= Java Man =

Java Man (Homo erectus erectus) is the popular name given to early human fossils discovered on the island of Java (Indonesia) in 1891 and 1892 . Led by Eugène Dubois , the excavation team uncovered a tooth , a skullcap , and a thighbone at Trinil on the banks of the Solo River in East Java . Arguing that the fossils represented the " missing link " between apes and humans , Dubois gave the species the scientific name Anthropopithecus erectus , then later renamed it Pithecanthropus erectus .

The fossil aroused much controversy . Less than ten years after 1891 , almost eighty books or articles had been published on Dubois 's finds . Despite Dubois ' argument , few accepted that Java Man was a transitional form between apes and humans . Some dismissed the fossils as apes and others as modern humans , whereas many scientists considered Java Man as a primitive side branch of evolution not related to modern humans at all . In the 1930s Dubois made the claim that Pithecanthropus was built like a " giant gibbon " , a much misinterpreted attempt by Dubois to prove that it was the " missing link " .

Eventually , similarities between Pithecanthropus erectus (Java Man) and Sinanthropus pekinensis (Peking Man) led Ernst Mayr to rename both Homo erectus in 1950 , placing them directly in the human evolutionary tree . To distinguish Java Man from other Homo erectus populations , some scientists began to regard it as a subspecies , Homo erectus erectus , in the 1970s . Other fossils found in the first half of the twentieth century in Java at Sangiran and Mojokerto , all older than those found by Dubois , are also considered part of the species Homo erectus . Estimated to be between 700 @,@ 000 and 1 @,@ 000 @,@ 000 years old , at the time of their discovery the fossils of Java Man were the oldest hominin fossils ever found . The fossils of Java Man have been housed at the Naturalis in the Netherlands since 1900 .

= = History of discoveries = =

= = = Background = = =

Charles Darwin had argued that humanity evolved in Africa , because this is where great apes like gorillas and chimpanzees lived . Though Darwin 's claims have since been vindicated by the fossil record , they were proposed without any fossil evidence . Other scientific authorities disagreed with him , like Charles Lyell , a geologist , and Alfred Russel Wallace , who had thought of the theory of evolution around the same time as Darwin . Because both Lyell and Wallace believed that humans were more closely related to gibbons and orangutans , they identified Southeast Asia as the cradle of humanity because this is where these great apes lived . Dutch anatomist Eugène Dubois favored the latter theory , and sought to confirm it .

= = = Trinil fossils = = =

In October 1887 , Dubois abandoned his academic career and left for the Dutch East Indies (present @-@ day Indonesia) to look for the fossilized ancestor of modern man . Having received no funding from the Dutch government for his eccentric endeavor ? since no one at the time had ever found an early human fossil while looking for it ? he joined the Dutch East Indies Army as a military surgeon . Because of his work duties , it was only in July 1888 did he begin to excavate caves in Sumatra . Having quickly found abundant fossils of large mammals , Dubois was relieved of his military duties (March 1889) , and the colonial government assigned two engineers and fifty convicts to help him with his excavations . After he failed to find the fossils he was looking for on Sumatra he moved on to Java in 1890 .

Again assisted by convict laborers and two army sergeants , Dubois began searching along the Solo River near Trinil in August 1891 . His team soon excavated a molar (Trinil 1) and a skullcap (Trinil 2) . Its characteristics were a long cranium with a sagittal keel and heavy browridge . Dubois

first gave them the name Anthropopithecus , or " man @-@ ape " , as the chimpanzee was known at the time . He chose this name because a similar tooth found in the Siwalik Hills in India in 1878 had been named Anthropopithecus , and because Dubois first assessed the cranium to have been about 700 cubic centimetres (43 cu in) , closer to apes than to humans .

