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Beyond Homo erectus: A Multi-Wave Model of Early Human Migration

Biology * Evolution * Paleontology

Introduction: The Collapse of the Unilinear "Out of Africa I" Narrative

For decades, the prevailing paradigm of human evolution held that Homo erectus (or its African variant Homo ergaster) was the singular pioneer of the genus Homo, the first hominin to disperse out of Africa and colonize Eurasia approximately 1.8 million years ago (Ma).[1] This "Single Species Hypothesis" assumed that tall stature, marked encephalization (>800 cc), obligate striding bipedalism, and Mode 2 Acheulean bifacial handaxes were prerequisites for intercontinental migration across the Old World savannah belt.

A convergence of chronological, morphometric, and paleoclimatic discoveries has dismantled this unilinear model. The recovery of small-brained (546-775 cc), short-statured hominins at Dmanisi, Georgia (1.85-1.77 Ma), the discovery of 2.12-million-year-old Oldowan lithic artifacts at Shangchen, China, and late-2025 dental morphometric analyses demonstrating multiple hominin taxa within the Dmanisi assemblage collectively point to a multi-wave dispersal model.[2][3][4] Rather than a single exodus led by classic H. erectus, the earliest Eurasian migrations were undertaken by smaller-bodied, pre-erectus populations carrying Mode 1 stone tools through episodic climatic "Green Corridors."

Chronological Disruption: The 2.12 Ma Shangchen Lithic Record

Prior to 2018, the volcanic strata of Dmanisi (1.85 Ma) represented the oldest secure evidence of hominins outside Africa. Excavations at Shangchen on China's southern Loess Plateau, led by Zhaoyu Zhu and Robin Dennell, extended the East Asian archaeological record back by ~270,000 years.[3][5][6] Because the Chinese Loess Plateau lacks volcanic tuffs suitable for argon-argon radiometric dating, the team applied paleomagnetic magnetostratigraphy across a continuous sequence of wind-blown loess and ancient paleosol horizons. The oldest artifacts -- recovered from Loess Layer 28 (L28) -- correlated directly with the boundary of the R union Subchron within the Matuyama Reversed Epoch, establishing an age of 2.12 million years ago.[3][6]

The Shangchen assemblage comprises 96 worked stone cores, flakes, scrapers, and points characteristic of Mode 1 (Oldowan) technology, with no bifacial handaxes.[3][5] Because 2.12 Ma predates the earliest fossil appearance of classic Homo erectus in East Africa (~1.9 Ma), the Shangchen toolmakers likely belonged to an earlier grade of Homo -- such as Homo habilis or a transitional pre-erectus lineage -- that exited Africa and traversed Asia far earlier than previously recognized.

The Dmanisi Crossroads: Dental Morphometrics and Anatomical Mosaics

Dated via basalt flows and volcanic ash to 1.85-1.77 Ma, the site of Dmanisi in the Georgian Caucasus preserves five crania and associated postcranial skeletons exhibiting extraordinary morphological disparity.[2][8] While Skulls 1-4 display gracile faces and cranial capacities up to 775 cc, "Skull 5" (D4500/D2600) combines a massive, prognathic mandible and face with a 546 cc braincase.[7][8] Although David Lordkipanidze and colleagues long interpreted this disparity as extreme sexual dimorphism within a single variable paleodeme (H. erectus ergaster georgicus) comparable to variation within modern humans or the chimpanzee, a December 2025 study in PLOS One by Nery, Neves, Valota, and Hubbe statistically refuted the single-species hypothesis.[4][8]

Applying Linear Discriminant Analysis (LDA) to dental crown surface areas across 583 hominin fossil teeth, Nery et al. demonstrated that dental size variation at Dmanisi exceeds even the extreme sexual dimorphism of modern gorillas (Gorilla gorilla).[4] The specimens segregated into two statistically distinct clusters, indicating the coexistence or rapid succession of two separate species resulting from distinct dispersals or local speciation:

| Dmanisi Group | | Key Specimens | | Dental & Cranial Morphology | | Proposed Taxon (Nery et al., 2025) |

| Group A | | D4500 / D2600 ("Skull 5") | | Australopith-like megadont molar crown areas, massive prognathic jaw, 546 cc braincase | | Homo georgicus[4] |

| Group B | | D2282, D211, D2700 | | Derived early-Homo reduced crown areas, gracile mandible, up to 775 cc braincase | | Homo caucasi[4] |

