

The Fossil Record of Early Man: What Does the Scientific Literature Reveal?

By: Arnold C. Mendez, Sr.

Many people are under the mistaken idea that the scientific literature in journals and publications will only support the idea of evolution. While it is true that most writers of articles that appear in peer reviewed scientific literature are evolutionist, this very same literature can be interpreted to show that evolution has many weaknesses. This implied "support" for evolution is founded on the bias that scientists have for evolution, especially in the area of early man. All scientists are biased because all scientists are human. Because all scientists are human they will all have biases that colors their research. All honest scientists admit that they have biases. An honest creation-scientist will also admit bias. Since creation-scientists are biased in the belief of a literal creation as outline in the book of Genesis, this interpretation will color their research and findings. The worse bias is to claim that you have no bias. If you claim you have no bias you deceive yourself.

Most information can be interpreted many ways. The fossil record of early man as catalogued in the scientific literature is no exception. There is often vehement disagreement among evolutionary scholars about the interpretation of this information even among themselves. Evolutionists disagree about dates, evolutionary relationships, and taxonomy etc., even when interpreting the same fossil or reading the same journal article. It should therefore come as no surprise to evolutionist writers when non-evolutionist can find other interpretations in the scientific literature.

If a person is persistent, it is possible to sort through the scientific literature and find support for the concept of Biblical Creationism. This support will in essence nullify the support for the evolutionary theory since they are mutually exclusive. That is the reason I have assembled this information. This shows that the fossil record of early man can be interpreted to support creation and that it contradicts the evolutionary theory.

The information in this binder makes it easy to see how the scientific literature can be interpreted from a creationist point of view.

- The journal name, author, volume, page and date are typed in the heading.
- Whole page(s) of actual scanned copies of the journal, book, or pertinent article are included. Evolutionists often claim that they are quoted out of context. This will allow you to get the whole idea or thought that is being expounded in the correct context.
- Notes are written on the side of each page so that relevant information is easily noted.
- Arrows and brackets are used to highlight various passages/pictures in the article.
- A summary of ideas is included at the bottom of each page.
- Cited material is numbered and in parentheses. A works cited page is included.

It is hoped that this information presented in this way will encourage the reader to do further research.

Woodward AS. A new cave man from Rhodesia, South Africa. *Nature*. 108:371. 1921

NOVEMBER 17, 1921]

NATURE

371

A New Cave Man from Rhodesia, South Africa.

By Dr. ARTHUR SMITH WOODWARD, F.R.S.

This skull was found in a lead zinc mine along with two or possibly three other individuals (1), one of which has a very modern looking maxilla. They were all probably miners. Interestingly, most evolutionists state that Rhodesian man was found in a cave.

The skull exhibits what some believe is a bullet hole. There is also an exit hole near the foramen magnum not visible in the picture (2).

This skull was originally dated at 45kya and has been re-dated to 200-400kya. Notice that the skull is not fossilized indicating that it is not very old.

DURING recent years the British Museum has received from the Rhodesia Broken Hill Development Co. numerous bones from a cave discovered in their mine in North-west Rhodesia about 150 miles north of the Kafue river. All except the smaller of these bones are merely broken fragments, and they evidently represent the food of men and flesh-eating mammals who have at different times occupied the cave. As described by Mr. Franklin White (*Proc. Rhodesia Soc. Assoc.*, vol. 7, p. 13, 1908) and Mr. F. P. Semell (*Geological Magazine* [5], vol. 4, p. 443, 1907), rude stone and bone implements are abundant among the remains, and there can be no doubt that the cave was a human habitation for a long period. Very few of the bones can be exactly named, but, so far as they have been identified by Dr. C. W. Andrews and Mr. E. C. Chubb, they belong to species still living in Rhodesia or to others only slightly different from these. The occupation of the cave, therefore, seems to have been at no distant date—it may not even have been so remote as the Pleistocene period.

Until lately no remains of the cave man himself have been noticed at Broken Hill, but at the end of last summer Mr. W. E. Barren was so fortunate as to discover and dig out of the earth in a remote part of the cave a nearly complete human skull, a fragment of the upper jaw of another, a sacrum, a tibia, and the two ends of a femur. These specimens have just been brought to England by Mr. Ross Macartney, the managing director of the company, and they are to be added to the many generous gifts of the company to the British Museum.

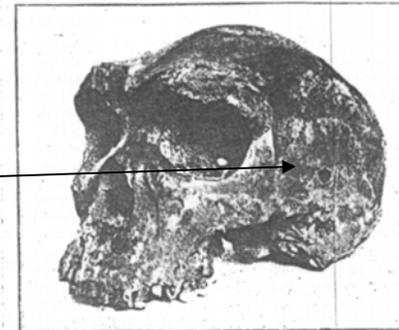
The skull is in a remarkably fresh state of preservation, the bone having merely lost its animal matter and not having been in the least mineralised. As shown in the accompanying photograph, it is strangely similar to the skull of the Neanderthal or Mousterian race found in the caves of Belgium, France, and Gibraltar. Its brain-case is typically human, with a wall no thicker than that of the average European, and its capacity, though still not determined, is obviously well above the lower human limit. Its large and heavy face is even more simian in appearance than that of Neanderthal man, the great inflated brow-ridges being especially prominent and prolonged to a greater extent at the lateral angles.

The roof of the skull at first sight appears remarkably similar to that of *Pithecanthropus* from Java, having the same slight median longitudinal ridge along the frontals and rising to its greatest height just about the coronal suture. It is, however, very much larger, and the resemblance may not imply any close affinity. The length of the skull from the middle of the glabella to theinion is about 210 mm., while its maximum width at

NO. 2716, VOL. 108]

the parietal bosses is 145 mm. The skull is therefore dolichocephalic, with a cephalic index of 69. Its greatest height (measured from the basion to the bregma) is 131 mm. In general shape the brain-case is much more ordinarily human than that of the La Chapelle Neanderthal skull, which differs in the expansion and bun-shaped depression of its hinder region. The mastoid process, though human, is comparatively small. The supramastoid ridge is very prominent and broad. The tympanic meatus is short and broad, as always in man. The foramen magnum occupies its usual forward position, so that the skull would be perfectly poised on an erect trunk.

The facial bones much resemble those of the La Chapelle skull, the great flat maxillaries, without canine fossae, being especially similar. The nasal bones, however, are more gently sloping; the sharp lateral edge of the nasal opening runs down on the face (as in the gorilla), allowing the



premaxillary surface to pass uninterrupted into the floor of the nasal cavity; and the infranasal region is unusually deep. The typically human anterior nasal spine is conspicuous.

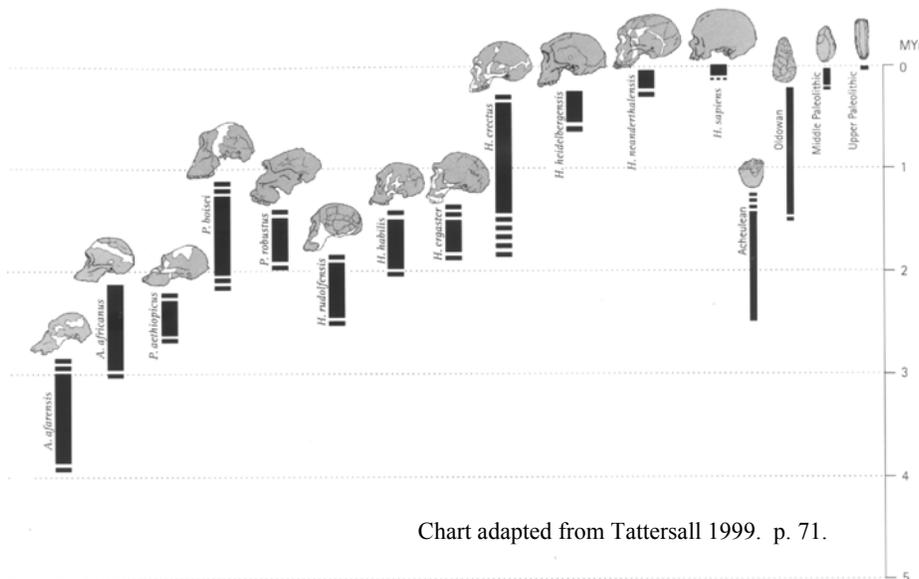
The palate is of enormous size, as large as that inferred by Boule from the fragments preserved in the La Chapelle skull. It is, however, in all respects human, being deeply arched and bounded by the horse-shoe-shaped row of teeth, which are unusually large, but also entirely human. The teeth are much worn, and those of the front of the jaw met their lower opposing teeth in the primitive way, edge to edge. The canines are not enlarged. The second molar is square, 13.5 mm. in diameter. The third molar is much reduced, measuring 12.5 mm. in width by 9.5 mm. in length. The total length of the molar series is about 33 mm. The outside measurement of the dentition across the second molars is 78 mm. The width between the sockets of the third molars

- Rhodesian man is not 200-400k years old. The skull is not mineralized as would be expected if it were as old as claimed. All indications are that the skull is only a few hundred years old.
- Cause of death may have been a gunshot wound.
- Rhodesian man was in the company of several other individuals one of which has a very modern jaw. All the postcranial material, of all individuals is very modern looking. He was probably mining lead or zinc.

The Age of Fossils and their Evolutionary Relationship

According to evolution the genus *Homo*, which includes *Homo sapiens*, has constantly improved. This is made possible because of natural selection. Natural selection is the survival of the more efficient organism because the inefficient have been selected out by nature. The more primitive give rise to the more specialized and this allow organisms to improve. This also means that the less fit individuals should not survive for any extended period of time because they have to die off for natural selection to proceed. If the less fit organisms survived they would in essence infect the more fit organism with their defective genes through interbreeding.

An example of this is Neanderthal man, *Homo neanderthalensis*. Most evolutionists believe that Neanderthal was a completely separate species. They consider *H. neanderthalensis* to have been inferior to modern *H. sapiens*, this inferiority is a result of natural selection. *H. sapiens* are more fit. In theory Neanderthal man would leave the scene and modern man would achieve the ascendancy. This is an example of the above principle. If evolution were true the fossil record should show a smooth appearance of one Homo species to another. *H. erectus* should lead to *H. heidelbergensis* (Rhodesian man), then to *H. neanderthalensis*, and finally to *H. sapiens*, or some such variation (there is much disagreement even among evolutionist).



This chart shows the evolutionary time line and the proposed dates for the appearance of various Homo groups. At first appearance this seems to show a smooth transfer from one Homo species to another. As with most charts of this type it is very deceiving. In actuality the scientific literature shows a much larger time overlap for all Homo species. This in effect would nullify the "more primitive to

the more specialized" theory of the evolutionist. The fossil record shows that all Homo species were contemporaries of each other and there is no smooth phasing in and out of fossil men. The above chart is one of many examples of how evolutionists allow the data to be misrepresented to fit their preconceived notions of how evolution operates

The following series of articles show these various Homo species existed at the same time in the same location for long periods of time. This is the exact opposite of what evolution proposes. This is another example of how the scientific literature supports special creation and nullifies evolution. (Please bear in mind that the author does not necessarily agree with the evolutionary dates assigned to these fossils, they are used for comparison purposes.)

Brown F. Harris J. Leakey R. Walker A. Early *Homo erectus* skeleton from west Lake Turkana, Kenya. *Nature*. 316:788. 1985.

This article shows that *Homo erectus* fossil individuals have been dated to 1.6 mya. This particular *H. erectus* fossil is known as KNM-WT 15000.

KNM = Kenya National Museum
WT = West Turkana
15000 = museum number.

Early *Homo erectus* skeleton from west Lake Turkana, Kenya

Frank Brown*, John Harris†, Richard Leakey‡ & Alan Walker§

* Department of Geology, University of Utah, Salt Lake City, Utah 84112, USA
† Los Angeles County Museum, Los Angeles, California 90007, USA

‡ National Museums of Kenya, Box 40658, Nairobi, Kenya

§ Department of Cell Biology and Anatomy, Johns Hopkins University School of Medicine, Baltimore, Maryland 21205, USA

The most complete early hominid skeleton ever found was discovered at Nariokotome III, west Lake Turkana, Kenya, and excavated in situ in sediments dated close to 1.6 Myr. The specimen, KNM-WT 15000, is a male *Homo erectus* that died at 12 ± 1 years of age, as judged by human standards, but was already 1.68 m tall. Although human-like in many respects, this specimen documents important anatomical differences between *H. erectus* and modern humans for the first time.

DURING the course of palaeontological exploration on the west side of Lake Turkana, Bw. Kamoya Kimeu found a small fragment of hominid frontal bone exposed on the surface at the site of Nariokotome III, on the south bank of the Nariokotome River. The approximate latitude and longitude of the site are $4^{\circ}08' N$, $35^{\circ}54' E$ (Fig. 1). Near the site the Plio-Pleistocene beds strike $N 7^{\circ} E$ and dip 5° to the west. Exposures are reasonably good along the south bank of the Nariokotome where a section was measured to establish the stratigraphic position of the hominid (Fig. 2). Several tuffs occur within this section that have been correlated with tuffs elsewhere in the Turkana Basin on the basis of their chemical composition. The hominid derives from a siltstone that immediately overlies a tuff identified as a component ash of the Okote Tuff complex of the Koobi Fora Formation. The age of this tuff is ~ 1.65 Myr^{1,2}. An ash that correlates with Tuff L of the Shungura Formation (Chari Tuff of the Koobi Fora Formation) dated at 1.39 Myr^{3,4} lies 34 m above the hominid level. An un-named tuff dated at 1.33 Myr⁴ lies 46 m above the specimen. Thus, the hominid is probably very close to 1.6 Myr in age.

The strata consist predominantly of pale yellowish-brown sandstones and siltstones and very pale yellowish-brown to medium-brown siltstones. The sandstones and siltstones are either laminated or massive. The tuff that underlies the hominid fills cracks in an underlying sandy siltstone and contains small-to-medium-scale trough crossbeds truncated at their tops and overlain by siltstone. A small lens of fine tuffaceous sand that lies ~ 1 m above the hominid level contains abundant amphioxes and amphistrongyls of freshwater sponges. A tuff that lies 6.7 m above the hominid level contains reworked molluscs at the base and a sandstone 13.8 m above the hominid is capped by an ostracod-rich layer 10 cm thick. Mammalian fossils are rare at this locality, the most abundant vertebrate fossils being parts of small and large fish. The depositional environment was evidently an alluvial plain of low relief, consistent with the fossil fauna in the section. It is likely that the plain was only slightly higher in elevation than a lake which existed nearby, such that with only minor changes in lake level, typical lacustrine forms (for example, ostracods, molluscs) could invade the area.

Twenty-five other vertebrate-bearing sites were located and collected during the 1984 season. Individual sites were labelled by the name of the ephemeral river draining their exposures and were further numbered sequentially in order of their discovery (Table 1). As at Koobi Fora, the Okote Tuff was used as a marker horizon in the subdivision of the fossiliferous succession. Fossil assemblages were retrieved from horizons a short depth below the Okote Tuff at five localities and slightly above it at eight localities (see Table 2). Appreciably fewer taxa are represented at these new localities than at equivalent places at Koobi Fora, but this may be an artefact of sample size. The distribution of identifiable species at sites on both sides of the lake, specifically the presence of *Deinotherium bozasi*, *Elephas recki iheretensis*, *Diceros bicornis*, *Metridiochoerus andrewsi* and

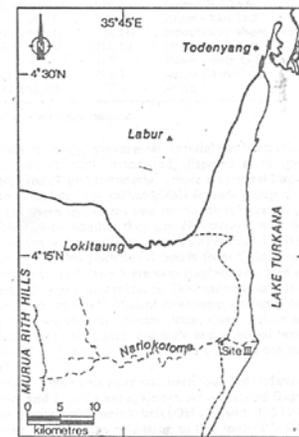


Fig. 1 Map of northern Kenya to show location of site Nariokotome III.

Gazella janenschii only at horizons below the Okote tuff and *Metridiochoerus compactus* only at horizons above this tuff, provides a measure of correlative support for geochemical analyses of the tephra. *Tragelaphus scriptus* is the only species from this part of the section on the west side of the lake that is not represented yet at Koobi Fora.

