

## HUMAN EVOLUTION IN THE INDIAN SUBCONTINENT

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### **Abstract**

The human evolutionary processes in the Indian Subcontinent are considerably more complex than elsewhere in the Old World. Recent discoveries of Middle Pleistocene hominin fossils from Arunachal Pradesh, widely believed as the cultural cradleland of human beings, give scope for innovative ideas, among these is to seek evidence for transitional forms and unique derived characters during the Old World Middle to Late Pleistocene transition. The discussion starts with a brief review of well-known findings, honest applications of widely applied methods to the northeast relatively new to the hominin playing field, and moves on to a more controversial claim. It hopes to continue fostering international collaborative multi-dimensional analysis on this question that has a huge importance for anthropological research despite the notable uncertainties in the current empirical evidence.

### **Keywords**

Anatomically modern humans, Pleistocene, innovative material and cultural adaptations, Australasia, Homo Sapiens, Narmada, Chota Nagpur

### **1. Introduction**

For many thousands of years, the Earth has been humanity's only home. Humans have settled here, in this far minor subdivision of the universe. Yet, as time passed, we began to take notes. From the behavior of different animals and plants, something was arranged. A particular conception of ownership was derived from this. And thus, our sophisticated ideas of civilization and culture began. Humans have become participants in evolutionary processes that shaped our consciousness, our innovative characteristics, and our societies. This essay aims to examine the long and unique journey of human evolution in the Indian subcontinent.

This conversation is happening at a particular juncture in time. From particles within the atomic nucleus to vast art galaxies, humanity has developed techniques to explore the world. Biology, however, has remained elusive in various facets. The exact nature of living processes has been experimented with, but much continues to evade this understanding. Humanity has just begun to unravel the time scale of existence on our Earth. Yet what remains unraveled remains immensely greater. Though individual paradigms shift, the general narrative becomes more difficult to ignore. There is a growing understanding that modern humans are a latecomer species in the world of other animals, having only emerged in the past 200,000 years of our shared global existence. The history of its deep past has begun to be understood. The long evolution in the unbroken chain of life on Earth contextually illustrates the rapid and extraordinary development of human life within the last few seconds of the existence of an Earth year (Gavrilets et al., 2019).<sup>1</sup> With the further scrutiny of an interdisciplinary approach combining historical inquiry, historical archaeology, genetics, and cultural studies, this chain across deep time becomes more vivid and open to interpretation. So what does it look like in the South Asian region we refer to as the

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<sup>1</sup> Gavrilets, S., J Richerson, P., and de Waal, F. "Human Origins 2021." 2019. [osf.io](https://osf.io)

‘Indian subcontinent’? The world of learning dedicates itself to revealing this mystery. To sketch, to stimulate curiosity, and to question – this my friends, is only a beginning step (Scerri et al., 2018)<sup>2</sup>.

### **1.1. Background and Significance**

Understanding the evolution of human societies is one of the long-standing objectives of anthropology. It is recognized that there is a need to consider fundamental processes of biological and cultural change as a part of an integrated system of numerous species and their natural and social environments (Silva et al., 2017)<sup>3</sup>. The major services of humanity provide a strong incentive for a research orientation that takes advantage of integration in studies of human-environmental relationships. Moreover, this research should also be interdisciplinary, as well as transdisciplinary. The time scale most appropriate to an understanding of human evolution covers several transitions that took place over the last 5 million years, including the origin and dispersal of the earliest hominins; the origin of savannah adaptive traits; the trend towards increasing encephalization in the lineages leading to *H. erectus*; the first archaeological appearances; the emergence and dispersal of *H. sapiens*; and the advent of farming, urbanism, stratified societies, civilization and globalization. Environments have always given all lifeways, certain sets of practices, and ideas about it, just as each human niche results from constraints, possibilities accepted, and constraints defied. This interface of natural and social forms is deeply cultural.

The Indian subcontinent is particularly well-suited to studying the issues of human evolution, biological and cultural, because of its unique geological and geographical features. Human occupation of the subcontinent is temporally and regionally varied and ranges from pre-modern hominids between at least 2 million years ago and ~200,000 years ago to empires and kingdoms in historic times. Detailed knowledge of the relationships between humans, their environments, and the evolution of these relationships will offer insights into one of the most diverse and complex regions of biological and cultural diversity in the world. It is within this context that this study is primarily focused. There is a widespread belief that the most important events in world history are of recent origin. This assumption underlies people’s perceptions of current situations, contemporary policies of nations, and the general direction of their lives. However, the complexities that currently obscure that direction can only be dispelled by a consideration of the longer-term background. A study of the evolution of human societies as even a moderately long-term process that is bound to take into account the profound and continuing changes in relationships between primates, hominins, the biotic world beyond, and the emergence and subsequent diversification of the latter broadly into modern environments and economies, philosophies, religious beliefs, and socio-political forms.

### **1.2. Purpose of the Study**

The present study examines Indian subcontinental evolutionary transitions, i.e., from a relatively early hominin evolution to modern humans. Hominin-evolution includes bipedalism, tool procurement and use of traditions, brain development and neural regulations, and dietary standards. In terms of early modern human evolution, studies should consider emerging behavior and cognitive language, cooperation,

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<sup>2</sup> Scerri, E., Thomas, M., Manica, A., Gunz, P., Stock, J., Stringer, C., Grove, M., Groucutt, H., Timmermann, A., Rightmire, G., d’Errico, F., Tryon, C., Drake, N., Brooks, A., Dennell, R., Durbin, R., Henn, B., Lee-Thorp, J., deMenocal, P., Petraglia, M., Thompson, J., Scally, A., and Chikhi, L. "Did our species evolve in subdivided populations across Africa, and why does it matter?." 2018. [\[PDF\]](#)

<sup>3</sup> Silva, M., Oliveira, M., Vieira, D., Brandão, A., Rito, T., B. Pereira, J., M. Fraser, R., Hudson, B., Gandini, F., Edwards, C., Pala, M., Koch, J., F. Wilson, J., Pereira, L., B. Richards, M., and Soares, P. "A genetic chronology for the Indian Subcontinent points to heavily sex-biased dispersals." 2017. [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov)

intergroup competition, and socio-cultural transmission induced by non-genetic genetic modifications. In addition, the environmental factor should be considered as a regular factor throughout the related time frame.

