Being Human, Again: Stories of Evolution Part 2

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Seeing is believing (or not)

Seeing is believing, they say; but there is something profoundly wrong with that statement, as borne out by our knowledge of most things in almost every sphere. Science, for example, does not demand that a concept (for example, 'energy') be directly visible, only its manifestations may be. It is said that most of the current ideas in Physics are dark matter, as most hypotheses are not physically testable. This was true even during Galilean times, Galileo himself did not – and in fact, plausibly could not -- perform most of the experiments, as most of the experiments were hypothetical or thought experiments. For example, a statement like "If a ball were to roll down a frictionless surface …" can only be an idealistic set up as it is not possible to have in reality a frictionless surface. No one "saw" the atom before particle Physics was founded, no one found the use of graphic design before Euclidean Geometry was founded, and so forth. Yet, time and again, and more so now—for reasons which have to do with a multitude of factors, including instant gratification—demonstrable results are demanded; something has to be *seen* to be *believed*.

THIS is also the reason for a recent public statement about Darwin's theory of evolution (see *The Indian Express*, Jan. 22, 2018) when a Union minister stated that "Nobody, including our ancestors, in written or oral, have said they saw an ape turning into a man," over which, the media had a hearty laugh for a week or two. However, I would like to consider this statement more academically, because, I think, such popular statements, shared by many, need to be analysed and dissected for everyone to see, and not just maligned or laughed at. There are at least two things in the above statement that need attention in the context of the topic that we are discussing in this series (that is, evolution)—one, revolving round the word "saw" or seeing, and the other, involving the use of the phrase "turning into". We have already discussed briefly above the relevance of "seeing", but if we were to situate this sentiment (*seeing is believing*) within the world of ideas then we must make reference to the debate between Rationalism and Empiricism, a debate which I termed elsewhere (Bhattacharya, 2015, "Pollock-er Bakkyo-bhongo Othoba Butterfly Effect" [in Bangla] *Ebong Mushaira*, Vol 22, Nos. 3-4: pp. 21-32) as the greatest, on-going football match of the millennia, the result of which is becoming more and more apparent.

A short foray into the Rationalism versus Empiricism debate

THE dominant discourse around us is based on various shades of Empiricism—that all knowledge is derived from or reducible to aspects of experience, that is, reality cannot be knowable from reason or rationality alone (roughly, Rationalism). Policies, funding, sympathies, and 'knowledge', are all geared towards what is 'visible' or visibly effective. Further support for the *status quo*, namely, that empiricism is winning the greatest on-going football match can be understood from the results of the PhilSurvey as in Table 1.

Other	1158 / 3226 (35.9%)
Accept or lean toward: empiricism	1254 / 3226 (38.9%)
Accept or lean toward: rationalism	814 / 3226 (25.2%)

Table 1: Knowledge: empiricism or rationalism? *(Source: http://philpapers.org/surveys/results.pl (31.03.17))*

IN fact, if we go by the various groups of respondents, the highest leaning towards empiricism obtains for (philosophy) undergraduates (42.4%) and the lowest leaning towards rationalism obtains for the group not affiliated to philosophy (22.9%) at all. Although this a small survey restricted mostly to philosophy students and faculty, it nonetheless shows the trend clearly; the trend being, for every person who leans toward rationalism, there are almost 2 persons who lean toward empiricism. If this is the result of a survey conducted among philosophy affiliated students and faculty, a similar survey in the context of an economically poorer region of the world will surely widen this gap considerably; and when such a survey is made open to the general public, the gap will be even wider (for more discussion, see Bhattacharya, forthcoming, "Disability Studies as Resistance: The Politics of Estrangement" in *Disability in South Asia*, ed. Anita Ghai, Sage Publications). This was about "seeing", the phrase "turning into" has a much more focussed relevance for the theory of evolution, to be discussed below.

Denying Darwin -- the old game

"TURNING into", when viewed with the Darwinian lens of natural selection must mean a long series of stages where each stage is reinforced through natural selection of some trait or other. Within this perspective, "turning into" cannot be an instantaneous event that can be "seen" by anyone, let alone by a potential observer who is yet to be turned into; in fact, there lies the fallacy of the minister's statement which no media has picked up—if, as per the Darwinian theory, the first human ever were to be turned into, from an ape, who is there to observe it, since by definition there is no human yet? Quite apart from this and a philosophical problem of the observer's paradox, the process of "turning into" in the parlance of evolution must involve several millennia.

Denial of Darwin's theory is not new; apart from theological creationism believed by 40% of Americans influenced by fundamental Christians who deny evolution and believe that god created humans, there have been scientific critiques of Darwin's natural selection soon after the *Origin of Species* was published in 1859. One of the most significant critiques came from a British zoologist, St. George Mivart (1817-1900). Mivart was influenced by religion and his thinking in zoology was often derived from religion.

