



Lucy in the Sky of Neuroevolution: **Evolutionary Insights for Clinical Neurology***

(Neuroperspective)

Francesco Brigo¹

¹ Innovation, Research and Teaching Service, Teaching Hospital of the Paracelsus Medical Private University (PMU), Azienda Sanitaria dell'Alto Adige, Bolzano, Italy.

Corresponding Author:

First and last name: Francesco Brigo - ORCID: 0000-0003-0928-157

E-mail address: dr.francescobrigo@gmail.com

* The writing of this article was inspired by the profound emotions and reflections evoked during two visits to the *Lucy & Selam* exhibition, held at the National Museum of the Czech Republic in Prague from August 25 to October 23, 2025. For the first time in Europe, the original fossils of *Australopithecus afarensis*—Lucy and Selam—were on display, having arrived from Ethiopia, the land of their origin. This extraordinary event offered a rare opportunity to contemplate the deep evolutionary roots of our species and served as the catalyst for the ideas explored in this article.



Abstract

The discoveries of “Lucy” (AL 288-1) and “Selam” (DIK-11), two iconic *Australopithecus afarensis* fossils from Ethiopia, have reshaped our understanding of human evolution and offer valuable insights for clinical neurology. These fossils show that habitual bipedalism emerged 3.2 million years ago—well before significant brain expansion. Lucy’s partial skeleton revealed adaptations for upright walking, while Selam’s remarkably preserved juvenile remains included a rare natural endocast, enabling study of early brain morphology. Findings indicate that *A. afarensis* retained an ape-like occipital cortex, while the frontal regions showed early enlargement. Selam’s relatively small brain compared to chimpanzees suggests prolonged neurodevelopment—an evolutionary precursor to the extended childhood seen in modern humans. Though paleoanthropology may seem distant from clinical neurology, evolutionary interpretations of fossil evidence illuminate the origins of the human nervous system and the persistence of deeply conserved motor and neural circuits. Primitive reflexes like the Babinski sign, spastic postures resembling climbing biomechanics, and locomotor automatisms can be viewed as evolutionary echoes—latent repertoires embedded in our neural architecture. Prolonged brain maturation in *A. afarensis* also contextualizes modern neuroplasticity and neurodevelopment. Lucy and Selam thus bridge paleoanthropology and medicine, revealing the nervous system as both an ancient archive of motor strategies and a platform for cognitive innovation. Recognizing this evolutionary “baggage” enriches clinical interpretation of neurological signs, linking deep evolutionary history with present-day neurophysiology and patient care.

Keywords:

Australopithecus afarensis; Bipedalism; Evolution; Neurodevelopment; Paleoanthropology



[Donald Johanson] “What’s wrong?”

[C. Owen Lovejoy] “What’s wrong? The whole goddamned thing is wrong. I’m thinking of what some people are going to think when they first see this little fellow. He could run on his hind legs. He could really scamper. But I’ll bet his brain wasn’t much bigger than a peanut. How could it be? He was scarcely more than three feet tall himself.”¹

Johanson DC, Edey MA. *Lucy: The Beginnings of Humankind*. Simon & Schuster; 1981.

1. Introduction

At first glance, the study of fossilized bones may appear far removed from the clinical practice of neurology. Paleoanthropology, with its focus on the skeletal remains of early hominins, seems to belong more to the realm of archaeology and anthropology than to the wards and clinics where neurological disease is encountered. Yet, as the evolutionary biologist Theodosius Dobzhansky famously remarked, “*nothing in biology makes sense except in the light of evolution.*” (Dobzhansky 1973). The nervous system, no less than the skeleton, is a product of evolutionary history. Within its circuitry are preserved vestiges of ancient motor strategies and developmental patterns that continue to shape neurological function and dysfunction.

In this sense, the iconic fossils of *Australopithecus afarensis* hold more than historical interest. The discoveries of “Lucy” (AL 288-1) in 1974 and “Selam” (DIK-11) in 2000 revealed not only the skeletal foundations of habitual bipedalism, but also offered rare insights into the early evolution of the hominin brain.