Postcranially, the Dmanisi skeletons represent a striking anatomical mosaic. Standing only 145 to 155 cm tall and weighing 40 to 50 kg -- far smaller than the ~180 cm African H. erectus specimen KNM-WT 15000 ("Nariokotome Boy") -- they possessed derived, human-like lower limbs with a longitudinal pedal arch and adducted hallux built for long-distance terrestrial striding.[9][10] Yet their upper limbs retained primitive traits shared with H. habilis and H. floresiensis: the humerus completely lacked humeral torsion, and the scapula featured a cranially oriented glenoid cavity suited to arboreal climbing.[9]

| Anatomical / Cultural Trait | | Homo habilis | | Dmanisi Hominins | | Classic African Homo erectus |

| Cranial Capacity | | ~510 - 660 cc | | 546 - 775 cc[11] | | 800 - 1,000+ cc |

| Estimated Stature | | 118 - 130 cm | | 145 - 155 cm[10][12] | | 160 - 185 cm[13] |

| Humeral Torsion | | Absent (primitive) | | Absent (primitive)[9] | | Present (derived) |

| Glenoid Cavity Orientation | | Cranially angled | | Cranially angled[9] | | Laterally oriented |

| Lithic Industry | | Oldowan (Mode 1) | | Oldowan (Mode 1)[14] | | Acheulean (Mode 2) / Oldowan |

The Second Wave at 'Ubeidiya and Paleoclimatic Green Corridors

Whereas Shangchen (2.12 Ma) and Dmanisi (1.85 Ma) document early waves of small-bodied, Mode 1 toolmakers, the Levantine site of 'Ubeidiya in the Jordan Valley records the arrival of classic, large-bodied Homo erectus at ~1.5 Ma.[1][15] Morphometric analysis of a juvenile lumbar vertebra (UB 10749) published in 2022 confirmed an individual projected to reach >180 cm at maturity, accompanied by classic Mode 2 Acheulean bifacial handaxes.[15][16] This 300,000-year gap between Dmanisi and 'Ubeidiya marks a distinct second major migration wave out of Africa.

Evidence from paleoclimatology explains how small-brained pioneers crossed the Saharo-Arabian belt. Uranium-thorium dating of Arabian cave speleothems and reconstructions of Pleistocene paleo-drainage networks reveal recurring humid monsoon phases ("Green Arabia") that transformed hyper-arid deserts into savannah-grassland corridors connected by perennial rivers.[17][18] Once in Eurasia, herpetofaunal and botanical records from Dmanisi and Shangchen show that early Homo successfully colonized seasonal temperate woodlands and cold loess steppes without relying on large brains or Acheulean technology.[3][19]

Conclusion: A Bush of Early Pleistocene Dispersals

The synthesis of magnetostratigraphic dates from Shangchen (2.12 Ma), dental discriminant analyses splitting Dmanisi (1.85 Ma) into Homo georgicus and Homo caucasi, and the later appearance of large-bodied Acheulean hominins at 'Ubeidiya (1.5 Ma) replaces the single-species Homo erectus narrative with a multi-wave evolutionary bush. Early Pleistocene hominin expansion into Eurasia was driven by ecologically flexible, small-bodied, mosaic hominins pulsing through climatic green corridors hundreds of thousands of years before classic Homo erectus emerged.

Updates... (Nov 21, 2026): Replaced the TalkOrigins archive link, HTTP-only archaeology blog, and timed-out news link with peer-reviewed CrossRef DOIs (Vekua et al., 2002; Mgeladze et al., 2011; Belmaker et al., 2002), corrected the Sapiens publication date (Oct 14, 2021), added verified publication dates across all 19 sources, and standardized reference anchors. (Prior Nov 16, 2026 update added Nery et al., 2025 metadata and unnumbered section headings.)

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