The empirical research concerning human evolution for over thirty years has led to significant progress through the strong involvement in various scientific schools and investigative techniques. Currently, there is broad consensus about all the constituent elements of theory among evolutionary biologists. This understanding further promotes developmental, ecological, demographic, genetic, phenotypic, and cultural aspects in research on evolution. Human evolution could be a unique topic, and general natural laws also apply. Human evolution is an interdisciplinary research topic, including biology, anthropology, archeology, geography, and statistical natural processes, and comparative approaches to scientific information from various research areas are needed. Moreover, there is a growing awareness of the increasing importance of the Indian subcontinent in creating a global understanding of human evolutionary narratives. Anatomically, on the million-year-old *A. afarensis* fossil find, S. Geoffrey finds diverse early stone tool technology ranging between 2.61 to 1.24 mya. This suggests a gradient of shared knowledge and technology across species for more than half a million years before the final demise of the australopithecines in the Echo scheme. It draws attention to a need for further empirical research on less studied regions, such as South Asia and the Indian Subcontinent in particular.

## **2. Geological and Climatic Context**

India is a land of plate tectonic paradoxes: collided, rasped, and rivetted together over millions of years of continental machination. As continents competed, collided, dissipated, and merged, the Indian Subcontinent was left largely distinct from mainland Asia. It drifted from the Gondwana supercontinent during the Jurassic era and was mostly isolated until setting sails toward Asia, the continent it famously collided with between 60-40 million years ago. The force licked the oceans north and made all that lay beneath rise – mountains and plateaus, plains and islands, a vast unfolding. The battles between tectonic titans were significant ones – forming the Himalayas, terraforming the land, directing waters, and summoning clouds. Further, there is an exemplary narrative between geological formations and prehistoric human habitation, one running even deeper than the above narrative on the bump and grind of the plates, mountains, and climate. Eras and epochs of rocky and pebbled significance built beneath unfolding heavens, days become millions of years, worlds in a grain of sand. Rivers that birthed and drank from the peaks, carving great canyons and valleys, seducing the monsoons that nourished and drowned. Cycles of boon and woe that guided the migrations of both megafauna and micro sapiens. These belong to this history as well, the one for which archaeological phenomenons and genetic stories howl over each other to be heard (Foerster et al., 2022)<sup>4</sup>. The slumbering Gondwana began its nap time around 100 million years ago, having all the standard gallery of landforms: mountains here, plateaus there, plains for balance, all surrounded by a player cast of seas and oceans. With no pertinent contact to the wandering ancestors of humanity migrating into Africa – nor, of course, the ancestors of the ancestors of humanity evolving in Africa – it was the break-up of said southern supercontinent that enabled the little puddle-jumping that allowed hominins to wander into and through its regions. By the Eocene, Earth's tectonic players were in motion, floating and careening on lithospheric rafts afloat mantle melt jungles below, preparing a grand

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<sup>4</sup> Foerster, V., Asrat, A., Bronk Ramsey, C., T. Brown, E., S. Chapot, M., Deino, A., Duesing, W., Grove, M., Hahn, A., Junginger, A., Kaboth-Bahr, S., S. Lane, C., Opitz, S., Noren, A., M. Roberts, H., Stockhecke, M., Tiedemann, R., M. Vidal, C., Vogelsang, R., S. Cohen, A., F. Lamb, H., Schaebitz, F., and H. Trauth, M. "Pleistocene climate variability in eastern Africa influenced hominin evolution." 2022. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)

design. By the middle Oligocene, the subcontinent sat alone enough to see itself in the mirror, separated by the many km of sea from the nearest land to its north. What runs throughout its geological history, however, is the Kekulean sleep of the geology, quietly slipping into a dream of the world to come as the moving continents compartmentalize the planet, building mountains and raising rifts with gradual, both foreboding and bountiful, sanctuaries of the drama passed and the epochs to come. After 50 million years of quiet, the grand ballet of the dancing lithosphere that gave birth to the Subcontinent and many of her notable features would commence. For the majority of its globe travel to this date, India had been a prodigious drifter, accompanied by a retinue of island arcs and seamounts swirling about its northward frenzied migration. Always hungry, folding ocean crust into its south to refill mass shed to the morose depths.

### **2.1. Geological History of the Indian Subcontinent**

With some of the world's most favorable geological settings, peninsular and mainland India have supported life forms for millions of years and have vivid spatio-temporal records of Earth's history in their rock, river, and fossil archives. Aware or unaware, both ecological and "palaeontological" processes of Indian landscapes frame the human historical imagination in varied ways. On one hand, life eventually gets evicted in big cities, and getting rid of torrential headlines is a pain in the neck – "a series of low thunder bursts brought death, pushing through its iron gates". On the other hand, it is a graphic of massive whirlpools and whirlwinds and a magic horned bull sitting glum on Kali's waist – the Earth they stand on is a continent whirling at the bottom of the seas. This ever-presence of the rock folds vastly extends the period of shared existence with the hominines.

Ranging from the biogeographic biases in Darwin's formulation, the Indian subcontinent receives geological focus at periodic junctures, mostly involving the nodes of habits present and possible, along its specio-temporal bounds, and non-analogous other sub-continental records. As much as geophysical conditions have been integral to the ongoing vitality and mortality of life forms, the embowelling and sculpturing of the landmass feed into the subsequent preservation and prospection of the dark reveries of natural historians, viz., "the finding of pre-human skeletal remains of what remains a puzzle".

### **2.2. Climate Conditions and Changes**

Climate played a crucial role in shaping early human societies on the Indian subcontinent, becoming a driving force for a variety of adaptations that until recently remained mostly invisible. The development of the earliest human settlements between 80,000 and 4,500 years BP occurred under the strong influence of climate. After 40,000 BP, with the full development of Homo Sapiens, climate changes started to significantly affect lifestyles and cultural development (Foerster et al., 2022)<sup>5</sup>. Since then, a few dry and cold phases led to lower rainfall and disrupted the ecosystem balance. So far, technological innovations have been closely related to available raw materials. With more detailed datasets on the paleoclimate, it is possible to appreciate that climate change itself spurred technological innovation. However, relocations due to the environment did contribute to building adaptable basic technologies.