Following the initial discovery, screening and washing of surface float and pebble lag led to the recovery of most of the hominid calvaria. The facial skeleton was found just eroding out from tuffaceous sediments. Excavation of an area $\sim 5 \times 6$ m has led so far to the recovery of the mandible, several isolated teeth and much of the postcranial skeleton. A list of the parts found so far is given in Table 3. The site plan of the excavation (Fig. 3) shows that the skeleton was dispersed before final sedimentary burial. The bones were found in a layer of tuffaceous silt of variable thickness deposited on a more indurated, flat-lying tuffaceous sand with orange root casts. The top of the fossiliferous horizon shows many signs of bioturbation and several of the bones were found broken or lying in positions suggesting that they had been trampled by large mammals. The

- Most anthropologists assign the dates for *H. erectus* from 300,000-1.8mya. This is a time period of about 1.5 million years (3). This is a very long time of stability for a *Homo* species that should be evolving into *H. neanderthalensis* or archaic *H. sapiens*. This represents a time period of no evolution.
- Please bear in mind that according to the evolutionary theory *H. erectus* are a distinct type of morphological individual.
- The following articles will show that *H. erectus* individuals are contemporaneous with modern *H. sapiens*, in reality they are simply a variation of modern men. In order to lend credence to evolution they and other fossil men have been given their own species status.

Throne AG. Macumber PG. Discoveries of Late Pleistocene Man at Kow Swamp, Australia. Nature. 238:316. 1972.

316

NATURE VOL. 238 AUGUST 11 1972

Discoveries of Late Pleistocene Man at Kow Swamp, Australia

A. G. THORNE

Department of Prehistory, Research School of Pacific Studies, The Australian National University, Canberra

P. G. MACUMBER

Geological Survey of Victoria, Mines Department, Melbourne

Homo erectus like individuals existed up until about 10,000 years ago.

This article states that more than 35 individuals were unearthed. Obviously we are not dealing with an anomaly, this was a widespread phenomenon.

Notice that these *H. erectus* fossils were all dug out of burial graves. Stone artifacts, shells, ochre, and marsupial teeth were buried along with the individuals.

The late Pleistocene human remains from Kow Swamp display archaic cranial features which suggest the survival of *Homo erectus* in Australia until as recently as 10,000 years ago.

This article describes the first extensive collection of late Pleistocene human remains from Australia. Analysis of the cranial morphology of more than thirty individuals reveals the survival of *Homo erectus* features in Australia until as recently as 10,000 years ago.

In August 1967, a highly mineralized and carbonate encrusted partial skeleton with archaic cranial features was examined during a survey of the skeletal collections held by the National Museum of Victoria. The rest of this skeleton (KS1) was excavated during 1968¹ from silts bordering Kow Swamp in northern Victoria (Fig. 1). Subsequent excavations in this area have produced the remains of at least forty individuals. Burial areas at two nearby sites, Gunbower and Bourkes Bridge, contain material of similar morphology but as yet have not been explored in detail.

At Kow Swamp there is a distinct concentration of burials near Taylors Creek. Thirteen graves have been excavated and many burials remain to be investigated. The construction of an irrigation contour channel through part of the site disturbed at least twenty burials. Reconstruction of these disturbed skeletons is simplified because differential mineralization has rendered each individual a different colour. The population includes infants and juveniles. At present fifteen adult individuals are complete enough for detailed description.

Most of the skeletal material is the result of shallow, primary burials into relatively soft lacustrine and aeolian sediments. Preservation has been enhanced by carbonate mineralization, generally with encrustation up to 10 mm thick. Orientation of cadavers included full extension, crouching and tight flexion. Stone artefacts, ochre, shells and marsupial teeth were placed in some graves. At least one individual had been cremated. (Evidence of cremation is not surprising, in view of its presence in Australia at 25–32,000 years BP².) A gritty shoreline deposit adjacent to the KS2-17 site yielded more than fifty quartz artefacts, many of them carbonate encrusted.

Geology

All the sites lie on the Riverine Plain in Victoria, astride a major flow path of the ancestral Murray River system and its

tributaries—a path that has been in existence since late Miocene times. The association of burials with ancestral rivers indicates general occupation of this area in the late glacial period when the streams had much greater discharges than at present^{3,4}.

Physiographically, the sites fall into two groups—those associated with an ancient Kow Swamp shore line (KS1-17), and burials in the levees of a former stream system, a distributary of which (Mead Stream) once flowed past the northern edge of the swamp. The Cohuna Cranium⁵, discovered in 1925, stems from the second group, as do the Gunbower and Bourkes Bridge burials (Fig. 1).

Kow Swamp Group

Kow Swamp is at present a largely artificial reservoir which occupies the depression of an earlier late Quaternary lake formed in a back levee position to the ancient Mead Stream⁶. Around the eastern edge of the swamp is a narrow belt of lacustrine silts (Cohuna Silt), about 0.25 km wide and only 1 m thick. The Cohuna Silt is in part overlain by the Kow Sand which forms a low crescentic dune (lunette), rising to a height of about 4 m above the plain. Skeletal material occurs in both the Cohuna Silt and Kow Sand.

(a) Cohuna Silt sites. In this area, two distinct sites have yielded portions of about thirty-five individuals, of which twelve were recovered from undisturbed graves. These graves had been dug from the present (albeit fossil) surface. The silts are a near-shore lacustrine deposit which marks the eastern limits of the former Lake Kow. They wedge out to the east against the rising underlying clay plain but lakewards are underlain by lacustrine fine sands. The presence of unionid shells throughout the entire sequence indicates freshwater conditions during deposition. The silts were later infused by carbonates of groundwater origin. Subsequent remobilization of the carbonate has led to a dynamic, highly calcareous environment which provides optimum conditions for bone preservation. In some instances grave margins have been preserved by a continuous layer of carbonate, precipitated along the junction of the grave fill and the undisturbed silts.

(b) Kow Sand sites. The lunette commences south of Taylors Creek and rises abruptly to 4 m. In this region skeletal material was obtained from two out of three pits dug at random—one contained the undisturbed KS9 skeleton at a depth of 1.4 m. The grave of this individual is the only one dug from an old surface, which was subsequently covered by continuing dune accretion. The lunette partially overlies the Cohuna Silt, with no major intervening palaeosol to indicate a significant

- *H. erectus* men have lived as recently as 10,000 years ago. (6,500 years ago, see next article)
- *H. erectus* buried their dead and believed in some form of afterlife as evidenced with the items buried in the graves. *H. erectus* was not culturally inferior to modern man.
- This recent age does not allow *H. erectus* enough time to evolve into a more "modern man."
- *H. erectus* and *H. sapiens* have existed side by side for the last 1.6 million years. One did not evolve into the other one. *Homo erectus* is simply a variation of modern *H. sapiens*. This supports the creation concept.

Freedman L. Lofgren M. The Cossack skull and a dihybrid origin of the Australian Aborigines. Nature 282:299. 1979.

The Cossack skull was discovered 3 km ESE of Cossack, W. Australia.

The Cossack skull is similar to *H. erectus* fossils. It is similar to the Kow Swamp people.

Notice that this *H. erectus* morphology was continent wide and was not a local phenomena.

The skull has the same features of other *H. erectus* crania.

- Skull low and broad.
- Occipital bun
- Thick cranial wall
- Supraorbital ridges (Thick eyebrow ridges)

Nature Vol. 282 15 November 1979

significant differences (Table 1). Cranial length is more than 5 standard deviations greater than the series mean. Although estimated breadth is slightly greater than the maximum Western Australian value, the cranial index of Cossack is comparable to the series lowest figure. Parietal size (bregma-lambda chord) is close to 3-standard deviations greater than the Western Australian mean. The Cossack skull's frontal curvature index is more than 5 standard deviations below the series minimum value. Cranial bone thicknesses are considerably greater than those of recent Australian Aborigines¹⁵. The most notable metrical mandibular comparison is of the corpus projective length, which yields a value more than 3 standard deviations greater than the series mean.

The features in which the Cossack skull differs from recent Western Australians are precisely those in which it resembles certain prehistoric South-East Australians (Table 1). Low frontal index and great length (the Cossack skull has the highest Australian values yet recorded) as well as general robusticity, highlighted by cranial vault bone thickness, are characteristic of the postulated robust group, including Talgai, Cohuna, Mossiel and Kow Swamp. Comparison of lateral cranial contours¹⁵ reinforces the referral of the Cossack skull to this group.

The demonstrable affinity of the Cossack skull to the robust South-East Australian group indicates that this morphology was not a regional variant but continental in distribution. This newly

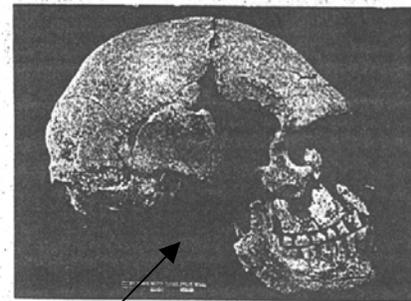


Fig. 2 Lateral view of the Cossack skull.

established range strengthens the evidence for a two-population occupation of Australia.

It is now generally accepted that human colonisation of the Australian continent first occurred at least 40,000 yr ago and probably earlier⁹. Fossil evidence in Australia of a more robust population extends from about 13,000 yr BP (Kow Swamp) to 6,000 yr BP (Mossiel) and now possibly to even more recent times (Cossack). For the more gracile group the time span now ranges from 26,000 yr BP (Lake Mungo) to 13,000 yr BP (Keilor) to 6,000 yr BP (Green Gully)^{8,11,13}.

The two Asian stocks from which these populations could have been derived are: (1) a South-East Asian population, perhaps from Java and adjacent areas, and (2) a more northern population, possibly from southern China. These would be early *Homo sapiens* populations perhaps differing morphologically from each other as do the earlier Javanese and Chinese *Homo erectus* people. The more robust South-East Asian population, possibly morphologically related to the Solo (Ngandong) people¹⁹, could have taken a southerly route from Java by way of Timor into northwestern Australia and then down the west coast (Fig. 1). The more gracile population from southern China may have followed a more northerly course, perhaps passing through Indo-China, Borneo and New Guinea before arriving at the northeastern part of Australia. They would then have passed down the east coast and perhaps finally across the land bridge to Tasmania (Fig. 1). The 40,000-yr-old Niah cranium²⁰ from Borneo and the apparently more gracile appearance of the recent Tasmanians¹¹ may be the best evidence of this migration. These two early colonising Australian populations may have used different adaptive strategies. Their subsequent fusion might have been triggered initially by the climatic and faunal changes of the late Pleistocene but was only completed in recent times²¹.

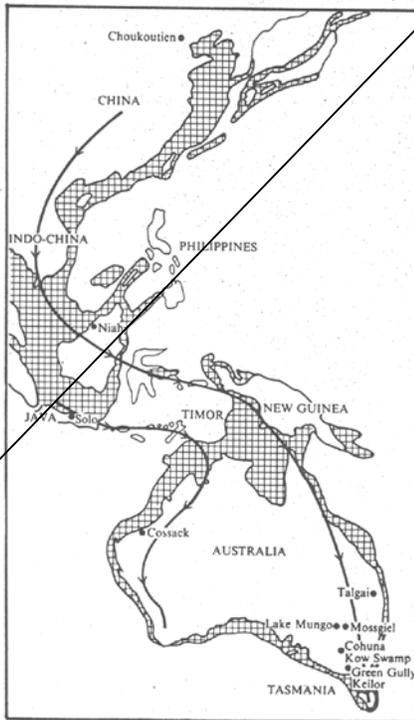


Fig. 1 Present and late Pleistocene (hatched) land areas. Fossil hominid sites and possible migration routes to Australia.

Table 1 Selected metric comparisons

Measurement	Cossack ¹⁵	Male West. Aust. ¹⁶ (range)	Kow Swamp ²¹ (range)
Max. cranial length	220	169-202	190-214
Max. cranial breadth	(145)	117-143	128-150
Bregma-lambda chord	131	104-128	115-126
Cranial index	65.9	64.64-76.33	(66.67)-72.39
Frontal curvature index	12.6	18.58-25.66*	12.71-16.12
Mandibular corpus projective length	98	71-95	

Measurements are given in mm.

- p. 298 "Direct dating of this individual is not feasible at present. However, the region's coastal features indicate that rising post-Pleistocene sea levels first reached the contemporary coastline around 6,500 yr. BP, thus apparently restricting the materials age to a period after that event."
- Here we have scientific evidence that *H. erectus* individuals were walking the Earth as recently as 6,500 years ago.
- Compare what these articles say about the date range of *H. erectus* to the chart on page 3. You will see that evolutionists are very selective in the information they publish.

Hublin J. Spoor F. Braun M. Zonneveld F. Condemi S. A late Neanderthal associated with Upper Paleolithic artifacts. Nature. 381:224. 1996.

31. Walker, R. J. & Morgan, J. W. *Science* **269**, 819-821 (1995).
 32. Newsom, H. E. in *Origin of the Earth* (eds Neuharth, H. C. & Jones, J. H.) 273-288 (Oxford Univ. Press, New York, 1990).
 33. Ringwood, A. E. *Geochim. cosmochim. Acta* **55**, 2083-2110 (1991).
 34. Shiley, S. B. & Walker, R. J. *Analyst* **100**, 2136-2141 (1995).
 35. Exalt, T. M. *Int. J. Mass Spectrom. Ion Proc.* **148**, 159-170 (1995).
 36. Woodhead, J., Vokac, F. & McCulloch, M. T. *Analyst* **120**, 35-39 (1995).
 37. Leeman, W. P., Genck, D. C., Garcia, M. O. & West, H. B. *Contr. Miner. Petrol.* **118**, 62-77 (1994).

ACKNOWLEDGEMENTS. We thank M. Garcia for providing many of the picrite samples, and for comments on an earlier version of this manuscript. We also thank G. Rosenberg and W. White for constructive reviews, and H. West for providing our interesting picrites.

A late Neanderthal associated with Upper Palaeolithic artefacts

Jean-Jacques Hublin*, Fred Spoor†, Marc Braun‡, Frans Zonneveld§ & Silvana Condemi||

* Laboratoire d'Anthropologie, Musée de l'Homme, Place du Trocadéro, 75116 Paris, France

† Evolutionary Anatomy Unit, Department of Anatomy and Developmental Biology, University College London, 1 University Street, London WC1E 6JJ, UK

‡ Department of Anatomy, University of Nancy I, 9 Avenue de la Forêt de Haye, 54505 Vandœuvre-les-Nancy, France

§ Department of Diagnostic Radiology, Utrecht University Hospital, Heidelberglaan 100, 3584 CX Utrecht, The Netherlands

|| Institut de Paléontologie Humaine, 1 rue Panhard, 75013 Paris, France

This Neanderthal was dated to 34,000 years ago.

These Neanderthals used personal ornaments.

The French site of Arcy-sur-Cure is a key locality in documenting the Middle-Upper Palaeolithic transition in Europe. Reliable attribution of the fragmentary hominid fossils associated with its early Upper Palaeolithic Châtelperronian industry has not been possible. Here we report the first conclusive identification of one of these fossils as Neanderthal on the basis of newly discovered derived features of the bony labyrinth. Dated at about thirty-four thousand years (34 kyr) ago, the fossil is representative of the youngest known Neanderthal populations, and its archaeological context indicates that these hominids used a rich bone industry as well as personal ornaments. The evidence supports the hypothesis of a long term coexistence with technocultural interactions between the first modern humans and the last Neanderthals in Europe. However, the complete absence of the derived Neanderthal traits in labyrinths of modern Upper Palaeolithic specimens from western Europe argues against phylogenetic continuity between the two populations in this region.

The Châtelperronian, an early Upper Palaeolithic industry known from northern Spain and central and southwestern France, is of the utmost importance for our understanding of the Middle-Upper Palaeolithic transition in western Europe. In contrast to the contemporary Aurignacian, the Châtelperronian appears to have emerged from the local Mousterian industries, associating Middle Palaeolithic artefacts with Upper Palaeolithic elements such as blade technology and a developed bone industry¹⁻⁴. The Châtelperronian and Aurignacian may have emerged at multiple locations as independent parallel technological inventions, perhaps in association with the predominantly local evolution of modern humans, with significant genetic input from Neanderthals^{5,7}. Alternatively, modern humans may have invaded Neanderthal territory, introducing the Aurignacian. According to this view, the Châtelperronian could have resulted from an acculturation process of the last western Neanderthals during a variable period of coexistence with modern humans^{1,2,8}.

The identity of the Châtelperronian tool-maker is crucial to the assessment of the two scenarios. Thus far, the only firm fossil evidence comes from Saint-Césaire (Charente-Maritime,

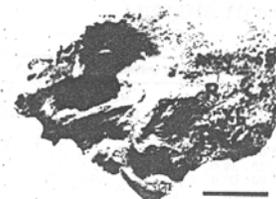


FIG. 1 Lateral view of the Arcy-sur-Cure juvenile temporal bone. Scale bar, 10 mm.

