postcanine (i.e., the premolar and molar teeth) more robust jaws and with flatter faces were found at Kromdraai and Swartkrans, and more recently in caves at Drimolen, Gondolin and Coopers. This more megadont material was originally assigned to a second genus, *Paranthropus*, as *Paranthropus robustus* (some workers also recognize the Swartkrans material as a separate species, *Paranthropus crassidens*); it is conventional to treat these latter fossils as at least a separate species and in these notes they are treated as a

separate genus. The *Paranthropus* remains are sometimes referred to as the "robust" australopiths because of their large faces and jaws, but in this class they will be referred to as paranthrops. Some researchers believe that fossil hominin remains from a relatively unexplored lower part of the Sterkfontein cave complex (Member 2 and the Jacovec Cavern) push the southern African fossil record back to 4 Ma, and perhaps beyond, but this old date has been challenged. More recently still two associated skeletons found at Malapa have been assigned to a separate species of *Australopithecus*, as *Australopithecus sediba*. In the case of the Jacovec fossils it has been claimed that they may sample a more primitive hominin species than *Au. africanus*, and in the case of the Malapa fossil remains it is claimed that they sample a taxon that links *Au. africanus* with *Homo*. But they may both be variants of *Au. africanus.* How are these hominin taxa recovered in southern Africa related to the evidence recovered from East African sites?

Class 15: 'Megadont archaic hominins: evidence from East Africa'
(C pp. 249-252; L&F pp. 272-283; K: pp. 226-228)

The OH 5 cranium, which was discovered by Mary Leakey at Olduvai Gorge in 1959, was designated as the type specimen of *Zinjanthropus* (it was later called *Australopithecus (Zinjanthropus) boisei*). Subsequent discoveries at Olduvai and at other sites (e.g., Shungura, Koobi Fora and West Turkana, all located in the Omo region and Konso in Ethiopia) have confirmed the existence of a species that was distinct from and more derived than *Paranthropus robustus*. Some researchers consider that the East African evidence belongs to the same clade as *P. robustus* and that both enough from species attributed to *Australopithecus* that the genus name *Paranthropus* should be revived to accommodate them, and in this class we will refer to this East African megadont archaic hominin as *Paranthropus boisei*. *Paranthropus boisei* has a wide, flat face, a large mandible, diminutive anterior and very large-crowned and thick-enameled premolar and molar teeth. Similar, but morphologically distinctive and temporally earlier (>2.3 Ma) material from West Turkana has been assigned to a separate species, *Paranthropus aethiopicus*. The two East African taxa, *P. boisei* and *P. aethiopicus*, are sometimes referred to as "hyper-robust" to distinguish them from the "robust" forms from southern Africa and strictly they should be referred to as "hyper-megadont" for all archaic hominins are megadont according to the current definition of megadontia.

Class 16: 'Megadont archaic hominins: the case for a *Paranthropus* clade'
(C pp. 253-255; L&F pp. 320-330; K pp. 228-234, 241-249)

The morphological similarities shared by the southern African "robust" and East African "hyper-robust" forms may either be the result of similar adaptations affecting separate, regionally-distinct, hominin lineages (i.e., convergent evolution) making the grouping polyphyletic) and a grade and *not* a clade, or the shared morphological similarities may have been inherited from a recent common ancestor *not* shared with *Au. africanus* and thus *P. robustus* and *P. boisei* form a morphologically coherent and distinctive monophyletic group (i.e., they are a grade *and* a clade of fossil hominins). If there is support for the hypothesis that they are a clade then this would provide further justification for the reintroduction of the genus *Paranthropus.*

This class will use *Paranthropus* species as an example of how to determine whether a group of species comprises a clade or a polyphyletic group. What criteria should be used to decide whether there are cladistic reasons to separate paranthrop species at the genus level?

