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Research Progress of Human Origins

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Abstract: The birth of human is a miracle in earth history, and the earliest human could be traced back to *Sahelanthropus tchadensis*, who had existed for at least about seven million years. In cultural anthropology, human is defined as a creature capable of using language, having a complex social organization, and science and technology. The origin of human has always been the focus of the field of paleoanthropology, including creationism, theory of evolution, panspermia, and aquatic ape hypothesis. Although there is some evidence to support each hypothesis, conclusive evidence is still lacking. China has a favorable geographical location and a good foundation in the field of paleoanthropology and related disciplines. The scientists from China successively discovered the fossils of *Homo erectus*, Heidelberg man, *Homo sapiens* and Danisova man, and made an important breakthrough in the "from fish to man" research. However, the exploration of the origin of human beings in China is facing challenges such as extensive research fields, lack of high-level scientific research bases and insufficient fossil discovery and identification. It is suggested that the research on the origin of human beings in China should focus on the three fields of land, ocean, and space, find more fossils and evidence, strengthen the identification and research of fossils, and cultivate more talents with international perspectives through the construction of high-level research bases and cross collaboration.

Keywords: Human origin; Creationism; Evolutionary theory; Panspermia; Aquatic ape hypothesis; fossils

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1. Hypothesis of the human origin

Humans are primate groups that walk upright [1]. Walking upright is an important factor in promoting human evolution, which leads to the division of labor between the hands and feet. The hand, as an independent organ, helps humans to manufacture and use tools, effectively promoting the expansion of human vision, brain development, and intellectual development [2]. Creativity is a comprehensive skill unique to human beings, enabling them to generate new ideas, make discoveries, and create things. Creativity empowers us to shape and transform our environment in a way that no other creature can achieve, and it distinguishes humans and other species more than any other trait.

What is the point of human origin? Where do we come from? For thousands of years, Chinese and foreign scientists and philosophers have continuously explored and contemplated the true origin of human beings. With the progress of science, technology, and the improvement of people's cognitive ability, several theories have emerged regarding the origin of human beings.

1.1. Creationism

"Creationism" is a concept in which a "God" created man [3,4]. It can be found in the myths and legends from various cultures around the world.

In many foreign mythological system, there are widespread legends of God creating humans. For instance, the first chapter of Genesis introduces the legend of God creating the world in seven days. On the sixth day, God formed a man from the dust of the earth and named him Adam. He then created a woman from Adam's rib and named her Eve. After Adam and Eve stole the forbidden fruit, two people were driven out of the Garden of Eden, and human reproduction began, leading to the existence of the present human population.

Egyptian mythology holds that man was called into existence by God; Indian mythology holds that God created heaven and earth and then led man from the ground and lived on the earth. Ancient Indian mythology suggests that Brahma created everything in the universe, including man.

In Chinese mythology, the creation story of Nuwa holds a significant place in the hearts of people. According to historical records like the "Taiping Imperial Tour," it is commonly believed that in the beginning, there was no one in heaven and earth. Nuwa, a revered figure, is said to have created human figures from loess soil. As life unfolded, the need for procreation arose, leading Nuwa to shape more people from mud using ropes, breathing life into them. These human figures, crafted from yellow mud, were called "humans." Over time, the population gradually increased through reproduction, symbolized by humans emerging from dried vines on the ground.

1.2. Evolution

A British biologist, Charles Robert Darwin, proposed the concept of evolution in 1858 [5] (**Figure 1**), which is supported by three main arguments. Firstly, all organisms have a common ancestor, because biology and medicine confirm that all species share a set of genetic codes. Secondly, species are not fixed entities, but rather have evolved naturally over time. Humans, for example, are believed to have evolved from forest-dwelling apes in Africa. Thirdly, natural selection is the main driving force behind evolution. Organisms evolve in order to adapt to the natural environment of life, that is, natural selection and survival of the fittest. As soon as the concept of evolution was proposed, it completely overturned the concept of creationism and ruled the scientific community for more than one hundred years.