France), where a partial Neanderthal skeleton is dated at 36 ± 3 kyr before present (BP)^{9,10}. The only other Châtelperronian site with well associated hominid remains and the northernmost appearance of this industry, is Arcy-sur-Cure (Grotte du Renne) in the River Yonne Basin, 35 km south-east of Auxerre (France). Establishing the affiliation of these fossils is of particular interest because the Arcy assemblage is one of the latest known occurrences of the Châtelperronian, persisting beyond 33 kyr BP (refs 11,12). Moreover, it is unique in that it includes a rich bone and ivory industry and personal ornaments (pierced or grooved animal teeth and ivory rings), classically referred to the Upper Palaeolithic^{13,14}. Although the morphology of some hominid teeth suggested a possible non-modern assignment¹⁵, the fragmentary nature of the fossils have precluded conclusive identification, including doubt over the hominid status of some of these specimens. The Châtelperronian layer Xb at Arcy yielded a previously undescribed hominid temporal bone fragment, which preserves parts of the petrous, tympanic and mastoid portions (Fig. 1). Judging by its development, it belonged to an individual of about one year old, which makes taxonomic assignment on the basis of the usual criteria very difficult. Layer Xb is dated at 33,820 ± 0,720 yr BP by ¹⁴C (ref. 16), which is consistent with the ¹⁴C ages of underlying and overlying deposits¹⁷.

The morphology of the bony labyrinth within the temporal bone has the potential to provide information about hominid phylogenetic relationships¹⁸. We explored the comparative morphology of this structure in Neanderthals and modern humans in an attempt to establish the affinities of the Arcy specimen. Methods for visualization of the bony labyrinth in extant and fossil hominid crania using high-resolution computed tomography have been reported^{19,20}. The specimens that were studied are described in the legend to Fig. 3. The labyrinth gains its adult morphology long before birth, and direct comparison can therefore be made between adult and non-adult specimens²¹.

The radii of curvature of the semicircular canals indicate that



FIG. 2 Lateral aspect of the left labyrinths of a, *Pan paniscus*; b, modern *Homo sapiens*; and c, the Neanderthal cranium La Ferrassie 1. An., anterior; Su, superior. The sagittal labyrinthine index indicates what percentage of the posterior canal is situated inferiorly to the plane of the lateral canal ((l/s + l) x 100). Exact definitions and method of taking the measurements are given in refs 18, 20 and 21.

- This is the latest date attributed to Neanderthal remains.
- The article states that the Neanderthal remains are associated with personal ornaments. Many evolutionists believed that *H. neanderthalensis* was not intellectually able to make personal ornaments. Also because of research studies comparing the manual dexterity of chimpanzees to modern humans, Neanderthal man was considered clumsy and manually inept (4). Because of anthropologist's evolutionary bias, Neanderthal was considered subhuman. Therefore personal ornaments were an evolutionary "no-no."

Stringer CB. R. Grun R. Schwarcz HP. Goldberg P. ESR dates for the hominid burial site of Es Skhul in Israel. *Nature*. 338:757. 1989.

Middle Eastern Neanderthals from Tabun and *H. sapiens* remains from Skhul both existed at the same time period at the same place.

crystals exhibited the topotaxy predicted by Poirier's model, but other crystals displayed the octahedral crystal habit and lacked the topotaxy, making interpretation difficult. In the light of our annealing results, we believe that the simplest explanation for their observations is that stress concentrations produced during pressurization in their apparatus led to production of martensitic nuclei in the earliest stages of their experiments and that coarsening of those nuclei by normal phase-boundary migration during the experiment produced their large, cuboidal, crystals. At the temperatures of their experiments, incoherent nuclei were also produced, leading to the crystals that did not display topotaxy with the olivine.

The present results resolve the discrepancies in the literature concerning the mechanism of the transformation in static or quasi-static experiments. The results also imply that the nucleation mechanism should always be martensitic in shock experiments. Indeed, the extreme stresses in shock deformation might lead to complete transformation by the martensitic mechanism rather than the coarsening by normal phase-boundary migration reported here.

One must use caution, however, when extrapolating these results to natural environments, because none of the studies summarized above includes the complication of the β phase^{1,17} (which does not exist for most of the analogue materials, including Mg_2GeO_4). We believe, however, that under most circumstances extrapolation to natural environments should be straightforward. At high temperature and low stress, α transforms to γ by incoherent nucleation and growth in all systems studied, and $\gamma \rightarrow \alpha$ in Mg_2GeO_4 (ref. 21) and $\alpha \rightarrow \beta$ in Co_2SiO_4 (ref. 25) also follow this mechanism. Therefore, in normal mantle environments, where the temperature is high and stresses are very low, the forward or reverse transformation to either β or γ should be accomplished by the reconstructive mechanism. On the other hand, in shocked meteorites the common circumstance should be sudden transformation into the γ stability field at low temperature and high stress (that is, by martensitic nucleation). Immediately thereafter, the stress and pressure will fall and the temperature will rise, in some cases leading to the β -phase before the reaction is quenched²⁶⁻²⁸. Downgoing lithospheric slabs present an environment in which both temperatures and stresses are intermediate between these other two environments. Under such conditions, the data are not yet sufficiently comprehensive to rule out either mechanism. We are continuing our experiments at intermediate temperatures and stresses to pursue this question.

It follows from these results that the level of stress could be a factor in experiments aimed at determination of the mechanism or kinetics of other transformations occurring in the deep Earth. In particular, if a martensitic mechanism is possible, then it is to be expected in shock experiments and also is likely in the laser-heated diamond cell. If such mechanisms are observed, their geophysical significance should be interpreted with caution. □

Received 9 January; accepted 10 March 1989.

1. Bina, C. R. & Wood, B. J. *Nature* **324**, 449-451 (1986).
2. Sung, C. & Burns, R. G. *Tectonophysics* **31**, 1-32 (1976).
3. Sung, C. & Burns, R. G. *Earth planet. Sci. Lett.* **32**, 165-170 (1976).
4. Vaughan, P. J., Green, H. W. & Coe, R. S. *Nature* **290**, 357-358 (1982).
5. Boland, J. N. & Liebermann, R. C. *Geophys. Res. Lett.* **10**, 87-90 (1983).
6. Rubie, D. C., Takahashi, Y., Utsumi, W., Kinoshita, T., Shimamura, O. & Yagi, T. 28th High Pressure Conference of Japan 132-133 (1987).
7. Yagi, T., Aoyagi, M., Shimamura, O., Suzuki, T. & Akimoto, S. *J. geophys. Res.* **92**, 6207-6213 (1987).
8. Hornsberg, A. R., Boland, J. N., Gasparik, T. & Liebermann, R. C. *Phys. Chem. Miner.* **15**, 498-506 (1988).
9. Vaughan, P. J., Green, H. W. & Coe, R. S. *Tectonophysics* **106**, 299-322 (1984).
10. Rubie, D. C. & Champness, P. E. *Bull. Miner.* **110**, 471-480 (1987).
11. Liebermann, R. C. & Poirier, J. P. *Nature* **228**, 155-157 (1980).
12. Boland, J. N. & Liu, L. *Nature* **303**, 233-235 (1983).
13. Hamaya, N. & Akimoto, S. in *High Pressure Research in Geophysics* (eds Akimoto, S. & Manghoni, M. E.) 373-389 (Gunter Academic, Tokyo, 1982).
14. Hamaya, N. & Akimoto, S. *Phys. Earth Planet. Inter.* **29**, 6-11 (1982).
15. Furnish, M. D. & Bassett, W. A. *J. geophys. Res.* **88**, 333-342 (1983).
16. Will, G. & Lauterjung, J. in *High Pressure Research in Mineral Physics* (eds Manghoni, M. H. & Syono, Y.) *Geophys. Monogr.* **39**, 177-188 (American Geophysical Union, Washington, DC, 1981).

756

17. Green, H. W. *Geophys. Res. Lett.* **11**, 817-820 (1984).
18. Poirier, J. P. in *Anelastic Properties and Related Processes in the Earth's Mantle Geodyn. Ser. 4*, 113-117 (American Geophysical Union, Washington, DC, 1981).
19. Burnley, P. C. & Green, H. W. *Eos* **69**, 1436-1437 (1988).
20. Green, H. W. *Geophys. Res. Lett.* **15**, 205-211 (1988).
21. Burnley, P. C. & Green, H. W. *Eos* **69**, 1471 (1987).
22. Green, H. W. & Birch, R. S. *Eur. J. Miner.* (in press).
23. Wede, S. J., Jackson, I. & Tsvet, H. *Phys. Chem. Miner.* **11**, 167-171 (1984).
24. Homstra, J. *J. phys. Chem. Solids* **15**, 311-323 (1960).
25. Hornsberg, A. R., Boland, J. N., Gasparik, T. & Liebermann, R. C. *Eos* **68**, 1539 (1987).
26. Putnis, A. & Price, G. D. *Nature* **280**, 217-218 (1978).
27. Price, G. D., Putnis, A. & Agral, S. O. *Contrib. Mineral. Petrogr.* **71**, 211-218 (1979).
28. Price, G. D., Putnis, A. & Smith, D. G. W. *Nature* **298**, 729-730 (1982).

ACKNOWLEDGMENTS. This work is supported by the NSF.

ESR dates for the hominid burial site of Es Skhul in Israel

C. B. Stringer*, R. Grün†, H. P. Schwarcz‡ & P. Goldberg§

* Department of Palaeontology, British Museum (Natural History), London SW7 5BD, UK

† Subdepartment of Quaternary Research, Cambridge University, Cambridge CB2 3RS, UK

‡ Department of Geology, McMaster University, Hamilton, Ontario L8S 4M1, Canada

§ Institute of Archaeology, Hebrew University, Jerusalem 91905, Israel

THE Middle East has been critical to our understanding of recent human evolution ever since the recovery of Neanderthal and early anatomically modern fossils from the caves of Tabun and Skhul (Mount Carmel) over 50 years ago^{1,2}. It was generally believed, on archaeological and morphological grounds, that middle eastern Neanderthals (such as those from Tabun, Amud and Kebara) probably dated from more than 50,000 years ago, whereas the earliest anatomically modern specimens (from Skhul and Qafzeh) probably dated from about 40,000 years³. Recent thermoluminescence and electron spin resonance (ESR) determinations, however, have supported biostratigraphy in dating the Qafzeh deposits to an earlier part of the late Pleistocene, probably more than 90,000 years ago⁴. These dates have been questioned on unspecified technical grounds^{5,6}, and it has also been argued that they create explanatory problems by separating the morphologically similar Qafzeh and Skhul samples by some 50,000 years, thus implying a long-term coexistence of early modern humans and Neanderthals in the area^{7,8}. Here we report the first radiometric dating analysis for Skhul, using ESR on bovine teeth from the hominid burial levels. Early uptake and linear uptake ages average 81 ± 15 and 101 ± 12 kyr respectively. These analyses suggest that the Skhul and Qafzeh samples are of a similar age and therefore it is possible that the presence of early modern humans in the area was episodic, rather than long term during the early late Pleistocene.

The Israeli site of Es Skhul is located in the canyon of Nahal Mearot (Wadi el-Mughareh), near the site of Tabun which has yielded Neanderthal hominid remains. The site of Skhul originally consisted of a 2.5-m thick accumulation of densely cemented, reddish-brown breccia deposited on a triangular rock-cut platform about 11 m above the present level of the wadi floor. McCown⁹, who excavated the site, identified three successively older units. Layer A (<60 cm thick) contained a mixed assemblage of Middle and Upper Palaeolithic artefacts as well as some potsherds. Layer B (a breccia 2 m thick) contained the cranial and post-cranial remains of at least 10 hominids, the majority of which seem to have been intentionally buried, and over 9,800 lithic artefacts representing a Levallois-Mousterian (Middle Palaeolithic) industry. Layer C (a breccia <30-cm thick) contained a sparse industry similar to that in Layer B, but no faunal material.

The hominids represent an archaic type of modern *Homo sapiens* and studies of their skeletal morphology demonstrate

NATURE · VOL 338 · 27 APRIL 1989

- Modern *H. sapiens* and Neanderthals existed together at the same time in the Middle Eastern region about 100,000 years ago.
- This implies that there was not a gradual blending of *H. neanderthalensis* into modern *H. sapiens*.

Valladas H. Reyss HL. Joron JL. Valladas G. Bar-Yosef O. Vandermeersch B. Thermoluminescence dating of Mousterian 'Proto-Cro-Magon' remains from Israel and the origin of modern man. *Nature*. 331:614. 1988.

Notice that there is so much overlap in the fossil record that it is difficult to say who was there first, Neanderthal or modern man?

Modern humans range is very old (100,000 years) it overlaps the Neanderthal range.

Solely because of the evolutionary time scale interpretations and suppositions, Cro-Magnons (archaic *H. sapiens*) and Neanderthals are assumed to be unrelated.

614 LETTERS TO NATURE NATURE VOL. 331 18 FEBRUARY 1988

Our calculations give rise to some interesting implications for the origin and early development of life on Earth. Although there are minor differences among different surface environments, we conclude that, for an ejecta blanket of 3 m as the criterion for serious disruption, the first primitive organism might have evolved at the surface between 4,000 and 3,700 Myr. Estimates for different assumptions about T_c and critical ejecta thickness can be found to be in the same range. In the deep ocean hydrothermal vents, the origin of life could have taken place as early as 4,200 to 4,000 Myr—substantially earlier than at the surface. In addition, the surface would probably have been sterilized as late as 3,600 to 3,700 Myr by global trauma due to impact processes, and even the deepest ocean environments might have been made terminally uncomfortable for life (except perhaps thermophilic forms) as late as 4,000 to 3,900 Myr.

Another factor is that severe climatic events would remain frequent (every 10^5 to 10^6 yr) until 3,600 to 3,800 Myr. Of course, if the reader has a different preference for the timescale of abiogenesis, he can choose his own estimate for these events from Fig. 2.

Some conclusions can be drawn from these inferences. If life could have evolved in or near the mid-ocean ridge hydrothermal systems, then it probably began there. Because of the interconnected nature of the ridges versus the more patchy nature of the suitable surface sites, it might have been more likely to propagate as well. Wherever life did first appear, it would seem possible that it was eradicated from at least the surface of the planet (perhaps several times), re-evolving in some new location or radiating from a preserved, more heat-tolerant population each time, before it took possession of the Earth undisputed by impact events. These multiple extinctions (and possibly origins) are inferred from the extent of overlap between the period at which life first would have appeared and the last probable instance of impact sterilization for any of these environments. An additional conclusion is that photosynthesis would have been rather difficult before 3,700 to 3,800 Myr because of frequent climatic events, including a near-total lack of sunlight for extended periods. It is also intriguing that the biosphere contained a relatively complex and diverse set of organisms by 3,500 Myr in light of the potentially short time period involved since the last sterilization event, and/or inception of life. This could imply a type and rate of evolutionary process no longer in operation.

Received 11 August; accepted 3 December 1987.

1. Chang, S. *Phys. Earth planet. Inter.* 29, 261-290 (1982).
2. Alvarez, L. W. *et al. Science* 208, 1095-1106 (1981).
3. Alvarez, W. *EOS* 65, 649-658 (1984).
4. Carr, M. H. *et al. NAGS*, 539-540 (1984).
5. Shoemaker, E. M. in *The New Solar System* (ed. Beatty, J. K. *et al.*) 33-44 (Cambridge Univ. Press, 1981).
6. Shoemaker, E. M. *A. Rev. Earth planet. Sci.* 11, 461-494 (1983).
7. Grieve, R. A. F. *A. Rev. Earth planet. Sci.* 15, 245-270 (1987).
8. Grieve, R. A. F. & Denno, M. R. *Jour. Geol.* 38, 230-242 (1979).
9. Levine, J. S. & Angerstein, T. R. *Origins of Life* 15, 299-318 (1985).
10. Kasha, J. & Epstein, S. *Gen. ev. cosmochim. Acta* 50, 1745-1756 (1986).
11. Kasting, J. E. *Origins of Life* 14, 75-82 (1984).
12. Moushah, S. *Origins of Life* 15, 251-261 (1984).
13. Froude, D. O. *et al. Nature* 304, 616-618 (1983).
14. Abbott, D. & Hoffman, S. *Tectonics* 3, 429-448 (1984).
15. Awramik, S. M. *et al. in Mineral Deposits and the Evolution of the Biosphere* (ed. Holland, H. D. *et al.*) 309-320 (Springer, New York, 1982).
16. Lazzarini, A. *et al. Precamb. Res.* 20, 259-282 (1983).
17. Barov, J. A. & Hoffman, S. E. *Origins of Life* 15, 327-345 (1985).
18. Vain-Smith, A. G. *Science* 206, 99-100 (1985).
19. Miller, S. L. in *Mineral Deposits and the Evolution of the Biosphere* (ed. Holland, W. D. *et al.*) 155-176 (Springer, New York, 1982).
20. Shoemaker, E. M. & Martin, E. C. *Jour. Geol.* 89, 99-114 (1981).
21. Grieve, R. A. F. & Parmentier, E. M. *Proc. 27th Int. Geol. Cong.* 19, 109-114 (1984).
22. Hartman, W. K. in *Comets, Asteroids, Meteorites* (ed. Delsemme, A. H.) 277-281 (Univ. Toledo Press, 1973).
23. Schmidt, R. M. & Hobbapp, K. A. *Geol. Soc. Am. Sp. Pap.* 190, 93-102 (1982).
24. Schoemaker, E. M. *et al. in Asteroids* (ed. Gehrels, T.) 253-262 (Univ. Arizona Press, Tucson, 1979).
25. McCreechin, T. R. *et al. Earth planet. Sci. Lett.* 20, 226-236 (1973).
26. Seebaugh, W. R. in *Impact and Explosion Cratering* (ed. Roddy, D. J.) 1043-1056 (Pergamon, New York, 1977).