Class 17: 'Transitional hominins: the discovery of *Homo habilis*'
(C pp. 334-346; L&F pp. 284-307; K pp. 234-240, 249-278)

In the early 1960s Louis and Mary Leakey made a series of discoveries at Olduvai Gorge of fossils belonging to a hominin that was clearly distinct from *P. boisei*. This prompted Louis Leakey, Phillip Tobias and John Napier to propose in 1964 that these remains sampled a new, more primitive, species of the genus *Homo* so they referred the new material to *Homo habilis* (literally "handy man"). Critics considered the new taxon to be unjustified, some claiming the new material was indistinguishable from *Au. africanus*, while others regarded it as being closely-related to *Homo erectus* (see below). *Homo habilis* was the subject of intense discussion and debate in the 1960s and the debate continues today. This class will review the history of the early discoveries of *H. habilis*, summarize the debate about the justification of the new species, review the fossils attributed to *H. habilis* since 1964 and present the background to contemporary interpretations of that evidence.

Class 18: 'Early *Homo* – how many species, and are they in the correct genus?'
(C pp. 346-357; L&F pp. 294-5; K pp. 234-240)

Since 1964 *Homo*-like fossil material found at Olduvai Gorge has been added to the *H. habilis* hypodigm. However, it was discoveries made at Koobi Fora that were being referred to an informal taxonomic group called "early *Homo*" that proved to be decisive in prompting researchers to reassess the remains from that site as well as those from Olduvai Gorge. Some researchers claimed that the extent and nature of the variation in "early *Homo*" was excessive for a single species and it was proposed that the material *Homo* should be divided between two species. One widely adopted "two-species" scheme recognizes *Homo habilis sensu stricto* (with OH 7 as its type specimen), which is known from both Olduvai Gorge and the Omo region and perhaps from sites elsewhere, and a second species, *Homo rudolfensis*, of which KNM-ER 1470 is the type specimen. Recently, researchers have gone even further and questioned whether it is appropriate to include these taxa in *Homo*. What criteria should be used to decide whether taxa deserve their own genus? When these criteria are applied to early *Homo* species, what is the outcome?

Class 19: 'Pre-modern *Homo*: *Homo ergaster* – origins and dispersal beyond Africa'
(C pp. 380-382, 426-440; L&F pp. 331-361; K pp. 279-281, 273-280, 313-329)

By perhaps 2.0 Ma, and certainly by 1.8 Ma, the remains of a new form of hominin, *Homo ergaster* (most researchers now refer to it as early African *Homo erectus*) appear in sites in the Omo region of East Africa. What distinguishes it from all the hominin taxa that have been referred to in earlier classes is a reduction in the relative and absolute size of the face, jaws and chewing teeth, perhaps a reduction in sexual dimorphism (but the discovery of small-brained *H. erectus* challenges this hypothesis) together with a postcranial skeleton that is consistent with it being an obligate biped. Cranial specimens similar to those of *Homo erectus* from the Far East (see below) are also found in East Africa, but these (e.g., OH 9) postdate the remains attributed to *H. ergaster*. Fossils with similar characteristics have been recovered from a *c*.1.8 Ma site in Georgia called Dmanisi. Some researchers suggest the

Dmanisi fossils bridge the morphological gap between *H. habilis* and *H. ergaster*/early African *H. erectus* but others see them as being a variant of *H. ergaster*/early African *H. erectus*.

Classe 20: 'Pre-modern *Homo*: *Homo erectus - sensu stricto'*
(C pp. 382-411, 424-440; L&F pp. 331-361; K pp. 257-273, 282-287)

Despite claims that archaic hominins were among the hominin fossils recovered from Indonesia there has never been any convincing evidence that hominins belonging to *Au. africanus* or *Au. afarensis* have been recovered from sites beyond Africa. The earliest hominin fossil evidence outside of Africa is from Dmanisi, Georgia (see above) and from Indonesia where absolute dates of *c*.1.8 Ma have been claimed for *H. erectus* remains. Other than these sites and an archaeological site in the Near East called Ubeidiya the evidence for hominin occupation much beyond 1 Ma is weakened either by unreliable dating or by the inconclusive nature of the paleontological or archeological evidence (the discovery of a *c*.1.2 Ma tooth from deposits in the Sima del Elefante one of the caves at Atapuerca is an exception as may be evidence from other sites in Spain). Were the first hominins to leave Africa *H. ergaster*-like or were they more primitive *H. habilis*-like hominins? There is evidence that *H. erectus* persisted in Asia for well over a million years (*c*.1.8 - *c*.0.2 Ma, but this very recent date has been challenged) so *H. erectus* in Asia overlapped temporally with *Homo sapiens* in Africa (see below). Did *H. erectus sensu stricto* ever penetrate Europe? Where does the *c*.90-18 Ka *Homo floresiensis* fit into all this?