In August 1892 , Dubois 's team found a long femur (thighbone) shaped like a human one , suggesting that its owner had stood upright . Believing that the three fossils belonged to a single individual , " probably a very aged female " , Dubois renamed the specimen Anthropopithecus erectus . Only in late 1892 , when he determined that the cranium measured about 900 cubic centimetres (55 cu in) , did Dubois consider that his specimen was a transitional form between apes and humans . In 1894 , he thus renamed it Pithecanthropus erectus (" upright ape @-@ man ") , borrowing the genus name Pithecanthropus from Ernst Haeckel , who had coined it a few years earlier to refer to a supposed " missing link " between apes and humans . This specimen has also been known as Pithecanthropus 1 .

= = = Comparisons with Peking Man = = =

In 1927 , Canadian Davidson Black identified two fossilized teeth he had found in Zhoukoudian near Beijing as belonging to an ancient human , and named his specimen Sinanthropus pekinensis , now better known as Peking Man . In December 1929 , the first of several skullcaps was found on the same site , and it appeared similar but slightly larger than Java Man . Franz Weidenreich , who replaced Black in China after the latter 's death in 1933 , argued that Sinanthropus was also a transitional fossil between apes and humans , and was in fact so similar to Java 's Pithecanthropus that they should both belong to the family Hominidae . Eugène Dubois categorically refused to entertain this possibility , dismissing Peking Man as a kind of Neanderthal , closer to humans than the Pithecanthropus , and insisting that Pithecanthropus belonged to its own family , the Pithecanthropoidae .

= = = Other discoveries on Java = = =

After the discovery of Java Man , Berlin @-@ born paleontologist G. H. R. von Koenigswald recovered several other early human fossils in Java . Between 1931 and 1933 von Koenigswald discovered fossils of Solo Man from sites along the Bengawan Solo River on Java , including several skullcaps and cranial fragments . In 1936 , von Koenigswald discovered a juvenile skullcap known as the Mojokerto child in East Java . Considering the Mojokerto child skull cap to be a closely related to humans , von Koenigswald wanted to name it Pithecanthropus modjokertensis (after Dubois 's specimen) , but Dubois protested that Pithecanthropus was not a human but an " ape @-@ man " .

Von Koenigswald also made several discoveries in Sangiran , Central Java , where more fossils of early humans were discovered between 1936 and 1941 . Among the discoveries was a skullcap of similar size to that found by Dubois at the Trinil 2 site . Von Koenigswald 's discovers in Sangiran convinced him that all these skulls belonged to early humans . Dubois again refused to acknowledge the similarity . Ralph von Koenigswald and Franz Weidenreich compared the fossils from Java and Zhoukoudian and concluded that Java Man and Peking Man were closely related . Dubois died in 1940 , still refusing to recognize their conclusion , and official reports remain critical of the Sangiran site 's poor presentation and interpretation .

= = Early interpretations = =

More than 50 years after Dubois 's find , Ralph von Koenigswald recollected that , " No other paleontological discovery has created such a sensation and led to such a variety of conflicting scientific opinions . " The Pithecanthropus fossils were so immediately controversial that by the end of the 1890s , almost 80 publications had already discussed them .

Until the Taung child ? the 2 @.@ 8 million @-@ year @-@ old remains of an Australopithecus

africanus ? were discovered in South Africa in 1924 , Dubois 's and Koenigswald 's discoveries were the oldest hominid remains ever found . Some scientists of the day suggested that Dubois 's Java Man was a potential intermediate form between modern humans and the common ancestor we share with the other great apes . This supposition has been confirmed , but the current consensus of anthropologists is that the direct ancestors of modern humans were African populations of Homo erectus (possibly Homo ergaster) , rather than the Asian populations of the same species exemplified by Java Man and Peking Man .

