HAYATI Journal of Biosciences, December 2007, p 123-126 Vol. 14, No. 4
ISSN: 1978-3019

INVITED PAPER

The *Homo floresiensis* Controversy

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A completely new and unexpected quasi human species, *Homo floresiensis*, nicknamed the Hobbit, was described in 2004 from Liang Bua, a cave in Flores. Like many important new contributions to the human fossil record in the past, many commentators refused to believe that a new species had been discovered, and the type specimen was interpreted as a pathological modern human, usually as a microcephalic dwarf. There is no substance to these claims: close analysis shows that *Homo floresiensis* is not only a genuinely new species, but that its closest affinities lie with Plio-Pleistocene African species such as *Homo habilis*, so that it documents an earlier dispersal of hominins from Africa and had hitherto been suspected.

Key words: Flores Hobbit, *Homo floresiensis, Homo erectus, Homo habilis,* microcephaly

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HISTORICAL BACKGROUND

On October 28, 2004, came the startling announcement that the remains of a tiny little humanlike creature had been found in Late Pleistocene deposits in Liang Bua, a cave on the island of Flores in Nusatenggara. It was a joint Indonesian-Australian discovery: Thomas Sutikna of the Indonesian Centre for Archaeology in Jakarta, Mike Morwood, of the University of New England in Armidale (New South Wales), and their teams. The new species was represented by a nearly complete adult skeleton, Liang Bua 1, and the isolated lower premolar of a second individual, LB2. LB1 (Figure 1) was found at a level dated to approximately 18,000 BP; LB2 was much older. The detailed description of the remains, and the description and naming of the new species *Homo floresiensis,* was by the renowned palaeoanthropologist Peter Brown. This being the age of *The Lord of the Rings*, all over the world people seemed to invent the same nickname for it – the Hobbit.

Figure 1. *Homo floresiensis* LB1 front 2 skull (courtesy of Debbie Argue, School of Archaeology and Anthropology, Australian National University).

PALAEOANTHROPOLOGICAL BACKGROUND

Until about 20 years ago, many people assumed an almost straight line of human evolution: *Australopithecus afarensis*—*Australopithecus africanus*—*H. habilis*—*H. erectus*—*H. sapiens*. The two acknowledged divergences from this straight line were: (i) the massive vegetarian *Paranthropus* (sometimes called the "robust australopithecines"), known between 2.5 and about 1 million years ago in Africa; (ii) the famous Neanderthal species, *H. neanderthalensis*, which lived in Europe and the Middle East between about 200,000 and 30,000 years ago.

Since about the mid-1980s, new discoveries more and more indicated that human evolution had involved numerous "speciation events", extinctions, ancestral species persisting alongside their descendants, and cases of some species surviving little changed for long periods of time. Human evolution now appears much more like that of other mammals with good fossil records, such as elephants, pigs, and antelopes.

Homo habilis is first known from Hadar, Ethiopia, at 2.3 million years old. At about two million we have the first appearance of its presumed descendant, *H. ergaster*, and the two lived apparently side-by-side in East Africa until about 1.4 million. Descendants of *H. ergaster* spread out of Africa; one is *H. georgicus*, from deposits 1.8 million years old at Dmanisi, in Georgia, and another is *H. erectus*, from sites such as Trinil and Sangiran in Java.

Homo erectus is distinguished by its thick angular braincase, massive supraorbital torus, and large palate and teeth. It is known almost entirely from cranial and mandibular remains; when some palaeoanthropologists describe aspects of "the postcranial skeleton of *H. erectus*", they are invariably referring to the magnificent specimen KNM-WT 15,000, which is actually a specimen of *H. ergaster*, often, rather unhelpfully, dubbed "African *H. erectus*", and it must be stressed that we know almost nothing about the postcranial skeleton of the Javanese species itself. *Homo erectus* survived virtually unchanged, except that its brain was somewhat larger, in Java (Ngandong, Sambungmacan, Ngawi) until very late – controversially, perhaps as little as 30,000 years ago – and, as we now know, died out without issue and was not ancestral to *H. sapiens*.

