Intro
Hello and welcome to All About the Ancient World! Our channel is dedicated to promoting the voices of Early Career Researchers in studies of the ancient world.

This presentation is titled “Doctor doctor, gimme the news: Diagnosis 2,000 Years Removed.” It will discuss how to diagnose the diseases of people from the ancient past. It is presented by Susanna Pilny.

Susanna has an Master of Philosophy in Classics from Trinity College Dublin and an Master of Science in Biological and Biomolecular Science, with a focus on microbiology and infection biology, from University College Dublin. She is currently a data analyst, but she still spends her summers volunteering at the Agora Excavations in Athens (during non-Covid years, of course) and her spare time pursuing independent scholarship.

Susanna has asked us to share the following content warnings with our audience: images of human remains, such as bones, will be shown in this presentation.

Now, without further ado, please enjoy this presentation All About the Ancient World!

Lecture
Hello everyone! As you know, I’m Susanna Pilny. I have long black hair and green eyes. I am wearing a blue dress with wildflower print and I use the pronouns she and her. Now just as a quick warning, I will be showing pictures of human remains, specifically bones. I would just like to quickly emphasize that the bones shown were once, or currently are, part of living, breathing people. So it would be disrespectful for anyone to reproduce these images outside of certain contexts, such as for educational purposes.

So, as you all know, I am here to talk about diagnosing diseases from the ancient world. I think that most of us just take it at face value when we’re told that, hundreds of years ago, people suffered from the plague or that someone died of TB more than a thousand years ago. But what most of us miss when experts come to these conclusions is the intensive research and dialogue that happens beforehand.

Now, I have a focus on the diseases of Classical Greece, which is generally seen as the period between 500 and 323 BCE, so this means that we’re talking about people who died more than 2,000 years ago. So think about it, you call your doctor, you have a telehealth conference -- it’s not really as good as seeing your doctor in person. Think about how difficult it is to diagnose someone 2,000 years dead! You can’t really see as a living, breathing person going through these symptoms. How in the world do you diagnose them and how confident can you actually be in this retrospective diagnosis?

I'm going to start by mudding the waters a bit. We see retrospective diagnoses of ancient diseases pretty regularly. So what are some of the challenges that experts face when attempting to diagnose ancient illnesses?

Broadly, diagnoses are made using a lot of sources, so, for example, you could have textual evidence ranging from books written by doctors to graffiti. You could have non-textual art sources, like paintings or pottery. And then you can have the more physical evidence like human remains.

Starting with textual evidence, when you're looking at, say, an ancient Greek book. What might be some of the problems with trying to figure out exactly what's going on? So, there are a lot of things to consider. First, there's the issue of language. If you even look at Victorian English, words for different diseases are different from the words we use now, like ague, or consumption, or dropsy. And even these words that were used by people roughly 150 years ago can cause confusion in those who aren't versed in the dialect of the period. Especially because some of these words don't have an equivalent in modern English.

Now, consider ancient Greek, an entirely different language used more than 2,000 years ago, so it's even farther removed from us now. And of course, a lot of the words don't have a direct equivalent in modern English. Like, for example, φθσις, which is p-h-t-h-s-i-s, it's a word from greek that often gets translated as tuberculosis, but it often just is used to refer to a number of wasting diseases, not just TB specifically. So, familiarity with language is definitely needed to navigate translation pitfalls. And usually reading a translation in English isn't enough to get the proper nuances so you can speak with authority.

So, beyond translation problems, there's also a misalignment between how WE understand disease and illness, and how the ANCIENTS understand disease and illness. So, essentially, modern science and medicine have given us a very, very specific idea of what a disease is, and this shapes how we search for and understand diseases in texts. This is going to be very different from how an ancient doctor or layperson understood disease, and there will be nuances in the way that they write about disease that we might miss or misunderstand entirely.

So, for example, we have very sharp boundaries between different diseases, like malaria and typhoid, but in ancient Greece, these likely would've just been recorded as a disease called "fever," πυρετός (pyretos).

Now, further, ancient doctors writing about a diagnosis, they might not always highlight the same information WE would like to see to a diagnosis using modern medicine. Because the process of diagnosis itself was even different. And to make things even worse, we can't assume that every single ancient doctor had the same understanding of diagnosis and disease. For example, in the case of Classical ancient Greece, medical historian Vivian Nutton explained it this way:

"The diversity of standpoints found in the medical writings of the late fifth and early fourth centuries is arguably greater than that in any other comparable block of Classical Greek literature. To concentrate on one theory or on those believed to be most closely associated with one man, Hippocrates, is to miss what are surely the most significant features of this medicine, its intellectual vitality and variety."