Interpreting contemporary neurological phenomena as evolutionary echoes of ancestral motor patterns, however, presents significant epistemological challenges (Brigo 2025). Because the nervous systems of extinct hominins cannot be examined directly, evolutionary neurology cannot rely on classical experimental models that establish straightforward cause–effect relationships. Instead, it must draw on interdisciplinary triangulation—integrating comparative neuroanatomy, neurophysiology, developmental biology, and clinical neurology. Evidence from central pattern generators, primitive reflexes, and the contrasting roles of corticospinal and reticulospinal pathways illustrates how ancient subcortical circuits continue to shape motor control. At the same time, more speculative analogies—such as interpreting spastic postures as remnants of climbing mechanics—must be clearly distinguished from empirically grounded observations. The goal is not definitive proof but the construction of converging lines of evidence that render hypotheses of ancestral continuity scientifically plausible (Brigo 2025).

This article explores how Lucy and Selam—two of the most iconic fossils in human evolutionary history—contribute, albeit indirectly, to our understanding of neurophysiology, neuroanatomy, and clinical neurology.² It offers a concise overview of their discovery, a

¹ This quote captures a conversation between Donald Johanson and C. Owen Lovejoy—an anthropologist and anatomist renowned for his expertise in human locomotion—focused on their examination of the distal femur and proximal tibia (Knee AL 129 a + 1b), which together constitute the femorotibial joint. These skeletal remains were unearthed by Johanson in 1973 in Ethiopia’s Afar region and were later identified as belonging to *Australopithecus afarensis*, the same species as the iconic Lucy, discovered the following year.

² Somewhat surprisingly, medicine as a whole—and neurology in particular—has been slow to interpret its findings through an evolutionary lens, especially when it comes to integrating paleoanthropological evidence. In a striking contrast, psychology has been far more willing to draw on insights from comparative ethology and paleoanthropology, even though these fields rely



summary of their skeletal and neuroanatomical features, and a discussion of how these findings inform the interpretation of neurological signs and developmental patterns in modern medicine.

2. Milestones in the History of Paleoanthropology

The emergence of paleoanthropology as a scientific discipline in the late 19th and early 20th centuries was marked by a series of landmark discoveries, debates, and even deceptions that shaped our understanding of human origins. Its central aim was to identify humanity's evolutionary roots and to locate the so-called “missing link” between apes and humans.

The first scientifically recognized Neanderthal fossil was unearthed in 1856 in the Neander Valley near Düsseldorf, Germany. Studied by Johann Carl Fuhlrott (1803-1877) and later named *Homo neanderthalensis* by the Irish geologist William King (1809-1886) in 1864, it was the first hominin specimen recognized as belonging to a prehistoric human species. Although controversial at the time, the Neanderthal find began to dislodge the entrenched belief that humans were a divinely created, fixed species.

Philosophical and theoretical frameworks soon followed. Ernst Haeckel (1834-1919), the German biologist, proposed the existence of *Pithecanthropus alalus* (“speechless ape-man”), a hypothetical transitional form that reflected the evolutionary mindset of his time. Although no fossil evidence ever substantiated this claim, Haeckel's construct shaped early paleoanthropological inquiry. It even inspired the Dutch anatomist Eugène Dubois (1858-1940), whose 1891 discovery on the island of Java of what he named *Pithecanthropus erectus* (later reclassified as *Homo erectus*) represented one of the first concrete attempts to fill that theoretical gap.

For Haeckel as for paleoanthropology in its inception, man was seen as a cultural product of biology, a superorganic³ organism not only shaped by evolution and physiology, but also carrier of culture, language, symbols, and collective memory—elements that operate beyond the boundaries of organic biology.

Once initial resistance was overcome and the narcissistic wound healed—the one inflicted by the realization that humans are animals among animals, generated by nature through natural selection rather than divinely created⁴—and once the fixist view of species was definitively abandoned, a new idea began to emerge: that our ancestor likely possessed ape-like traits. However, two features were considered non-negotiable in defining human uniqueness: bipedalism and a large brain. After all, humans are the only primates with obligatory bipedal locomotion—not optional or occasional—and with a voluminous brain. It was long believed that these two traits evolved in tandem and were always present together throughout our evolutionary history.

heavily on fossil morphology—an approach that might seem mismatched with psychology's introspective and behavioral orientation. Yet it is precisely this unexpected intellectual convergence that has helped give rise to evolutionary psychology. See: Buss DM. *Evolutionary Psychology: The New Science of the Mind*. Routledge; 2019.