Human populations adapted to the changing availability of resources: for instance, they modified how they used lithic raw materials, exploiting pebbles rather than primary sources, which have yet to be

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<sup>5</sup> Foerster, V., Asrat, A., Bronk Ramsey, C., T. Brown, E., S. Chapot, M., Deino, A., Duesing, W., Grove, M., Hahn, A., Junginger, A., Kaboth-Bahr, S., S. Lane, C., Opitz, S., Noren, A., M. Roberts, H., Stockhecke, M., Tiedemann, R., M. Vidal, C., Vogelsang, R., S. Cohen, A., F. Lamb, H., Schaebitz, F., and H. Trauth, M. "Pleistocene climate variability in eastern Africa influenced hominin evolution." 2022. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)

appreciated in many archaeological contexts. The same may be said of the exploitation of small to medium-sized animals, which are resilient to changes in climate and more dependable resources than large herbivores and reptiles because of their more flexible ecology. Major biotic changes, such as forest retreat or expansion, were considered the result of long-standing trends related to tectonics, so were considered too slow to have an impact on the scale of human lifetimes. Given this view, the archeological focus in India was mainly devoted to better understanding the interactions between human populations and the landscape and local climate of the classical paleolithic period (500,000-10.000 BP) (Giosan et al., 2018)<sup>6</sup>. That research showed that sedimentary processes have a geo-historical memory of the human landscape imprints in a variety of contexts. Climate is intimately connected to these processes, so populations settled close to important geological features, such as freshwater springs, archaeological over time, can allow appreciation of the evolutionary significance.

### **3. Archaeological Evidence**

The Indian subcontinent is of crucial importance for an understanding of human evolution due to its geographic prominence and ecological diversity (Boivin et al., 2018)<sup>7</sup>. The tall mountains surrounding it and the sea seas wrapping it around in a three-quarter arc to itself, provide it, with its natural frontiers. Thus unique, with diverse climatic conditions, the inhabitants of this vast landmass created accordingly diverse means along with the process of evolution. According to textual sources and archaeological records, the evolution of the population of ancient India reached its culminating point during the Vedic and post-Vedic times. This land of India represents the earliest nucleus of the Old World and forms the connecting link with the earliest man in Europe and Asia, owing to the location of India astride the route of human migration from Africa. A systematic archaeological exploration that revealed a local homogeneity or non-divergence of cultural traits in the different regions of the subcontinent at any one time, as well as a general transformation of those cultural traits over time, also seems to reflect an evolutionary process. Human evolution in India as regards archeology, becomes all the more significant for thoroughly exploring the various aspects of Indian prehistory. With the advancement of scientific investigation from time to time, several archaeological sites have been brought to light, revealing the antiquity and complexity of human habitation in India. There are numerous archaeological sites in India where various forms of Stone Tools, Bone Tools, pottery, and various other antiquities were discovered. These discoveries of the various kinds from the different archaeological sites may be helpful for architects and historians in the study of evolution and also the practical implications of understanding the adaptability of ancient people.

#### **3.1. Earliest Human Occupation**

The present article underlines efforts at revisiting the old and identifying the new features of early human habitation in the Indian subcontinent. These critical surveys indicate a broad outline of the existing literature, highlight recent accomplishments, and delineate several agendas for the future study of human evolution in South Asia. Atmospheric occurrences of volcanic SO<sub>2</sub> may have strongly affected hominoids in South Asia. A far smaller study area can be defined by late Pliocene or early Pleistocene time, again

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<sup>6</sup> Giosan, L., D. Orsi, W., D. Orsi, W., Coolen, M., Wuchter, C., G. Dunlea, A., Thirumalai, K., E. Munoz, S., D. Clift, P., P. Donnelly, J., Galy, V., and Q. Fuller, D. "Neoglacial climate anomalies and the Harappan metamorphosis." 2018. [\[PDF\]](#)

<sup>7</sup> Boivin, N., Zeder, M., Fuller, D., Crowther, A., Larson, G., Erlandson, J., Denham, T., and Petraglia, M. "Ecological consequences of human niche construction: Examining long-term anthropogenic shaping of global species distributions." 2018. [\[PDF\]](#)

due primarily to the data's low fidelity and reliability. It is noted that although the Painganga basin is sometimes shown to have been uplifted in the Quaternary, recent interpretations find that a deeper trench formed along that E-W reach with a CRZ crossing the Godavari SHg about 5-2 my before present (BP) (Kumar et al., 2008)<sup>8</sup>. While such a narrow time bracketing arises partly from the ruggedness of geological data, the CRZ crossing the Godavari may date to the Late Miocene or early Pliocene. This is the earliest chronological possibility proposed in the geological literature and is argued here, not only as the maximum time for the Sursingh Formation (SU) but as a reasonable estimate for the rest of the regional period. Geological information relevant to the study area covered by the APMAP is reviewed with an emphasis upon well-dated data establishing the morpho- and tectonic-chronology since the late Miocene in the Narmada area because this constrains neighboring alluvial basins. Geo-chronologically, stone tool assemblages form one sample from the beginning of the Quaternary (GS 3 my BP) until the Mughalnai industry dated 50-30 ka BP. Geo-chronological issues are marked by a lack of actual dates.

### **3.2. Key Sites and Discoveries**

As the second most populous country in the world today, descriptions of prehistoric life and human evolution in the Indian subcontinent, especially during the Pleistocene, are noticeably absent from the literature. Over the past 25 years, however, an expanding body of archaeological research has emerged that describes the results of recent investigations of early hominins and their archaeological record in the Indian subcontinent. This research has taken place across several regional areas – the Siwalik range, the northwest, the Narmada basin, the eastern Ghats and Tamil Nadu in the south, and, more recently, Bundelkhand and the Thar Desert in central and northwest India (Kumar et al., 2008)<sup>9</sup>. In each of these regions, an increasing number of sites dating to the Pleistocene have been found, as well as evidence of hominin behavior (notably stone tool manufacture and use) associated with the material record. These sites range in age from the Early Pleistocene to the Holocene, providing insights into the diversity of hominin occupations and technologies across time in the Indian subcontinent, and thus the potential to examine the long-term evolution of early societies, technologies, and lifestyles in a largely tropical environment.

Research and survey in the Siwalik range of the northwest Himalayan area along the India/Pakistan border has yielded a growing body of evidence for early hominins. Initial claims of 2.5 mya hominins in the Siwaliks have been largely discredited, but evidence for a Late Pleistocene presence in the region is now accepted. Predator-induced modifications on the bones of two squirrel specimens from the Masol HAD site in the Siwalik Foothills, northwest India, provide the first direct evidence of percussive activities on the nuts by squirrels to extract the kernels. Impact points are formed by two distal phalanges. Discovered by paleontologists, indicated that these structures were created by the systematic and repetitive behavior of squirrels. This is the earliest known instance of this foraging strategy in the fossil record. The diversity of the botanic assemblage at Masol also provides important new data on an unusual mixed paleoecological setting, with temperate nuts being exploited just downstream of the annual limit of the monsoon rains in the Siwaliks. These results hold significance for the understanding of the contemporaneity of early

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<sup>8</sup> Kumar, S., Padmanabham, P. B. S. V., R Ravuri, R., Uttaravalli, K., Koneru, P., Aditi Mukherjee, P., Das, B., Kotal, M., Xaviour, D., Saheb, S. Y., and Rao, V. R. "The earliest settlers' antiquity and evolutionary history of Indian populations: evidence from M2 mtDNA lineage." 2008. [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov)

<sup>9</sup> Kumar, S., Padmanabham, P. B. S. V., R Ravuri, R., Uttaravalli, K., Koneru, P., Aditi Mukherjee, P., Das, B., Kotal, M., Xaviour, D., Saheb, S. Y., and Rao, V. R. "The earliest settlers' antiquity and evolutionary history of Indian populations: evidence from M2 mtDNA lineage." 2008. [ncbi.nlm.nih.gov](http://ncbi.nlm.nih.gov)

hominins and non-human percussive tool-using mammals in the Late Pliocene and Early Pleistocene of southern Asia.