So, even then, we may assume that ancient sources share the same exact viewpoint of disease, which could lead us even further astray in our interpretations. Of course, we also have to assess the validity of a source. Ancient Greek works as we know them, come from copies of copies of copies, of original documents. We don't have the originals. Sometimes, words were accidentally or maybe even purposefully changed between copies. So, we have to try to assess the lineage of our current version, to make sure it's the best option to study.

And even in ancient times, the transmission of words wasn't always accurate. So, for example, some of our knowledge of ancient Greek medicine comes from later Roman authors or later Greek authors. In the case of some Roman authors, we have to trust that they both transmitted or translated the Greek authors correctly into Latin, and that they haven't colored their interpretations of ancient Greek medicine with Roman ideas.

Now, besides all that, it was not uncommon for ppl in ancient Greece to lie or sometimes get a bit confused about who wrote certain documents. So, for example, Hippocrates is the father of medicine, he was very famous in ancient Greece as a medical practitioner and he has around 60 still-existing works to his name. However -- big however -- Hippocrates definitely, definitely did not write all 60 of these works. Analysis of the language used in some of them indicates that they were written hundreds of years after he died. And even the famous Hippocratic Oath that doctors take is thought to have been written by a different person.

So, what happened here? It seems likely that some authors wrote using Hippocrates' name because they wanted more people to read their work. In other cases, it seems that authors were sometimes mixed up in people's personal libraries and the wrong name got assigned to the wrong work.

Related to all of this there is another huge issue. As we've all learned from Coronavirus, bacteria and viruses both mutate and die out constantly. Now, this means that for us, there's a chance that a disease we're reading about in a text might not be one that currently exists, and therefore might not be something we can really properly diagnose. It can also mean that we confuse a modern disease with something that died out 1500 years ago.

Further, even if a doctor is discussing an illness caused by a virus or bacteria around today, thousands of years of mutations could mean that the symptoms that we recognize today might not be the same ones that they exhibited in 500 BCE. A relevant modern example, the delta variant of the coronavirus only mutated recently, but its prevailing symptoms are different than prevailing symptoms of previous forms of the coronavirus.

Another issue is something not extremely well studied currently, but another issue is what happens when patients have more than one illness at the same time. Bacteria, viruses, and other pathogens can interact inside human bodies. This alters how those pathogens act and also alters how our body responds to them. This, in turn, will change the symptoms that we exhibit. For example, if you have malaria and syphilis at the same time, malaria will eradicate the syphilis. In fact, this was used to treat syphilis at a time when there wasn't any other treatment available and having syphilis could lead to severe brain damage and death otherwise. The reason behind this is because malaria causes such high fevers that the bacteria that causes syphilis couldn't survive. This treatment actually won the Nobel Prize for medicine in 1927.

Moving on from textual evidence, as for more visual evidence, in terms of ancient Greece, potential recordings of disease might have been made in paintings, on pottery, in sculpture, and more. Now, no ancient Greek paintings survive to this day (we know they existed, for example thanks to descriptions of paintings that were done in what could be considered the first public art gallery – the Painted Stoa in Athens).

But as for the rest, the remaining forms of art were often formulaic in depiction or they were made to represent idealized forms of human body (for example, kouros statues); they were not necessarily exact living portraits of people at the time. Moreover, many diseases look the same visually, and hard to distinguish what may be represented in art work.

Finally, when trying to diagnose ancient diseases, we can turn to physical evidence through archaeology. This is primarily done by studying the condition of human bones (osteology), and by performing DNA analysis on the bones.

Now different diseases can change the condition of your bones – either temporarily or permanently. Osteology looks for the key markers of different conditions in bones to indicate which diseases a person might have had. As mentioned before, diseases that no longer exist might have made bone changes similar to some modern diseases, and there's a potential for some diagnoses here to be incorrect.

Another major issue with the study of human bones is what's known as the osteological paradox. Changes in human bones don't occur immediately when a disease begins. Often, it will take time (maybe a few weeks) for these changes to occur. So, if you are facing a very powerful illness – as is often the case with something like malaria – you might die from the illness before your bones have a chance to reflect this disease.