In fact, the last chapter (chapter 12) of his book described below, is titled 'Theology and Evolution.' At the age of 17 he renounced the Anglican church and converted to Roman Catholicism. Given the importance of religion in other spheres of life at that time, the dominant prevailing atmosphere of Anglican Protestantism in England made his entry into Oxford or Cambridge to study Zoology impossible. Mivart ended up studying Law instead. However, he kept his interest in Zoology alive but pursuing the subject on the side and after completing his career in law, established himself as a distinguished anatomist. He did not deny evolution, but he strongly argued against Darwin's position on natural selection. He agreed that natural selection has a role to play when it comes to preservation and increasing of a preferred adaptive trait, but when it comes to the origin of that trait, Darwin's theory has nothing to say.

The incipient stages and the suddenness thesis

THIS questioning led Mivart to publish his major work in 1871, the title of the book was *On the Genesis of Species* a play on the title of Darwin's famous book mentioned above. The main criticism of Darwin's theory appeared in the chapter right after the Introduction, with a long-winded title, as was the practice of those times, 'The Incompetency of "Natural Selection" to Account for the Incipient Stages of Useful Structures.' The phrase "incipient stages" is very important to understand the debate. Mivart was questioning the difficulty and in fact impossibility on part of natural selection to explain how an organism can proceed from one intermediate stage to another intermediate stage in the course of evolution; what would be the selectional advantage of progressing from one such stage to another? Stephen Jay Gould, in an essay this section relies upon, titled "Not necessarily a wing" (*Natural History*, 1985), has a nice way of highlighting this dilemma, namely, that no organism could fly with 2% of a wing. Mivart thus raised a valid objection by saying that "Natural selection utterly fails to account for the conservation and development of the minute and rudimentary beginnings, the slight and insignificant commencements of structures, however useful those structures may afterwards become."

MIVART'S own solution to this dilemma is in fact the first foray into the somewhat strange idea of 'sudden' change that is more famously associated in fact with Darwin. In part 1 of this series (vol. 3, issue 4, p.20), the suddenness idea was mentioned in relation to language evolution, a topic that I will engage with throughout the series. Let us first see, how Mivart came upon this idea. After a fair amount of illustrations, Mivart arrives at the following conclusion:

> "Arguments may yet be advanced in favour of the view that new species have from time to time manifested themselves with *suddenness*, and by modifications *appearing at once*.... It is difficult, then, to believe that the Avian limb was developed in any other way than by a comparatively *sudden* modification of a marked and important kind." (italics mine)

AS can be read off from this quote, the suddenness thesis is really Mivart's idea, since Darwin's theory, on the contrary, prides itself on gradual changes sanctioned by natural selection. In fact, Darwin explicitly prohibits sudden change: "Natural Selection, if it be a true principle, will banish the belief ... of any great and sudden modification in their structure." Mivart's theory of evolution therefore is definitely an anti-Darwinian version of evolution.

Darwin's defence

DARWIN, on his part, though understood the seriousness of the issue that Mivart's critique raised, attacked it nonetheless, by playing on the ridiculousness of believing that a complex structure like a wing can evolve in a day:

> He who believes that some ancient form was transformed suddenly through an internal force or tendency into, for instance, one furnished with wings, will be... compelled to believe that many structures beautifully adapted to all the other parts of the same creature and to the surrounding conditions, have been suddenly produced; and of such complex and wonderful coadaptations, he will not be able to assign a shadow of an explanation....To admit all this is, as it seems to me, to enter into the realms of miracle, and to leave those of Science.

THUS, according to Darwin the suddenness thesis is nothing but a miracle, a miracle our controversial minister complained about nobody witnessing. Thus, not having witnessed such a miracle (for example, an ape "turning into" a human) is quite Darwinian since as per Darwin, it is not possible for such a sudden change to take place. In a strange way, therefore, our minister was being Darwinian rather than anti-Darwinian, since believing otherwise will not be within the realm of Science.

OF course, the story cannot end here, for at least two reasons; first, the attack on Mivart was to some extent unkind, as he did not really think anything can suddenly turn into any other thing. His knowledge and study of regularity in embryology and anatomy drove him to the conclusion that only those complex changes are possible that are already present as developmental programmes in ancestors. Secondly, the attack on Mivart does not make the dilemma go away, the dilemma can be represented schematically as in Figure 1:

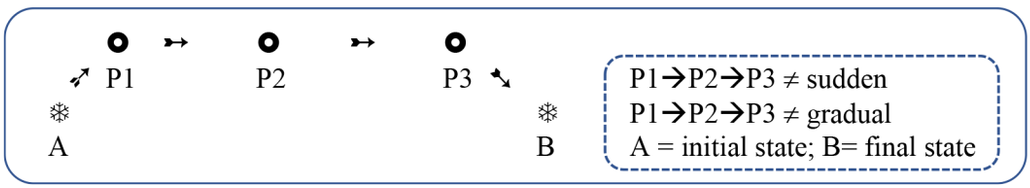

Figure 1: Schematic representation of the dilemma of Natural Selection

THAT is, complexity of the forms prohibits sudden transformation, and Natural Selection prohibits gradual development of the incipient stages. In short, Darwin had a task at hand.

