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BOOK REVIEW

Ancient DNA: tracing DNA in echoes of the past

By Vural B, Erten Yurdagül G, Bayram Akçapınar G. (Editors), Istanbul: Ginko Bilim, 2024. 344 pp. ISBN:978-625-8362-23-7 (paperback)

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Abstract

The book *Antik DNA: Geçmişin Yankılarında DNA'nın İzini Sürmek* (*Ancient DNA: Tracing DNA in the Echoes of the Past*), edited by Burçak Vural, Gaye Erten Yurdagül, and Günseli Bayram Akçapınar, is reviewed in this paper. The book explores and presents a number of aspects of ancient DNA researches and was prepared in 15 chapters with contributions from 20 authors from diverse molecular genetics specialties. The goal of the book, according to the editors, was to introduce anthropology students to ancient DNA and reated researches. Additionally, a brief dictionary of terms connected to the issue has been included at the end of the text to aid individuals who are unfamiliar with the field in understanding ancient DNA and related subjects.

Ancient DNA

One of the traits that set humans apart is our ability to trace the past, or more precisely, "make or write history," as José Ortega y Gasset correctly points out. Over time, the resources and opportunities accessible to anyone who write or create history have greatly expanded and changed. Researchers today have access to a vast array of data sources, from physics to chemistry, from geology to genetics, in their endeavors to reconstruct the past, whereas ancient thinkers who sought to write the history of humans and nature had only oral narratives (such as mythologies and epics). We can say that as scientific methods and procedures have advanced, the use of more tangible data and evidence to support historical claims has grown.

Paleogenomic research has grown in significance as a means of illuminating the past, particularly with regard to the evolution of living organisms, their migrations and dispersions, their interactions with the environment (such as microbiota), illnesses, and living conditions. In the preface, the editors of the volume *Antik DNA: Geçmişin Yankılarında DNA'nın İzini Sürmek* (*Ancient DNA: Tracing DNA in the Echoes of the Past*), which was edited by Burçak Vural, Gaye Erten Yurdagül, and Günseli Bayram Akçapınar, noted that it was the first Turkish volume to deal with these themes. In her preface, one of the editors, Burçak Vural, highlights that the book was designed to address the lack of Turkish resources available to students in her undergraduate anthropology course.

DNA: evolutionary perspective

The fifteen chapters in this collection explore ancient DNA from various angles. The title "Evolution and DNA" can be used to group the first three chapters of the work, which was written by 20 contributors. The first chapter, "Fossil in the genome," was written by Naci Çine. It is taught in this chapter, which provides broad information regarding the DNA molecule, that the genome also contains information about the evolutionary history of living things. The second chapter, authored by Ceren Gezik and Bilge Ş. Özsait Selçuk, first explores the molecular mechanisms of evolution before going over DNA sequencing methods and bioinformatics in the study of evolutionary change. Notably, the latter portion of this chapter contains a list of databases that are employed in this subject. Despite the importance of the information provided to the reader, it should be emphasized that providing more detailed information (and examples) about bioinformatics and next-generation sequencing is more crucial. Çağrı Güleç devised a plan for the utilization of data from paleogenomic investigations in phylogenetic mapping. This part does not exhibit the failure that was encountered in the preceding section. The author has written it in a fashion that is appropriate for an undergraduate book chapter, complete with examples on molecular phylogenetics and mapping.

Havva Altunçul, Özlem Bülbül, and Gönül Filoğlu wrote the book's fourth chapter, "Identification in ancient DNA." It is significant that there is a discrepancy between the section's title and its content because the first half of the chapter covers a broad overview of ancient DNA studies carried out in Turkey, most of which are about population genetics rather than identification. The chapter's second portion provides some historical findings that demonstrate the use of ancient DNA in identification.