³ The term was popularized by anthropologist Alfred L. Kroeber (1876-1960).

⁴ “It is quite certain that the Ape which most nearly approaches man, in the totality of its organisation, is either the Chimpanzee or the Gorilla [...]”. Huxley TH. *Man's Place in Nature: And Other Anthropological Essays*. D. Appleton; 1899:97.



In Britain, the Piltdown Man (*Eoanthropus dawsoni*), “discovered” in 1913 by Charles Dawson (1865-1916), was hailed as the missing link due to its combination of a large cranial capacity and features suggesting upright walking (Dawson and Woodward 1913). Yet it was later exposed as a fraud — a composite of human skull fragments and an orangutan jaw — more than forty years after its introduction (Walsh 1996). The appeal of Piltdown lay precisely in its apparent confirmation of the belief that bipedalism and a large brain had evolved together.

This belief was further challenged in 1925, when Raymond Dart (1893-1988) described the *Australopithecus africanus* fossil known as the Taung Child (Dart 1925). Despite the forward position of its foramen magnum, which suggested bipedal locomotion, its small cranial vault made many reluctant to accept it as a human ancestor. Nevertheless, Dart’s discovery pointed to Africa as the cradle of humanity — a hypothesis that subsequent finds would confirm thanks to the pioneering excavations by Louis (1903-197) and Mary Leakey (1913-1996) in Olduvai Gorge in the mid-20th century.

3. Unearthing “Lucy” and “Selam”: A Turning Point in Hominin Discovery

The mid-1970s marked a decisive turning point in paleoanthropology with discoveries in the Afar region of Ethiopia. In 1973, Donald Johanson (b. 1943) unearthed a femorotibial joint — the distal femur and proximal tibia (Knee AL 129 a + 1b) — whose morphology confirmed habitual bipedalism in an early hominin (Johanson and Edey 1981). This finding provided the first concrete evidence that upright walking had deep evolutionary roots, even before the identification of a complete skeleton. Reflecting on these remains, Johanson discussed them with C. Owen Lovejoy (b. 1943), an anatomist renowned for his expertise in human locomotion. Lovejoy noted the paradox: a creature capable of efficient bipedalism, yet unlikely to have possessed a large brain (Johanson and Edey 1981).

Only a year later, on November 24, 1974, Johanson and his team recovered the remains of a partial skeleton in Hadar, Ethiopia. Designated AL 288-1 and later nicknamed “Lucy,” the find comprised approximately 40% of a skeleton, an extraordinary level of completeness for such an ancient fossil (Johanson and Edey 1981) (Figure 1). Dated to about 3.2 million years ago, Lucy belonged to a new species formally described in 1978 as *Australopithecus afarensis* (Johanson et al. 1978). The skeletal remains clearly demonstrated habitual upright walking, supported by pelvic, femoral, and tibial features, but the cranial elements indicated a brain size far smaller than that of modern humans.

Additional evidence came from Tanzania, where Mary Leakey’s team uncovered the Laetoli footprints, dated to 3.6 million years ago (Leakey and Hay 1979). These prints preserved in volcanic ash bore unmistakable signs of bipedal locomotion, reinforcing the view that upright walking long preceded the expansion of the brain. In conjunction with Lucy’s skeletal remains, the Laetoli footprints firmly established *Australopithecus afarensis* as a pivotal species in the evolutionary transition toward habitual bipedalism.

A generation later, on December 10, 2000, another remarkable discovery was made in Ethiopia, this time in the Dikika site, approximately ten kilometers from where Lucy was discovered. Zeresenay Alemseged (b. 1969) and his team uncovered the exceptionally well-preserved skeleton of a juvenile *Australopithecus afarensis* (Alemseged et al. 2006). Officially catalogued



as DIK-11 and affectionately nicknamed “Selam,” (“Peace” in Amharic) or the “Dikika Child,” the fossil is 3.32 million years old and represents the most complete skeleton of a young hominin ever found. Her remains, estimated at 60–70% complete, included elements rarely preserved in the fossil record, such as the shoulder blades, the collar bones, most of the cervical and thoracic spine, ribs, and delicate cranial bones.