In 1865, an Austrian botanist Mendel made a conclusion of particle inheritance through hybrid experiment with peas [6]. He demonstrated that genetic material does not fuse but rather separates and recombines during reproduction and inheritance. Based on these findings, Mendel proposed that organisms evolve through mutation, gene combination, and natural selection. According to Mendelian theory, gene mutation is the fundamental cause of biological evolution instead of external environment alone. This theory complements the causes of evolution proposed in Darwinian evolution.

In 1937, Dubzinsky *et al.* proposed the concept of comprehensive evolution, with the main argument being that the gene pool is the basic unit of biological evolution, and the sum of all genes in a population is called the gene pool of a population [7]. While the genotype of individual species may not be constant for generations, but the sum of all genes in the population is relatively constant Furthermore, various selection mechanisms operate

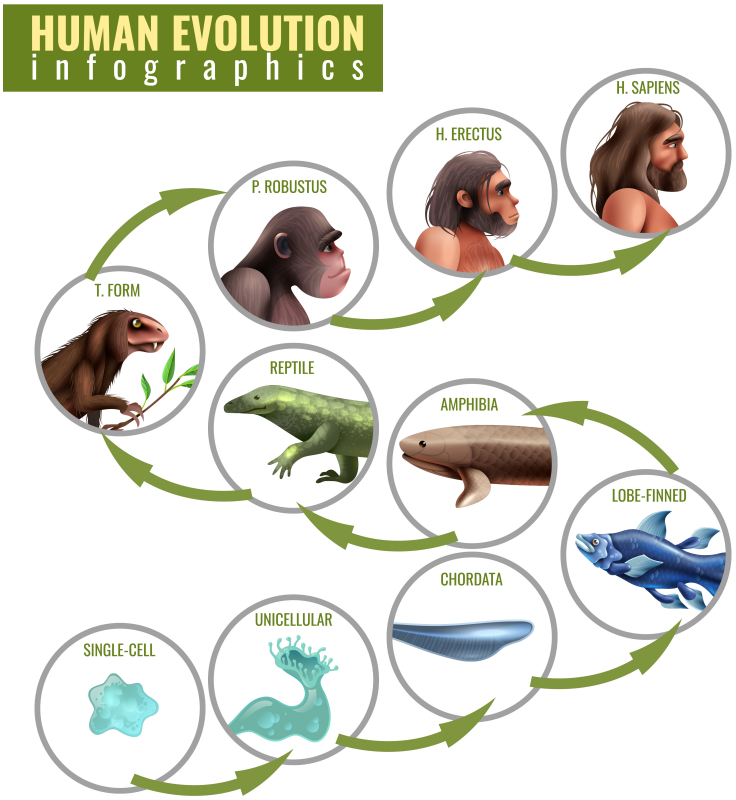

Figure 1. Schematic diagram of the evolution theory [1]

in nature, including gene mutation, natural selection, and isolation. This theory first put forward the concept of "gene pool," which supplemented the evolutionary mechanism proposed in Darwinian evolution and better explains the evolutionary process of population.

The DNA double-helix structure was proposed by Watson and Crick in 1953 [8]. It reveals that DNA is formed by a sequence of deoxyribose and phosphate, which are connected through ester bonds, resulting in a parallel arrangement and forming a double helical configuration. The discovery of DNA double helix structure unveiled the chemical nature of genes and allowed the study of genetics and evolution into the molecular level. It transcended the limitations of merely understanding life phenomena at the genetic phenotype level and revealed the molecular intricacies of genetics. This breakthrough accelerated the advancement of molecular biology, providing deeper insights into mutation and genetic properties.

In 1972, Eldredge and Gould jointly proposed the theory of "intermittent balance," which suggests that evolution is a combination of mutation and gradient, that is, most species are form relatively quickly, while the process of species formation through mutation occurs slowly under the influence of selection [9]. In his evolutionary theory of "natural selection and survival of the fittest," Darwin believed that evolution is a stable, gradual, and continuous process, rejecting the idea of leaps in nature. However, the evolution of organisms is not a slow and gradual accumulation but an alternation of prolonged stability and transient upheaval, leaving many gaps in the geological record. The "intermittent equilibrium" theory better explains the discontinuities and jumps observed in paleontological evolution.