Class 21: 'Pre-modern *Homo*: later archaic *Homo'*
(C pp. 450-471, 474-482; L&F pp. 331-361; K pp. 330-434)

The distinctive morphology of *H. erectus* gives way to hominins with a less specialized but still "robust" skull and postcranial skeleton (i.e., relatively wide mandibular body and ectocranial features in the skull plus relatively thick long-bone shafts in the postcranial skeleton) (e.g., Kabwe in Africa, Petralona and Mauer in Europe and Jinnuishan in China) but there is an ongoing debate about the degree of regional distinctiveness of these remains. There is no consensus about the most appropriate taxonomy for this material and researchers have espoused interpretations that range from those who support species-level distinctions (e.g., *H. heidelbergensis, H. rhodesiensis, H. antecessor*) to others who are content to interpret it as intraspecific (or polytypic) variation within an inclusive interpretation of *H. sapiens* that would see such a taxon subsume all of *Homo* post-*H. erectus*.

Class 22: 'Pre-modern *Homo*: focus on the Neanderthals: I. The fossil evidence'
(C pp. 534-548, 573-587; L&F pp. 331-361; K pp. 435-614)

See the text for Class 23.

Class 23: 'Pre-modern *Homo*: focus on the Neanderthals: II. The molecular evidence'
(C pp. 556-563; L&F pp. 381-399)

Homo neanderthalensis, or Neanderthals for short, are a group of pre-modern *Homo* that has what many, but not all, researchers interpret as a particularly distinctive morphology. The fossil evidence of this group is found at sites spread across Europe, the Near East and western Asia. The remains date from *c*.>200-30 Ka (this date would be c.530 ka if the Sima

de los Huesos material is included). Their distinctive facial shape, robust long-bones and large joints have been interpreted as being a phenotypic consequence of their occupying cold and marginal environments armed with relatively unrefined tools. However, this simplistic interpretation is being challenged. The second of the two classes will review evidence from Neanderthal DNA. These data provide important new evidence about whether Neanderthals are a separate species and thus about the relationship between Neanderthals and modern humans.

Class 24: 'Modern human origins: I. – The anatomy of the debate and the molecular evidence'
(C pp. 500-515)

See the text for Class 25.

Class 25: REVIEW OF CLASSES 12-24: TOPICS CHOSEN BY THE CLASS

Class 26: THANKSGIVING

Class 27: 'Modern human origins: II. – The fossil evidence'
(C pp. 485-500, 520-533, 588-599; L&F pp. 366-446; K pp. 464-706)

The origin of modern humans is a topic that has dominated human evolutionary studies for the past decade or more. However, despite this attention there has been little substantial progress. The crux of the debate is whether, or not, anatomically-modern humans originate from a series of hominin migrations "Out of Africa". In this hypothesis successive migrations each took their gene pools with them so that modern humans everywhere have a genome that is mainly made up of genes that originated in Africa. The competing hypothesis is that modern humans arose by a series of regional transitions from archaic to anatomically modern humans with, or without, significant admixture with immigrants from Africa. The latter hypothesis allows for genes to be transferred *between* regions (by either migration of interbreeding) but it also implies there was substantial morphological continuity *within* each major region through time.

We will examine whether, and in what ways, the paleontological and archeological evidence can be reconciled with the molecular evidence from individuals sampled from modern human populations. Each of the three lines of evidence (*molecular*, *anatomical* and *behavioral*) has its strengths and weaknesses and these will be discussed. This class will also focus on the implications of the *c*.170 ka modern human-like crania from Herto in the Middle Awash, Ethiopia and on the Omo crania that researchers have suggested are *c*.190 ka.

Class 28: Overview of evolutionary trends in the hominin clade: I. Diet

Class 29: Overview of evolutionary trends in the hominin clade: II. Posture, locomotion and dexterity

Class 30: REVIEW OF THE COURSE: TOPICS CHOSEN BY THE CLASS

(N.B. ASSESSMENT OF SECTION 2 WILL BE IN THE EXAM PERIOD)

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