DARWIN now makes a brilliant move. He points out that the situation represented in Fig. 1 has a latent assumption, namely, that P1, P2, and P3, or each of the incipient stages, is associated with a particular function, which is assumed to continue as well; that is, a notion of functional continuity is assumed. To take historically the most typical example in this domain, namely, that of the anatomy of wings for the function of flying, it may be true that no creature can fly with only 2% of the wing structure, but why should the function of that 2% be assumed to be that of flying? Perhaps the development at each incipient stage, determined as it is by Natural Selection, is for a different function; in other words the schema in Fig. 1 should be really as shown in Fig. 2, which shows that going from the initial state A (let us say, of having feathers) associated with function F1 (let us say, of thermoregulation) to state B (let us say, of having wings) associated with function F2 (let us say, of aerodynamics), each incipient stage P1, P2, and P3, has a unique function f1, f2, and f3, respectively, associated with it. This, in short, is the principle of *functional change in structural continuity*.

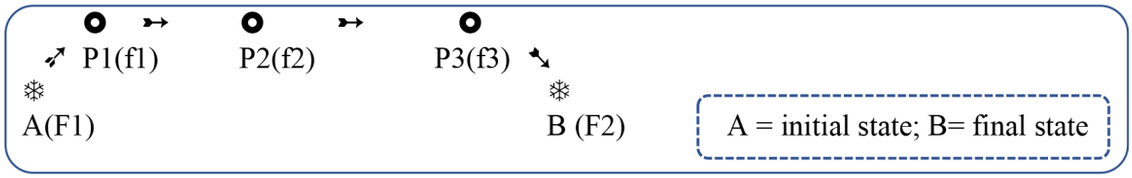

Figure 2: Schematic representation of functional change in structural continuity

DARWIN admitted that this is "an important subject, which was not treated at sufficient length in the former editions of this work," further adding that "in considering transitions of organs, it is so important to bear in mind the probability of conversion from one function to another." This admission, on the part of Darwin, appearing in later editions of *Origin of Species*, must stand as a homage to Mivart's critique of the incipient stages.

To fly or not to fly

HOWEVER, this defence of Darwin has not been picked up by the scientific community enthusiastically, mainly due to a lack of any confirmed evidence in favour of it. Gould's 1985 report of the study by Kingsolver & Koehl (1985) ('Aerodynamics, Thermoregulation, and the Evolution of Insect Wings: Differential Scaling and Evolutionary Change,' in *Evolution*) must count as a good evidence in favour of the theory of functional change. In fact, I would like to claim that Kingsolver & Koehl's (KK, henceforth) evidence in favour of Darwin's theory is in fact a demonstration of Mivart's suddenness thesis. KK created artificial Palaeozoic insects and manoeuvred several components like body shape, wind velocity, presence or placement of legs, and mounting position of wings to see their effect on aerodynamic ability of these artificial insects.

THE reason for them to go back to Palaeozoic times (541-251 ma) was because it is widely believed that *Rhyniognatha hirsti*, which is the world's oldest known insect, emerged very early during the Early Devonian Period, its fossil being estimated to be 407 to 396 million years old. Since the species is reputed to possess dicondylic mandibles, it suggests evolution of wings, since such mandibles is a feature associated with winged insects. Fig. 3 shows the fossil of *Rhyniognatha hirsti* discovered in 1919 near Aberdeen, Scotland. However, most of the earliest winged insects (Pterygota), which includes *Blattodea* (cockroaches) as well, appeared during the Carboniferous (359 to 299 ma).

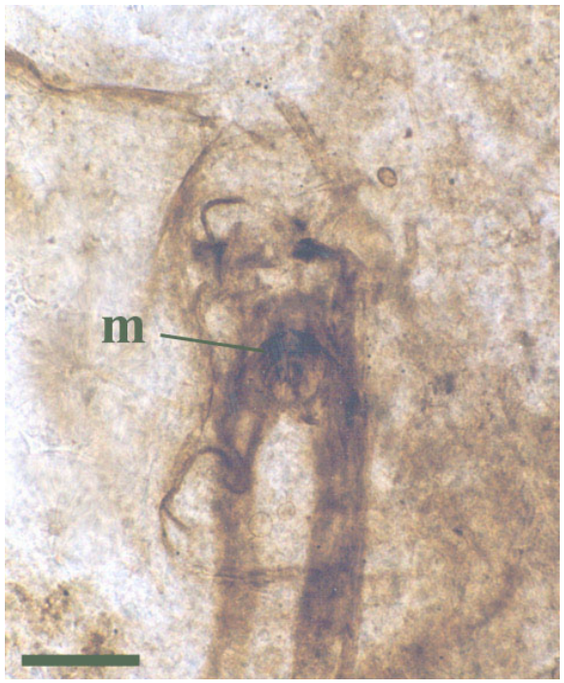

Figure 3: *Rhyniognatha hirsti*, the oldest insect fossil (M=bladed mandibles)
(http://www.abdn.ac.uk/rhynie/faunbasic8.htm)

COMPARED to this, the Archaeopteryx, the genus of a transitional bird-like winged dinosaur, lived in the Late Jurrasic (around 150 ma) (Fig. 4). The ability to fly in general may have evolved much earlier, at least 200 million years earlier than the transition of 'flying' dinosaurs to birds. Looking for the origin for the trait of flying is therefore more profitably and easily (and economically) studied in the domain of insects rather than through scattered and scarce late dinosaur fossils.