Similarly, with DNA analysis, ancient DNA may reflect illnesses we haven't seen before. It's also somewhat tricky to gather ancient DNA; contamination from modern sources (like the people doing the excavation) can make analysis impossible, but also, DNA needs a cool, dry environment and minimal disturbance to survive in good condition. Often, the DNA we can gather is only in really tiny fragments, so it's harder to assess. When we do find ancient DNA that matches a modern disease, it can be extremely genetically different thanks to mutations, so we don't know exactly what they might have been facing. Also, and more important for archaeology, DNA analysis is relatively expensive, so it's not used as often as we would like.

So what gives? Does all this mean we don't know anything?

No. Despite all these possible complications, as long as you take proper precautions, you can be reasonably confident in the diagnoses made by experts.
'But Susanna, that's not 100% confident!'
Welcome to science.

Okay so now that we've muddied the waters, let's clear them up. With all these potential problems, how do you diagnose an ancient disease? Let me walk you through an example: malaria in Classical Greece.

Of course, it's very important to note that this shouldn't be taken as a fun, scholarly exercise. Malaria is a devastating disease and a daily reality for millions of people. In fact each year, an estimated 600,000 people will die (most of which are children) and

millions more will get sick – like hundreds of millions more - and these figures are probably underreported by about half. It can lead to permanent disability, especially in children, and also has massive economic impacts as well.

All that being said, we can only begin to imagine how bad malaria might have been in the ancient world. These figures that I've mentioned before are despite the fact that we have modern medical care – in the 1800s, even with quinine, an estimated 10% of those infected died. In fact, some people have estimated that malaria has been the most deadly disease in all of human history.

So before you can even attempt to diagnose malaria in Classical textual and archaeological sources, it's pretty useful to ask: If Greece doesn't currently have malaria, is there even a chance in the first place it existed in ancient times?
The simple answer is yes, mainly because Greece actually had malaria up until 1974, and that's when it was declared eradicated. And in fact, there have actually been some cases of Malaria in Greece in recent years. More or less, a major campaign began in 1946 to eradicate malaria from Greece – this involved draining a lot of swampland and distributing anti-malaria medication to residents - as a result, eradication.

Further to this point, there are a number of genes in the Greek populace which have provided protection against malaria, and are believed to have been selected for due to the presence of malaria in Greece over the course of history. And, while malaria has not been detected in ancient Greek samples as of yet, it has been detected in ancient Roman and Egyptian samples, including King Tut!

With that question out of the way, how, how do we go about diagnosing malaria in textual sources? Mainly, we can look for key signs or symptoms of the disease, as well as environmental conditions that would lead to it being prevalent.

Malaria is a parasite (neither a bacterium nor a virus, it's a protozoa) and it's transmitted from mosquitoes to humans. It can't survive outside of mosquito or human hosts. And essentially what it does is It uses your red blood cells for food. Red blood cells are the part of the blood that carry oxygen around your body and which keeps your tissues alive, and the way it reproduces destroys red blood cells. It can also cause red blood cells to clump together, and it does so in your veins, and this restricts blood flow to your tissues. And, to top it all off, malaria also releases toxins into your bloodstream - because why can't it just have those other bad things, let's add on to it - and these toxins have some really nasty side effects.

Human bodies will react to the presence of malaria in ways that can be fairly destructive as well. In particular, the body uses high fevers to destroy the pathogens, but these high fevers also can harm us, especially with regards to our brains. Pretty much, between the actions of the parasites and the reactions of the human body, you get low numbers of red blood cells (which is anemia), you get reduced blood flow to various tissues, meaning different parts of your body may not be getting enough oxygen, and you'll get high fevers as well, which can also destroy parts of our body.

And from all of this, we'll see a variety of signs and symptoms that we can use to try to diagnose malaria in Classical Greek texts. Fever is by far the most important indicator of a malarial infection, especially because malarial fevers will repeat at intervals of 24, 48, or 72 hours depending on which species you caught. Malarial parasites essentially spend a lot of time reproducing inside your red blood cells and then once they're done reproducing they're released from your cells all at the same time all across the body and then they move on onto new, uninfected red blood cells and reproduce all over again. Essentially this release mechanism is timed using your innate circadian rhythms (the 24 hour cycles that your body goes through). And pretty much when they release into your blood, the human body recognizes the presence of the parasites and launches an attack against them especially in the form of fever. Because these parasites generally release every 24, 48, or 72 hours, the fevers occur every 24, 48, or 72 hours.

