Observing evolution by ancient DNA

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Q. What is the one thing you want to know the most right now?

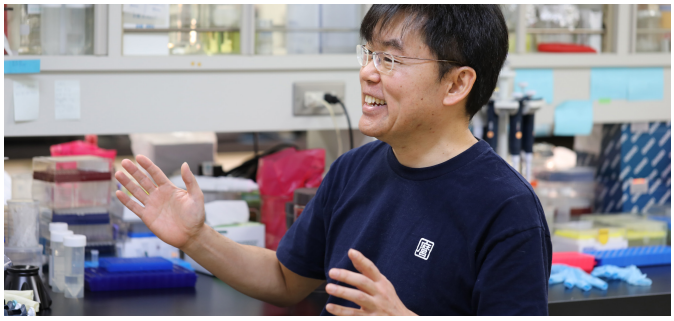
The question I most want to know is as follows. Researchers aim to understand how certain phenomena occur in many fields of science. For instance, when humans eat meat, the meat dissolves in the stomach—a process called digestion. Scientists have discovered mechanisms like protein-digesting enzymes that function in acidic stomach fluids by studying this phenomenon.

The study of evolution, however, is the opposite. Evolutionary “phenomena” occurred in the distant past and are almost impossible to observe directly. Instead, evolutionary biologists often study the “results” of evolution, such as genetic changes. In other words, we analyze the results and hypothesize evolutionary processes.

For example, evolutionary biologists often conclude that “positive selection played a role in this evolutionary process.” However, the conclusion reached is based on the inference from the DNA analysis, which shows that “if positive selection operates, we can infer this result.” This approach relies on inference rather than direct observation.

I aim to elucidate the process of evolution by observing the phenomena and analyzing the underlying mechanisms. Specifically, I want to understand how organisms adapt to their environment and how new species emerge. I aim to observe these processes and identify the molecular mechanisms driving them.

Although this may sound impossible, a small but growing number of studies have begun to observe these evolutionary phenomena directly. Additionally, advances in technologies like ancient DNA analysis allow us to look back in time and examine evolutionary processes from the past. These tools bring us closer to witnessing the mechanisms of evolution in action.



Q. What is something you find mysterious right now?

The first fundamental question is: what is a species? The definition of species has been debated for centuries. However, with the advent and widespread use of next-generation sequencing, the concept of species at the genomic level will become more apparent. This progress sheds light on the complexity of species boundaries. Understanding the nature of species is one of the greatest mysteries for me.

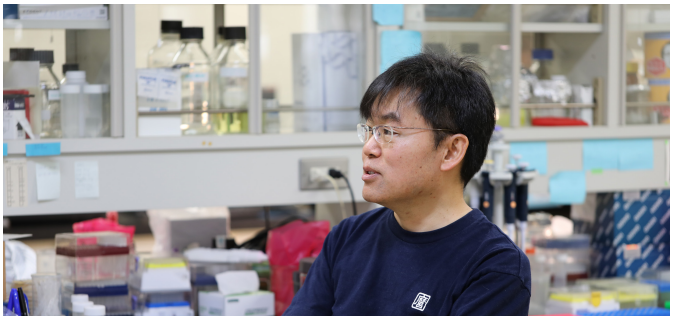
The second question is domestication. Specifically, I am studying the origins of dogs, the oldest

domesticated species. The domestication of dogs occurred so long ago that we have very few clues about how this process began. As an evolutionary biologist, I am fascinated by the relationship between humans and dogs as two distinct species. How did this unique relationship first form? This question is my second greatest mystery.

Q. Could you share your thoughts on the future prospects of this field?

Studying ancient DNA allows us to access genomic information from organisms that lived at specific points in the past. As I mentioned above, this makes it one of the most promising methods for directly observing evolutionary processes. By integrating ancient DNA analysis into evolutionary studies, we can gain deeper insights into how evolution has occurred over time.

For example, ancient DNA provides invaluable clues in my research on the domestication of dogs. Through this approach, we can observe how dogs adapted to human cultures across different historical periods.



Q. What was the most enjoyable moment and the most challenging moment during your research?

Research is always enjoyable for me, but if I had to pinpoint the most exciting moments, that would be the following. When I am doing research, I have a hypothesis. Then, when the results come out, sometimes the results are far from the hypothesis. Further research shows that the initial hypothesis was incorrect, and the newly obtained results are consistent. At such times, I realized that my hypothesis is tiny and that I cannot easily estimate the greatness of nature. That is the moment when I enjoy my research the most.

It is not challenging for me to do research, but research on foreign organisms is becoming more difficult due to stricter regulations.

Q. Do you have a message for undergraduate and graduate students who are interested in joining your lab? Also, do you have any interests other than research?

As I often tell graduate students, “There is no negative data” is my message to them. I am an experimental scientist, so I usually get new data. Even if the data contradicts my expectations, it is still new knowledge. I can then incorporate the findings for further research. That is why I always treat data contrary to my expectations, not as negative data, but as positive data that will help me progress my research.

As for hobbies outside of research, many of my hobbies are biology-related and related to my research. Even keeping dogs and cats is connected to my research. Aside from biology, one of my hobbies is building a small size bicycle and riding it along the coast for exercise. I also play games, which helps improve my decision-making speed.