Selam’s skeleton revealed a mosaic of traits. The curved fingers and shoulder blades suggested some arboreal adaptations, indicating that climbing may still have played a role in the daily life of *A. afarensis* (Alemseged et al. 2006). At the same time, the structure of the lower limbs confirmed habitual bipedalism, demonstrating the species’ dual adaptation to both terrestrial and arboreal environments. Even more striking was the preservation of the cranial cavity, filled with fine-grained sandstone, which created a natural endocast. This rare occurrence allowed researchers to study aspects of brain morphology and organization with unprecedented precision.

4. Anatomy and Neurodevelopment: Insights from Fossilized Skeletons

The skeletons of Lucy and Selam provide a unique window into the biology of *Australopithecus afarensis*, revealing both the locomotor adaptations and the neurological potential of this early hominin species.

Skeletal Features

Lucy’s pelvis is broad and basin-shaped, confirming her female sex and reflecting adaptations for bipedal locomotion. Her femur angles inward toward the knee, and her tibia is aligned to efficiently transfer weight across the joint—hallmarks of upright walking. These features, taken together, provide unequivocal evidence of habitual bipedalism. Notably, her femur is relatively longer in proportion to the humerus compared to chimpanzees, further distinguishing her locomotor pattern from that of arboreal apes and underscoring the terrestrial nature of her gait (Johanson et al. 1978). The supratrochlear foramen (septal aperture),⁵ a rare anatomical feature in the distal humerus, is present in both of Lucy’s humeri, suggesting a retained primitive trait common in some non-human primates (Singhal and Rao 2007). Its presence may reflect evolutionary continuity in limb morphology and offers insights into locomotor adaptations and joint structure.

⁵ One of the first to evaluate the humeral supratrochlear foramen in humans and primates was Fabio Frassetto (1876–1953), professor of anthropology at Bologna, who in 1902 reported variable frequencies across populations and suggested it was a vestigial trait with limited functional significance. Frassetto F. Osservazioni comparative sul foro olecranico. *Atti della Società romana di antropologia* 1902;7:264-296.



Figure 1. Cast of the *Australopithecus afarensis* specimen AL 288-1 (“Lucy”) shown in anatomical position. Photograph taken from a museum exhibit at the Muséum national d'histoire naturelle in Paris. Source: Wikipedia, Public Domain.

Selam’s skeleton enriches our understanding of early hominin anatomy with elements rarely preserved in the fossil record. Approximately 60–70% complete, her remains include several articulated postcranial elements: both scapulae and clavicles, the cervical, thoracic, and first two lumbar vertebrae, along with numerous ribs (Alemseged et al. 2006). The curvature of her fingers, along with the ape-like morphology of her shoulder blades and the upward orientation of the shoulder socket—more akin to that of non-human apes than modern humans—suggests retained climbing abilities, consistent with arboreal behavior. Yet, her lower limb anatomy clearly indicates obligatory bipedalism. This is further supported by the position of the occipital foramen, located directly beneath the head’s center of gravity—more anterior than in apes of



similar age, and characteristic of upright posture in humans. However, the structure of the inner ear—particularly the semicircular canals—remains more similar to that of chimpanzees, suggesting that aspects of balance and spatial orientation had not yet fully adapted to habitual bipedalism (Alemseged et al. 2006). Additionally, Selam's thoracic spine comprises twelve vertebrae, consistent with most later hominins, whereas chimpanzees typically possess thirteen (Ward et al. 2017).

This blend of features exemplifies the mosaic nature of early hominin evolution: Selam was terrestrial in locomotion, yet retained anatomical traits suited for climbing. Her skeleton reflects a transitional phase, where adaptations for life on the ground coexisted with remnants of an arboreal past.

Brain Size and Morphology

Comparisons of brain size across mammals highlight why Lucy and Selam are central to understanding the trajectory of human neuroevolution.

The cranial capacity of adult *A. afarensis* ranged between 380 and 520 cubic centimeters, with a mean of approximately 450 cc. This was about 15–20% larger than that of modern chimpanzees (*Pan troglodytes*), and 30–40% larger than *Ardipithecus ramidus*. However, the brain remained considerably smaller than that of later *Homo* species (Cofran 2019).

