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Epidemics and pandemics in the history of humankind and how governments dealt with them
A review from the Bronze Age to the Early Modern Age

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Abstract
This review offers an overview of several devastating historical epidemics and pandemics. The first pandemic ravaging the Middle East and Ancient Egypt was an unidentified "plague" in the late Bronze Age. The plague of Athens was apparently "only" a local epidemic but with fatal consequences for that ancient democracy. Great empires with well-developed trade routes seem to be very susceptible to rapid and devastating spreads as the Antonine Plague, the Plague of Cyprian and the Justinian Plague testify. The great Medieval plague wave in Europe was absolutely devastating, but for the first time it brought along with it substantial containment measures that are still being successfully used today (e.g. isolation, quarantine) as well as the seeds of the development of a new form of medical theory and practice. The blame game that can be observed in the current COVID-19 pandemic has also been seen in previous epidemics and pandemics. Particularly in the case of syphilis, its origin was often attributed to foreign countries. Finally, the paper comparatively stresses the historical importance of an early implementation of a lockdown-based approach as an effective form of controlling epidemic spreads.

Keywords: plague; smallpox; ebola; syphilis; genetics; COVID-19.

Riassunto. *Le epidemie e le pandemie nella storia dell'umanità e la maniera tenuta dai governi nel gestirle. Una review dall'Età del Bronzo alla prima Età moderna*

Questa rassegna offre una panoramica su diverse devastanti epidemie e pandemie nella storia. La prima pandemia che ha devastato il Medio Oriente e l'antico Egitto è stata una "peste" non ancora identificata alla fine dell'Età del Bronzo. La Peste di Atene fu apparentemente "solo" un'epidemia locale, ma con conseguenze fatali per l'antica democrazia. Grandi imperi con vie commerciali ben sviluppate sembrano essere molto suscettibili alla rapida e devastante diffusione epidemica, come testimoniano la Peste Antonina, la Peste di Cipriano e la Peste di Giustiniano. La grande ondata epidemica di peste nell'Europa medievale si è rivelata assolutamente devastante, ma per la prima volta ha portato con sé sostanziali misure di contenimento che ancora oggi vengono utilizzate con successo (ad es. isolamento, quarantena) e lo sviluppo di una nuova forma di teoria e pratica medica. Il gioco dell'incolparsi vicendevolmente che si può osservare nell'attuale pandemia di COVID-19 può, inoltre, essere osservato anche nelle precedenti epidemie e pandemie. In particolare nel caso della sifilide, l'origine del morbo era spesso attribuita a nazioni straniere. L'articolo, infine, sottolinea in maniera comparativa l'importanza storica dell'applicazione precoce di un approccio basato sul confinamento quale forma di di efficace forma di controllo delle diffusioni epidemiche.

Parole chiave: peste, vaiolo, ebola, sifilide, genetica, COVID-19

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1. Introduction

Pandemics have long affected humankind and the current outbreak of COVID-19, caused

by the newly emerged SARS-CoV-2 virus, demonstrates that, despite decades of grand scientific and technological advancements, infectious disease pandemics are still accompanying the human species and may well continue to walk alongside it in the future.

During the present COVID-19 crisis, a problematic article by a Swiss historian featured in the widely-read and respected German-language newspaper *Neue Zürcher Zeitung*, in which it was seriously claimed that it is not worthwhile to look at the past in order to learn from it for the present and the future (Reinhardt 2020):

> Jede Zeit ist anders, auch jede Epidemie-Zeit. Gerade deshalb lohnt sich ein Vergleich, nicht, um daraus Lehren zu ziehen, die es wegen der ganz unterschiedlichen Zeitverhältnisse und Zeitbefindlichkeiten nicht geben kann, sondern um nüchtern nebeneinanderzustellen.
>
> Every time is different, even every epidemic time. For this very reason a comparison is worthwhile, not in order to draw lessons from it, which cannot exist because of the very different time relations and the sensibilities of the time, but to soberly juxtapose them (authors' translation)

The author of the article, Prof. Volker Reinhardt, argued that the unique variables associated with each historical pandemic do not allow us to make useful comparisons that can improve our understanding of pandemics as a general concept and, above all, the present one. In fact, his article only focused on the Black Death of the mid-14th century AD but, surprisingly, the author precisely drew the kind of comparisons he had rejected before.

Today we can observe similar egoistic behaviours of the rich and powerful fleeing to the countryside and hiding themselves in their luxury estates in several affluent nations. Following in the footsteps of a novel academic trend of analyzing past pandemics now also reaching out to the popular press (Huber 2020), this article attempts to compare different historical epidemics by highlighting different strategies devised by past government to deal with them (Table 1). To this aim we have selected nine epidemics or pandemics (the Bronze-Age Middle Eastern "plague", the Plague of Athens, the Antonine Plague, the Plague of Cyprian, the Plague of Justinian, the Black Death, the English Sweating Sickness, syphilis and lastly, smallpox outbreaks in the Americas).