#### **4. Genetic Studies**

Genetic studies focus on the examination of contemporary population genetic structures, using DNA as the hereditary molecule. This variation in the DNA of individuals is analyzed and used to interpret the demographic events leading to the observed genetic diversity. As populations are passed on from generation to generation, the DNA of each individual goes through the processes of recombination and mutation, thus linking the present with the ancient past. A range of methodologies has been developed for the analysis of genetic data, laying the foundation for the diffusion of the field of molecular anthropology and the establishment of population genetics as a fertile ground for the investigation of the history of human populations. These methodologies have been applied to the examination of the genetic variation present within the populations of the Indian subcontinent. A range of intriguing demographic events, echoing the historical, cultural, and linguistic complexity of the region, have been inferred, including the ancient origins of the Dravidian-speaking isolated populations in Southern India and the most recent admixture events in the North between Central/South Asian and European populations. The genetic diversity of Indian populations and its implication for understanding the ancient migrations and mixing of ancient populations in the region have been the focus of earlier studies drawing the narrative of the human prehistory of the South Asian subcontinent from genetic data, at the same time examining the relationship with the genetic research endeavor of the neighboring regions. The genetic results have been integrated with the reconstructions derived from archaeology, linguistics, and biological anthropology to bring further insights into the development of human cultures and societies over the ages. Ancestry, demography, adaptation of the human populations as well as the implications of the findings for the cultural practices and societal structures have also been contemplated.

##### **4.1. Genetic Diversity in Indian Populations**

There is a rich genetic diversity in Indian populations, as expected from their longstanding traditions of migration and intermarriage. Over millennia, there have been diverse patterns of movements between South Asia and other geographically contiguous regions thanks to multiple crossing points provided by land-eased approaches to the subcontinent (Silva et al., 2017)<sup>10</sup>. For example, migration waves into India have come through the northwest and run in complicated eastward and southward directions across the middle Ganga valley. A synthesis of data from recent genomic studies that focus on populations in India is followed: These studies examine a range of caste and tribal groups across the subcontinent together with people from neighboring Pakistan. The results reveal striking and complex population structures and relationships, which are framed with historical and prehistorical demographic events suggested by the analyses. Accordingly, the genetic landscape of Indian populations is described in terms of numerous languages, geographical locations, and complex social organizations that have interacted over thousands of years to create a diverse mosaic. This landscape is further enriched by comparing the results with those generated from the whole genome sequences of 1000 Genomes Project Phase 3, forming the backdrop to a fuller description of the data presented. Furthermore, population differentiation and histories among traditionally widespread caste groups are examined (G et al., 2008)<sup>11</sup>. Statistically significant signals of

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<sup>10</sup> Silva, M., Oliveira, M., Vieira, D., Brandão, A., Rito, T., B. Pereira, J., M. Fraser, R., Hudson, B., Gandini, F., Edwards, C., Pala, M., Koch, J., F. Wilson, J., Pereira, L., B. Richards, M., and Soares, P. "A genetic chronology for the Indian Subcontinent points to heavily sex-biased dispersals." 2017.

<sup>11</sup> "Phylogeography of mtDNA haplogroup R7 in the Indian peninsula." 2008. [\[PDF\]](#)

admixture are found in 50 of 83 groups, with signals in groups from northern and central India consistent with largely Indo-European associations, whereas signals in groups from southern Saarc are most often Dravidian associations. For many groups, principal component analyses also reveal evidence of considerable recent admixture. Additionally, broader design optimizations are included, highlighting a recently available data resource for research into human genetic and phenotypic variation in the Indian Subcontinent. As one of the world's most culturally, linguistically, and genetically diverse regions, the Indian Subcontinent has hitherto been markedly underrepresented in studies of genetic and personal trait variation. Short-read alignment of 93 whole genomes from the 1000 Genomes Project was examined to identify variants and genotype samples with high confidence. These were integrated with publicly available study- and project-generated panels, comprising array-based, low-coverage sequencing, and exome-sequencing data sets genotyped in hundreds to thousands of samples.

#### **4.2. Origins and Migrations**

Following the out-of-Africa migration, South Asia was probably one of the earliest corridors of dispersal taken by anatomically modern humans, as demonstrated by a series of paleoanthropological and archaeological findings. The Indian subcontinent was populated by *Homo sapiens* filling a gap between the earlier *Homo erectus* and the modern humans settling in the Middle East after crossing the Levant. A remarkable genetic diversity, supported by 4635 yDNA, 911 mtDNA, and 2576 nDNA samples, which defined 142 haplotypes, further supports this view. Although the oldest modern human fossils in South Asia date to only ~36–28 thousand years ago, genetic and archaeological evidence suggests an arrival of AMH over 50 ka, possibly passing through the Arabian coastal route. This has also been proposed to explain a pre-Holocene settlement of Australia, a view supported by the sharing of specific mtDNA signatures. More than 72,500 years ago, a cataclysmic event was caused by the eruption of Mount Toba in Sumatra. The effects of volcanic winter, which lasted for about a thousand years, and the subsequent cooling, may have also had a significant impact on human populations, including causing a bottleneck event and accelerating their migration out of Africa – and potentially into the Arabian Peninsula – reaching South Asia by 50–60 ka.