There is also something known as the malarial paroxysm that might be used to try to diagnose malaria. The paroxysm is essentially a cluster of syndromes.
First, you feel cold and shivery. Then, you are really hot and feverish. And then finally, you start sweating.

Other potential symptoms include swelling of the spleen and liver, black or bloody stools or vomit, coma, confusion, headaches, dizziness, abdominal pain, flu-like symptoms, dry cough, and more! Starting to sound like a pharmaceutical ad here. Further, all of these symptoms can last from weeks to months.

Besides how humans react to malaria, there are other things that could indicate malaria was present. For example, malaria is carried by mosquitoes. Mentions of swampland or rainy seasons that lead to standing water could increase the suspicion that malaria was present, because it increases the chances of many mosquitoes being present. Malaria tends to be associated with certain seasons as well, like spring through fall.

Moreover, there are also populations who are more likely to catch malaria in some situations. For example, infants, children, and those who are pregnant often bear the

brunt of the disease (infants/children because they are likely being infected for the first time and so they don't get the partial immunity you get after catching it before, pregnant people because pregnancy decreases your immunity). Malaria also frequently results in the loss of the pregnancy. Those traveling from a region without malaria into one that does are also more likely to have a strong reaction to malaria, due to a lack of partial immunity. Moreover, travelers who are infected with malaria can also spread malaria to regions where it didn't exist before, so we can give special consideration to times when there were mass movements of people, like war, maybe the Olympics, as this could have helped spread malaria. Malnourished populations, whether due to poverty or famine, are more likely to suffer from severe malaria as well, because in times of famine, most people don't die from lack of food, but die from disease, because malnourishment severely decreases your immune system's abilities.

Besides knowing key symptoms or situations that could aid in diagnosis, knowing key ancient Greek vocabulary helps as well. There isn't a single word in ancient Greek for "malaria," although one scholar proposed that the word for fever, "puretos," came more or less to mean malaria. I would disagree with him on this front; while malaria was likely to be extremely prevalent, and considered by many people to be the central disease that plagued Classical Greece, there were a lot other sources of fevers, and the word "puretos" alone did not distinguish between them. However, however, because the most diagnostic symptom of malaria is the 24-hour interval periodic fever, and because the ancient Greeks did in fact sometimes seem to specify these kinds of fevers by describing them as "ampheemeros, tritaios, and tetartaios" (quotidian daily, tertian, and quartan fevers), you can have a pretty good guess that malaria is around. There are also fevers described as "heemitritaios," which is semitertian, this means that the fevers are roughly every 48 hours. Medical historian Robert Sallares argues that this word undeniably refers to a species of malaria called P. falciparum. This species causes the most severe form of malaria, and therefore we would associate semitertian fevers with severe cases.

So, armed with all this modern knowledge of malaria, we leap into a case study: Epidemics I, which is the first of seven works titled Epidemics in the Hippocratic Corpus. These works present many case studies of medical patients, they note signs and symptoms that could allow later physicians to estimate the severity of a similar condition. These works also forecasted outcomes of patients, and potentially allow doctors to try to intervene with medical aid. The authors of the Epidemics books (there are likely to be several - the one I'm discussing is potentially written by Hippocrates) - the authors are also careful to note that environmental conditions, like winds, the seasons, rain, and temperature, might've also had an effect on disease.

Epidemics I features mainly on the island of Thasos across multiple years. So first: "Beginning in the early summer… In the majority of cases the symptoms were there. Fever with shivering… of the semitertian type… sweats were continual… Severe chill in the extremities… Bowels disordered… Delirium in many cases as death approached." Or, as I've mentioned before, many symptoms of malaria, paired with the proper season for it and a specific mention of semitertian fevers.

Then, the next year:
"The whole year having been wet… in the winter, the public health in most respects was good, but in early spring, many, in fact most, suffered illnesses. In summer… diarrhea… vomitings… sweats… These complaints in many cases were unattended with fever… but in many others there was fever… semitertians, exact tertians, quartans… Each of the fevers mentioned found many victims."
We find here some more things here that pique our interest. A wet year, followed by a spring and summer filled with malarial symptoms and specifically calling out types of fever that we associate with malaria.

The author then goes on in 1.2.6-1.2.7 to describe how long tertian and quartan fevers normally last, which is around two weeks or more, and then mentions that the semitertian fevers were among the most severe types of fever, pairing with chills, coma, coughing, and diarrhea – all of which fits what we know about malaria. Finally, later in Epidemics I (1.3.24), the author describes semitertian fevers as a fever that is, quote, "more fatal than any other."