COMING back to the many experiments conducted by KK, one of the first results obtained is shown in Fig. 5. It shows that after a certain wing size, aerodynamic benefits begin and they increase proportionately with the wing size. If we concentrate on the two outer curves at body size of 2 cm, for the solid line (temperature gain)

Figure 4: The Archaeopteryx
By H. Raab (User: Vesta) - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=8066320

we find no substantial gain after 0.3 relative wing length. This means that wing size has no thermodynamic effect after this point. Whereas if we look at the dashed line, we find sudden gain in lift/ drag ratio after 0.7 relative wing length, until then the wing size has no substantial effect on lift/ drag.

THIS seems like a good support for Darwin's theory of functional change, showing that incipient wings aid thermoregulation but no aerodynamic benefit is obtained while larger wings provide aerodynamic advantage but no thermodynamic gain. The zone of functional change is marked out in the graph with a rectangle. Note, however, that within this zone, there is no substantial gain either from the temperature side or from the lift/ drag side; what would then be the motivation for continuing till the transition point? In other words, we are back to Mivart's objection. In fact, the only reason to continue would be if the system was somehow clairvoyant, knowing that there is going to be gain and a transition point at the right edge of the rectangular zone. As far as I can see, that would be leaving the realms of Science and entering those of miracle.

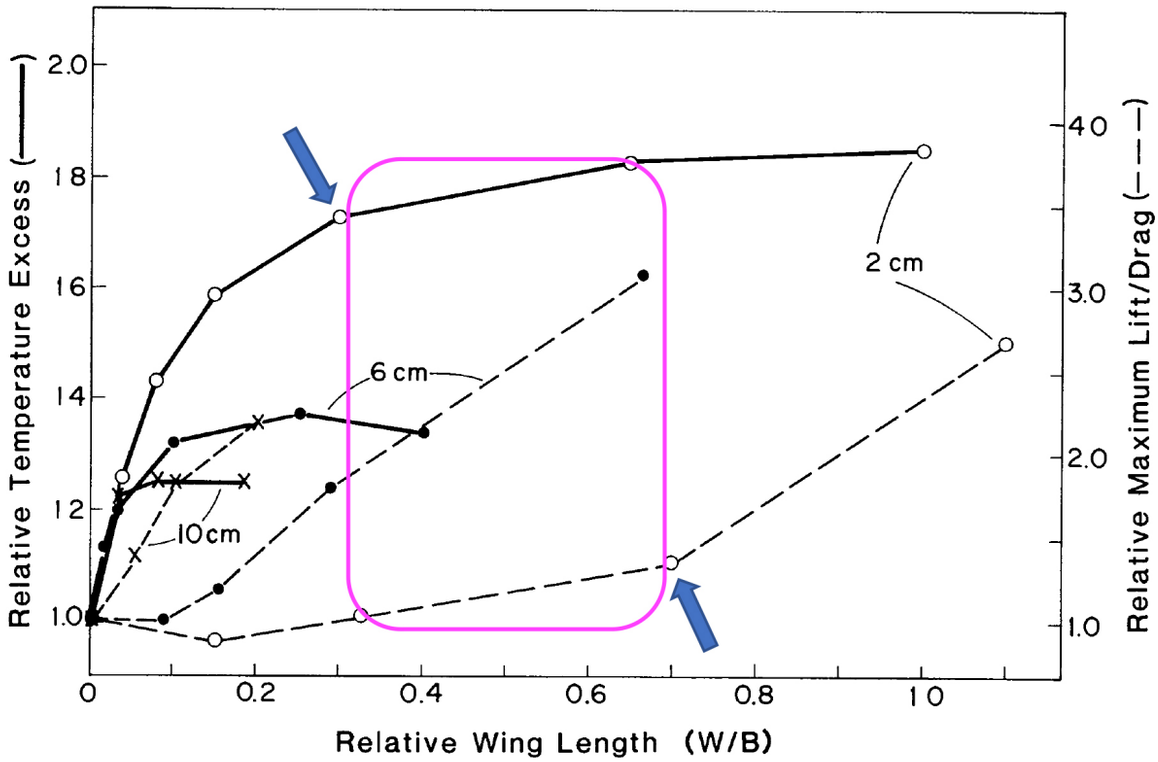

Figure 5: Relative temperature excess (left ordinate, solid lines) and maximum lift/ drag ratio (right ordinate, dashed lines) as a function of relative wing length (wing length/ body length) for body lengths of 2 cm (o), 6 cm (•), and 10 cm (x) (adapted from Kingsolver and Koehl, 1985: 501)

THIS is where KK's experiments become more interesting. As is clear from the graph in Fig. 5, body length is an important factor in determining a transition point. For example, if we compare the dashed curves for 2 cm and 6 cm of body length, we notice that the transition point for 6 cm is much earlier at 0.1 relative wing length, that is, a 6 cm body achieves lift at only 10% of the body length. Thus, if the body size of a Palaeozoic insect increased for some other reason, it would achieve the ability to fly much earlier, and that surely, would count as an adaptive advantage.