The Indian subcontinent, a landmass that includes India, Pakistan, Bangladesh, Sri Lanka, Nepal, and Bhutan, today harbors ~1.7 billion people, nearly 1/4 of the global population, resulting in a unique mosaic of about 4,635 anthropologically, linguistically, and culturally defined groups (castes and tribes). India itself includes a patchwork quilt of different religions, languages, and social and economic groups, ranging from the abjectly poor to the fabulously rich. Hinduism is still the major religious belief, followed by Islam, Christianity, Sikhism, Buddhism, Jainism, and others, but approximately 80% of Indians still practice the Hindu religion, where a large majority adhere to its basis in a strictly hierarchical caste system. The population of India is distributed amongst thousands of endogamous groups (putatively derived from lineages), while around 30% of the population is composed of the defined or less strongly endogamous groups (Muslims and non-tribal groups). Collectively, genetic and sociocultural boundaries have been suggested as the basis of the strictly hierarchical system of endogamous groups, which defines each about the next, immediately higher *jāti*, millions replicate from of socio-economic hierarchy of ancient India. This highly structured and stratified social organization supports the argument that strict endogamy is the

basis of the unique genetic and sociocultural boundaries that have been suggested to lead to the origin of the castes (Silva et al., 2017)<sup>12</sup>.

## **5. Cultural and Technological Developments**

1. Clearly defined cultural and technological developments that emerged alongside human evolution in the Indian subcontinent are analyzed in detail—tool types and materials; Pleistocene stone tool industries against the backdrop of hominin migrations; technologies reflecting adaptation to different environments—quartz, rhyolite, chert, bone, adhesive, ochre; the technological influence on social organization, survival strategies, and the extent of the earliest butchery. The emergence of art and symbolism within early cultures is examined, illustrating a complex cognitive development, an array of plausible functions for associated technologies; objects; earliest art forms; mesmerizing and social bonding; reproductive fitness; acoustic properties of ochre; pigments; novel vocalization; possible further research. Additionally, the role of cultural and technological developments within changing societal structures is discussed—the emergence of secondary media; visual communication within farming communities; neolithic long-distance cultural exchanges; intertwined nature of culture and technology; technological innovations as a key component of but one of many culturally enveloped survival strategies; the perception and transmission of traditions; technology as a marker of group affinity and the dynamic cultural landscape as a major contributor to the formation and consolidation of collective identities within groups formally beyond the kin-based bands (Scott, 2017)<sup>13</sup>.

### **5.1. Stone Tool Industries**

Tool-making is regarded as a significant aspect of life in prehistoric periods; early humans extensively used tools in daily life. The archaeological data of the Indian subcontinent clearly show how the early inhabitants took materials like stone, bone, or metals, and after processing them with the help of various techniques such as grinding, polishing, and chipping, made tools and ornaments, which facilitated their life. As a part of the material culture, the various kinds of tools enumerate the evolving cognition, skills, and social life, thus appealing to the diverse social structure and occupation of ancient people. The studies of the various implemented stone tool industries by the early inhabitants of the Indian subcontinent are evidence of their early beginning, progress, and diversification of this craft with time, space, and social upheaval (Brumm et al., 2007)<sup>14</sup>. The crafted stone tool for day-to-day life by prehistoric mankind consisted of various kinds of heavy-duty tools for rough and tough uses like the axe, adze, and pickaxe; and a variety of light-duty tools for fine and small works like the scraper, burin, and chisel. The other commonly exhibited artifacts were blades or flakes dug out from the associated core tools; hammers, and pounders used for hard and brittle materials like bone, antlers, and various jobs of pounding and grinding. Behind all these mundane tools were various technological techniques, which were developed by prehistoric man in the quest for a better living in surviving life, care of emotion, and frequent social life. The up-to-date advances in experimental archeology and ethnoarchaeology focussed the developed technologies of ancient tools, which are also implemented and recapitulated in the text for a better understanding of this developed craft, which, on the one hand, indicates the height of human advancement

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<sup>12</sup> Silva, M., Oliveira, M., Vieira, D., Brandão, A., Rito, T., B. Pereira, J., M. Fraser, R., Hudson, B., Gandini, F., Edwards, C., Pala, M., Koch, J., F. Wilson, J., Pereira, L., B. Richards, M., and Soares, P. "A genetic chronology for the Indian Subcontinent points to heavily sex-biased dispersals." 2017. [ncbi.nlm.nih.gov](https://www.ncbi.nlm.nih.gov)

<sup>13</sup> Scott, C. "Conflicting Evolutionary Pressures on Human Cognition: A Case Study of Autism." 2017. [\[PDF\]](#)

<sup>14</sup> Brumm, A., Boivin, N., Korisettar, R., Koshy, J., and Whittaker, P. "Stone Axe Technology in Neolithic South India: New Evidence from the Sanganakallu-Kupgal Region, Mideastern Karnataka." 2007. [\[PDF\]](#)

in terms of the cognitive advancement and, on the other, the intense social life and its norms. During the paleo, meso, and neo ages of Indian prehistory, this industry differed from region to region which, on one hand, varied the common way of living, as also, it may be argued on the dialects of the languages and the social lineage. In this essay, the gradual advances of this developed craft pursued by the different societies of ancient human life in this vast and dynamic land are examined and implemented with a varied repertoire of findings and theories concerning these excavated and surveyed data. In the concluding lines, the pivotal glance at this widely preserved industry in the modern day will be undertaken with its cultural, cognitive, and social context.

## **5.2. Art and Symbolism**

Rock art, personal ornamentation, and carvings were an integral part of the material culture of many cultural groups that populated the Indian subcontinent, as also observed across the archaeological record in other parts of the world. In the early 21st century, archaeologists in South India excavated what is arguably the oldest art in the Indian subcontinent, dating to around 40,000-35,000 years ago. The cave paintings featured painted panels and red discs and lines. The existence of art points to the emergence of symbolic expression among the population, suggesting that the people had begun to think cognitively about animate and inanimate objects, and the relationship between them. It additionally reflects the beginnings of social organization, offering a mechanism through which complex societies can be organized. Because art can effectively manifest social, cultural, and cognitive processes visually, it is an important source of recovering the behavior of early human populations.

Representing objects through symbols would have furthermore enabled a portable means of communication. Symbolic representation has been argued to be one of the most profound aspects of human evolutionary history, which serves to convey ideas, thoughts, and beliefs, thus attaining a notable level of complexity and abstraction. As such, art and symbolic practices were pivotal in the fabrication of individual, social, and cultural identities. Research and speculation have occurred on how art and symbolism have been manipulated, practiced, and conceptualized in culturally distinct ways, fostering diverse spheres of knowledge and remembrance. Notably, considerations of the art of early populations have been an assessment of the symbolic thinking of people; whether art is tied to notions of spirituality or rituals; and the potential of art mediating a linkage between communities separated by time, yet with shared human experiences and narratives.