DNA: different aspects

The volume's fifth chapter, "Ancient DNA and epigenetics," was authored by Yelda Tarkan Argüden. Recent years have seen a disproportionate rise in the public acceptance of genetic determinism due to the growing quantity of DNA research. This has something to do with the scientific community's partial disregard for epigenetics. Thus, adding a chapter on epigenetics to the volume will aid students in learning about the topic from a variety of perspectives. In fact, the information revealed by ancient DNA investigations regarding gene expression was consistent with the chapter's central thesis.

Tugay Türkyılmaz and Hülya Akdemir's sixth chapter offers information on ancient plant DNAs. It then describes how to analyze this information after outlining the methods and locations for obtaining plant genetic remnants, which are an essential component of human life and ecological relationships. The agricultural revolution and vast crop cultivation are two significant areas that plant DNA analysis will support. Actually, the writers examine the material on plant domestication and concentrate on this subject toward the end of the chapter.

The authors of the seventh segment, "Ancient DNA under water," are Cemaliye Akyerli Boylu and Şirin Yüksel Kılıçturgay. Compared to those found on land, the genomes of ancient creatures found in lakes, marshes, and oceans have received less research attention. Notwithstanding this drawback, DNA molecules extracted from water offer incredibly useful insights into the ecosystem and climate conditions. For instance, paleogenomic data collected beneath Antarctica's glaciers showed that the continent had a warmer climate approximately 90 million years ago, with an average temperature of about 20 degrees Celsius—that is, a tropical environment.

DNA: practical uses

In the eighth chapter, Bilge Ş. Özsait Selçuk discussed "Ancient DNA and sex chromosomes." The X and Y chromosomes, together with their genetic characteristics, are described sequentially in the literature that explains how sex chromosomes developed from a pair of autosomes. Since sex determination is the initial stage of identification in anthropological, archeological, and forensic contexts, it has always been significant. Amelogenin, which is commonly chosen for sex determination, is also highly supported in this work, as can be seen in the chapter. However, just one sentence touches on the possibility that the test could produce inaccurate findings because of mutations in this gene. Recent research, however, has shown that X and Y deletions in populations and mutations in primary binding sites cause significant discrepancies in amelogenin-based sex determination (e.g., Chang et al., 2003; Tozzo et al., 2013; Dash et al., 2020). The fact that amelogenin might not be a reliable indicator of sex in historic and prehistoric human bones has been highlighted in support of this conclusion (Arıcan et al., 2018). In a work of this extent, it is clear that this topic merits a closer look. The author also discusses the significance of the X and Y chromosome haplogroups in determining human migrations. It is easy to say that students studying anthropology and archaeology will find this information both intriguing and helpful.

Human evolution and aDNA

Ancient mitochondrial DNA (mtDNA) is the topic of the book's ninth chapter. Evrim Kömürcü Bayrak, the chapter's author, discusses the significance of mtDNA in anthropology and human origins study after giving a general overview of its composition and characteristics. The genesis of humans and their global spread, the evolutionary links of Neandertals, and the genetic traits of Ötzi the Iceman are just a few examples of the contributions that ancient mtDNA investigations have made to anthropology.

Research on the immune system is one of the most abundant fields of paleogenomics. In the tenth chapter, Sema Bilgiç Gazioğlu and Gaye Erten Yurdagül discussed this subject and provided an initial explanation of acquired and innate immunity. In addition to introducing acquired and innate immunity components, the authors attempted to explain the advancements in human evolution and their global dissemination. It was underlined that new defense mechanisms were developed as a result of the novel microbial threats brought about by humanity's adoption of agriculture and move toward settled life.

As is well known, identifying genetic illnesses is one of the most popular applications of ancient DNA analysis. In the eleventh chapter, Güven Toksoy and Bilge Ş. Özsait Selçuk attempt to clarify this matter. Anthropologists study the evolution of genetic illnesses as well as how they are distributed in both ancient and modern societies. In recent years, they have started using

paleogenomic material to follow disorders in addition to more conventional diagnostic techniques. Contrary to popular belief, aDNA results do not guarantee 100% reliable results, even though paleogenomic analyses boost the reliability of the results. The authors stress that sequencing errors would result from nucleotide alterations in ancient DNA that are C>T and G>A.