With the continuous progress of science, especially the advancements in geology, cytology, molecular biology, and other fields, strong evidence supporting evolution has been provided. In the field of geology, a

large number of discovered biological fossils offer substantial evidence for evolution. Among these fossils, the Chengjiang fauna, discovered by Luo *et al.*, in 1993, stands as one of the most representative. Located in Kunming, Yunnan province, this fossil group dates back approximately 500 million years and represents the oldest and most complete preserved shell metazoan fossils in China. The Chengjiang fauna comprises a diverse range of species, including arthropods, vercoids, tentacles, trichogillans, echinoderms, chordates, heads, and vertebrates, encompassing almost all major categories on the Earth's animal tree [10]. Notably, the discovery of real vertebrates (Kunming, Haikou, and Zhong Jian) in this group has pushed back the history of vertebrates by 50 million years [11]. As a witness of the Cambrian explosion, the Chengjiang fauna confirms that the vast majority of invertebrates underwent rapid evolution within a short period, which accounted for less than one percent of Earth's overall history. Furthermore, the discovery of the Chengjiang fauna also shows that the evolution of organisms does not always occur gradually, but can involve both incremental and sudden leap forward [12].

In the field of molecular biology and cytology, Shi *et al.* have combined homologous proteins and gene trees to propose a new method for evolutionary verification at the gene level, aiming to determine direct homologous relationships. Orthologous relationships represent identical functions, while paralogous relationships signify functional differences. The relationship between the homology and functional similarity depends on the evolutionary distance. Shi *et al.* built a gene tree of secreted regulatory proteins (hedgehog protein) from flies, zebrafish, frog, chicken, mouse, and human, thereby confirming the orthologous relationship between Drosophila and other chordates [13].

Molecular biology also provides great thrust in the advancement of the evolution concept. Li *et al.* [14] proposed a calculation scheme for the absolute evolutionary rate of homologous biomolecules, calculated the divergence time of some major animal species during the Cambrian biological explosion and concluded that the divergence time between protostomes and deuterostomes was 500 million years ago. This finding offered a new idea and method for studying the origin and evolution of organisms. According to Darwin's theory of evolution, the origins of any complex life form can be traced back to a known or unknown single-cell simple life form. Li *et al.* conducted some calculations and revealed that red algae appeared about 1.331 billion years ago, green algae emerged about 1.174 million years ago, mosses differentiated from green algae 452.7 million years ago, and ferns emerged 437 million years ago. These findings provide evidence that prokaryotes evolved along the direction of algal, fungal, and protozoan lineages. Remarkably, these results were consistent with literature reports based on fossil record [15].

However, it is important to note that Darwin's theory of evolution has faced increasing skepticism from various individuals. The primary concerns raised include the absence of sufficient fossil evidence to support the transition from forest apes to humans and the perceived brevity of the timeline for human evolution, which is estimated to have occurred approximately 7 million years ago [16].

1.3. Biological alien theory

The concept of "biological alien" suggests the possibility that humans may originate in other planets (**Figure 2**) [17,18]. This theory arises due to the perceived lack of scientific clarity in explaining the physiological characteristics of human beings, which seemingly contradict the fundamental principles of evolution.