Other descendants of *H. ergaster* remained in Africa, or entered southern Europe; one of the ultimate descendants, which arose in Africa, was *H. sapiens*, modern humans. The earliest remains of modern humans have been found in the Kibish Formation along the Omo River, Ethiopia, dated at 195,000 years ago, and from there they spread gradually across Eurasia and island Southeast Asia; they were even in Australia and New Guinea by 50,000 years ago. As far as we knew in early 2004, the Old World at 30,000 years ago was inhabited mostly or entirely by our own species. At 30,000 years ago, and until as late as 12,000 years ago, sea levels were low, and Sumatra, Java, Borneo, and Bali (Sundaland) were joined to the Southeast Asian landmass, but being largely rain forested they might have been habitable by humans only around the edges. So it may well be that *H. sapiens* spread around the northern edge of Sundaland and island-hopped across to New Guinea and then down across another land-bridge to Australia, and did not reach Java and discover the *H. erectus* survivors until later: but this so far is speculation.

And now suddenly, at the end of 2004, we learned of another species that had shared the world with us even after the last Neandertalers and the last *H. erectus* had gone. Peter Brown and his colleagues at first argued that *H. floresiensis* was a descendant of *H. erectus*, which had moved a few islands along to the east: it had a receding forehead and receding chin, and made stone tools, like *H. erectus*, but had smaller body size (only 1 metre tall!), smaller brain, smaller brow ridges, and strangely short legs compared with its arms. Large mammals isolated on islands tend to reduce in size (insular dwarfing), and in fact the remains of a dwarf species of the elephantlike *Stegodon* were found in the same deposits as the Hobbit.

THE HOBBIT-DENIERS

Enter the "Deniers". The common theme of the deniers was that LB1 was an ordinary modern human, probably afflicted with microcephaly, a condition which occurs (very rarely) in modern human populations, in which the brain is underdeveloped. In modern humans the cranial capacity (ECV, endocranial volume) varies from about 1200 to 1700 cc; a person is called microcephalic whose brain is less than 700 cc, and a few people with under 400 cc have even been recorded. Mostly these people are also small in stature. The ECV of the Hobbit was around 400 cc, and its stature was about 1 metre. Did this indicate microcephaly?

The first detailed analysis, claiming that the Hobbit was no more than a microcephalic dwarf, appeared in a paper led by Indonesia's leading palaeoanthropologist, Professor Teuku Jacob, in 2006, and including Australian, American and Chinese co-authors. They made a number of points: (i) the Rampasasa people, who tend to be short-statured, live in Flores today, not too far from Liang Bua; (ii) some of the Rampasasa people have receding chins; (iii) LB1 has a very asymmetrical skull, as would be expected in a person with a pathological condition, rather than a healthy person.

A second paper seriously disputing that *H. floresiensis* was a new species was by Professor Robert Martin, of the Field Museum of Natural History in Chicago, and an Anglo-American team. Martin is a specialist in allometry (relative growth). Consider that a child is not just a small adult: the body proportions, and the proportions of the head and face, are different, and gradually change during growth. Likewise, body proportions change as a consequence of size changes during evolution: brains, for example, are relatively larger in small species, and proportionately smaller in large species, so that mice have *relatively* larger brains than rats, and cats have relatively larger brains than tigers. Martin and his colleagues argued that if the Hobbit were, as the describers had suggested, a dwarfed descendant of *H. erectus*, then its brain would be much bigger than it is: there was no way, in other words, that *H. floresiensis* could be its dwarf descendant. They concluded that it must therefore be pathological – a microcephalic, just as Jacob and his colleagues had argued.

A few other papers appeared questioning that the Hobbit was anything but a microcephalic dwarf modern human being, but it was Jacob *et al.* and Martin *et al*. who had offered actual details.

IS THE HOBBIT JUST A PATHOLOGICAL MODERN HUMAN?