One widely used metric for comparing brain size across species is the encephalization quotient (EQ)—a ratio that adjusts brain volume relative to body size, offering a more meaningful measure of cognitive potential than raw brain mass alone. Chimpanzees have an EQ of ~2, australopithecines like *A. afarensis* around 2.5, and humans exceed 5, with brain volumes ranging from 1 to 1.7 liters. Fossil evidence charts the evolutionary progression: *Sahelanthropus tchadensis* (~350 ml), *Australopithecus afarensis* (~440 ml), *Homo erectus* (~910 ml, EQ ~3.7), and later *Homo heidelbergensis* and Neanderthals surpassing 1,000 ml (Roberts 2009).

The natural endocast preserved in Selam's skull provided exceptional insights. High-resolution imaging revealed the persistence of the lunate sulcus in an ape-like position, suggesting that the occipital cortex remained organized much like that of chimpanzees, and that visual and sensory regions of the cortex had not yet shifted toward a human-like configuration (Gunz et al. 2020). In contrast, the postorbital region of the skull appeared widened, indicating a potential increase in prefrontal cortex volume. This hints at early, though modest, expansion of brain regions associated with higher cognition, planning, and social behavior.

These findings reveal that *A. afarensis* occupied a transitional stage — slightly above apes in relative brain size, with hints of frontal reorganization — setting the stage for the disproportionate cortical growth that became a hallmark of the genus *Homo*.



Conversely, evidence from earlier hominins indicates that small brain size persisted well before the emergence of *A. afarensis*. Although the fragmentary nature of their post-cranial remains limits firm conclusions about locomotion, the diminutive cranial capacities of *Ardipithecus ramidus* (ca. 4.4 Ma) (White et al. 1994) and *Sahelanthropus tchadensis* (ca. 7 Ma) (Brunet et al. 2002) show that potential early bipeds retained brains comparable in size to those of modern apes. This pattern strengthens the view that substantial encephalization did not precede bipedalism; rather, it followed the establishment of habitual upright walking, unfolding gradually over subsequent hominin lineages.

Brain Development and Neoteny

One of the most revealing insights comes from comparisons of juvenile brain growth. Selam, estimated to have died at around two and a half years of age, had a brain size smaller than that of a chimpanzee child of the same age. Her cranial capacity is estimated at approximately 275–330 cm³, representing about 65–88% of the adult brain volume in *Australopithecus afarensis*, which ranged between 375–435 cm³ (Alemseged et al. 2006). In contrast, chimpanzee brains develop more rapidly, reaching about 90% of their adult size by age three.

This paradox—smaller juvenile brain size despite a relatively larger adult brain volume—suggests that *Australopithecus afarensis* experienced slower brain development, with maturation extending well into later childhood. Such delayed growth is a hallmark of human evolution and anticipates the prolonged childhood that would later define *Homo sapiens*, linking skeletal and neurological changes in a trajectory toward increasing cognitive capacity. This developmental pattern reflects an early form of neoteny—the evolutionary extension of juvenile traits into later life stages. In humans, neoteny allows for prolonged brain plasticity, extending the window for learning, socialization, and cultural transmission.⁶ Supporting this interpretation, another juvenile specimen, AL 333-105, exhibits similar evidence of delayed brain growth (Cofran 2019).

5. Evolutionary Echoes in Clinical Neurology

By tracing the evolutionary trajectory of our species, paleoanthropology helps illuminate why certain neural circuits remain so deeply embedded in the human nervous system and why they exhibit extraordinary resilience (Brigo 2025). Central pattern generators — networks responsible for rhythmic movements such as walking, chewing, and breathing — exemplify this continuity (Tassinari et al. 2009). These circuits are not vestigial remnants but evolutionary inheritances that have been refined over millions of years. Their robustness is such that they can re-emerge even after extensive cortical injury, and in rare cases may persist in individuals with brain death, provided the spinal cord remains intact and the heart continues to beat (Brigo, 2011a).