NOTE however, that at the left and right edge of the rectangular box, the points marked with an arrow each, at 0.3 and 0.7 of the relative wing length, can be considered as transition points where there is a sudden change—a sudden lack of thermodynamic gain and a sudden aerodynamic gain, respectively. This therefore supports the suddenness thesis, except that it is in the domain of functional change rather than morphological change. So, in a way both Mivart and Darwin have been right, there is suddenness but not in structural but only in the functional domain. The suddenness thesis is more appropriately termed as the *exaptation* thesis, by Gould and Vrba (1981), where an organ either changes a function or acquires a function from a state of non-functionality.

Language non-evolution

SO, there is no hope for our minister to catch anyone changing from one form to another physiological form (e.g. ape to human), but exaptation of traits was certainly possible. Recall (from Part 1) that at least the species *Australopithecus afarensis*, dated to about 3.7 Ma, found bipedalism to be of a distinct adaptive advantage. But a much more striking example of the supposed applicability of the exaptation thesis is in the domain of language 'evolution'. As in Part 1 and here, enclosing the word evolution within quotes is deliberate when it comes to language evolution. The theory of language evolution that I shall elaborate in this series, incrementally, can be called for want of a better term, the 'Non-evolutionary theory of language evolution'; in short, such a theory proposes that language never really evolved – it just happened one fine day, in short, the suddenness or the exaptation thesis.

JUST as the feathers changed from its function to keep the body warm to the development of wings for flying, a certain part of the brain anatomy, which was either non-functional or performing some other function previously, suddenly

exapted to its current function, which in turn resulted in language. However, in this series, by language we mean language as in our heads, not really as in speech. In fact, to recall again the introduction in Part 1, we will make a strong claim that language is *not* speech. But more of that later; here, let me emphasise that the appearance of language in our brains is a result of exaptation, a change in function, not structure. That significant event, perhaps ~100 ka, may have been the trigger for the second Out of Africa movement.

The global politics of 'tools'

We are however now back to the same conundrum that we ended Part 1 with, namely, the lack of hominin fossil finds in south Asia. If Out of Africa is associated with sophisticated tool making, why do we have a 'tools rich but fossil poor' situation in south Asia? In other words, there is a plethora of early tools that have been found, at least in India, but no hominin fossil worth reporting has been discovered. This imbalance also gives rise to the global politics of archaeology, whereby confirmed and published lithic finds from India or south Asia are not reported in the global platform. For example, the Indian subcontinent is amazingly rich in Acheulian tools, since "with the exception of northeast India and parts of Konkan Maharashtra, western Kerala, south of the Cauvery River in Tamil Nadu and Sri Lanka, Acheulean assemblages are found throughout most of the Indian subcontinent," (Patnaik & Chauhan, 2009: 733). Yet, when creating popular knowledge portals on Acheulian tools, such as in Wikipedia, no mention of these finds in south Asia can be found.

ONE significant event that has often been conjectured to be cause of demographic decimation in the Indian subcontinent and therefore the reason for lack of hominin fossils in the region, is the super-eruption of the Toba volcano, in Sumatra, known as the world's largest eruption, around ~74,000 years ago. Its extent of spread of erupted magma is estimated to be ~2800 km^3, which resulted in the deposition of a blanket of volcanic ash over India, Malaysia, the Indian Ocean, and the Arabian and South China Seas. Terrestrial tephra deposits have been found in many river valleys in India. Fig. 6 shows the marine and terrestrial distribution of the Toba tephra deposit sites in south and southeast Asia. The relationship between Toba ash deposit and archaeological assemblages