Jacob *et al*. (2006) used the photograph of a living Rampasasa man with a receding chin as evidence that the receding mandibular symphysis of LB1 is within the modern human range. But this is a very superficial comparison, because, as shown in detail by Schwartz and Tattersall (2000), the mandibular symphysis of *H. sapiens* has a distinctive structure. The modern human bony chin, however receding, always has a strong ridge running along the lower margin of the jaw, and a weaker ridge running down the midline to meet it (this has been called the Inverted T). But earlier members of the human lineage, like *H. erectus* or *H. habilis* or the australopithecines, lack this external buttressing but have an internal buttressing system, consisting of the Inferior Transverse Torus, at the lower margin, and usually a smaller Superior Transverse Torus above it (the two tori are separated by a depression where the tongue muscles insert). The symphysis of *H. floresiensis* entirely lacks the structural features of *H. sapiens*; instead, it has internal buttressing like earlier members of the human lineage. Brown *et al.* (2004) specifically likened the symphyseal cross-section of LB1 to that of LH 4 (Laetoli Hominid 4), a specimen of *A. afarensis* from Tanzania, dated at 3.5-3.75 million. A key paper by Argue *et al.* (2006) compared all the features of the LB1 skull to what was at that time known of modern microcephalic skulls, showing that in a great many observable features it differs strikingly.

My colleagues F. D. Bulbeck and M. Oxenham (personal communication) have recently completed a worldwide survey of preserved skeletal material of microcephalic individuals (including a few individuals suffering from syndromes mimicking microcephaly, such as cretinism). Not one of the specimens studied by them in any way resembles LB1, beyond the sheer fact of reduced brain size. On the contrary, presumably for biomechanical reasons, in microcephalic skulls, the structures of the sagittal midline of the face, such as the nasal region and the chin, tend to be exaggerated.

The claimed asymmetry of the skull of LB1 (Jacob *et al*. 2006) is in fact an artefact of damage to the skull (partly at the time of excavation), together with a slight degree of post-mortem distortion, making the two sides look different. The left orbit was partly shorn away, making it look rounded, not angular like the right orbit; and the right zygomatic was partly caved in.

Some of the Rampasasa People May be Short, but None is as Short as LB1.

The brain of LB1, as analysed by Falk *et al.* (2007), was very like a tiny, but normal, human brain, and quite different from the series of microcephalic brains studied by them, which have characteristic changes from the normal human pattern quite apart from size.

Martin *et al*.'s (2006) allometric argument is correct: the Hobbit was most unlikely to be a dwarfed *H. erectus*. But it turns out to be irrelevant. Morwood *et al*. (2005) reconsidered the "dwarf *H. erectus*" model in the light of new discoveries (see below), and preferred instead a new hypothesis: that *H. floresiensis* was a direct descendant of a more primitive species, perhaps *H. habilis*, which had spread its range outside Africa before the ancestors of *H. erectus* did the same thing.

It is important to note that all the claims that *H. floresiensis* is just a pathological modern human considered only LB1. There is now further material available.

THE 2005 DISCOVERIES

In October 2005 – just one year after the initial announcement of LB1 and the isolated tooth, LB2 – Morwood and his colleagues announced the discovery of more specimens from Liang Bua. More parts of LB1 had been discovered, as well as remains of seven other individuals: (i) LB3, a tiny ulna; (ii) LB4, a child represented by a radius and tibia; (iii) LB5, a vertebra and a metacarpal from an adult; (iv) LB6, represented by several hand bones, a scapula (shoulder blade) and a mandible; (v) LB7, a tiny, but adult, bone from the thumb; (vi) LB8, another tibia; (vii) and LB9, a femur.

All these are diminutive in size, actually smaller than their counterparts in LB1. Especially important is the LB6 mandible, which almost exactly resembles the mandible of LB1. Like LB1, LB6 has not only a receding symphysis but internal buttressing (well-developed inferior and superior transverse tori), and like LB1 it completely lacks the Inverted T, which puts both of them well outside the range of modern humanity.