Remarkably, many of these circuits manifest in the form of primitive reflexes present at birth. The stepping reflex in newborns, where infants instinctively perform walking-like movements when held upright with their feet touching a surface, demonstrates that motor programs for

⁶ The term *neoteny* derives from the Greek *neos* (νέος), meaning “young,” and *teínein* (τείνειν), meaning “to stretch” or “to extend,” reflecting the evolutionary stretching of youthful characteristics across the lifespan. In humans, this manifests not only in physical features—such as a flatter face and larger cranial vault—but also in behavioral traits like curiosity.



bipedal locomotion are active before voluntary control develops (Brigo 2025). Similarly, reflexes such as rooting, sucking, palmar and plantar grasp, Moro, and Babinski represent conserved behaviours that link modern humans with both other primates and ancestral hominins (Brigo 2025). These responses can be regarded as examples of “evolutionary baggage” — neurological echoes of survival strategies that shaped our lineage.

Clinical neurology provides a unique window into the persistence of these traits. Signs such as the Babinski reflex, spasticity patterns, and the triple flexion response reflect ancestral motor strategies once critical for arboreal locomotion. Research by Fulton and Keller showed that the threshold for eliciting Babinski decreases as one ascends the primate scale, with apes displaying this reflex more readily than monkeys (Fulton and Keller 1932). Robert Wartenberg (1887-1956) later emphasized that spastic postures often resemble phases of climbing, with features such as toe spreading, thigh abduction, and limb flexion recalling the mechanics of arboreal grasping (Wartenberg 1947). Even the evolutionary history of the hallux supports this view: in *Ardipithecus ramidus* the great toe was divergent and suited for grasping, whereas in humans dorsiflexion substitutes imperfectly for abduction, a trace of adaptation to upright walking (White et al. 1994; Lovejoy et al. 2009).

Beyond reflexes, gestural automatisms, as forced grasping, utilization behaviour, manipulation automatisms in epilepsy, and mirror movements reveal further evolutionary continuity (Brigo 2025). These behaviours, often unmasked by cortical damage, may represent vestiges of a motor repertoire in which grasping and bilateral coordination were essential for survival. Their suppression in healthy adults depends on cortical inhibition, particularly within the frontal lobes (Brigo 2011b), highlighting the evolutionary transition from arboreal locomotion to voluntary, precise motor control in the genus *Homo*.

Conclusion

The fossils of Lucy and Selam offer more than a glimpse into our evolutionary origins—they provide a lens through which clinical neurology can be reinterpreted. For neurologists, adopting an evolutionary perspective helps illuminate the deeper biological significance of primitive reflexes, spastic postures, and motor automatisms: they are evolutionary echoes, conserved neural patterns that resurface in development and disease. Lucy and Selam remind us that the nervous system is not only a platform for higher cognition but also a scaffold built upon ancient motor strategies.

When clinical signs are viewed through this evolutionary framework, they cease to be isolated anomalies and instead become meaningful expressions of our deep biological heritage—living footprints of adaptation and survival. Just as the Laetoli footprints mark the physical presence of early bipeds, the traces of ancestral behavior lie embedded in our neural circuitry, reemerging in pathology as silent witnesses to our evolutionary journey.