27. Melosh, H. J. *Geol. Soc. Am. Sp. Pap.* 190, 121-127 (1982).

28. Gault, D. E. & Soren, C. P. *Geol. Soc. Am. Sp. Pap.* 190, 69-92 (1982).

29. O'Keefe, J. D. & Ahrens, T. J. *Nature* 291, 122-127 (1982).

30. Tapp, O. B. *et al. Geol. Soc. Am. Sp. Pap.* 190, 187-200 (1982).

31. Prinz, R. G. *EOS* 66, 813 (1985).

Thermoluminescence dating of Mousterian 'Proto-Cro-Magnon' remains from Israel and the origin of modern man

H. Valladas*, J. L. Reyss*, J. L. Joron†, G. Valladas*, O. Bar-Yosef‡ & B. Vandermeersch§

* Centre des Faibles Radioactivités, Laboratoire mixte CNRS-CEA, Avenue de la Terrasse, 91198 Gif sur Yvette Cedex, France
† Group des Sciences de la Terre, Laboratoire Pierre Süe, CEN, Saclay, 91191 Gif sur Yvette, France
‡ Isotope Department, Weizmann Institute of Sciences, Rehovot 76100, Israel
§ Laboratoire d'Anthropologie, Université de Bordeaux I, UA 376 du CNRS, 33405 Talence, France

The Qafzeh¹ and Skhul^{2,3} caves in Israel have yielded the remains of over 30 hominids. Despite their association with Mousterian deposits, these have been recognized as forerunners of other *Homo sapiens sapiens* morphological groups and have been called 'Proto-Cro-Magnon'. Other west Asian caves (Amud, Tabun, Kebara and Shanidar) have yielded skeletal remains of Neanderthals associated with similar Middle Palaeolithic deposits. The lack of precise dates for these deposits has made it difficult to ascertain which of the two hominids was present first in the area⁴⁻⁶. Recently we reported an age of ≈ 60 kyr for the Neanderthal burial at Kebara⁷ (Israel). Here we report thermoluminescence dates for 20 specimens of burnt flints recovered from the hominid-bearing layers of Qafzeh¹. The dates, which range from ≈ 90 to 100 kyr BP, provide an independent measure for the great antiquity of southwest Asian modern humans which have previously been dated to ≈ 40 kyr BP on the basis of European models⁸⁻⁹. Our results also exclude a close phylogenetic relationship between the Cro-Magnons and Neanderthals¹⁰⁻⁶.

The Qafzeh cave (lower Galilee) was excavated by Neuville and Stekelis (1932-1935) and more recently by Vandermeersch (1965-1979)^{1,10}. The 4.5 m thick Mousterian sequence is subdivided into two major accumulation units. The first (layers V-XV) is 2 m thick and is rich in broken mammalian bones and lithic artefacts, demonstrating intensive human occupation. The second (layers XVII-XXIV) is 2.5 m thick and is rich in bones of microvertebrates, indicating ephemeral human use of the cave. The rodent assemblages¹¹⁻¹³ of the second accumulation unit, from which all the hominid remains have come, include two archaic species of African rats (*Mastomys bateli* and *Arvicantis ectos*) and a subspecies of the Eurasian dormouse (*Myomimus roachi qafzensis*), all of which became extinct during the early Mousterian. The presence of new arrivals, such as *Cricetulus migratorius* (a grey hamster), and the evolution of the modern dormouse subspecies (*Myomimus roachi roachi*) mark the late Mousterian deposits such as Tabun C, Hayonim cave upper E, Kebara, Geula¹³.

The cultural stratigraphy of the Tabun cave⁷ is often taken as a yardstick for Levantine Middle Palaeolithic sites. Artefact morphology and the thickness/width ratio of flakes indicate that the Qafzeh Mousterian resembles that of Tabun C¹⁴ or later assemblages and should therefore be dated to the end of the Middle Palaeolithic, that is ≈ 40 kyr BP¹⁵. The discrepancy between relative dates based on metrical lithic analysis (suggesting that the Neanderthals predated the Qafzeh hominids) and those derived from the seriation of microvertebrate assemblages

- Modern man and Neanderthal man have co-existed in the Middle East for at least 60,000 years.
- According to this article modern man's lineage stretches back for at least 100,000 years.
- Also notice that Neanderthals buried their dead in caves. Burial in caves was a common practice in the Middle East during the time of the patriarchs (Gen. 23:19, 25:9, 50:13, Jos. 10:16)

Tattersal I. *The Last Neanderthal*. Nevraumont Publishing Co. New York, NY. p.116. 1999.

Notice that the time period for *H. sapiens* and *H. neanderthalensis* overlaps by more than 60,000 years. Other articles in this series have shown that they co-existed at the same time and the same place for long periods of time.

a million and a half a million years ago, independently of what was going on in other parts of the world.

Very recently, new dates have emerged from the Levant that demonstrate that Neanderthals shared that region with anatomically modern people in that region for a very long period of time. ESR dates on mammal teeth associated with the hominid remains from Skhūl (virtually modern human) and Tabūn (lightly built Neanderthal) have come out at around 100,000 years and 120,000 years, respectively. These dates match well with the new TL date on burned flints from Qafzeh (modern human) of more than 90,000 years. At the other end of the scale, Neanderthal sites in Israel such as Amud, excavated in the 1960s by a Japanese team, and Kebara, excavated in the 1980s by an international group, have come in with dates of about 40,000 and 60,000 years, respectively. [Plate 81 and 82 and see Plates 93, 100, 101, and 105] This range of dates indicates that Neanderthals and moderns overlapped in their occupation of the Levant for a period of up to 60,000 years or perhaps more, though whether the two ever existed in exactly the same place at exactly the same time is harder to determine. Interestingly, the stone tool kits used by the Neanderthals and anatomical moderns were similar—they've all been classified as Mousterian—during almost that entire span of time. Recent work indicates that the first known Upper Paleolithic tools from the region appeared only about 47,000 years ago, at the site of

Boker Tachtit in the Negev desert. These tools were non-Aurignacian (the Aurignacian showed up late in the Levant), and their method of manufacture hints at Middle Paleolithic technology, but there are no associated human fossils to say who made them. What seems significant, though, is that the last appearance of the typical Mousterian in the Levant occurred only a little later, at under 40,000 years ago.



Defining the Neanderthals

In this long historical chapter, I have not yet mentioned a single attempt to define the Neanderthals as a group distinguished from all other kinds of fossil humans. The reason for this is simple: the whole notion of Neanderthals as a distinctive entity developed at the level of intuition, rather than of rigorous analysis. Ever since the discovery of the original Neander Valley fossils, everyone knew that the Neanderthals were different—so different, indeed, that for more than a century it hardly seemed necessary to inquire exactly how they differed, or to provide anything other than an impressionistic definition of the group. Thus, not until 1978 did two researchers—Albert Santa Luca, then of Harvard, and Jean-Jacques Hublin, now of the Centre National de Recherches Scientifiques, in Paris—independently take the bull by the horns and point out that no adequate definition of Neanderthals existed. To redress this problem Santa Luca identified a "core group" of fossils (La Chapelle, La Ferrassie, Spy, and a number of others)

- An evolutionist wrote this book. He is the curator and chairman of the Dept. of Anthropology at the American Museum of Natural History. He has written hundreds of articles and books in support of the evolutionary theory and early man.
- This co-existence raises several evolutionary problems. For this reason some anthropologist do not believe that Neanderthal man and modern man are related.
- Because of the problems that this co-existence raises, there is much disagreement over this issue even among evolutionary anthropologist.
- If Neanderthal man is simply a variation of modern man then this co-existence makes perfect sense.

The Antiquity of Modern Man (*H. sapiens*) in the Fossil Record

The correct interpretation of the fossil record of early man shows that the concept of evolution is not a correct understanding of the evidence. The previous scientific articles are merely a small sampling of the preponderance of books and literature that prove this point. The fossil record of early man does not show a transition, smooth or otherwise, that leads from one Homo species to another. How could *H. erectus* be the evolutionary ancestor of *H. neanderthalensis* and or *H. sapiens* if *H. erectus* was alive and well a few hundred or a few thousand years ago? Rhodesian Man, *H. rhodesiensis*, could not be the evolutionary ancestor of any Homo genus if he died a few hundred years ago as the journal article, when properly interpreted, reveals. The dates assigned to these fossil remains are highly subjective and are merely educated guesses by evolutionist. All evolutionists interpret the fossils to fit the theory of evolution. Evolutionary science is the only branch of science where the ones who develop the theory are the only ones who are allowed to interpret the data. If you are not an evolutionist you are not allowed to pass judgment on the fossil record. This occurs in no other branch of science. This is circular reasoning! —And not scientific.

In reality *H. erectus*, *H. rhodesiensis*, *H. neanderthalensis*, and *H. sapiens*, were all contemporaries of each other. They often lived in the same place at the same time for long periods of time. One did not give rise to the other as evolutionist claim. True biological evidence reveals that all species have great variations. This is not evolution but simply variations that were designed into the human lineage at creation. Also much of the morphology of early man, supposedly showing a similarity to apes, may be caused by non-evolutionary factors, including disease, differing environments, and other pathological factors. These factors will be examined in a later section. There is great variation among humans even today. Consider the modern day Europeans compared to the present day African pygmies. From an examination of their skeletal remains one could incorrectly conclude that they are vastly different and even different species. Yet they are both living at the same time, both of the family of Homo, both descendants of Adam and hence the same species. The Homo genus, including modern man, and fossil man, are simply variations of the created stock. The fossil record supports this conclusion. Evolutionists have colored the findings of the fossil record with their own preconceived notions about how evolution and fossils relate to each other. In reality evolution is a philosophy since it cannot be proven false even by direct fossil evidence.

One of the areas, which falsify evolution, is in the area of anatomically modern but archaic (very old) *H. sapiens* fossils. According to the evolutionary theory modern man is not very old. Most evolutionists state that modern man appeared on the scene less than 400 kya. Many scientist say even this age is too old and give a more recent age of less than 200 kya.

Homo sapiens; genus and species to which all modern human beings (*Homo sapiens sapiens*) belong and to which are attributable fossil remains of humans perhaps as much as 400,000 years old (5).

By assuming an average rate of change of about three percent per million years, Wilson and colleagues initially came up with a molecular age for *Homo sapiens* of about 400,000 years—more than somewhat at odds with the fossil record. This age has been steadily modified, however until the latest estimate of about 140,000 to 130,000 years sits fairly well with the admittedly rather sparse African fossil evidence (6).

Evolutionists believe that half a million years ago anatomically modern looking *H. sapiens* had not yet evolved. Does this agree with the fossil record? The answer is no! Many instances of very modern looking *H. sapiens* fossils that are more than half a million years old have been discovered.

Another area that proves the longevity of modern man is artifacts. This includes structures, weapons and other non-skeletal evidence. Many artifacts have been found in the wrong place at the wrong time. A few scientific articles on this subject are also included in the following. These also speak against evolution.

What happens when scientists find fossils or artifacts that belong to modern man in very old strata? Do they admit that their evolutionary scenarios are not correct? No, what usually happens is that the fossil and or artifact are attributed to a supposed earlier form. This occurs even though they are indistinguishable from the modern counterpart. In other words evolutionists do not let the fossil record speak for itself. They interpret the fossil remains to support their evolutionary preconceptions.

It may come as a surprise to the layman to find out that there are many unexplained young looking fossils of *H. sapiens* (anatomically modern man) in very old strata. Also if man is constantly improving and tools and artifacts show a supposed continuum from primitive to more complex, we should not find modern day tools and artifacts in supposed old strata. These two facts in essence falsify the theory of evolution and support the creation concept. If the members of the Homo line are all variant descendants of Adam, then we would expect to find modern looking fossils and artifacts of *H. sapiens* in very old strata. Please bear in mind that we have seen, in the previous articles, how all the Homo groups coexisted at the same time.

This next section will look at some examples, out of the scientific literature, that supports the view that *Homo sapiens* have been around for at least 4.5 million years. The articles will discuss crania, an interesting section on fossil footprints, and fossil artifacts. We will trace the *H. sapiens* lineage from the more recent (+100 kya) to the limits of human fossil prehistory (4.5 mya). This is more than 4 million years longer than the evolutionists allow. Once again bear in mind that the author does not necessarily agree with the dates given by evolutionist. These dates are used to demonstrate that even when using the evolutionist's dates and fossils, the fossil record of early man supports creation.

Day MH. Leakey MD. Magori C. A new hominid fossil skull (L. H. 18) from the Ngaloba Beds, Laetoli, northern Tanzania. *Nature*. 284:55. 1980.

This is a very modern looking skull. Notice the photo.

Notice that the authors admit that this is very modern looking skull.

It has been dated at 120 kya ± 30 ky.

Nature Vol. 284 6 March 1980 55

6. Binns, R. E. *Bull. geol. Soc. Am.* 89, 1475-1490 (1978).
 7. Quenardel, J.-M. 103^e Congrès national des sociétés savantes, Nancy, Sciences 4, 55-65 (1978).
 8. Zwaan, K. B. & Roberts, D. *Norg. geol. Unders.* 343, 53-71 (1978).
 9. Armistage, A. H., Hooper, P. R., Lewis, D. & Pearson, D. E. *Norg. geol. Unders.* 269, 319-322 (1973).
 10. Armistage, A. H. *Norg. geol. Unders.* 324, 21-28 (1976).
 11. Roberts, D. & Gale, G. H. in *Evolution of the Earth's Crust* (ed. Tarling, D. H.) 255-342 (Academic, London, 1978).
 12. Ramsay, D. M. *Norg. geol. Unders.* 269, 314-317 (1971).
 13. Holland, C. H. & Sturt, B. A. *Norsk. geol. Tidsskr.* 50, 341-355 (1970).
 14. Sturt, B. A., Miller, J. A. & Fish, F. J. *Norsk. geol. Tidsskr.* 42, 255-273 (1967).
 15. Halls, C., Reinshakken, A., Ferriday, I., Haugen, A. & Rankin, A. *Geol. Soc. Lond. Spec. Pub. No. 1*, 128-151 (1977).
 16. Sturt, B. A. & Roberts, D. *Can. geol. Surv. Pap.* 78-13, 17-24 (1978).
 17. Foslie, S. *Norg. geol. Unders.* 149, 1-298 (1941).
 18. Nicholson, R. & Rulland, R. W. R. *Norg. geol. Unders.* 260, 1-86 (1969).
 19. Kulling, O. in *Scandinavian Caledonides* (eds Strand, T. & Kulling, O.) 149-285 (Wiley-Interscience, London, 1972).
 20. Nairn, A. E. in *The Ocean Basins and Margins* Vol. 2 (eds Nairn, A. E. & Stehli, F. G.) 161-203 (Plenum, New York, 1974).
 21. Hooper, R. R. *Norg. geol. Unders.* 269, 147-158 (1971).
 22. Bennett, M. C. *J. geol. Soc. Lond.* 130, 179-182 (1974).
 23. Hooper, P. R. & Gronow, C. W. *J. geol. Soc. Lond.* 174, 421-217 (1969).
 24. Zwaan, K. B. *Norg. geol. Unders.* (Prelin. utgave) (1977).
 25. Christen, P. N. *Norg. geol. Unders.* 312, 59-90 (1974).
 26. Atwater, T. *Bull. geol. Soc. Am.* 81, 3913-3536 (1970).