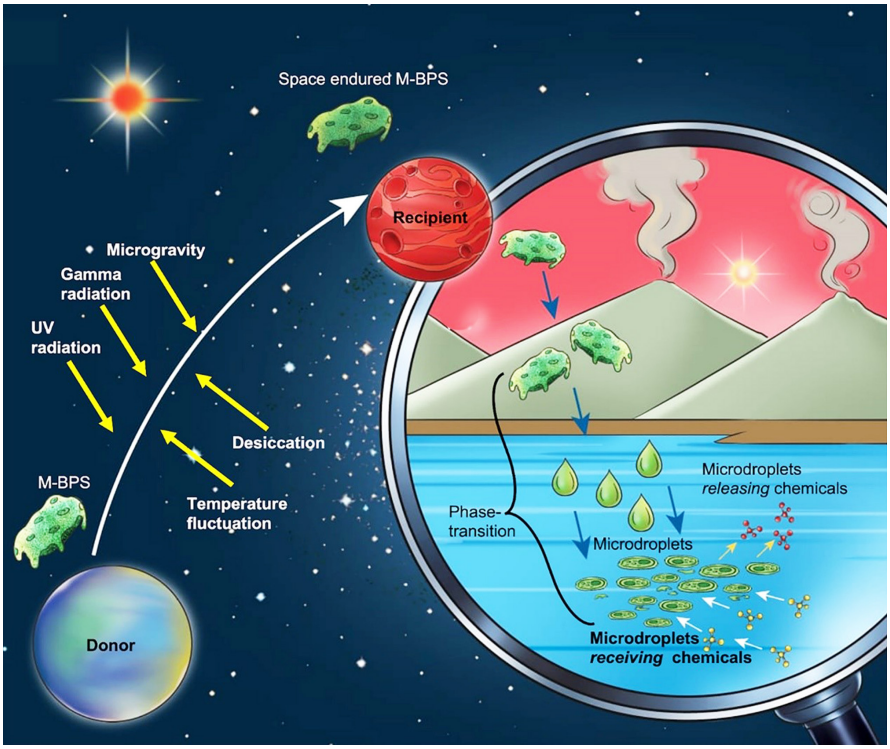

Figure 2. Schematic diagram of biological theory [18]

In 2003, Wang utilized a radio telescope and employed molecular spectroscopy to detect C_{60} molecules in the interstellar cloud, the discovery of which laid the foundation for the study of complex alien organic matter [19]. Subsequently, in 2004, NASA discovered the presence of amino acids in dust particles obtained from Wild 2 comet through the Stardust probe [20]. Moving forward to 2020, American scientists used cutting-edge mass spectrometry to discover a blood stone protein in the Acfer 086 meteorite, which is not native to Earth [21]. Likewise, in 2022, Japanese scientists discovered more than 20 amino acids in sand sample brought back from the Dragon Palace by the Hayabusa 2 asteroid probe [22]. During the same year, American and Japanese scientists discovered purines and pyrimidines in the Murchison meteorite[23]. Although nucleic acids, amino acids and proteins cannot be equated with the source of life, these aforementioned discoveries validate the existence of fundamental life-building materials in space, Consequently, these findings heighten the possibility of favorable conditions for the emergence of life on Earth.

1.4. Aquatic ape theory

In response to the scarcity of ancient ape fossils, British anthropologist Alister Hardy proposed the aquatic ape theory in 1960 [24], It believes that 4–8 million years ago, the sea flooded large areas of eastern and northern Africa, leading some ancient apes to inhabit the water and evolve into aquatic apes. Millions of years later, as the sea water retreated, these aquatic apes transitioned back to the land, eventually becoming the ancestors of mankind. Miyake *et al.* studied the pectoral fins of the Australian lung fish (*Neoceratodus forsteri*) and the African lung fish (*Protopterus aethiopicus*). The fossil scan showed that the muscles of the lung fish were arranged similar to the human shoulder and elbow joints [25]. This group of muscles is involved in maintaining a stable posture and undertaking weight-bearing movements, suggesting a potential evolutionary link between fish fins and animal limbs. In 2002, a French medical scientist Michael Odent put forward a new idea: humans and dolphins are more related than apes, suggesting that dolphins may be the ancestors of humans [26].