References

- Alemseged Z, Spoor F, Kimbel WH, Bobe R, Geraads D, Reed D, Wynn JG. A juvenile early hominin skeleton from Dikika, Ethiopia. *Nature*. 2006;443(7109):296–301.
- Brigo F. Central pattern generators: a bridge between life and death. *Can J Neurol Sci*. 2011a;38(3):532.
- Brigo F. Gestural automatisms during syncope: the unifying concept of central pattern generators. *Epilepsy Behav*. 2011b;22(2):416.
- Brigo F. Ancestral Traces in The Nervous System: Evolutionary Clues for Neurology. *Neurol Sci*. 2025 [in press]
- Brunet M, Guy F, Pilbeam D, Mackaye HT, Likius A, Ahounta D, Beauvilain A, Blondel C, Bocherens H, Boisserie JR, De Bonis L, Coppens Y, Dejax J, Denys C, Düringer P, Eisenmann V, Fanone G, Fronty P, Geraads D, Lehmann T, Lihoreau F, Louchart A, Mahamat A, Merceron G, Mouchelin G, Otero O, Pelaez Campomanes P, Ponce De Leon M, Rage JC, Sapanet M, Schuster M, Sudre J, Tassy P, Valentin X, Vignaud P, Viriot L, Zazzo A, Zollikofer C. A new hominid from the Upper Miocene of Chad, Central Africa. *Nature*. 2002;418(6894):145–51.
- Cofran Z. Brain size growth in *Australopithecus*. *J Hum Evol*. 2019;130:72–82.
- Dart RA. *Australopithecus africanus*: The man-ape of South Africa. *Nature*. 1925;115(2884):195–199.
- Dawson C, Woodward A. On the discovery of a Palaeolithic human skull and mandible in a flint-bearing gravel bed at Piltdown. *Q J Geol Soc Lond*. 1913;69(1–4):117–123.
- Dobzhansky T. Nothing in Biology Makes Sense Except in the Light of Evolution. *The American Biology Teacher*. 1973;35(3):125–129.
- Fulton JF, Keller AD. *The Sign of Babinski: A Study of the Evolution of Cortical Dominance in Primates*. Charles C. Thomas; 1932.
- Gunz P, Neubauer S, Falk D, Tafforeau P, Le Cabec A, Smith TM, Kimbel WH, Spoor F, Alemseged Z. *Australopithecus afarensis* endocranial casts suggest ape-like brain organization and prolonged brain growth. *Sci Adv*. 2020;6(14):eaa4729.
- Johanson DC, Edey MA. *Lucy: The Beginnings of Humankind*. Simon & Schuster; 1981.
- Johanson DC, White TD, Coppens Y. A new species of the genus *Australopithecus* from the Pliocene of Hadar, Ethiopia. *Kirtlandia*. 1978;28:1–14.
- Leakey MD, Hay RL. Pliocene footprints in the Laetoli Beds at Laetoli, northern Tanzania. *Nature*. 1979;278(5702):317–323.
- Lovejoy CO, Latimer B, Suwa G, Asfaw B, White TD. Combining prehension and propulsion: the foot of *Ardipithecus ramidus*. *Science*. 2009;326(5949):72e1–8.
- Roberts A. *The Incredible Human Journey*. London: Bloomsbury Publishing; 2009.
- Singhal S, Rao V. Supratrochlear foramen of the humerus. *Anat Sci Int*. 2007;82(2):105–7.
- Tassinari CA, Cantalupo G, Högl B, Cortelli P, Tassi L, Francione S, Nobili L, Meletti S, Rubboli G, Gardella E. Neuroethological approach to frontolimbic epileptic seizures and parasomnias: The same central pattern generators for the same behaviours. *Rev Neurol (Paris)*. 2009;165(10):762–768.
- Walsh J. *Unraveling Piltdown: The Science Fraud of the Century and Its Solution*. Random House; 1996.
- Ward CV, Nalley TK, Spoor F, Tafforeau P, Alemseged Z. Thoracic vertebral count and thoracolumbar transition in *Australopithecus afarensis*. *Proc Natl Acad Sci U S A*. 2017;114(23):6000–6004.



Wartenberg R. The Babinski reflex after 50 years. *J Am Med Assoc.* 1947;135(12):763-7.

White TD, Suwa G, Asfaw B. *Australopithecus ramidus*, a new species of early hominid from Aramis, Ethiopia. *Nature.* 1994;371(6495):306-12.

Specific Statements

Permissions: The photo reproduced in this article is in the public domain.

Patient Consent: Not applicable.

Funding: The author received no specific funding for this work.

Conflicts of Interest: The author declares no conflicts of interest.

Provenance and peer review: Not commissioned; externally peer reviewed. Submitted: October 1, 2025. Accepted: December 11, 2025.

Disclaimer

The content provided on The Charcot Journal website is for informational and educational purposes only. It is not intended as a substitute for professional medical advice, diagnosis, or treatment. Always seek the advice of your physician or other qualified health provider with any questions you may have regarding a medical condition. Never disregard professional medical advice or delay in seeking it because of something you have read on this site. The Charcot Journal and its contributors do not accept any responsibility for any loss which may arise from reliance on information contained on this site.

Terms and Conditions

Unless otherwise stated, all content is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0). You may share the content for non-commercial purposes, provided that (a) proper attribution is given to the original authors and The Charcot Journal; (b) the content is not modified or adapted in any way. Commercial use and the creation of derivative works are not permitted without prior written permission from the copyright holder. Authors retain full copyright and may reuse their own work in any form, including for commercial purposes. The website may contain links to third-party websites. We are not responsible for the content or practices of these external sites. We reserve the right to update or modify these terms at any time without prior notice.