A new hominid fossil skull (L.H. 18) from the Ngaloba Beds, Laetoli, northern Tanzania

M. H. Day*, M. D. Leakey† & C. Magori*

* Anatomy Department, St Thomas's Hospital Medical School, London SE1 7EH, UK
 † Olduvai Gorge, PO Box 30239, Nairobi, Kenya

In 1976, a fossil hominid skull was recovered from the Ngaloba Beds at Laetoli, Northern Tanzania; its morphology is discussed here. The discovery of this skull is of great interest and importance because of its very substantial presumed antiquity and its largely anatomically modern morphology. The discovery has considerable implications for the antiquity and origin of modern *Homo sapiens*, a subject of longstanding interest and one which has gained renewed attention recently.

The Ngaloba Beds¹, lying above the vogesite lavas which separate them from the underlying Ndolanya and Laetoli Beds²⁻⁴, are stream deposits, principally sandstones and claystones, of which only patches are preserved. These patches consist chiefly of detritus eroded from the underlying Ndolanya and Laetoli Beds and they contain artefacts of Middle Stone Age affinity. The skull was recovered from a 2-m thickness of the Ngaloba Beds at Locality 2 that also yielded artefacts, some fossil reptilian and avian bones as well as fossil mammalian bones. This exposure is principally of sandy claystone and contains a water-worked vitric tuff. The tuff is trachytic and contains the pyroclastic minerals biotite and anorthoclase; it is tentatively correlated with the marker tuff in the lower unit of the Ndutu Beds at Olduvai Gorge⁵. This is the only trachytic tuff younger than Bed IV in Olduvai Gorge and its age is estimated at 120,000 ± 30,000 yr BP (R. L. Hay, personal communication). The skull was found by E. Kandini *in situ* but eroding out of the deposits.

The skull is almost complete and includes the bones of the vault, much of the base, both temporal bones, part of the

Measurement	Value
Greatest length (glabella/opisthocranium)	205 mm
Greatest breadth (biparietal)	140 mm
Cranial index	68.3
Vault thickness (right and left parietomastoid and bregma)	12 mm

0028-0836/80/100055-02\$01.00

sphenoid and much of the face including the palate and part of the upper dentition. The bones are all heavily mineralised with no signs of pathology, but there are signs of post-mortem plastic deformation that has resulted in torsion to the right of the supraorbital region and some springing of the temporo-occipital suture on the left. As recovered, the skull was in 22 pieces and coated with greyish calcareous matrix. Cleaning produced fossil bone of an ivory colour and natural texture with the preservation of remarkable surface detail. It was possible to reassemble the vault and base into one structure and the paired maxillae into



Fig. 1 Left lateral view.

another. There is no point of contact between the facial skeleton and the calvaria although very little bone is missing. The relationship between these two main fragments of the skull remains speculative. The age at death seems to have been between 18 and 30 because the sutures of the vault are all open, but one third molar is present and fully in wear. The state of wear of this tooth suggests that the upper end of the age range is most likely.

Dimensions of the skull are given in Table 1. In lateral view (Fig. 1) the skull shows several striking features including marked recession of the forehead, a rounded occipital profile, an undercut central occipital torus and a small mastoid process. The frontal view (Fig. 2) shows a divided supraorbital torus, a relatively low vault and a mid-parietal swelling. The frontal bone is very slightly keeled in the sagittal plane but there are no



Fig. 2 Frontal view.

© 1980 Macmillan Journals Ltd

- This basically modern skull was found in strata that has been dated to 120 kya ± 30 ky. This is near the limit of the supposed evolutionary beginnings of *H. sapiens*, yet here is a basically modern cranium.
- P. 56 "The dating of the skull also adds considerably to its importance as it places the fossil near to the root of the evolution of *H. sapiens* in East Africa out of the early *H. erectus* stock..."
- The author is stating that this fossil is a good example of the evolutionary transition of *H. sapiens* from *H. erectus*. Bear in mind that other scientific journal articles have shown that *H. erectus* existed up until a few hundred years ago in Australia (Cossack skull).

Behrensmeier AK. Laporte LF. Footprints of a Pleistocene hominid in Northern Kenya. *Nature*. 289:169. 1981.

P. 167 "1.6-1.7 mya." Is given as the date for these fossil footprints.

Note the two human feet framing the two fossil imprints.

These footprints are the average size of a modern day human. The height of the person would have been about 5'3"-5'11".

The authors are not sure who made the footprints.

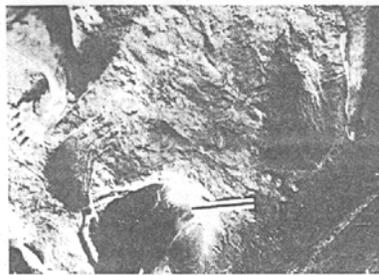


Fig. 2 Two of the best-preserved footprints in the 1.5-Myr old trail discovered in northern Kenya, framed by the modern feet of *Homo sapiens* (27 cm long). These prints are referred to as L2 and R3 in Fig. 1c. Scale bar, 15 cm. (Photograph by Léo F. Laporte.)

tracks can be attributed to the same individual although they would not be identifiable as hominid if observed separately from the trackway defined by the other five footprints. The complete tracks are shallower towards the east, in the direction of movement (Table 1). The westernmost tracks (L1 and R1) are oversized and poorly shaped compared with the others, and bear evidence of minor erosion and slumping before burial. The absence of an L2 track is puzzling, but may be due to a patch of substrate that was compact enough to bear the weight of the hominid or to local scouring before burial. More hominid tracks would probably be uncovered if the excavation were extended westward along the line of the trackway, although the increasing amount of overburden would make that a difficult operation.

From the dimensions of the best-preserved tracks, L3, R3 and R4, we estimate that the hominid foot was about 26 cm long and 10 cm wide (Table 1). These fall close to average dimensions for American *Homo sapiens* males¹¹. Other tracks in the series are enlarged or incomplete and cannot be used to reconstruct foot shape. The height of the hominid can be estimated at 1.6-1.7 m based on the relationship of foot length to stature for American negro and white males¹¹, and 1.8 m based on those for San bushmen¹². The hominid prints are longer and relatively narrower than those recorded at Laetoli, which average 18.5 cm long and 8.8 cm wide (trail 1) and 21.5 x 10 cm (trail 2)¹³.

In the study of footprints, a standard definition of 'stride' is the distance from a point on one foot (left or right) to the same point on the next impression of the same foot¹⁴. The length of the stride of the hominid is about 80 cm, less than that of modern humans with feet of comparable size during normal walking¹⁴. This, along with the orientation of the feet, seems to indicate a hesitant, somewhat sideways progression across a slippery surface with one mis-step (L4) into a deep hippopotamus track, which may have been concealed by turbid water.

At least two bipedal hominid taxa are represented by fossil bones from the Koobi Fora Formation at the time of deposition of the footprint unit: *Homo erectus* and *Australopithecus robustus*¹⁵⁻¹⁷. In Area 103, only the remains of *H. erectus* have been found in the Koobi Fora Tuff although in the Karari and Ileret regions both taxa occur in units correlated with the Koobi Fora Tuff. The *H. erectus* specimens from the Koobi Fora Tuff occur within its lower 6 m; none has been found within the upper part where the hominid trackway is recorded. It is not possible to determine which hominid made the footprints.

Tracks of early hominids known from the Pliocene Laetoli Beds in northern Tanzania were preserved in subaerial volcanic ash strata dated at 3.60-3.75 Myr (refs 1, 12). They occur with a large series of tracks and trails representing a wide diversity of savannah animals. The hominid tracks are thought to belong to the same species as hominid fossils from the Laetoli Beds,

designated as *Australopithecus afarensis*^{1,17,18}. In contrast, the Koobi Fora footprints occur on a muddy lake margin with tracks of a limited number of semi-aquatic vertebrates. The Koobi Fora footprints contribute a reference point on hominid foot morphology, locomotion, behaviour and ecology 2 Myr younger than the Laetoli occurrences and ~ 1 Myr older than late Pleistocene human footprints in Europe¹⁹.

A latex mould and plaster cast of the Koobi Fora hominid footprints described here is stored at the National Museums of Kenya, Nairobi. We thank the Government of Kenya, the National Museums of Kenya and the International Louis Leakey Memorial Institute for African Prehistory for their cooperation and support. Richard Leakey, Meave Leakey, Glynn Isaac, Kamoya Kimeu and Tim White are acknowledged for their suggestions and help. The excavation crew, headed by Muteti Nume and Mukilya Mun'goka, were directly responsible for the technical work that led to the discovery of the trackways. Hilde Schwartz and Mahmood Raza assisted with the excavation work. Palaeoecological research was sponsored by NSF grant EAR77-23149 and is a part of the overall Koobi Fora Research Project, which is supported by grants from the National Geographic Society, the NSF and the W. H. Donner Foundation.

Received 7 July, accepted 4 November 1980.

1. Leakey, M. D. & Hay, R. L. *Nature* 278, 317-323 (1979).
2. Fiedler, I. C. in *Koobi Fora Research Project Vol. 1* (eds Leakey, M. G. & Leakey, R. E.) 14-31 (Clarendon, Oxford, 1978).
3. Vondra, C. F. & Bowen, B. E. in *Geological Background to Fossil Man* (ed. Bishop W. J.) 395-414 (Scottish Academic, Edinburgh, 1978).
4. Fiedler, I. C. in *Earliest Man and Environment in the Lake Rudolph Basin* (eds Coppens, Y., Howell, F. C., Isaac, G. L. & Leakey, R. E.) 94-104 (University of Chicago Press, 1976).
5. Fitch, F. J. & Miller, J. A. in *Earliest Man and Environment in the Lake Rudolph Basin* (eds Coppens, Y., Howell, F. C., Isaac, G. L. & Leakey, R. E.) 123-147 (University of Chicago Press, 1976).
6. Brown, F. H., Howell, F. C. & Eck, G. G. in *Geological Background to Fossil Man* (ed. Bishop W. J.) 473-495 (Scottish Academic, Edinburgh, 1978).
7. Cerling, T. E., Brown, F. H., Cerling, B. W., Curtis, G. H. & Drake, R. E. *Nature* 279, 118-121 (1979).
8. Harris, J. M. & White, T. D. *Trans. Am. phil. Soc.* 69, 1-128 (1979).
9. Laporte, L. F. & Behrensmeier, A. K. *J. Stud. Evol.* 50 (in press, 1980).
10. Harris, J. M. in *Koobi Fora Research Project Vol. 1* (eds Leakey, M. G. & Leakey, R. E.) 32-63 (Clarendon, Oxford, 1978).
11. Hrdlicka, A. *Am. J. phys. Anthropol.* 12, 15-33 (1928).
12. White, T. *Science* 203, 175-176 (1980).
13. Sargeant, W. A. in *The Study of Trace Fossils* (ed. Frey, F. W.) 283-324 (Springer, New York, 1978).
14. Murray, N., Dunlop, A. B. & Noye, R. C. *J. Bone Jt Surg.* 46-A (2), 335-360 (1964).
15. Walker, A. & Leakey, R. E. *Science* 200, 54-66 (1978).
16. Leakey, R. E. *Nature* 231, 241-245 (1971).
17. Day, M. H. in *Early Hominids of Africa* (ed. Jolly, C.) 311-346 (Duckworth, London, 1978).
18. Johnson, D. C. & White, T. D. *Science* 203, 321-350 (1979).
19. Oakley, K. P., Cambell, B. G. & Molleson, T. I. (eds) *Catalogue of Fossil Hominids Part II: Europe*, 349-350 (British Museum (Nat. Hist.) pub. 711, 1971).

Relationship between fungus and alga in the lichen *Cladonia cristatella* Tuck

Vernon Ahmadjian* & Jerome B. Jacobs†

*Department of Biology, Clark University, Worcester, Massachusetts 01610

†St Vincent Hospital and University of Massachusetts Medical School, Worcester, Massachusetts 01605

The nature of the lichen symbiosis is not clear. It is generally thought to be mutualistic but this concept is not supported by experimental evidence¹. Early workers^{2,3} considered that lichens represented algae parasitized by fungi—as evidence, they noted algal cells in a lichen thallus that were dead or penetrated by fungal haustoria. Others, however, cited the seemingly healthy and long-lasting nature of lichens as evidence of mutualism. As we report here, our observations of artificial syntheses of the mycobiont *Cladonia cristatella* ('British soldiers') with different algae suggest that the relationship in this lichen is one of controlled parasitism. The mycobiont formed squamules mostly with algae related to its natural phycobiont, an indication perhaps of a long period of co-evolution between the symbionts of this lichen.

- These footprints are the same size and shape as modern *H. sapiens*. Yet they are dated at more than 1.6 million years old. *H. sapiens* are not supposed to exist for another 1.4 million years.
- The authors do not know which hominid made the tracks. They attribute them to either *H. erectus* or *Australopithecus robustus*. They will not assign them to *H. sapiens* even though they are the same size and shape as modern day footprints because of their antiquity. If they had been found in modern strata there would be no question that they were made by *H. sapiens*.
- If they are indeed the tracks of *H. erectus* the same logic would still apply because *H. erectus* and *H. sapiens* were merely varieties of the same species.

Leakey MD. Footprints in the ashes of time. National Geographic. p. 446, 452. April 1979.

Mary Leakey the author of this article is the wife of Louis Leakey and the mother of Richard Leakey all recognized anthropologist. The Leakey family has discovered hundreds of fossils of early man in Africa. The Nat'l Geographic magazine has funded much of the Leakey research in Africa.

These footprints are similar to modern man's.

3.6 MILLION YEARS OLD

Footprints in the

IT HAPPENED some 3,600,000 years ago, at the onset of a rainy season. The East African landscape stretched then, much as it does now, in a series of savannas punctuated by wind-sculptured acacia trees. To the east the volcano now called Sadiman heaved restlessly, spewing ash over the flat expanse known as Laetoli.

The creatures that inhabited the region, and they were plentiful, showed no panic. They continued to drift on their random errands. Several times Sadiman blanketed the plain with a thin layer of ash. Tentative showers, precursors of the heavy seasonal rains, moistened the ash. Each layer hardened, preserving in remarkable detail the footprints left by the ancient fauna. The Laetoli Beds, as geologists designate the oldest deposits at Laetoli, captured a frozen moment of time from the remote past—a pageant unique in prehistory.

Our serious survey of the beds, which lie in northern Tanzania 30 miles by road south of Olduvai Gorge (map, page 450), began in 1975 and gained intensity last summer after the discovery of some startling footprints. This article must stand as a preliminary report; further findings will almost certainly modify early interpretations.

Still, what we have discovered to date at Laetoli will cause yet another upheaval in the study of human origins. For in the gray, petrified ash of the beds—among the spoor of the extinct predecessors of today's elephants, hyenas, hares—we have found hominid footprints that are remarkably similar to those of modern man. Prints that, in my opinion, could only have been left by an ancestor of man. Prints that were laid

down an incredible 3,600,000 years ago!

My late husband, Dr. Louis S. B. Leakey, and I had first explored the Laetoli Beds in 1935. In that year we were searching for fossils in Olduvai Gorge when Masai tribesmen told us of the rich remains at Laetoli, which in their language refers to the red lily that grows there in profusion. When heavy rains ended the Olduvai excavation season, we made the difficult, two-day journey south.

We did find fossils, but they were much more fragmented than those of Olduvai. At that time, accurate dating was impossible. So we left the site. A German expedition combed the beds in 1938-39, and we ourselves returned twice with indifferent results. But I could not help feeling that, somehow, the mystique of Laetoli had eluded us.

Then, in 1974, two things occurred. I was drawn back once more to these ancient volcanic deposits, and one of my African associates, Mwangela Mwoka, found a hominid tooth. Analysis of the lava that overlies the beds assigned the tooth an age of at least 2,400,000 years. Since this is older than anything at Olduvai, I decided to concentrate my efforts at Laetoli. In 1975, with National Geographic Society support and the cooperation of the Tanzanian Government and its director of antiquities, A. A. Mturi, I mounted an intensive campaign.

For almost two field seasons we diligently collected hominid and other fossils. Then, as is so often the case in pivotal discoveries, luck intervened. One evening Dr. Andrew Hill of the National Museums of Kenya and several colleagues were larking about on the beds, pelting each other with dry elephant dung. As Andrew ducked low to avoid one



"They looked so human, so modern, to be found in tuffs so old," says footprint expert Dr. Louise Robbins of the University of North Carolina, Greensboro. The best-preserved print (left) shows the raised arch, rounded heel, pronounced hall, and forward-pointing big toe necessary for walking erect. Pressure exerted along the foot attest to a striding gait. Scuff marks appear in the toe area, and a fossilized burrow seems the footprint.