After comparing the physiological structures of humans and apes, it was discovered that humans have a lot in common with aquatic animals, such as dolphins. For instance, humans lack a thick hair covering on their bodies. This absence of hair reduces resistance in water, resulting in decreased energy consumption and increased speed of movement. However, the lack of body hair hampers heat preservation. Since water conducts heat more effectively than air, heat is lost rapidly in water. To compensate for this, humans, like aquatic animals, develop a thick layer of subcutaneous fat. Another distinguishing feature is the flexibility of the human spine, which allows for efficient movement in water. In contrast, an ape's spine cannot extend backward [27]. These findings provide clues regarding the potential aquatic origins of humans.

Nevertheless, there exist several objections to both the aquatic ape theory and the dolphin theory, with the primary objection being the absence of fossil evidence for aquatic humans.

2. Research status of human origin in China

2.1. From ape to man

China, with its vast territory, is home to a wealth of ancient human fossil resources. Since the 1920s, many human fossils, including *Homo erectus*, Heidelberg man, *Homo sapiens* and Denisovan, have been found in 25 provinces and regions across China.

In 1930, Pei and his colleagues discovered the "summit" fossil group, which included various human fossils such as skull, mandible, teeth, and limb bones. These fossils were found in the mountains.

Additionally, in 1965, Professor Qian Fang from the Institute of Geological Sciences found the fossil of Yuanmou Man in the northwest region of Yuanmou Shangdu, Yunnan. The fossil consisted two teeth, classified as *Homo erectus*, and was named Yuanmou *Homo erectus*. It is noteworthy that this discovery predates the findings of ape men in Beijing and Lantian, making it the earliest known ape man fossil discovered in southern China [28].

In 1984, Professor Huang Wanbo discovered a fossil assemblage from Longgupo cave, China. These fossils, dating back approximately 2 million years, consisted of over 20 different types, making it the site with the highest diversity of quaternary species fossils. The following year, Professor Huang Wanbo found the ancient human mandible fossils, including a left lower gum and an upper medial incisor, indicating that there were humans in China 2 million years ago [29]. The Longgupo fossil assemblage is earlier than zhoukoudian Beijing people fossils and Indonesian fossils. The emergence of the Longgupo fossil assemblage has revised the timeline for the appearance of hominins in China, suggesting that it may coincide with the period of East African hominin presence [30].

To date, approximately 80 human fossils have been excavated in China. Academician Wu Xinzhi has summarized the characteristics of these human fossils, which include a flat face, low nose bridge, nearly rectangular orbit, bending of the lower edge of the maxilla, and specific features in the lower part of the frontal bone and the back of the upper front teeth [31]. Based on this, in 1998, Academician Wu Xinzhi put forward the hypothesis of "continuous evolution with collateral hybridization." The hypothesis states that the four stages of human evolution are Homo habilis, Homo erectus, early Homo sapiens, and late Homo sapiens. Throughout this process, humans undergo continuous evolution with intermittent contact and hybridization with foreign populations, with each stage not coexisting for extended periods [32]. This theory well explains the process of human origin.

2.2. From fish to people

Zhu, an academician of the Chinese Academy of Sciences, has made significant contributions to the field of

source exploration in the evolutionary process from fish to man. In 2009, Zhu's team discovered ghost fish in the vertebrate fauna of China. Zhu restored the membranous bone model of the skull roof and identified several distinguishing features. These features include long top nails and back tops, a non-toothed middle kissing bone, a midline nasal bone, variable shape and kissing spine, and near midline concave lines in the middle and back sections. The posterior outer nose of the ghost fish is surrounded by the anterior orbital bone, similar to the fin fish. By comparing the ghost fish with the fin fish, it is suggested that the preorbital bone may be a common feature of both ghost fish and fin fish [33]. As a jawed vertebrate, the ghost fish combines the characteristics from various large groups of jawed vertebrates. Filling the morphological gap between fish and vertebrates, ghost fish fossils provide the earliest evidence of jawed vertebrate ancestors [34].