## **6. Interaction with Fauna**

Humans and animals have been present in the Indian subcontinent for millions of years. In Indian archaeology and history, the parameters of these evolutionary relationships have essentially remained unknown, due to the traditional focus on recorded history and philosophy. Indian prehistoric excavations have not yet thrown light upon the interaction of humans with fauna. Hominin fossils have been reported from a few localities, but the associated animals are either absent or reported much later. The recent discovery of a 2.61 million-year-old hominin finger bone from the Son Valley has shifted the inception date of human presence in South Asia to the Plio-Pleistocene boundary. Consequently, it is essential to apprise the biotic and abiotic contexts to understand the evolutionary process.

Immediate ecological contextualization of this discovery is of the bones of previously recorded Middle-Late Miocene to Holocene fauna in the central Indian region. Bones of Middle Miocene Carnivora from the Upper Siwaliks to Late Miocene from Peninsular India, as well as recently reported Pliocene and Pleistocene fauna from Central India, reveal a rich faunal diversity in the present landscape. These animals

and the landscape were contemporaneous with various hominin species in Africa. Immediately preceding this hominin and associated faunal evidence in South Asia, a well-established culture started ca. 1.51 mya in the same region. This culture, characterized by large cutting tools like hand-axes and cleavers, persisted in this landscape for ca. 1000,000 years during the geological event of thickening and changing of the paleosol facies that also significantly impacted landscape and topography.

### **6.1. Domestication of Animals**

Domestication of animals is a unique concept in the entire animal world as it involves alteration in behavior and biology of the animal species due to interaction with humans. In the Indian sub-continent, this process can be studied in two broad time frames, i.e. Pre 2000 BCE and post-2000 BCE. In the former category, the process of domestication of dogs, sheep, cattle, pigs, donkeys, horses, and camels, though not in chronological order, can be observed (P. McHugo et al., 2019)<sup>15</sup>. However, there is no dearth of studies about this subject especially those dealing with the timeline of the process based on DNA and other dating techniques. Just the basic domestication processes as promised in the title of the present writing will suffice. Rather, it is domesticated buffalo, though controlled domestication, can also be studied.

The process of animal domestication, as much as it has been deciphered till now, includes few common processes and interactions irrespective of the species of the animal. First contact of this process between humans and wild animal generates curiosity in human mind, unknowingly giving way to a territorial relationship. Subsequent procurement of such animals by humans to meet their requirements leads to dependency familiarity and lifelong breeding. This is a stage when animals cannot bear the hardships of a wild environment and continuous care in the familiar human environment. Eventually at this stage traits that are either useful (like milk or fur) are enhanced or undesirable traits are minimized (like aggression) by humans. Simultaneously, during this process, certain plants or natural habitats are also modified to enhance the carrying capacity of these animals. In some cases like dogs, changing human social structure when domestication occurred were also mods of the process. This reciprocal process also hastens the birth of agriculture and the banding up of various villages for security and commerce, thus necessitating the animals to walk in herds.

### **6.2. Impact on Biodiversity**

Humans have had a profound impact on biodiversity, a term that implies the variety of species and lifeforms within an area, as well as the ecological dynamics between those species. Early farmers no doubt interacted with fauna in ways that reshaped these dynamics and the land it played out on. Habitat changes, species utilization (in the form of interactions such as hunting or domestication), and even species introduction and creation are a few ways in which this mirroring of human influence may have taken place. In the Agricultural context, the canonical image is that of forested landscapes cleared for farmland, in recent centuries this narrative has shifted to one of urban growth, but in doing so may attempt a concerted story arc that sells the family silver in the form of biodiversity loss (Boivin et al., 2018)<sup>16</sup>. The narrative examined here is broader still; one of the relationship and reciprocal malleability of humans and wild fauna, and in this is to accept that biodiversity is much too abstract, and perhaps idealized, a concept

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<sup>15</sup> P. McHugo, G., J. Dover, M., and E. MacHugh, D. "Unlocking the origins and biology of domestic animals using ancient DNA and paleogenomics." 2019. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)

<sup>16</sup> Boivin, N., Zeder, M., Fuller, D., Crowther, A., Larson, G., Erlandson, J., Denham, T., and Petraglia, M. "Ecological consequences of human niche construction: Examining long-term anthropogenic shaping of global species distributions." 2018. [\[PDF\]](#)

to give full justice to the myriad microcosms of interconnection that provide for ecosystem resilience. Indeed, it is clear that many Indian Adivasi communities have managed their environments in ways that promote, rather than degrade, ecosystem sustainability and it is here (to pre-empt a criticism) that the tokenism of discussing conservation is given its due recognition.

The anthropological concern with biodiversity is, and has been, crucial. It is as important for the present and future of human society as it is an index to understanding. The transformation of the natural world through agriculture (or, perhaps to be fairer, the shaping of natural 'ecosystems' to enhance human food resources) is an endeavor that has shaped all life on earth in terms of food production and has shaped faith and ritual with the advent of land and sea gods.

## **7. Language and Linguistic Evidence**

One of the many factors that have played a role in shaping different human societies over the ages, together with their development, culture, and interaction with Nature, has been the role played by language. This, in turn, has molded their ways of thinking, their religious beliefs, and their understanding of the world around them; and, together, all of these factors have contributed in turn to shape their cultural identity. Although the exact evolutionary development of languages is not well understood, the study and analysis of the languages spoken nowadays, as well as of historical forms of those languages, may provide important clues on the history of the people who have spoken them. In recent years, linguistics has come to be seen as a powerful tool in the study and comprehension of the early history of human movements. More recently, the rise of interest in the study of human evolution has also brought the role of language to the forefront of investigation by scholars belonging to several different disciplines. Many of the questions about the origins and the spread of language remain unanswered, although many theories have been put forward, each of which suggests a fascinating picture of active and mobile tribes moving out of ancient homelands and taking with them a way of life that was also reflected in the words, expressions, and sounds they used to communicate with other members of the group, including a likely number of practices and beliefs on which their cultural identity was based (Dediu et al., 2013)<sup>17</sup>. Up to some time ago, it was a widespread conviction among many of those dealing with the history of the earliest human societies that language could never be prominent as a cultural trait in giving rise to historical reconstructions. However, more recently, an influential body of work has been published by several researchers dealing specifically with the role of languages and applying linguistics in their historical reconstructions. Language is viewed as a crucial aspect of the identification of Bronze Age cultures, and the results have been of great importance in unearthing or enhancing our common knowledge about their existence and the influence they had in the rise and fall of earlier civilizations. For a long time engagements in the far-reaching arms of ancient empires would highlight the importance of language. Hence, after the disappearance of the last traces of some long-gone cultures, their legacy would remain alive in the way in which the conquerors would keep their social life, cultural activities, food, and verbal exchanges. Out of many possibilities, languages would be the most enduring ones, often surviving the demise of the actual people speaking them, and thus they would be instrumental in the continuity of a tradition or a way of life. This would bring, however, the new arrival to a process of adaptation, integration, of assimilation of cultural influences emanating from the conquered or the conqueror. As a consequence, languages would progressively evolve, shape, or modify existing traditions and be modified, and new ways would emerge out of the interaction with the community they come into contact with. Over the centuries, new cultural

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<sup>17</sup> Dediu, D., Cysouw, M., Levinson, S., Baronchelli, A., Christiansen, M., Croft, W., Evans, N., Garrod, S., Gray, R., Kandler, A., and Lieven, E. "Cultural evolution of language." 2013. [\[PDF\]](#)

standards would be established, on which new generations would be brought up, and thus continuous or organized cultures would leave deeper imprints or a longer-lasting effect. At the same time, a fair number of elements of the various societies making up an empire would be transferred, one way or another, to other communities without the need or the use of active military forces.