When studying ancient DNA, one of the questions that arises is what other creatures—particularly microorganisms—lived in the same habitat as humans. The answers to these intriguing questions can be found in Emrah Kırdök's twelfth chapter. This chapter emphasizes that teeth and dental plaque are the main source of information on the microbiota of humans who lived in the past. In fact, these investigations revealed that the Neolithic shift led to an increase in periodontitis, caries-causing, and carcinogenic microorganisms in the oral microbiome. Examining mummies and fecal remnants (coprolites) is the second method to uncover the ancient microbiota. Analyzing the microbiota change in the remains essentially entails analyzing the pathogens and the human being's life changes.

"The archaeological journey of the 'tooth' in the period preceding ancient DNA studies" is the title of the thirteenth chapter in the volume. The inclusion of this chapter, authored by Zerrin Aladinler, in the volume is unclear. It is unclear why the book, which discusses ancient DNA, explains the morphology of teeth, dentin, pulp, milk teeth, cavities, periapical gaps, periodontal disorders, enamel hypoplasia, tooth wear, and isotope analyses. These subjects are inappropriate for the volume's flow.

Emrah Yücesan wrote about the topic of using DNA studies to investigate human migration routes. A brief history of humanity based on fossil discoveries is presented at the beginning of the article, after which the problems surrounding the use of genetic material in migration research are explained. The author concludes by providing a brief overview of Y chromosome and mitochondrial haplogroups. Although this information is helpful to the reader, it is lacking in that the reader is not given the compatible and incompatible findings between the migrations inferred from mtDNA and Y chromosome haplogroups, nor are the significant migrations based on the indicated haplogroupings.

Paleogenomics and ethics

Burçak Vural and Arzu Atalay wrote the book's sixteenth and last chapter, which is devoted to ethics in aDNA research. According to the report, efforts to rebuild phenotypes using archaic material have also increased, and paleogenomic research has grown significantly in recent years. As a result, ethical debates of who will have a say in ancestral genomes and which groups would be impacted by these data accompany these developments. These discussions on research ethics include the views and recommendations of groups like the "Society for American Archaeology" and the "American Society for Human Genetics," but it is a serious shortcoming that the American Anthropological Association's (AAA) principles—established by the largest professional organization in the world for anthropology—are not taken into consideration. If these guidelines were followed, it would become clear that many of the difficult questions raised and attempted to be resolved in the book have been debated for years and that helpful recommendations have been made.[1]

Concuding thoughts

One could argue that the volume, which was written to introduce anthropology students to ancient DNA, only partially succeeded in its goal. By reading the book, students can learn the fundamentals of ancient DNA, including its definition, applications, and locations. A notable

[1] See Kottak (2016) for an outline of the ethical principles that the American Anthropological Association (AAA) has suggested serve as the foundation for a number of anthropological study areas (and are especially relevant to biological and cultural evidence from ancient human societies).

shortcoming, though, is that crucial subjects like DNA sequencing and bioinformatics are simply touched upon and not illustrated with examples. Aside from this, the book's editorial layout contains a few errors. For instance, given the methodological and introductory material they include, it would have been advantageous if the parts titled "ancient DNA and epigenetics" and "ancient mitochondrial DNA" had been introduced sooner when the themes' flow is taken into account. Furthermore, it has been noted that the issues are explained repeatedly. For instance, the second and fourth chapters both cover subjects related to DNA sequencing techniques.

In addition, it is noted that certain topics or chapters that are essential for a volume of this size are left out. For instance, this study does not address the extraction of ancient DNA, despite the fact that it is crucial for anthropologists, forensic anthropologists, and paleogenomics professionals. Likewise, a notable shortcoming is the lack of sections on haplogroups and population genetics. Lastly, arguably the most significant shortcoming in a volume written for anthropology students is the lack of a section assessing the significance of paleogenomics data, which is expanding like a snowball, for the field of anthropology.

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