In 2022, Zhu's team studied the fossils of armored fish, shield skin fish and cartilage fish in the Neolithic Age of China, and revealed the origin and early evolution of jawed vertebrates. Typically, the paired fins of fish generally serve as lateral fins. However, over time, only coelurosaurs and jawed vertebrates evolved forward, while the remaining fins shifted to the pelvic position. This evolutionary change favored active propulsion and rotation. This finding indicate that the evolution of chest and pelvic structures began early in the development of jawed vertebrates. This discovery advanced the fossil record of intact jawed vertebrates by 11 million years, filling a gap in the global scientific community in the fossil record of intact jawed vertebrates during this period [35].

2.3. Thoughts on the origin of human beings in China

These findings lay the foundation for research on the origin and evolution of humans. Nevertheless, China encounters several challenges in its pursuit of understanding human origins. Firstly, the scope of research is vast. China's interests span not only terrestrial investigations but also deep-sea and space exploration. In addition, there is a scarcity of top-tier scientific research facilities and institutions. Currently, China has only two high-level scientific research bases: the Archaeological Research Center of the State Administration of Cultural Heritage and the Institute of Vertebrate Palaeontology and Paleoanthropology, which cannot meet the growing demand of human origin research in China. Third, the discovery and identification of fossils are insufficient. Having more specimens forms the basis of exploring the origin of human beings. There are still many blind spots in the evolutionary picture of human origin in China, necessitating the urgent discovery of new fossil specimens as supporting evidence. In recent years, a lot of stone materials have been found in the country. However, many studies have only focused on describing these materials, leading to a limited number of published articles and minimal progress in developing theories. It is urgent to dig deep into the information contained within these specimens and gradually establish the theoretical system of human evolution in China. Given the current scientific research discoveries and the controversies surrounding human origin and evolution, it is imperative to increase funding for research in this field. By directing scientific researchers' attention and leveraging their expertise, we can tackle challenging problems and advance our understanding of human origin and evolution. This increased focus will also lead to the exploration of new evidence related to human origin and evolution, providing fresh insights and arguments to enrich the existing knowledge.

3. Recommendations for future works

Based on the current scientific research discoveries and the controversies surrounding human origin and evolution, we should increase the funding for the study of human origin and evolution. Adequate funding will enable researchers to conduct more comprehensive and in-depth investigations in this complex field.

To optimize the use of available resources, it is imperative to guide scientific research workers to focus their advantage and strengths on addressing the most challenging problems related to human origin and

evolution. By concentrating on these difficult issues, researchers can make significant breakthroughs and contribute valuable insights to the field.

Furthermore, efforts should be made to promote the exploration and analysis of evidence related to human origin and evolution. This could involve conducting further excavations, employing advanced technologies to analyze existing specimens, and fostering international collaborations to access diverse datasets.

The ultimate goal of these efforts is to provide new and robust arguments concerning human origin and evolution. new argument.details are as follows:

3.1. Focusing on three areas: land, sea, and space

China is an ancient civilization with a rich and extensive history, encompassing not only a vast land but also expansive oceans. Throughout its long historical development, our ancestors not only created the brilliant loess civilization but also cultivated a remarkable maritime civilization. The land and waters of China are home to a vast and invaluable cultural heritage, which serves as a precious resource for conducting research on human origins. To advance our understanding of human origin, it is imperative to collect more fossil materials and evidence. The wealth of cultural heritage in China's land and waters holds immense potential for unearthing crucial insights about the origins of humanity. By further exploring and gathering these valuable resources, we can make significant strides in unraveling the mysteries of our human ancestry.

On April 24,1970, China's first man-made satellite, Dongfanghong-1, was successfully launched, marking the country's entry into the space age. Over the past 52 years, China has made remarkable achievements in space exploration. With the development of space technology, China is now planning to construct a near-Earth asteroid defense system to address the potential threat of asteroid impacts and contribute to the safety of our planet and humanity. There are seven directions for space exploration of human origin, namely: Mars exploration, Jupiter and Saturn-related satellites, carbonaceous asteroids and comets, exoplanets, organic matter in meteorites, organic molecules in interstellar molecular clouds, and laboratory simulation reactions.