Now, Epidemics I is one work of around 60 in the Hippocratic Corpus. In my own research, I have identified around 15 works of the Corpus which, to our knowledge, make positive identifications of malaria either via semitertian, tertian, and quartan fevers – so roughly 25% of the existing Corpus. Beyond that, there are a handful of identifications outside of the Corpus (like in Plato's Timaeus), and also there are many, many more likely identifications that don't use this specific diagnostic language that we were looking for. In all likelihood, based off of this, malaria was extremely common in Classical Greece.

Of course now, thanks to modern archaeology, we also have more evidence to back this up. We can divide this archaeology into evidence from human remains and evidence from sites themselves.

When it comes to sites, evidence of a malaria epidemic can come in several forms. Mainly, when a regular cemetery is excavated, you tend to find scattered burials,

sometimes multiple people in one tomb, sometimes not. The different burial sites can be identified as having been created at different times - you know, normal things.

But, when an epidemic occurs, deaths happen so rapidly that you are much more likely to encounter mass graves. These graves feature multiple people in one area, with evidence that they were buried in relatively quick succession. For more elaborate burials, maybe for someone deemed more important at the time, there may be evidence that their tomb was hastily constructed.

Further, in the case of an epidemic, you may often find unusual plants, animal bones, or objects included in the burial site. These items may represent attempts at medicine, sacrifices to appease the gods, or even witchcraft in an attempt to turn the tide of the epidemic.

Lastly, as archaeology tends to be much more specific about location than textual sources, you can investigate whether the local environment included features like marshes.

Now osteological evidence offers a huge wealth of information beyond this. The father of osteology, Larry Angel, was particularly famous in using human remains to search for evidence of malaria. By using bones to age and sex skeletal remains, for example, we can determine whether an unusually high number of pregnant individuals, fetuses, infants, and young children died – which is what we might expect to see during a malaria epidemic.

Malaria also often causes anemia (which is low red blood cell count). It also causes an inflammation in the bones known as periostitis, which lead to changes in the surface of specific bones (this is known as bone lesions). A 2015 study identified five specific bone lesions associated with malaria: lesions of the eye sockets as seen here on this slide (lesions are like the little tiny holes that you see); you see lesions of the spine, lesions of the funny bone, lesions of the femur; you also get the lesions that occur on nonspecific bones due periostitis (the inflammation that I mentioned before). These lesions are all common in ancient Greek remains.
Moreover, as mentioned before, many of the worst effects of malaria are caused by toxins that the parasites release into the blood. One of these toxins is called haemozoin. Haemozoin is this crystalline pigment that distributes via your blood throughout your entire body, and it'll deposit in both bones and organs. Should someone die within several months of a malaria infection, haemozoin would likely remain inside the bone, and can in fact be detected in bone using X-ray diffraction. There's a picture here of what haemozoin itself looks like.

Lastly, ancient DNA offers the chance to sample both the DNA of the humans we find buried, and the diseases that died with them. In the case of human genomes, we can attempt to search for genes that confer resistance to malaria. A presence of these genes could indicate that malaria was present in the population historically at least a generation before the current one. And as mentioned before many of these genes, including mutations in glucose-6-phosphate dehydrogenase, are present in Mediterranean populations.

Further, we can search human remains for the genetic presence of malaria. This, along with searching for haemozoin, can help researchers determine if someone died with an active malaria infection – so even if they died too quickly for bone lesions to form, you can still find this genetic information. As mentioned before, the ancient DNA of malaria has not yet been detected in Greece, largely because historically speaking DNA testing has not been a common practice on remains found. However, evidence of the most deadly species of malaria, *P. falciparum*, the one that causes semitertian fever, has been detected in ancient Roman and ancient Egyptian remains.

In summary, diagnosing someone who died thousands of years ago is a very complicated process. But, by querying textual sources through a lens of modern science and by pairing this with scientific evidence accumulated through archaeology, experts can help intersect our lives with those long dead, making them seem a little bit less ancient.

Alright thanks for watching, hope you enjoyed!

Outro

Thank you for watching “Doctor Doctor gimme the news: Diagnosis 2,000 years removed,” presented by Susanna Pilny ! If you have any questions about the content of this presentation, please leave a comment below.

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