Fossilized bones of 22 individuals have been found in the vicinity of Laetoli, so named after the Masai word for the area's red lily. Both bones and footprint tuffs lay sandwiched between strata dated by potassium-argon tests to about 3.6 and 3.8 million years ago. Teeth, jaws, and skull fragments from adults, as well as ribs and hand, arm, and leg bones from a 5-year-old (below, right), may help determine the trail makers' species. Similar in type to later specimens discovered by Dr. Donald C. Johanson in Ethiopia, the bones belong to what Dr. Leakey and others consider the earliest hominids yet found. Dr. Johanson classifies both finds as *Australopithecus afarensis*.

This is a picture of one of the footprints. Notice how a footprint expert describes it as essentially modern looking. Yet it was found in stratum that is 3.6 – 3.8 million years old.

- This fossil reveals the obvious, that modern humans with modern shaped feet were walking in Africa more than 3.6 million years ago (according to the evolutionary timetable).

Johanson D. Edey M. *Lucy the Beginnings of Humankind*. Simon & Schuster. New York, NY. p. 250. 1981.

Here is a description of the Laetoli footprints as described in a book written by the discoverer of "Lucy," a supposed earlier ancestor of the Homo line.

Based on the shape of the footprints the evidence shows that their maker was fully erect and bipedal. The time period is earlier than 3 mya.

Here is a description of the footprints by one of the discoverers, Tim White. Notice that he describes them as completely modern looking. They have the same shape, size, and character as footprints made by modern *H. sapiens*.

- The Laetoli footprints are more than 3.5 million years old.
- They are modern looking in morphology and are indistinguishable from modern footprints. They have a raised arch, rounded heel, pronounced ball, and forward pointing toes, all features of *H. sapiens* morphology.
- Even a four-year would be able to say who made them!
- Since even a four-year would be able to say that modern humans made them, why are the evolutionists unable to say the same? The answer is that the footprints are too old to belong to modern man. According to evolution, modern man did not come on the scene until 3.4 million years later.

THE GOLDEN DECADE 1967-1977

But, by a wildly improbable linkage of random events, they are there. Sadiman had to blow out a particular kind of ash. Rain had to fall on it almost immediately. Hominids had to follow on the heels of the rain. The sun had to come out promptly and harden their footprints. Then another blast from Sadiman had to cover and preserve them before another obliterating shower came along.

All this had to happen over a period of only a few days. And the volcano had to synchronize its activity with that of the seasons. If its bursts had not come just when they did—at the beginning of the rains—the footprints would not have been preserved. A month or two earlier, during the dry season, the ash would not have had the consistency to take a sharp imprint. It would have been a hopelessly blurry one, a mere dent, like the one a passerby today makes in the dry sand on the upper margin of a beach. If it had come later, at the height of the rainy season, it is overwhelmingly likely that there would have been too much rain; the footprints would have been washed away before they could have been baked hard by the sun. Indeed, there had to be just what the beginning of a rainy season produces: sporadic showers interspersed with intervals of hot sun.

All things considered, the preservation and recovery of the Laetoli footprints are nothing short of a miracle. They confirm without a shadow of a doubt what Lucy confirmed at Hadar: that hominids were fully erect walkers at three million B.C. and earlier. At Hadar the evidence is in the fossils, in the shape of leg and foot bones. But at Laetoli, where the fossil remains—some extremely scrappy and enigmatic postcranial bits, jaw parts, and some teeth—are of very poor quality, there is no way without the footprints of deducing how those hominids got around.

"Make no mistake about it," says Tim. "They are like modern human footprints. If one were left in the sand of a California beach today, and a four-year-old were asked what it was, he would instantly say that somebody had walked there. He wouldn't be able to tell it from a hundred other prints on the beach, nor would you. The external morphology is the same. There is a well-shaped modern heel with a strong arch and a good ball of the foot in front of it. The big toe is straight in line. It doesn't stick out to the side like an ape toe, or like the big toe in so many drawings you see of australopithecines in books.

"I don't mean to say that there may not have been some slight differences in the foot bones; that's to be expected. But to all intents

McHenry H. Fossils and the mosaic nature of human evolution. *Science*. 190:425-431. 1975.

This study showed that although chimpanzee humeral and human humeral have some overlap in measurement, when all measurements are taken together it is possible to distinguish them.

This fossil humerus (bottom end of upper arm bone) has been dated at 4 – 4.5 million years old.

tinctive feature is the combination of a long femoral neck and a small femoral head, but there are many other subtle characteristics. The shape is so unusual that the first two of these femora discovered (SK 82 and SK 97 from Swartkrans) were not described with the other hominid specimens from the same site for more than two decades (25).

The basic difference between the two East Rudolf fossils and the other early hominids is the large size of their femoral heads, which gives the entire proximal end of the bones a modern human appearance. Subtle differences do exist between these bones and most modern human femora, however, as shown by a multivariate analysis performed by McHenry and Corruccini (51). Using ten dimensions of the proximal end, adjusting them for size and allometric differences, and applying multiple discriminant analysis yields results which show that all of the early hominid femora are most similar to *Homo sapiens* and not at all like any ape, although they all have a distinct morphological pattern (see Fig. 4a). The two fossils from East Rudolf approach more closely the modern human form, although they share certain unique features with the other early hominids, such as the long femoral neck and several other more subtle characteristics.

One biomechanical explanation for the long femoral neck involves the same argument as that explaining the lateral support system during bipedal walking mentioned above (26). The longer neck provides a longer power arm for the abductor muscles, which implies that less abductor force is necessary to stabilize the hip from side-to-side swaying. Less abductor force would mean less pressure transmitted through the hip joint to the femoral head and would explain why the femoral heads are so small in these early hominids. The relatively larger femoral head in the East Rudolf specimens might be due to a greater body weight and longer abductor load arm, which would be related in part to the larger birth canal size concomitant with the larger brain evident in that species of early hominid.

Fossil Legs, Feet, and Backbones

The same pattern can be seen in the leg and foot of these early hominids: all fossils are basically human, but some have a unique combination of characteristics. The tibia is well represented in the hominid fossil record, but unfortunately conclusions about morphological affinities, biomechanics, and taxonomy are difficult to make (47, 48, 53-55). None of the tibial fossils deviate substantially out of the range of variation seen in modern human tibia. Bio-

mechanical analysis of the Olduvai hominid 35 (OH 35) fossil shows that its shape is well adapted for the stresses typical in a biped (56).

The OH 8 foot shows the characteristics typical of the bipedal human organ with an adducted hallux, a relatively large fifth metatarsal, arches, and several other features (57). The shape of the big toe (OH 10) is just what would be expected in a biped (58) although there is some controversy over interpretation (59). The talus is more human than pongid (18, 20, 21, 47, 48, 53-55) although subtle differences in architecture have led some to argue that its adaptation to bipedalism is either incomplete or at least different from that of the typical modern human (25, 60). What vertebrae exist in the fossil record do not suggest an adaptation substantially different from that of modern *Homo sapiens* (25).

Forelimb Fossils

There is considerable diversity in the morphology of early hominid forelimbs. Certainly not all of the fossils are equally close to modern *Homo sapiens*, and the overall structure and function of some forms still remain elusive. The shoulder is represented by a few fragmentary clavicles, scapulae, and proximal humeri, which have led to conflicting opinions by those who have studied them (21, 25, 61). The distal humerus is represented by four very complete fossils, however, and three of them have been the subject of extensive multivariate analyses (38, 62, 63).

The hominoid distal humerus is ideal for multivariate analysis because there are such subtle shape differences between species, particularly between *Homo* and *Pan*, which are difficult to distinguish in a trait by trait (univariate) analysis (64). Multivariate analysis shows that although chimpanzee and human humeri overlap in almost all metrical characteristics taken one at a time, they differ when all traits are treated together in a single analysis where the bones are treated as integrated complexes. The study is still piecemeal, however, in that the distal humerus is not a separate unit but part of the larger complex of the forelimb and the total adaptation of the animal. Unfortunately, the fossil record is not complete enough to allow precise reconstructions of entire limbs and animals of all species of early hominids. With 16 measurements and over 300 comparative specimens, the multiple discriminant functions are able to separate all hominoid species very effectively (see Fig. 4b) (38). The results show that the Kanapoi specimen, which is 4 to 4.5 million years

old, is indistinguishable from modern *Homo sapiens*, the Kromdraai *A. robustus* fossil is about equally distant between *Pan* and *Homo*, and the large specimen from East Rudolf (KNM-ER 739) is unique among all of the hominoids tested (62, 63). None of these fossils bear a special relationship to the combined sample of knuckle-walking apes (chimpanzee and gorilla). Nor do any of the fossils have a lateral ridge on the posterior surface of the trochlea and olecranon fossa, which is present in all of the 124 knuckle-walking apes sampled.

The forearm of the hyperrobust *Australopithecus boisei* is represented by the nearly complete ulna from the Omo River Basin in Ethiopia (65). A multivariate analysis of 14 linear measurements taken on 222 hominoids indicates that this fossil is unique in shape among the extant hominoids, although it is most similar to *Pan* and *Homo* and very unlike *Pongo* (66). The same general results were found by Rightmire (67) for an *A. robustus* thumb metacarpal from Swartkrans. Detailed studies of an *A. africanus* wrist bone from Sterkfontein by Lewis (68) led to similar conclusions. A complete description of the Olduvai hand bones (OH 7) has not been published yet, but preliminary studies show that they do not differ fundamentally from the human pattern (69). Certainly no definite evidence of knuckle-walking traits in the fossil hand and wrist is apparent (70).

Fore- and Hindlimb Proportions

Further evidence that the postcranium of some forms of early hominids differed from that of modern *Homo sapiens* comes from comparing body proportions. Modern humans are unique hominoids in having relatively large and especially long hindlimbs in proportion to their forelimbs, and there is some evidence that early hominoid body proportions differed from this modern human condition. Individuals with associated fore- and hindlimb fossils are rare in the record, but a few are present. The type specimen of the South African robust australopithecine (TM 1519 from Kromdraai) has a talus smaller than would be expected from the size of its humerus, but the proportions are only slightly out of the human range of variation (71). Two individuals from East Rudolf have proportions similar to those of Kromdraai: KNM-ER 1500 and KNM-ER 1503-4 (48) have associated fore- and hindlimb parts which indicate proportions different from modern human ones (72). None of these fossils approach the range of proportion seen in modern apes, however. Their ratio

- This journal article and the following article are both describing the same fossil. It is known as KP 271 (7) and Kanapoi Hominoid 1.
- It was analyzed using multi-variate analysis, which is a process where all the measurements of a fossil are compared to all the other measurements of another bone/fossil.
- The results of this analysis show that it is virtually the same as a modern day human arm humerus!

Patterson B. Howells WW. Hominid humeral fragment from Early Pleistocene of Northwestern Kenya. *Science*. 156:64-66. 1967.

This study used a procedure called computer discriminate analysis. A total of seven measurements were used in the analysis.

This 4 - 4.5 million year old fossil has the same average measurements as a typical modern human humerus.

Here are the measurements of the Kanapoi fossil as shown side by side with the average measurements of *Paranthropus* (a supposed ape-like pre-ancestor of man), chimpanzee, and modern humans. Notice how close the measurements are to modern *H. sapiens*.

Compare the Kanapoi fossil fragment to a modern human humerus, they are identical!

ture of this part of the skeleton. Kanapoi Hominoid 1 can at once be recognized as a hominoid on its gross morphology, and it is readily distinguished on this basis from gorilla and orangutan. Detailed morphological and metrical comparisons have been made with chimpanzee, modern man, and a cast of *Paranthropus robustus*, the only early hominoid for which this part of the humerus is known (6, 7).

For the metrical comparison, samples of 40 human and 40 chimpanzee humeri were used, without regard to sex (8). We took seven measurements designed to register certain morphological differences among species (Table 1).

In these diagnostic measurements Kanapoi Hominoid 1 is strikingly close to the means of the human sample. It is larger than the individual of *Paranthropus robustus* represented by the corresponding humeral fragment from Kromdraai in each measurement; the latter fossil is difficult to place relative to *Pan* and *Homo* from these figures alone, since it is smaller than the means of both species throughout.

Certain morphological characters in this part of the humerus distinguish a large majority of men from a large majority of chimpanzees. Some of them are reflected in the measurements in Table 1; however, these show considerable species overlap. (i) In man the posterolateral margin of the trochlea extends only slightly more posteriorly than the posteromedial margin, and it projects only a little beyond the adjacent bone surface; in chimpanzee it is usually much more salient. (Compare the means in measurement 4, Table 1.) (ii) The medial border of the shaft in man usually flares out to a lesser extent than in chimpanzee, forming less of an angle with the medial epicondyle. (See the relations between measurements 2 and 3, Table 1: the excess of the distance from the most distal point on the trochlear ridge to the apex of the medial epicondyle over the distance from the same point to the medial shaft border is 3.45 in our chimpanzee sample but only .90 in the human sample.) (iii)

The distal margin of the capitulum is usually inclined anterolaterally and forms an angle of about 45° with the transverse axis in man, whereas in chimpanzee the margin generally curves out laterally before turning anteriorly. (iv) Most men differ from most chimpanzees in that comparatively little of the capitulum is situated on the distal face of the bone. (v) The area between

Table 1. Measurements of humeri of four different species. Measurements are in millimeters.

Measurement	Species			
	<i>Pan X</i>	<i>Paranthropus</i>	Kanapoi Hominoid 1	<i>Homo X</i>
Biepicondylar width	64.07	53.6	60.2	58.02
Trochlear ridge to apex, medial epicondyle	44.76	33.6	41.7	40.72
Trochlear ridge to medial border of shaft	41.31	32.1	39.4	38.82
Capitulum groove to post-trochlear margin	26.35	19.9	22.2	22.14
Length, medial epicondyle	24.71	15.5	20.8	20.34
Width, medial epicondyle	12.80	10.4	13.9	12.63
Capitulum to lateral epicondyle, maximum height	31.52	24.9	27.6	26.71

the capitulum and the posterolateral margin of the trochlea in man usually exhibits a more "squared-up" outline when viewed from below. (vi) In most chimpanzees the distal projection of the trochlear ridge forms a sharper and higher crest between the furrows on either side than is the case in man, in whom it is usually more smoothly rounded and lower. (vii) The line of the greatest anteroposterior diameter of the distal portion of the shaft is situated near the center in man and nearer the medial border in chimpanzee; therefore, the medial side above the epicondyle is more tapering in the former and more rounded in the latter. Of these various distinctions (vii) is rather constant. In (i) no men of our sample approach the chimpanzee condition, although approximately 25 percent of the chimpanzees approach the human condition (9). In characters (ii) through (vi) a minority of each sample, approximately 10 to 25 percent, approaches the condition seen in the majority of the other.

Kanapoi Hominoid 1 agrees with

chimpanzee in (vii), with man in (i), and with the majorities of our human sample in the rest. It is peculiar, although by no means unique, in one character. The medial epicondyle is stout, rather rugose, and deep, and maintains a nearly constant anteroposterior diameter almost to its distal extremity; minorities of men and of chimpanzees, approximately 15 and 20 percent respectively, approach it.

Paranthropus emerges from these morphological comparisons as rather less man-like than Kanapoi Hominoid 1. It agrees with man or majorities of men and with Kanapoi Hominoid 1 in traits (i), (ii), and (vi), with majorities of chimpanzees in (iii), (iv), and (v), and with chimpanzee and Kanapoi Hominoid 1 in (vii). *Paranthropus* is unique among hominoids in the flatness of the capitulum and peculiar in the rather pointed and slender medial epicondyle (6). In both these traits it differs decidedly from Kanapoi Hominoid 1.

In cases such as this, where there is much similarity and overlap between the

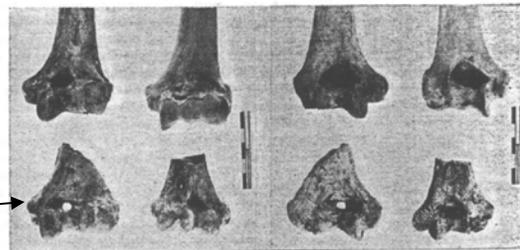


Fig. 1. Distal ends of hominoid humeri. Set on left are anterior views, those on right are posterior views. Upper left, modern man; upper right, chimpanzee; lower left, Kanapoi Hominoid 1; lower right, *Paranthropus robustus* (cast). The *Paranthropus* specimen is from the right side, the others from the left. The perforation of the fossa olecrani in Kanapoi Hominoid 1 is natural; this perforation is not uncommon in hominoids.

- This fossil when compared to modern man and three other species is almost identical to the measurements for a modern arm bone.
- This fossil has been dated to 4.5 million years old. It is the oldest *Homo* fossil yet discovered (that is of an examinable size) and it shows to be, in all respects, identical to modern *H. sapiens*.
- Some anthropologists assign this fossil to an earlier evolutionary ancestor of man, *Australopithecus*. This is done even though there is no evidence linking this fossil to that species. In evolutionary terms this fossil is too old to belong to modern man. This is a classic example of interpreting the data to fit the theory.
- Modern man predates *H. erectus* and *H. neanderthalensis* and therefore these cannot be the evolutionary ancestors of modern man.
- This fossil falsifies the theory of evolution!