To sum up, the mainstream theory of human origin covers three different fields: land, sea, and space While each theory is backed by specific evidence, none possesses conclusive proof. To advance our understanding, researchers should be guided and encouraged to conduct comprehensive and in-depth research in all three domains, capitalizing on their own expertise and strengths. By combining efforts and exploring various perspectives, we can strive to unravel the mysteries of human origin more effectively and achieve a more comprehensive understanding of our shared heritage.

3.2. Building a high-level scientific research base

The archaeological Research Center of the State Administration of Cultural Heritage and the Institute of Vertebrate Paleontology and Paleoanthropology in China have made significant progress over the years, diligently developing and conducting research. These institutions have now attained a considerable scale in terms of personnel quality, resources, and specimens. Given China's vast territory, it's crucial to tap into the collective enthusiasm of cultural departments, universities, research institutes, and interested academic and corporate partners dedicated to the study of human origins. Through collaborative efforts to establish high-quality scientific research centers and the cultivation of talented individuals with a global outlook, China can further enrich its scientific exploration in this crucial field of study. This will help enhance our understanding of human origins and evolution.

3.3. Discover more fossils and evidence

Although the study of human evolution in China has made certain achievements and obtained a broad outline,

it is still necessary to find more new fossils, fill the blind spots for the survival of ancient humans in China, and draw a more detailed evolutionary picture. Therefore, it is suggested that the state should formulate detailed archaeological plans and key areas, such as Chongqing, Guangxi, and Hubei provinces, to carry out the census work in a planned way. Simultaneously, efforts should be made to strengthen the popularization of science and enhance the public's appreciation of human fossils. This way, people can promptly report fossil clues to relevant departments for timely tracking and excavation. In fact, many important fossils in China have been discovered through this approach [36].

3.4. Strengthen the identification and research of fossils

In recent years, although many stone materials have been found in the country, there has been a lack of published articles and limited progress in theoretical advancements. To advance the field, future efforts should aim to elevate research findings into theoretical frameworks, including challenging the theory of African origin and exploring the potential of human origins in Asia. By delving into these challenging areas and presenting compelling evidence and arguments, researchers can contribute to the development of more comprehensive and robust theories on human origins.

The research includes stratigraphic comparison, analysis of chemical elements and organic components, and determination of absolute dating. The dating results are crucial for identifying whether our interpretations of human fossils in the past are accurate and for establishing human evolutionary systems.

In terms of research methods, new approaches and technologies, such as digital statistical analysis, computer data processing and modeling, stone making and use simulation, and combination research and are being employed. Only by applying new research methods and technologies and conducting comprehensive investigations on a site or a cultural layer can we aid the development of ancient anthropology. This evolution involves moving from subjective to objective interpretations, from qualitative to quantitative analyses, and from one-sided to comprehensive perspectives.

3.5. Promoting crossover and collaboration

To unravel the enigma surrounding human origins, it is essential for researchers from diverse disciplines to collaborate closely and exchange knowledge. By continuously enhancing the quality and significance of research findings, Chinese paleoanthropology and prehistoric archaeology can achieve a substantial breakthrough in their international status and influence. In this era of rapid scientific and technological advancements, it is recommended that scholars engaged in anthropology research unite their efforts to expedite the resolution of challenging questions regarding human origin. By doing so, we can bring scientific conclusions to the centuries-long mystery and contribute to the advancement of knowledge.

In summary, China has a relatively strong foundation in the research field of paleoanthropology and related disciplines, and has the advantages of geographical location. The current focus is on nurturing a large pool of professionals, providing sufficient financial support, strengthening domestic and international exchanges, leveraging the experiences of international peers, and adopting the latest technical means to extract more information from the strata and specimens. Additionally, it is suggested that comprehensive elective courses on the origin of the universe, earth, biology and human beings should be offered in higher education institutions. This approach would enhance the scientific spirit among college students, cultivate exceptional young talents, and facilitate China's significant contributions to the global study of human origins.

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