= = = Missing link theory = = =

Dubois first published his find in 1894 . Dubois 's central claim was that Pithecanthropus was a transitional form between apes and humans , a so @-@ called " missing link " . Many disagreed . Some critics claimed that the bones were those of an upright walking ape , or that they belonged to a primitive human . This judgment made sense at a time when an evolutionary view of humanity had not yet been widely accepted , and scientists tended to view hominid fossils as racial variants of modern humans rather than as ancestral forms . After Dubois let a number of scientists examine the fossils in a series of conferences held in Europe in the 1890s , they started to agree that Java Man may be a transitional form after all , but most of them thought of it as " an extinct side branch " of the human tree that had indeed descended from apes , but not evolved into humans . This interpretation eventually imposed itself and remained dominant until the 1940s .

Dubois was bitter about this and locked the fossil up in a trunk until 1923 when he showed it to Ales Hrdlicka from the Smithsonian Institution . In response to critics who refused to accept that Java Man was a " missing link " , in 1932 Dubois published a paper arguing that the Trinil bones looked like those of a " giant gibbon " . Dubois ' use of the phrase has been widely misinterpreted as a retraction , but it was intended an argument to support his claim that Pithecanthropus was a transitional form . According to Dubois , evolution occurred by leaps , and the ancestors of humanity had doubled their brain @-@ to @-@ body ratio on each leap . To prove that Java Man was the " missing link " between apes and humans , he therefore had to show that its brain @-@ to @-@ body ratio was double that of apes and half that of humans . The problem was that Java Man 's cranial capacity was 900 cubic centimeters , about two thirds of modern humans ' .

Like many scientists who believed that modern humans evolved " Out of Asia " , Dubois thought that gibbons were closest to humans among the great apes . To preserve the proportions predicted by his theory of brain evolution , Dubois argued that Java Man was shaped more like a gibbon than a human . Imagined " with longer arms and a greatly expanded chest and upper body " , the Trinil creature became a gigantic ape of about 100 kilograms (220 lb) , but " double cephalization of the anthropoid apes in general and half that of man " . It was therefore halfway on the path to becoming a modern human . As Dubois concluded his 1932 paper : " I still believe , now more firmly than ever , that the Pithecanthropus of Trinil is the real ' missing link . ' "

= = = Reclassification as Homo erectus = = =

Based on Weidenreich 's work and on his suggestion that Pithecanthropus erectus and Sinanthropus pekinensis were connected through a series of interbreeding populations , German biologist Ernst Mayr reclassified them both as being part of the same species : Homo erectus . Mayr presented his conclusion at the Cold Spring Harbor Symposium in 1950 , and this resulted in Dubois 's erectus species being reclassified under the genus Homo . As part of the reclassification , Mayr included not only Sinanthropus and Pithecanthropus , but also Plesianthropus , Paranthropus , Javanthropus , and several other genera as synonyms , arguing that all human ancestors were part of a single genus (Homo) , and that " never one more than one species of man existed on the earth at any one time " . A " revolution in taxonomy " , Mayr 's single @-@ species approach to human evolution was quickly accepted . It shaped paleoanthropology in the 1950s and lasted into the 1970s , when the African genus Australopithecus was accepted into the human evolutionary tree .

In the 1970s a tendency developed to regard the Javanese variety of H. erectus as a subspecies ,

Homo erectus erectus , with the Chinese variety being referred to as Homo erectus pekinensis .

= = Post @-@ discovery analysis = =

= = = Date of the fossils = = =

Dubois ' complete collection of fossils were transferred between 1895 and 1900 to what is now known as the Naturalis , in Leiden in the Netherlands . The main fossil of Java Man , the skullcap cataloged as " Trinil 2 " , has been dated biostratigraphically , that is , by correlating it with a group of fossilized animals (a " faunal assemblage ") found nearby on the same geological horizon , which is itself compared with assemblages from other layers and classified chronologically . Ralph von Koenigswald first assigned Java Man to the Trinil Fauna , a faunal assemblage that he composed from several Javanese sites . He concluded that the skullcap was about 700 @,@ 000 years old , thus dating from the beginning of the Middle Pleistocene .