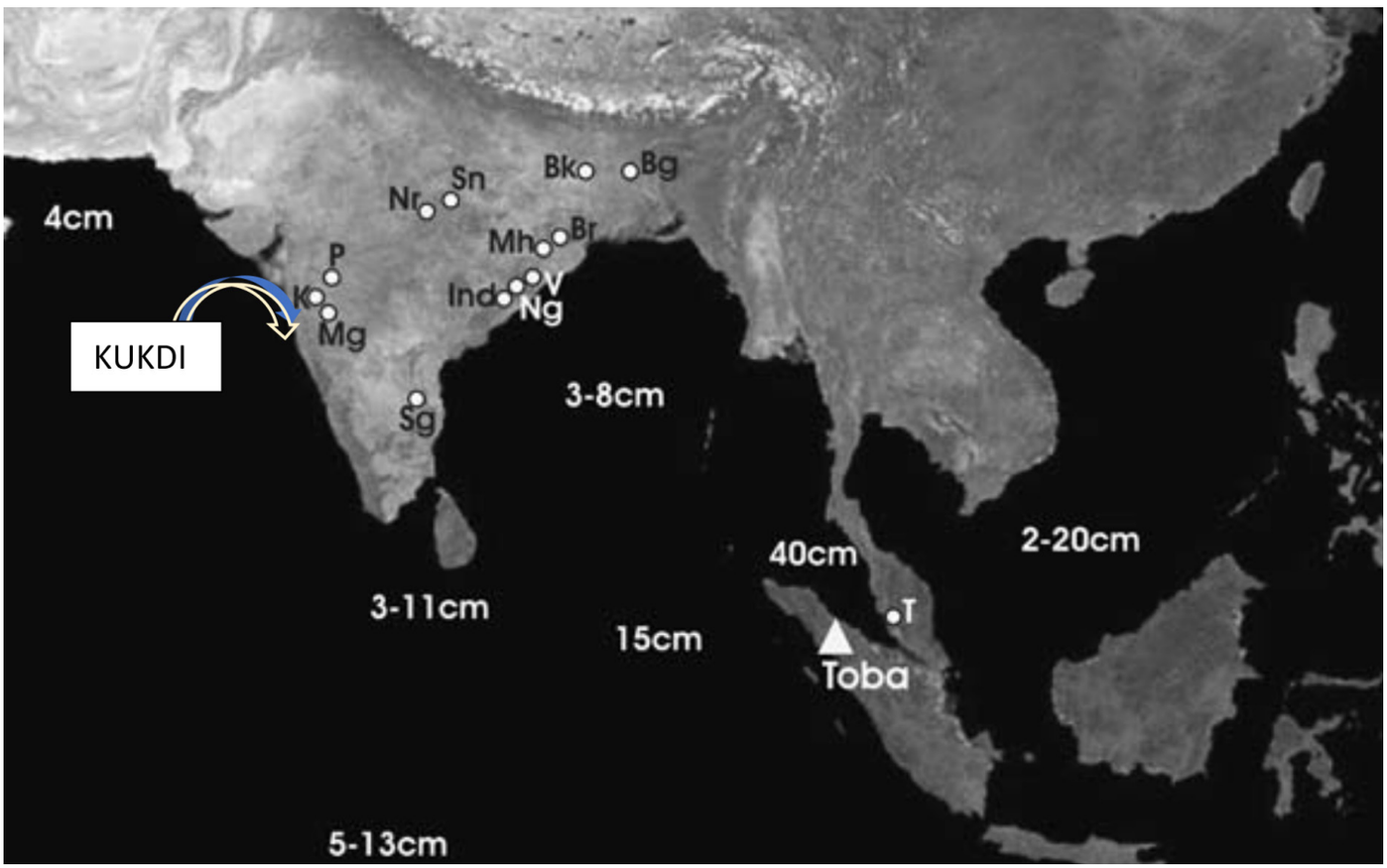

Figure 6: Marine and terrestrial distribution of Toba volcanic ash deposit sites in southern and southeast Asia. (from Jones, 2007: 179)

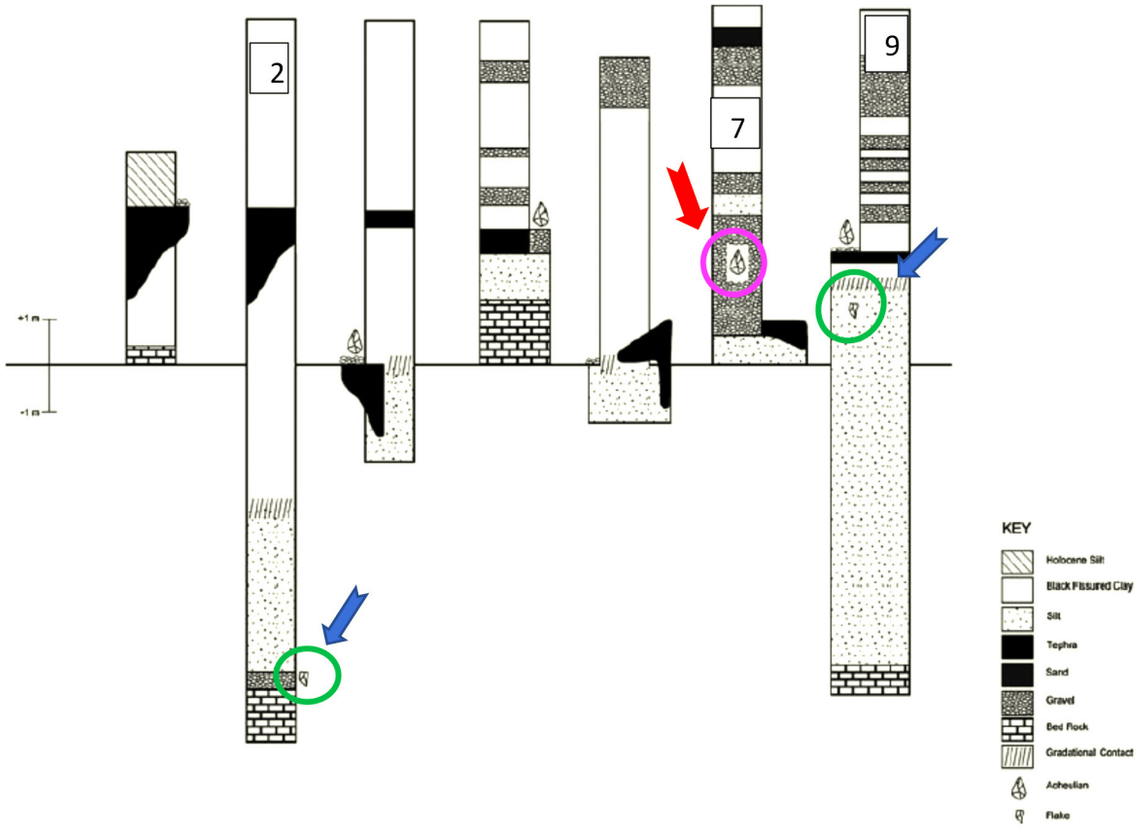

Figure 7: Tephra exposure along the Kukdi river (adapted from Mishra *et al*, 1995)