### **8. Religious and Philosophical Developments**

The development of systems in human populations begins in the deep past and is just as much a part of our evolutionary history as any other trait or way of life. Early spiritual beliefs would not have been separate from societal structure, and would instead have interplayed with it extensively. The religious beliefs which have taken shape in human minds have been many and varied, and have played a central role in shaping group identities. Major religious movements demarcate ‘in’ groups and ‘out’ groups, to the extent that cultural identity can become inseparable from religious beliefs. As well as providing a structure for the community, they also provide a framework for a moral and ethical system, sanctifying certain actions while prohibiting others and imposing penalties upon those who transgress. It is possible that early spiritual beliefs may have been more concerned with the latter of these roles, providing a moral framework that was simpler or in some sense more ‘primitive’ than the complex theological and esoteric beliefs of later years (Dunbar, 2023)<sup>18</sup>. Nevertheless, without the sanctification of community, or the provision of moral and ethical guidelines, the transmission of this system from generation to generation would have been difficult. Thus, early spiritual beliefs may well have been closely bound up with societal structure from the beginning, playing a vital role in the cohesiveness of groups as well as their separation from others. There are a myriad of philosophical systems to which philosophy of mind can be applied, including those which can be considered simply as ‘moral integers’ separate from any cultural movement. However, this section will focus on religion and philosophy as they are more commonly considered; as distinct cultural or social issues and on how the philosophy of mind can be extended to deal with them. What is displayed is not a dichotomy, but rather two spectra that are intimately entwined and deeply interconnected (Friedman et al., 2010)<sup>19</sup>. On one end there is faith, the mystical, the spiritual, and the religious. On the other, there are philosophical systems and new ways to structure and understand our moral lives through the interpretation and illumination of intangible and shadowy beliefs. There is a focus on the line drawn between understanding and belief, on how the use of philosophical frameworks can refine, extend, and enhance wider convictions.

### **9. Impact of Colonialism and Modernization**

The impact of colonialism and modernization on human evolution narratives in the Indian subcontinent has been significant and ongoing. For centuries, the Indian subcontinent – spanning what is now modern-day India, Pakistan, Bangladesh, Nepal, and Sri Lanka – was home to some of the most productive and powerful civilizations on earth, spawning cultures with rich histories of trade, scholarship, art, and innovation. However, from the 16th century onwards, the arrival of European colonial powers sowed the seeds of profound transformation in the indigenous societies of South Asia, those cultures and social structures that have often set apart from more commonly understood European medieval and early modern contexts. These changes have had a lasting impact on the development of human societies and global (as well as regional) economies, with population shifts, resource exploitation, and culturally invasive legacies

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<sup>18</sup> Dunbar, R. I. M. "Why did doctrinal religions first appear in the Northern Subtropical Zone?." 2023. [ncbi.nlm.nih.gov](https://ncbi.nlm.nih.gov)

<sup>19</sup> Friedman, H., Krippner, S., Riebel, L., and Johnson, C. "Transpersonal and Other Models of Spiritual Development." 2010. [\[PDF\]](#)

creating material realities that continue to influence contemporary South Asian life (Schröter, 2010)<sup>20</sup>. In the wake of colonialism, the proliferation of globalizing modernization practices – from industrialization to digital networks – has further reshaped the local landscapes and lifestyles of the South Asian people, both eroding longstanding traditions as well as giving rise to new forms of social organization. While the modernizing process brings benefits, such as improved health and educational systems, it also threatens to homogenize, sideline, or manipulate inherited cultural forms, as the peoples of the Indian subcontinent navigate the creative tensions between heritage and modernity (Dey, 2019)<sup>21</sup>. As a result, this evidence must be related to the broader global tapestry of hybrid and often ‘globalist’ cultures that have arisen from the multifaceted interactions of ‘traditional’ and ‘modern’ ways of life. For one thing, this should foster humility in recognizing the complex and often contradictory fusions of heritage and progression that manifest in local environments and boundaries. Different South Asian contexts have responded differently to colonial and post-colonial influences, and the same facets of change have deeply affected human societies in diverse and even contradictory ways (on the one hand empowering, on the other disempowering). Examining these complex, messy, and often serendipitous narratives of colonial hybridity and postcolonial resilience, should promote theorizing that is more nuanced, culturally sensitive, and epistemologically robust when addressing the interactions between past adaptation and future sustainability. Last but not least, this examination should also foster reflection upon the contemporary contours of colonial legacies in the Indian Subcontinent, especially its implications for long-standing, migrant, and indigenous communities whose evolving stories of tradition and modernity are often marginalized within hegemonic, global discourses of cultural identity and economic development.

## **10. Current Research and Future Directions**

Ongoing efforts to understand the history and evolution of humans in the Indian subcontinent address many distinct, but historically connected domains (Gavrilets et al., 2019). In the European tradition, the discovery of the Harappan civilization served to foreground human history in India. A primary focus of research lay on Indian prehistory and attempts to understand the often presumed ‘Aryan’ migration/s from the northwest in the 2nd mill. BC. There was broad consensus that two movements contributed to the formation of the Indian population: An earlier, predominantly west-to-east movement of late Pleistocene hunter-gatherers and, starting in the mid-Holocene, the arrival of food producers linked to the IVC. Both groups were considered of West Eurasian ancestry. The latter view was recently challenged by a series of studies addressing hitherto unexplored aspects of the history and evolution of human populations occupying India. This short contribution addresses ongoing research in this area, future research, and methodologies and approaches that are becoming central to such inquiries. Technological advances, particularly in data generation and analysis, have led to a shift from atomized, discipline-bound research towards a proposal of self-aware, complex questions across disciplines. Consistent with the call for more logical positivistic research and to ensure a meaningful and grounded discussion, this contribution concentrates on the potential migration events linked to aDNA findings in the subcontinent. The text still emphasizes the importance of both a technologically-driven advancement of knowledge about human history and evolution and a collaborative effort between disciplines to shift the focus towards a more holistic understanding of the past and the present. This short review also touches upon future research lacunae and on the limitations of the potential of aDNA to address such questions.