Though this view is still widely accepted , in the 1980s a group of Dutch paleontologists used Dubois 's collection of more than 20 @,@ 000 animal fossils to reassess the date of the layer in which Java Man was found . Using only fossils from Trinil , they called that new faunal assemblage the Trinil H. K. Fauna , in which H. K. stands for Haupt Knochenschicht , or " main fossil @-@ bearing layer " . This assessment dates the fossils of Java Man to between 900 @,@ 000 and 1 @,@ 000 @,@ 000 years old . (Work published in 2014 gives a " maximum age of 0 @.@ 54 ± 0 @.@ 10 million years and a minimum age of 0 @.@ 43 ± 0 @.@ 05 million years " for Ar @-@ Ar and luminescence dating of sediment in human @-@ predated shell material from Trinil . " Homo erectus at Trinil on Java used shells for tool production and engraving " Joordens et al . , 2014 , Nature online publishing ; work continues on assessing the dating of this complex site .) . Other fossils attest to the even earlier presence of H. erectus in Java . Sangiran 2 (named after its discovery site) may be as old as 1 @.@ 66 Ma (million years) . The controversial Mojokerto child , which Carl C. Swisher and Garniss Curtis once dated to 1 @.@ 81 ± 0 @.@ 04 Ma , has now been convincingly re @-@ dated to a maximum age of 1 @.@ 49 ± 0 @.@ 13 Ma , that is , 1 @.@ 49 million years with a margin of error of plus or minus 130 @,@ 000 years .

= = = Type Specimen = = =

The fossils found in Java are considered the type specimen for H. erectus . Because the fossils of Java Man were found " scattered in an alluvial deposit " ? they had been laid there by the flow of a river ? detractors doubted that they belonged to the same species , let alone the same individual . German pathologist Rudolf Virchow , for instance , argued in 1895 that the femur was that of a gibbon . Dubois had difficulty convincing his critics , because he had not attended the excavation , and could not explain specifically enough the exact location of the bones . Because the Trinil thighbone looks very much like that of a modern human , it might have been a " reworked fossil " , that is , a relatively young fossil that was deposited into an older layer after its own layer had been eroded . For this reason , there is still dissent about whether all the Trinil fossils represent the same species .

= = Physical characteristics = =

Java Man was about 5 feet 8 inches (170 cm) tall and his thighbones show that he walked erect like modern humans . The femur is thicker than that of a modern human . The skull was characterized by thick bones and a retreating forehead and no chin , as well as protruding browridges and a massive jaw . With 900 ccm , his cranial capacity was smaller than that of later H. erectus specimens . He had human teeth with large canines . Judging from anatomical and archeological aspects as well as Java Man 's ecological role , meat from vertebrates was likely an important part of their diet . Java Man , like other Homo erectus , was probably a rare species .

There is evidence that Java Man used shell tools to cut meat .

= = Material culture = =

H. erectus arrived in Eurasia approximately 1 @.@ 8 million years ago , in an event considered to be the first African exodus . There is evidence that the Java population of H. erectus lived in an ever @-@ wet forest habitat . More specifically the environment resembled a savannah , but was likely regularly inundated (" hydromorphic savanna ") . The plants found at the Trinil excavation site included grass (poaceae) , ferns , ficus , and indigofera , which are typical of lowland rainforest .

= = = Control of fire = = =

The control of fire by Homo erectus is generally accepted by archaeologists to have begun some 400 @,@ 000 years ago , with claims regarding earlier evidence finding increasing scientific support . Burned wood has been found in layers that carried the Java Man fossils in Trinil , dating to around from 500 @,@ 000 to 830 @,@ 000 BP . However , because Central Java is a volcanic region , the charring may have resulted from natural fires , and there is no conclusive proof that Homo erectus in Java controlled fire . It has been proposed that Java Man was aware of the use of fire , and that the frequent presence of natural fires may have allowed Java Man " opportunistic use [... that] did not create an archeologically visible pattern " .