Leakey LSB. Adventures in the search for man. National Geographic. p. 147, 152. January 1963.



in camp. Later we recovered almost the entire skeleton. It proved to be that of a new type of baboon.

Margaret's fossil baboon, which as yet has no scientific name, is larger than *Simopithecus jonathani*, which my son Jonathan discovered several years ago, and which at the time seemed the ultimate in size. It has a brain nearly as large as that of the smaller members of the so-called "near-men" of South Africa.

Unknown Hands Built Strange Structures

We have had many other surprises at the gorge the past year. One puzzling discovery by Jonathan was an area of about 10 feet by 8 strewn with the fossil remains of a kind of antelope new to us.

In that small but curious patch we unearthed 12 individual antelope skeletons, clear proof that the animals died together and were fossilized together. Such an occur-

rence is rare in paleontological work, and so far we have no idea how it happened.

One other mystery—a quite provocative one—appeared at Olduvai last year, and to me it is the most intriguing of all. There is a great deal more to be learned about it.

Again in the very lowest level of the gorge, well below the sites of *Zinjanthropus* and the pre-Zinj child, we have unearthed what can only be described as "structures," wide circles made of sizable stones, with some of the stones actually resting on top of others (page 147).

We know that no such stones existed on the site naturally when it was lakeshore more than 2,000,000 years ago. Where did they come from? How did they get there? What forces arranged them in those unmistakable circles, and why? Could they be the remains of primitive dwellings or windbreaks?

Somewhere in Olduvai, the answers to such questions await us. THE END

Notice of change of address of your NATIONAL GEOGRAPHIC should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your March number, the Society should be notified of your new address not later than February first. Please give BOTH your OLD and NEW addresses, including postal-zone number.

152



The caption with the picture on the left reads: "**World's oldest known structure**, possibly a windbreak, fascinates Mary S. Grilswold, a member of the (Nat'l Geo.) Society's staff. Some stones of the circle have stood atop one another at Olduvai for more than two million years."

These stone structures are, according to the article, mysterious. They supposedly have some kind of unknown use. They are attributed to early man, in many instances *Australopithecus* or *H. erectus*. They are not attributed to *H. sapiens* because they are too old.

Here is a painting of a band of *Australopithecus* building one of these structures (8).

- Stone structures, called "the oldest known structure(s)," have been unearthed in various places in Olduvai, Africa, by the Leakey's.
- Their function according to the Leakey's is unknown and mysterious.

- In actuality the Okombambi tribe of Southwest Africa and the Turkana tribe on Northern Kenya build this exact type of stone structure today. They stretch poles and skins over them to provide shelter from the desert wind and sun (9).
- The only reason that they are not assigned to *H. sapiens* is their age. Remember according to the evolutionary theory modern man did appear until 140,000 ya.
- The building of these structures, which require planning, foresight, and intelligence, and the fact that they are still being built today proves that true humans existed more than 2 millions years ago in the Olduvai gorge (According to the evolutionary time scale).

Ivanhoe F. Was Virchow right about Neanderthal? *Nature*. 227:577-579. 1970.

Was Virchow Right about Neanderthal ?

by
FRANCIS IVANHOE
Hughes Parry Hall,
Cartwright Gardens,
London WC1

Neanderthals living in early Würm times may have suffered from a vitamin D deficiency.

Notice that Virchow's original diagnosis has never been refuted. It was rejected, at the time, although modern science has since shown it to be correct.

NEARLY a hundred years ago Virchow diagnosed rickets in the Neanderthal bones, accounting so for their peculiar simian cast.¹ Though this was not the first time such an opinion had been published, it was the first authoritative statement by one expertly acquainted with the disease who was also personally familiar with the fossil material. As other diluvial hominids of the same type turned up in Belgium and France and the day was carried for Darwinism, however, Virchow's carefully argued and factual diagnosis concerning the earlier finds became discredited—by association, if never objectively. But the growth of knowledge since, anthropological as well as medical, suggests that Virchow's view may have been essentially correct.

Variation in Neanderthals

It has been clear for several decades, at least since the discovery of the Rhodesian² and Solo skulls³, that the Neanderthal phenomenon is not limited to Europe⁴. More recently, since the advent of isotopic dating methods, it has also become possible to situate each Neanderthal sample quite accurately—give or take a few millenia or centuries—in the 35,000 years frame extending from the onset of the Würm glaciation (70,000 BP), when Neanderthal enters, to the middle of the Paudorf interstadial (35,000 BP), when he vanishes⁵. If the general environment at each dated site is considered, it is found that the extreme variability evident in the Neanderthal populations can be related to two fairly straightforward conditions: latitude and palaeoclimate. Thus, if samples from the early Würm at Spy, La Chapelle-aux-Saints, and Monte Circeo, lying above 40° N latitude are compared with the contemporaneous samples from Gibraltar, Tabun and Mapa, lying below it, it can be seen that a cline exists, the typical Neanderthal traits decreasing towards the equator⁶, Solo Man at 7° S being the least affected^{7,8}. (It should be noted, however, that Shandier does not fit the gradient; the discrepancy may perhaps be accounted for on the basis of altitude.) In other comparisons drawn from the same latitude belt but not contemporaneous, and differing markedly in terms of palaeoclimate but not of culture, an attenuation of the Neanderthal facies is also

discernible in the interstadial samples, for example, in Krapina⁹ as related to La Ferrassie, in Skhul as related to Tabun¹⁰. (Similarly the Niah skull from Borneo, dated 40,000 BP may be related to the Solo population from nearby Java; but the cultural context in the comparison is less well defined.) The radiocarbon method of dating has also made it possible to assign the transition between Mousterian flake cultures and Upper Palaeolithic blade-burin-bone cultures, on something like a worldwide basis, to the end of the Paudorf interstadial¹¹. From the standpoint of human ecology, the most important element of the more recent cultures, in their fully evolved form associated with the Cro-Magnon type of modern man (30,000 BP and later), was the development of fishing by means of an expressly developed tool assemblage, and contributing substantially and routinely to the diet¹²⁻¹⁴. The archaeological record demonstrates that this revolutionary advance evolved from the Mousterian industries of the Neanderthals^{15,17}.

Aetiology of Rickets

Virchow was of course ignorant of the aetiology of rickets. Though certain fatty fish oils had been used in Northern Europe since the Middle Ages as a home remedy for a variety of ailments, and the relation between a sunless climate and a high incidence of rickets had been realized by medical practitioners for some time, vitamin D, the antirachitic principle, was not definitely implicated and identified until after World War I¹⁸. Of particular interest to the palaeoanthropologist is the restricted distribution of vitamin D: fatty fish and egg yolk are rich sources of these sterols, but fats in general, oil, and vegetable foods have, for practical purposes, none¹⁹. In man, vitamin D is also produced endogenously, through the irradiation by solar or artificial ultraviolet light of the provitamin 7-dehydrocholesterol in the deep layers of the skin. At lower latitudes, even during temperate interglacial epochs like the present, it is possible to get by largely on this endogenous vitamin D alone, provided sociocultural factors such as crowding and purdah do not impede direct access to sunlight.

Rickets is caused by a vitamin D deficiency. This deficiency can be overcome by eating foods rich in vitamin D, such as fish, or adequate exposure to sunlight.

Neanderthal morphology is directly related to latitude and climate.

- More than one hundred years ago Rudolf Virchow, called the "father of pathology," and an expert in the diagnoses of rickets was given the remains of a Neanderthal to examine. He claimed that rickets caused the morphology of the skull and skeleton. His work was dismissed by evolutionists of his time who were looking for evolutionary causes. The author of the above article Francis Ivanhoe believes that Virchow was fundamentally correct in his assessment of Neanderthal morphology.
- Rickets is caused by a lack of vitamin D in the diet. Vitamin D can be supplied by fish oils, and can be produced by the skin when exposed to sunlight. Since Neanderthal man lived in a cold climate he would cover himself with heavy clothing and furs and would not be exposed to adequate solar light.
- Neanderthal morphology is directly related to climate and mountainous regions. The more northern the latitude and the more elevated the climate (colder) the more Neanderthal like the fossils become. This would be due to the lack of fish in the diet and the colder climate.
- Most Neanderthal/erectus fossils are found in non-costal, cold, and alpine environments. In these localities fish would rarely be eaten (11, 12).

(The article is continued on the following page)

Above 40° N, except presumably during warm interglacials like the last, an exogenous source of vitamin D is also invariably required for normal growth in children and adequate bone maintenance in childbearing women: the alternative is rickets and osteomalacia. In a recent paper, Loomis has shown¹⁰ that the photosynthesis of endogenous vitamin D in man is kept at a constant rate the world over by the intensity of skin pigmentation, which on the whole can be seen to vary directly with the general availability of solar ultraviolet at different latitudes: as a rule, populations in the equatorial belt are the darkest, and marked depigmentation of the skin begins at 40° N and S.

Palaeoclimate of the Early Würm

It is presumed that Neandertal had limited access to ultraviolet. The palaeoclimate of the early Würm was characterized by cold and a marked increase in atmospheric turbulence and precipitation, which was worldwide but more intense in the higher latitudes above 40°^{11,12}. Because the rays at the lower end of the sunlight spectrum are quite liable to any sort of atmospheric interference, dust laden high winds, rains, snow, or overcast through the greater part of the year would filter out the ultraviolet reaching the surface of the planet, again very drastically at higher latitudes but less so around the equator. The cold itself contributed further to the reduced availability of ultraviolet by driving Neandertal out of the open to seek shelter in caves or tents, and perhaps to the wearing of thick furs. It has also been suggested that Neandertal had little access to dietary vitamin D, because his basic hunter's food list, relatively adequate in terms of calories, protein, calcium and phosphorus and vitamin B, included only negligible amounts of fatty fish and eggs^{13,14}. The evidence here is mostly of a negative nature: absence of specialized fishing implements, absence of the type of tool kit needed to make them, and absence of fish remains at Mousterian sites—all the opposite of the situation encountered in Aurignacian and Magdalenian times¹⁵. It would be more accurate to say that most Mousterian sites show no archaeological or osteological evidence of fish consumption; that the scant unidentified fish remains from Gibraltar are of doubtful association¹⁶; and that the three individual fish (one pike, one perch, one unidentified) excavated in the evolved Acheulian Mousterian site of Salzitter-Lebenstedt¹⁷ alongside the remains of eighty reindeer, sixteen mammoths, six bison, four horses and two rhinoceroses, only go to confirm the general impression that Neandertal made very little use of fatty fish—which it may be surmised were come by sporadically in the course of food gathering. Eggs also obtained by simple gathering, must have been rare for most Neandertals.

Evidence of Rickets in Neandertals

That an endemic deficiency of vitamin D prevailed for man during Mousterian times is certainly not contradicted by the direct evidence of the fossils themselves. It has long been held that the Neandertal child is a small replica of the adult¹⁸—a situation unique among Primates, and something of an oversimplification as well, because in some respects, for instance frontal height, the Neandertal child may fall within or even surpass the modern range of variation¹⁹. But the crucial point which has not been emphasized is that every Neandertal child skull studied so far shows signs compatible with severe rickets²⁰. Clinically, the disease is most active between 6 and 24 months of age, and as far as the skull is concerned is characterized chiefly by a large head, late closure of the sutures and fontanels, a high bulbous forehead ("olympian front"), bulging at the four corners ("caput quadratum"), localized round patches of weakened or defective bone ("cranio-

* I have examined the following Neandertal individual remains: La Chapelle-aux-Saints adult, Engis child, La Ferrassie I to VI adults and children, Gibraltar adult and child, Neandertal, Pech-de-l'Aze, La Quina adult and child, Skuhl IX adult, Tabun I adult.

tabes"), and faulty dentition^{14,17}. The 2 year old from Pech-de-l'Aze²¹ confirms the diagnosis for each of these criteria: estimated cranial capacity is a very substantial 1,200 cm³; bregma and the metopic suture are wide open; the ossification centres of the lofty brow are displaced inferolaterally on the frontal, which lacks the protruding tubera of thickened bone so characteristic of infant skulls; there is a smooth bagging out at the sides of the frontal and at the low posterior parietal region; there are several large areas of thin, pitted bone in the frontal, occipital, and right parietal, which in life must have been associated with focal softening; the grossly maloccluded teeth show a number of crown anomalies and enamel irregularities. A subtle face change which may escape the clinician is the increase in the size of the orbits, especially in the vertical dimension: the latter is another feature of rickets to be seen in the Pech-de-l'Aze child. Also from the Würm I above 40° N latitude, the skull of the 1 year old from Starosel²² shows obvious signs of severe rickets, and the 6 to 8 year olds from Engis²³, La Quina²⁴ and Subalyuk²⁵ indicate that the disease was allowed to run its course unchecked, and the bone to heal in the original deformed condition. On the other hand, Teshik-Tash²⁶, Gibraltar II²⁷, the Shanidar baby²⁸ and the Lebanese "Egbert"²⁹, as a rule show less extreme evidence of rickets, as one might expect from the greater general availability of vitamin D at these lower latitude or temperate interstadial sites. And although much less has been published on the long bones of Neandertal children³⁰, what little is available shows that the gross bowing of these, so characteristic of present day rickets, was not restricted to the adult members of these populations, in whom, especially among Neandertal women of child-bearing age, an element of osteomalacia cannot entirely be ruled out.

Vitamin D Deficiency and Neandertal Evolution

Two lines of evidence therefore, the ecological and the ontogenetical, point in the direction of vitamin D deficiency as a significant element in the determination of the Neandertal facies. At the onset of Würm I we appear to be dealing with an advanced *Homo erectus* (=pre-sapiens) of the Ehringsdorf/Fontchevade/Saccopastore/Rabat or similar stock whose thick bones have been deformed by severe rickets in childhood and perhaps by various grades of osteomalacia in adulthood; 30,000 years later, as Neandertal continued to evolve culturally and biologically in the direction of modern man, and as the milder climate of the Paudorf interstadial increased the general availability of endogenous vitamin D, he did not differ very much from the more archaic types³¹ of Upper Palaeolithic *H. sapiens* 5,000–10,000 years ahead. The transition from Middle Pleistocene to Late Pleistocene fossil man may therefore be conceived of as a gradual, worldwide one, and the vexing problem of where to fit the Neandertal throwback is largely taken care of.

One of the strengths of this extended and revised version of Virchow's original hypothesis is that it can be tested empirically. The ordering of the world Neandertal sample in terms of degrees of inferred vitamin D deficiency does constitute an indirect kind of controlled observation. But two promising quantitative techniques are also available now for the direct testing of vitamin D deficiency in Neandertal fossil material: (1) the teeth may be sectioned and examined under the microscope for the presence of interglobular spaces in the dentine, a lesion practically specific of rickets^{32,33}; and (2) the X-ray diffraction pattern of bone may be studied for the presence of rachitic matrix, which projects its own pattern³⁴. Sognnaes, using a small sample from lower latitude Würm I and the following interstadial, has demonstrated³⁵ that the teeth provide unequivocal evidence of serious vitamin D deficiency in Neandertal man; similarly, Baud *et al.*³⁶, using well dated high latitude bone samples, were able to identify what is arguably a rickets ring in a

Here the evidence for the cause of Neanderthal's unique morphology is given. Two factors are cited, the first I the cold climate, which would tend to drive Neanderthal indoors and out of the sun. The second is the lack of fish, which would supply a dietary source of vitamin D.

Neanderthal facial features can be caused by rickets.

The author states that every Neanderthal child skull that he has examined showed signs of rickets.

- The author of this article has given non-evolutionary dietary and environmental factors that can account for the appearance of the Neanderthal's face, crania, and skeleton. Evolution is not needed to produce the so-called apish appearance of Neanderthal. A physiological explanation is totally satisfactory with the fossil record.
- *H. erectus* and *H. neanderthalensis* both have similar appearances. The features, common to both, could easily be caused by the above-mentioned factors.

Wright DJM. Syphilis and Neanderthal Man. *Nature*. 229:409. 1970.

This author believes that syphilis could have played a part in the skeletal structure of Neanderthal man. He notes that syphilis and rickets often appear together.

Syphilis produces bone changes that are common Neanderthal features

NATURE VOL. 229 FEBRUARY 5 1970 409

(7) AMNH 19590, *H. theobaldi*, left upper molar, Brown 1922, from "1 mile north of Chinji Bungalow". Such a locality would be in the Chinji.