at the same site provides a valuable tool to evaluate the approximate hominin colonisation of the Indian subcontinent.

THE diagram in Fig. 7 shows the dated tephra by the river Kukdi near village Bori, in Junnar Taluka, Pune district. Most of the Acheulean artefacts were found in gravel cut into the tephra at sections 3, 4, 7, and 9, but apart from section 7 (marked in the diagram), the overlying deposit have been eroded from the gravel. In section 7, a total of 152 assemblages were found including handaxes, choppers, polyhedrons, and bifaces. Two artefacts were also recovered from the sediments underlying the tephra, at sections 2 and 9 (both marked in the diagram). These are simple flakes, and at least the artefact in section 2 predates the tephra considerably. This makes the overall dating of both the Acheulean artefacts found above the tephra and the tephra more contextually specific. Mishra *et al.* 1995 estimate the average age of the tephra in the sections to be 0.67±0.03 ma. These ages are apparently consistent with earlier reported age of 1.38 ± 0.24 ma dated through K/Ar. The Indian Acheulean is radiometrically dated as belonging to the beginning of the middle Pleistocene (~1.26 ma). Jones (2007) (in Petragalia and Allchin (eds.), 173-200) states on this basis that no Middle or Upper Palaeolithic assemblages have been found at any of these localities; in the last section, I will present an argument against this view.

The Indian Middle Palaeolithic

CONSIDER for example the recent report (Akhilesh *et al.* 2018 [Feb 1]) published in *Nature* in this connection. Excavation of a trench in Attirampakkam, Tamil Nadu (shown in Fig. 8) revealed layers of early Acheulean and middle Palaeolithic assemblages, the latter numbering 7,261 artefacts. Both the early Acheulean and middle Palaeolithic tools were made of locally available quartzite. Early Acheulean is dated approximately 1.7–1.07 ma, whereas the middle Palaeolithic had been previously dated approximately 140–46 ka. However, hominin dispersal linked to these dates have been varying, sometimes proposed to be between 130–80 ka pre-dating the Toba volcanic eruptions of 74 ka and sometimes 71–57 ka (see Akhilesh *et al.* 2018: 97, for references).

HOWEVER, the new study using much more accurate luminescence dating at Attirampakkam, confirms a much earlier date for the Indian middle Palaeolithic. The middle Palaeolithic assemblages were excavated from the layers 5-1, as shown in Fig. 9.

THE distinctive property of the tools found in layer 5 (and above) is their complete abandonment of the large flake Acheulean industry technology. Instead, small cores, using the Levallois technique, are plenty in layer 5; the upper layers also confirm use of blade removals.