Of the new finds, LB4 comes from a higher level than LB1, and is only 12,000 years old, while most of the other new specimens were from lower down, going back to a level dated between 74 and 95,000 years ago. *Homo floresiensis*, then, inhabited the cave over a period of more than 60,000 years. It is hardly credible that, over this long period, the remains of nine microcephalic people, and no one else, ended up in Liang Bua!

THE AFFINITIES OF *HOMO FLORESIENSIS*

Argue *et al*. (2006) discussed the affinities of *H. floresiensis*, and concluded that Brown and his colleagues were right second time: it is closest to *H. habilis*, representing a much more primitive condition than *H. erectus*. The implications of this are profound. The earliest spread of members of the human lineage out of Africa must have been before the generally acknowledged one that resulted in *H. erectus*, probably before 2 million years ago. There is as yet no trace of any early *Homo* between Africa and Java, the fossil record of the intervening areas is too poor (with the sole exception of Dmanisi, in Georgia — see above). Only in Java itself is the fossil record reasonable, although even here in the earlier levels there are mostly jaws and teeth (see Kaifu *et al*. 2005): the magnificent crania of *H. erectus* date from higher levels, perhaps a million years ago. Some of these earlier remains have been suggested, from time to time, to represent not *H. erectus* but one or more different species (*H. modjokertensis*, *Meganthropus palaeojavanicus*, and others). Perhaps it is time to reconsider the taxonomic and evolutionary status of this earlier material; perhaps *H. floresiensis* has an ancestor, so far undetected, among these early specimens from Java?

The stone tools from Liang Bua, apparently associated with *H. floresiensis*, have been analysed by Brumm and Aziz (2006), who found that they are nearly identical to those from open sites dating to 800,000 B.P. elsewhere on Flores. Evidently the ancestors of the Hobbit were already on the island by at least the beginning of the Middle Pleistocene.

DEFINITION OF *HOMO FLORESIENSIS*

Homo floresiensis most closely resembles hominin species from the Late Pliocene and Early Pleistocene: *H. habilis*, *H. ergaster*, and *H. georgicus*. The plesiomorphic conditions which it shares with them (in as far as they are known in these three species) include: From Argue *et al.* (2006): (i) very small cranial capacity (evidently further reduced during the process of insular dwarfing); (ii) very receding mandibular symphysis, with strongly developed inferior and somewhat developed superior transverse tori, entirely lacking the external structures characterising *H. sapiens* and certain Middle Pleistocene specimens; (iii) facial prognathism; (iv) receding frontal; (v) small rounded (somewhat vertically elongated) external auditory meatus, with very thin tympanic margin. From Larson (2007): (i) low bar-glenoid and axillo-spinal angles of the scapula; (ii) low humeral torsion angle; (iii) short clavicle relative to humerus. From Tocheri *et al*. (2007): (i) trapezoid wedge-shaped, the ulnar side of the articulation for second metacarpal fairly sagittally oriented, the articulation for scaphoid somewhat triangular, and lacking the expanded palmar non-particular area characteristic of Middle Pleistocene and later *Homo*; (ii) scaphoid and capitate correspondingly plesiomorphic.

Predominant among the features of *H. floresiensis* which appear to be uniquely derived include its tiny size, consistent with an insular dwarfing model (Bromham & Cardillo 2007), its shortened legs (D. Argue, personal communication), and its seemingly enlarged feet (not analysed in detail so far, but visible in published photos, such as in Larson 2007).

CONCLUSION

The discovery of a new species of the genus *Homo* is always a matter of intense interest, and has traditionally been attended with carping criticism, varying from useful critiques to little more than incredulity. This usual scenario has been magnified many times over in the case of *H. floresiensis*, and once again the criticisms have varied from helpful (if often misguided) to sheer nonsense. Now that much of the fuss has died down, and the validity of the new species has been established apparently to the satisfaction of most palaeoanthropologists, it has become possible to discuss its affinities soberly.

If the hypothesis of Morwood *et al.* (2005) and Argue *et al*. (2006), supported here, is correct, then the consequences for our understanding of human evolution are indeed dramatic.

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