(8) AMNH 19661, *H. antelopinum*, teeth and jaw fragments, collected by Brown in 1922, from "Lower Siwaliks-quarry ½ mile south of Dhok Pathan". This locality is in either the Dhok Pathan or Nagri zones.

If the locality data were accurate and reliable, the first appearance of *Hipparion* would have to be placed before Chinji time on the basis of one specimen, or possibly two. Its presence in the Chinji would be documented by, at most, three specimens; definite documentation, if the accompanying record is reliable, would be provided only by one specimen. It thus seems that a correlation based on the occurrence of *Hipparion* in the Chinji cannot be justified, and that Pilgrim's relative dating⁸ based on the remainder of the fauna is acceptable.

Should *Hipparion* have first appeared in the Siwaliks in beds of Nagri age as seems to be the case, then the Chinji deposits can be dated between about 12 and 15 million years old. The youngest Nagri beds are probably 9 or 10 million years old. Thus *Dryopithecus* and *Ramapithecus* species from India and Pakistan span a period of some 4 to 6 million years. The oldest *Ramapithecus punjabicus* specimens from the Chinji horizons are therefore probably as old as the East African *Ramapithecus* from Fort Ternan in Kenya, dated radio-metrically to around 14 million years⁹.

This research was supported in part by the US National Science Foundation and by a Smithsonian Foreign Currency Program award. We thank Richard Tedford and S. T. Hussain of the American Museum of Natural History for discussion of the age of *Hipparion*.

ELWYN L. SIMONS
DAVID PILBEAM
S. J. BOYER

*Peabody Museum of Natural History,
Yale University,
New Haven, Connecticut 06520*

Received September 30, 1970.

¹ Colbert, E. H., *Trans. Amer. Phil. Soc.*, N.S., 36, 1 (1935).
² Evernden, J. F., Savage, D. E., Curtis, G. S., and James, J. T., *Amer. J. Sci.*, 262, 145 (1964).
³ Lewis, G. E., *Amer. J. Sci.*, 33, 191 (1937).
⁴ Kurtén, B., in *Evolution and Hominization*, second ed. (edit. by Kurth, G.), 58 (Gustav Fischer Verlag, 1968).
⁵ Dehm, R., *Boyer Akad. Wiss.*, N.F., 114, 1 (1963).
⁶ Pilgrim, G. E., *Rec. Geol. Surv. India*, 43 (4), 264 (1913).
⁷ Crusafont-Pairo, M., *Ann. Paléont.*, 40, 13 (1954).
⁸ Arambourg, C., *Publ. Surv. Géol. Algérie Pal.*, 4, 1 (1959).
⁹ Simons, E. L., and Pilbeam, D. R., *Folia Primat.*, 3, 81 (1965).
¹⁰ Simons, E. L., *Nature*, 221, 448 (1969).
¹¹ Hussain, S. T., *Boyer Akad. Wiss.*, N.F. (in the press).

Syphilis and Neanderthal Man

BONE changes in Neanderthal remains which, it has been suggested¹, might be caused by rickets are not unlike those seen in certain treponemal diseases, notably congenital syphilis. Examining the Neanderthal collection at the British Museum (Natural History), I noted several features compatible with treponemal disease.

The Olympian brow, Parrot's nodes and Caput Quadratum are all examples of "bossing"² of the congenital phase of syphilis. These changes are well marked in the Gibraltar II and in the original Neanderthal skull and also appear in the descriptions of Staroselje³ and Pech de l'Aze⁴ remains. The thinning and pitting of the occipital and parietal areas with the relative depression of the bridge of the nose ("saddle nose") may support a diagnosis of a generalized syphilitic osteo-

myelitis. It is interesting that these changes persist into adult life. These changes were seen in both adult and child skulls.

The frequent lack of incisors and well worn flattened taurodont molars superficially suggest the crateriform decay of Moon's mulberry molars⁵, which are seen in congenital syphilis. Examination of the inner aspect of the calvarium shows no increase in vascular markings, making an external hydrocephalus unlikely. Some authorities have suggested, however, that there is evidence of a healed meningitis occurring⁶.

It was the inspection of the curves of the long bones, in particular, the backward curves of the femur and perhaps the changes at the metaphysis, that first made Virchow⁶ express his view that Neanderthal man was none other than *H. sapiens* with rickets. The effect of a syphilitic osteitis could produce these bone changes and might, in addition, account for the Neanderthal long bones being so short and stout⁷. Bowing of the tibiae⁸ has also been described but was not present in the specimens I examined.

In societies with poor nutrition, rickets and congenital syphilis frequently occur together. The distinction between the two is extremely difficult without modern biochemical, serological and radiographic aids⁹. The degree of confusion can be gauged by Parrot's untrue aphorism "without hereditary syphilis, there is no rickets"¹⁰. If rickets were widespread in Neanderthal man, osteomalacia would occur in the adult female pelvis, making parturition exceptionally difficult. There was, however, no evidence of this in the Neanderthal and Tabun specimens, or in innominate bones examined by other workers¹⁰.

The oldest treponemal disease known at present is pinta (caused by the organism *Treponema carateum*) which dates back 15,000 years¹¹. The changes described in Neanderthal man may thus provide a possible link between the human and the yaws-like treponemal disease found in monkeys¹².

I thank Miss R. Powers of the Sub-department of Anthropology of the British Museum (Natural History) for help.

D. J. M. WRIGHT

*Department of Venerology,
Guy's Hospital Medical School,
London SE1*

Received October 9; revised December 14, 1970.

¹ Ivanhoe, F., *Nature*, 227, 577 (1970).
² Parrot, M. S., *La Syphilis Héreditaire* (Paris, 1886).
³ Ullrich, H., in *Neanderthal Centenary Congress* (edit. by Königswald, G. H. R. von) (Kemink, Utrecht, 1958).
⁴ Patte, E., *L'Enfant Neanderthalien du Pech de l'Aze* (Masson, Paris, 1957).
⁵ Moon, H., *Trans. Odont. Soc.*, NS, 9, 223 (1877).
⁶ Virchow, R., *Z. Ethnol.*, 4, 157 (1872).
⁷ Stokes, J. H., Beerman, H., and Ingram, N. R., in *Modern Clinical Syphilology*, third ed. (W. B. Saunders, Philadelphia, 1944).
⁸ Fiumara, N. J., and Lessell, S., *Arch. Derm.*, 102, 78 (1970).
⁹ Parrot, M. S., *Lancet*, i, 703 (1879).
¹⁰ Brown, R., and Robinson, J. J., *Amer. J. Phys. Anthropol.*, 8, 151 (1949).
¹¹ Hackett, C. J., *Bull. Wild Hlth Org.*, 29, 7 (1963).
¹² Fribourg-Blanc, A., Niel, G., and Mollaret, H. H., *Bull. Soc. Path. Exp.*, 59, 54 (1967).

Non-ferritin Iron Compound in Rat Small Intestinal Mucosa during Iron Absorption

THE transfer of iron across the mucosal cells of the small intestine is an active metabolic process, and part of the iron taken up by the cells is rapidly delivered to the plasma while some of the remaining iron is deposited as ferritin¹. A study of the subcellular distribution of orally administered ⁵⁹Fe in

- A combination of syphilis and rickets could have caused the unique features of Neanderthal man.
- In modern day man disease and environmental factors can only mold the skeletal features for the life of the person. If the life expectancy is about 70 years the skeleton can only show the accumulative effects of 70 years of disease and environment. Remember that the Genesis record states that humanity at this time had a life expectancy of 700+ years. The effects of disease, environment, and diet combined with these long life spans would produce changes to the skeleton, musculature, and crania that we are totally unfamiliar with today.

Walker A. Zimmerman MR. Leakey REF. A possible case of hypervitaminosis A in *Homo erectus*. Nature. 296:248-250. 1982.

Here is listed the skeletal changes that are associated with a diet that has too much vitamin A.

This *H. erectus* skeleton KNM-ER 1808 shows changes that can be attributed to a toxic accumulation of too much vitamin A in the diet.

248

Nature Vol. 296 18 March 1982

and relatively homogeneous habitats (*K*-strategists). Some support for this conjecture is provided by the available empirical evidence^{1,4}.

The patterns of dispersion generated by simple models of population growth lead us to believe that observed relationships between variability in population abundance and average density, highlighted by the work of Taylor², are in general a simple and inevitable consequence of demographic and environmental stochasticity. It is not necessary to invoke explanations based on the behavioural tendencies of species to aggregate and migrate³ in order to understand the trends that have been observed in natural habitats. Indeed, in a spatially uniform world, and in the complete absence of demographic stochasticity, such tendencies will not generate power law relationships between population variability (*V*) and average abundance (*M*). When density-dependent factors are of limited significance (*r*-strategists) demographic stochasticity alone is sufficient to account for the approximately linear relationship between the logarithms of variance and mean abundance and for the slopes of such relationships lying on average between 1 and 2 (Fig. 2). In the presence of strong density dependence (*K*-strategists), a degree of environmental heterogeneity (either in space or time, or both) will ensure that such relationships remain approximately linear over all average densities (Fig. 3).

We thank M. Loewinson, J. Soberon, J. Lawton and T. R. E. Southwood for helpful discussions and comments on the manuscript.

Received 16 October 1981; accepted 28 January 1982.

1. Taylor, L. R., Woiwod, I. P. & Perry, J. N. *J. Anim. Ecol.* 47, 383-406 (1978).
2. Taylor, L. R. & Woiwod, I. P. *J. Anim. Ecol.* 49, 209-224 (1980).
3. Taylor, L. R. *Nature* 189, 732-735 (1961).
4. Taylor, L. R. & Taylor, R. A. *J. Nat. Hist.* 115, 415-421 (1977).
5. Taylor, R. A. & Taylor, L. R. in *Population Dynamics* (eds Anderson, R. M., Turner, R. D. & Taylor, L. R.) 1-27 (Blackwell, Oxford, 1979).
6. Taylor, L. R., Woiwod, I. P. & Perry, J. N. *J. Anim. Ecol.* 48, 289-304 (1979).
7. Bartlett, M. S. *Stochastic Population Models in Ecology and Epidemiology* (Methuen, London, 1960).
8. Bailey, N. J. *The Elements of Stochastic Processes* (Wiley, New York, 1964).
9. May, R. M. *Stability and Complexity in Model Ecosystems* (Princeton University Press, 1973).
10. Bartlett, M. S. *An Introduction to Stochastic Processes* (Cambridge University Press, 1955).
11. Kendall, D. G. *Ann. Math. Stat.* 19, 1 (1948).
12. Renwick, F. J. *Biometrika* 37, 358-382 (1950).
13. Ross, E. C. *An Introduction to Mathematical Ecology* (Wiley, New York, 1960).
14. Cox, D. R. & Miller, H. D. *The Theory of Stochastic Processes* (Methuen, London, 1965).
15. Hanski, I. *Oikos* 34, 292-310 (1980).
16. Krebs, C. *Ecology: The Experimental Analysis of Distribution and Abundance* 2nd edn (Harper & Row, New York, 1978).
17. Lack, D. *The Natural Regulation of Animal Numbers* (Oxford University Press, 1954).
18. Hanski, I., M. F., L. H. & May, R. M. *J. Anim. Ecol.* 48, 471-486 (1979).
19. Southwood, T. R. E. *Theoretical Ecology, Principles and Applications* (ed. May, R. M.) 2nd edn (Blackwell, Oxford, 1976).
20. Grant, P. R. & Morris, B. *Can. J. Zool.* 49, 1043-1052 (1971).
21. Levine, R. *Proc. natn. Acad. Sci. U.S.A.* 62, 1061-1065 (1969).
22. Lewontin, R. C. & Cohen, D. *Proc. natn. Acad. Sci. U.S.A.* 62, 1056-1060 (1969).

Fig. 1 Diagram showing the preserved (shaded) parts of *Homo erectus* specimen KNM-ER 1808.



The geological age of the specimen (KNM-ER 1808) is constrained by the ages of the overlying Koobi Fora Tuff and the top of the underlying Olduvai Event. The Koobi Fora Tuff is actually a complex body of tuff, tuffaceous sediment and sediment, as are the Okote and Middle Ileret Tuffs. Cerling and Brown (personal communication) have established that some parts of each of these tuff complexes can be correlated. Fitch and Miller³ reported K/Ar dates on sandstone separates from the Koobi Fora Tuff ranging from 0.53 to 4.44 Myr, dates on the Okote tuff ranging from 0.87 to 1.70 Myr, and a date of 1.48 Myr for the Middle Ileret Tuff. Their preferred ages for the Koobi Fora and Okote Tuffs are 1.57 and 1.56 Myr respectively. Curtis (personal communication) has dated the Okote Tuff at 1.48, 1.46 and 1.44 Myr. Thus a reasonable younger limit on the age of the specimen is 1.5 Myr. The age of the top of the Olduvai Event is given as 1.76 Myr by MacDougall⁴, providing an older limit for the age of the specimen.

The precise position of the polarity transition is uncertain, but is known to lie at least 12 m below the specimen, and may lie much lower in the section. Since the specimen lies fairly close to the Koobi Fora Tuff, a reasonable estimate of its age is 1.6 ± 0.1 Myr. This adult individual is presumed female by comparison of innominate parts with KNM-ER 3228 (ref. 5) and Olduvai Hominid 28 (ref. 6), which are considered male and female respectively by modern human osteological criteria.

The appendicular skeleton shows striking pathology, consisting of subperiosteal diaphyseal deposit of coarse-woven bone. The new bone, 7.0 mm thick in places, thins towards the metaphyses. There is minimal endocranial involvement. Ground thin sections of the tibial shaft (Fig. 2) show pathology confined to the outermost cortex, which has given rise locally to new bone. The sharply demarcated, coarse-woven new bone contains enlarged, sub-spherical and randomly placed lacunae. There is no evidence of abnormal remodelling of the underlying bone. The dense mineralization of the specimen accounts for the fine histological preservation, but precludes satisfactory radiological examination.

Although a disease that no longer exists or has changed its manifestations can neither be diagnosed nor excluded, we suggest that KNM-ER 1808 had chronic hypervitaminosis A. Although the night blindness of vitamin A deficiency has been known since antiquity, the deleterious effects of excessive ingestion

A possible case of hypervitaminosis A in *Homo erectus*

A. Walker*, M. R. Zimmerman† & R. E. F. Leakey‡

* Department of Cell Biology and Anatomy, The Johns Hopkins University, School of Medicine, Baltimore, Maryland 21205, USA
 † Department of Pathology and Laboratory Medicine, Hahnemann Medical College and Hospital of Philadelphia, Philadelphia, Pennsylvania 19102, USA
 ‡ National Museums of Kenya, Box 40658, Nairobi, Kenya

Following an initial discovery by Bw. K. Kimeu in 1973, sieving operations have recovered the most complete *Homo erectus* skeleton so far known (Fig. 1) from the Upper Member of the Koobi Fora Formation in Area 103, Koobi Fora, East Lake Turkana in Kenya^{1,2}. The partial skeleton shows pathological changes consistent with chronic hypervitaminosis A. We attribute this disorder to the high dietary intake of animal liver, most probably that of carnivores, during a period when the dietary habits of *Homo erectus* were changing.

0028-0836/82/110248-03\$01.00

© 1982 Macmillan Journals Ltd

- Hypervitaminosis A is caused in modern man by the ingestion of too much vitamin A. The source is usually the eating of animal livers, especially liver from carnivores. Carnivore animal liver contains large amounts of vitamin A.
- If *H. erectus* was eating large amounts of liver it would cause long-term skeletal changes. These changes would include, coarse woven bone, and other bone defects.
- Some of the unique skeletal features of *H. erectus* could be caused by non-evolutionary factors such as diet, which would in this case include hypervitaminosis A.

Works Cited

1. Day MH. *Guide to Fossil Men 4th Ed.* University of Chicago Press. Chicago, IL. 267. 1986.
2. Cuozzo J. *Buried Alive.* Master Books. Green Arrow, AZ. 70. 1999.
3. Lubenow ML. *Bones of Contention.* Baker Books. Grand Rapids, MI. 124. 1992
4. Cuozzo, 94.
5. Britannica CD, Version 98©. *Homo sapiens.* Encyclopedia Britannica, Inc. 1994-97.
6. Tattersall I. *The Last Neanderthal.* Nevrumont Publishing Co. New York, NY. 115. 1999.
7. Lubenow, 52.
8. Howell, F. Clark. *Early Man.* Time-Life Books. New York, NY. 72. 1965.
9. Lubenow, 172.
10. Tattersall, 119.
11. Becky S. Cylbulski JS. *Homo erectus Papers in Honor of Davidson Black.* University of Toronto Press. Toronto, Canada. 236-7 see map. 1981.
12. Day, 18 see map.