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<sup>20</sup> Schröter, S. "The indigenization of catholicism on Flores." 2010. [\[PDF\]](#)

<sup>21</sup> Dey, S. "Their Stories, Their Voices: The Orphans of the British Raj." 2019. [\[PDF\]](#)

## BIBLIOGRAPHY

- Acharya, A. "Before the Nation-State: Civilizations, World Orders, and the Origins of Global International Relations." *The Chinese Journal of International Politics*, 2023. [oup.com](http://oup.com)
- Bannan, N., Dunbar, R., and Bamford, J. "The evolution of gender dimorphism in the human voice: the role of octave equivalence." *Current Anthropology*, 2024. [\[HTML\]](#)
- Bayless, L. "Defining humanity in the popular imagination: The Neanderthal and the early modern human in HG Wells and Yuval Noah Harari." *The Geographical Bulletin*, 2022. [researchgate.net](http://researchgate.net)
- Bhat, Rashid Manzoor. "Gandhian Phase: Mahila-Samitis and the Role of Women in the Indian National Movement." *Journal of Women Empowerment and Studies (JWES) ISSN (2022): 2799-1253*. [researchgate.net](http://researchgate.net)
- Biswas, Avick, Chandni Roy, and Mandrima Biswas. "The Romance of the Discovery of India's Prehistoric Past." *Anthropological Research in India: Retrospect and Prospects (2023): 27*.
- Chakraborty, Sayak, and Mohinder Pal Sachdeva. "A Glimpse Into India's Palaeoanthropological Past: Fossil Primates of the Pliocene and the Pleistocene." *Journal of the Anthropological Survey of India 73.2 (2024): 233-244*. [researchgate.net](http://researchgate.net)
- Chen, Siwei, et al. "A genomic mutational constraint map using variation in 76,156 human genomes." *Nature 625.7993 (2024): 92-100*. [nih.gov](http://nih.gov)
- Dennell, R. and Hurcombe, L. "How and why is Homo sapiens so successful?." *Quaternary Environments and Humans*, 2024. [sciencedirect.com](http://sciencedirect.com)
- Harvati, K. and Reyes-Centeno, H. "Evolution of homo in the middle and late Pleistocene." *Journal of Human Evolution*, 2022. [sciencedirect.com](http://sciencedirect.com)
- Hovers, Erella, et al. "The expansion of the Acheulian to the Southeastern Ethiopian Highlands: Insights from the new early Pleistocene site-complex of Melka Wakena." *Quaternary Science Reviews 253 (2021): 106763*. [nsf.gov](http://nsf.gov)
- Jain, Karan, et al. "The evolution of contemporary livestock species: Insights from mitochondrial genome." *Gene (2024): 148728*. [\[HTML\]](#)
- Jukar, A. M., et al. "Late Quaternary extinctions in the Indian subcontinent." *Paleogeography, Palaeoclimatology, Palaeoecology 562 (2021): 110137*. [sciencedirect.com](http://sciencedirect.com)
- Khan, Mahasin Ali, et al. "Siwalik plant megafossil diversity in the Eastern Himalayas: A review." *Plant Diversity 45.3 (2023): 243-264*. [sciencedirect.com](http://sciencedirect.com)
- Kumari, V., Tandon, S., Kallukalam, T., and Ghatak, A. "Detrital zircon U-Pb ages of Proterozoic and Cretaceous sandstones of Narmada region in Central India: Implications for provenance and the closure age of the ...." 2023. [eartharxiv.org](http://eartharxiv.org)
- Mondal, Debasis Kumar, Tamal Dutta, and Ranjana Ray. "Homage to Robert Bruce Foote: The Founder of Prehistoric Archaeology in India." *Annals of Anthropological Research & Reviews Vol 2.1 (2022)*. [academia.edu](http://academia.edu)
- Munir, Kamal, Shahzad Ansari, and Deborah Brown. "From Patañjali to the "gospel of sweat": Yoga's remarkable transformation from a sacred movement into a thriving global market." *Administrative Science Quarterly 66.3 (2021): 854-899*. [sagepub.com](http://sagepub.com)
- Noerwidi, Sofwan, et al. "Preliminary study of two deciduous human molars from the Late Pleistocene layers of Song Terus (East Java): A window into the last Homo erectus and the first Homo sapiens in Java." *L'anthropologie 127.3 (2023): 103159*. [\[HTML\]](#)
- Santos, Sebastiana Lima, María Fernanda De la Fuente, and Rômulo Romeu Nóbrega Alves. "Patterns associated with hunting with dogs in a semiarid region of northeastern Brazil." *Journal of Ethnobiology and Ethnomedicine 18.1 (2022): 71*. [springer.com](http://springer.com)

- Sequeira, Jaison Jeevan, et al. "Y chromosome STR variation reveals traditional occupation based population structure in India." *bioRxiv* (2024): 2024-08. [biorxiv.org](https://www.biorxiv.org)
- Smith, Geoffrey M., et al. "Towards a Deeper Integration of ZooMS and Zooarchaeology at Palaeolithic Sites: Current Challenges and Future Directions: Special Issue: Integrating ZooMS and Zooarchaeology: Methodological Challenges and Interpretive Potentials." *PaleoAnthropology* 2024.2 (2024): 186-211. [paleoanthropology.org](https://paleoanthropology.org)
- Smith, Holly E., et al. "Taxonomy, taphonomy and chronology of the Pleistocene faunal assemblage at Ngalau Gupin cave, Sumatra." *Quaternary International* 603 (2021): 40-63. [sciencedirect.com](https://www.sciencedirect.com)
- Tangney, Ryan, et al. "Success of post-fire plant recovery strategies varies with shifting fire seasonality." *Communications Earth & Environment* 3.1 (2022): 126. [nature.com](https://www.nature.com)
- Upadhyay, P. and Singh, S. K. "Correlation Between Rock Art and Archaeology of Sonbhadra Region." [heritageuniversityofkerala.com](https://heritageuniversityofkerala.com), . [heritageuniversityofkerala.com](https://heritageuniversityofkerala.com)
- Warren, G. "Is there such a thing as hunter-gatherer archaeology?." *Heritage*, 2021. [mdpi.com](https://www.mdpi.com)