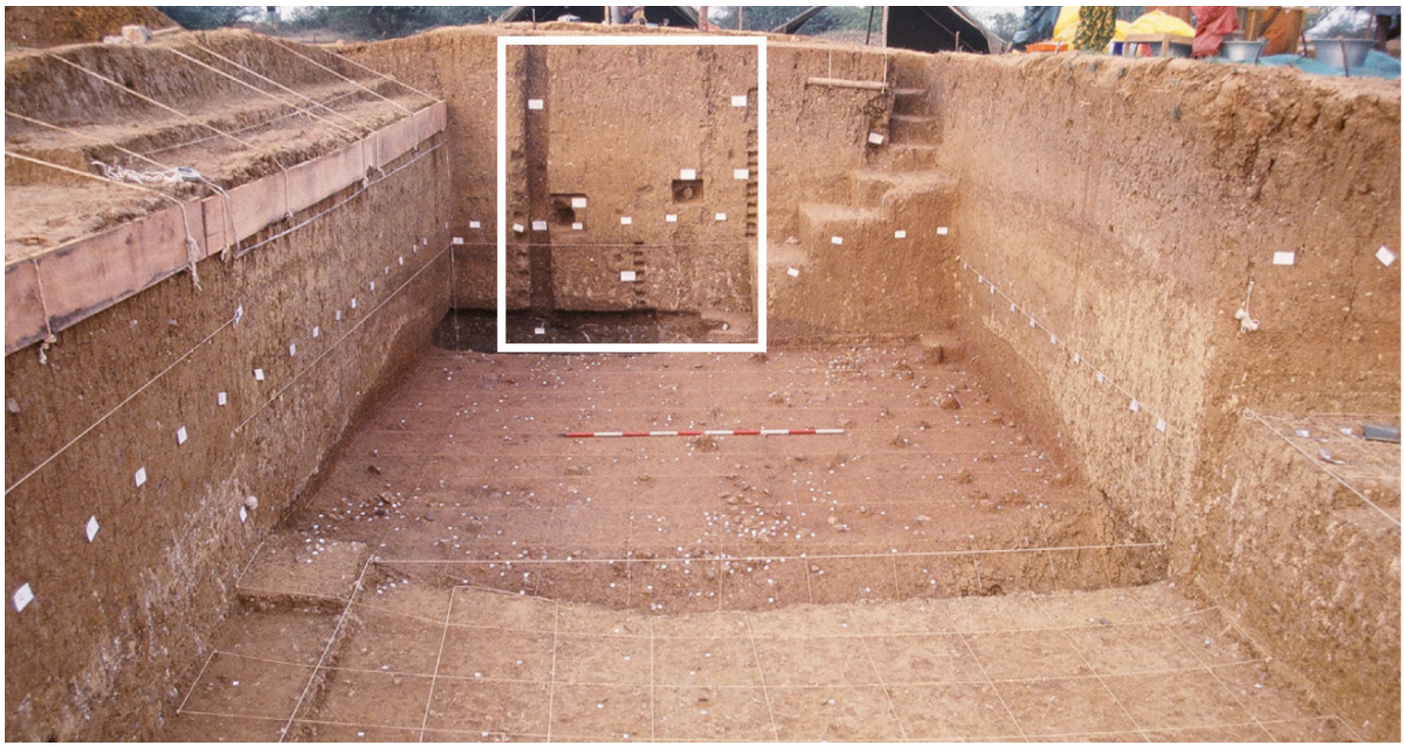

Figure 8: Stratigraphic section of the wall of the trench in Attirampakkam, Tamil Nadu (from Akhilesh *et al*. 2018: 99)

These technologies set these assemblages apart from the earlier, layer 6 finds. Akhilesh *et al*. 2018 confirm the dates for layer 5 to be 385±65 ka, to be considered truly representative of the Indian Middle Palaeolithic. This date now puts the Indian Middle Palaeolithic globally at par with Africa, west Asia and Europe, indicating hominin dispersal much earlier than the 2nd wave of Out of Africa of ~100 ka. This date also predates the Toba volcanic eruption of 74 ka by a huge margin, indicating a much earlier hominin dispersal in the Indian subcontinent, contrary to the predominantly European reporting, as in Petragalia & Allchin (2007), among others.

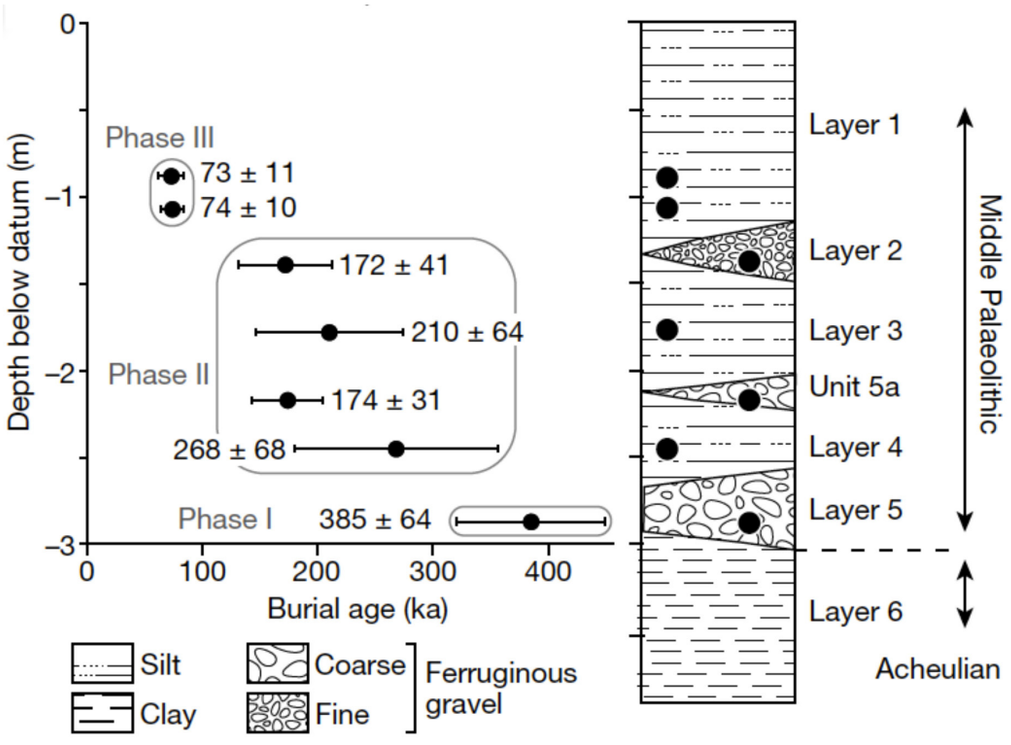

Figure 9: Layers and age clusters of middle Palaeolithic assemblages (from Akhilesh *et al*. 2018: 99)