Indeed, a closer look at the past and previous epidemics and pandemics shows that

certain strategies for their containment proved successful, while other decisions either proved mostly ineffective or only made those natural catastrophes worse.

2. The "plague" of the Late Bronze Age (14th century BC)

Among the earliest reported epidemics in history is the unidentified plague that hit Ancient Egypt in the Amarna period (late 18th Dynasty, ca. 1325 BC). Earliest hints may be the fact that Pharaoh Amenhotep III had hundreds of statues of the lion-headed goddess Sekhmet made (Sekhmet being thought to bring epidemics but also to remove them from society) (Norrie 2016, 22). Except for one Amarna-letter (EA II) written under his son Akhenaton, which mentions a plague in the time of his father, we have no direct historical evidence for Egypt.

Yet the political situation would fit. After a time of clash between Egypt and its neighbouring states, a time of peace followed with extensive exchange of goods and people. It was suggested that the bubonic plague may have originated in India, spread over to the Middle East, and eventually reached Egypt (Norrie, 2016, p. 23).

The decision of Amenhotep III to relocate his palace to Malqata on the western bank near Thebes, a somewhat isolated location, has been seen by some as a measure taken in the light of a menacing plague, some sort of mitigating attempt by self-isolation. The palace was built from around his eleventh year of reign, followed by a gap of eight years, a period on which there are but limited historical sources (Norrie, 2016, p. 25).

A new epidemic-like outbreak (or a reoccurrence) seems to have taken place in the last years of the reign of Pharaoh Akhenaton. It may be speculated, among other reasons (such as political factors), that Akhenaton felt that the traditional gods of Egypt had failed protecting their own worshippers, hence *de facto* helping him in his goal of promoting a new, henotheistic religion with sun-God Aten at its heart, ultimately replacing the old polytheistic pantheon.

In the time of Amenhotep III or Akhenaton, Deir el-Medina (located on the west bank of

Thebes), the village of the necropolis workmen, was destroyed by a fire. This may have been an accident or, in view of a epidemic, a deliberate attempt of liberating the village from a disease (Norrie, 2016, p. 29).

Not only did numerous inhabitants of the new capital Akhet-Aton seem to have died, but three daughters of Akhenaton and Nefertiti also perished (Neferneferure, Setepenre and Maketaton). Shortly afterwards, the queen mother, Tjye, died, although her mummy shows no clear evidence of such an infectious disease.

After the death of Tutankhamun, the military conflict with the Hittites led to an equally unclear epidemic in the military, which in turn spread to the Hittite Empire. The Hittite king Šuppiluliuma I and his successor Arnuwanda II both died of the disease. The war against Egypt collapsed as a result. Under the next ruler, Muršili II, the plague disappeared. The story of the plague is handed down in literature in the Hittite plague prayers (Kimball and Slocum). However, an exact identification of the disease is not possible. The descriptions are too vague to identify any one particular disease. Diseases of this kind were attributed to the wrath of the gods and the containment measures were therefore meant to appease the gods and consequently did not involve any medical measures. Such a mechanism of human-divine interaction is also typically seen in other cultures and societies, as testified by Apollo's wrath taking the shape of a pestilence in the opening verses of the *Iliad*.

3. The Plague of Athens (430-426 BC)

The disease, known as λοιμός τῶν Ἀθηνῶν, appeared in the second year of the Peloponnesian War between Athens and Sparta and raged devastatingly in Athens. Not only did the epidemic prevent an Athenian victory but, after years of continued war, it led to the ultimate defeat of the ancient "democratic" city against its oligarchic rival Sparta.

A considerable proportion of the population of Athens was killed by the disease (estimated at 75,000-100,000 deaths, Littman, 2009). The flight of the rural inhabitants into the city, protected by the great defensive walls, led to problems of overpopulation and poor

hygiene – an ideal breeding ground for an epidemic. What had originated as a military plan (i.e. the use of a defensive strategy meant to avoid direct confrontation with the Spartan army on Athenian home soil), actually turned into a perfect trap. However, after this devastating outbreak, according to the ancient sources, this seemingly geographically circumscribed epidemic did not evolve into a pandemic and never returned after the war.

3.2 Observations

Thucydides himself doubted the religious explanation, and sought for evidence through observation. The symptoms he described in his masterpiece, *History of the Peloponnesian War*, include fever, redness and inflammation of the eyes, sore throats that led to bleeding and bad breath, sneezing and the loss of voice. He also mentioned that the patients were coughing, vomiting and suffered from extreme thirst. The victims also had pustules and ulcers on the body and suffered from insomnia and diarrhoea. One potentially relevant is the descriptions of hiccups (λύγξ κενή). In addition, the Greek author remarked that

> while the nature of the distemper was such as to baffle all description, and its attacks almost too grievous for human nature to endure, it was still in the following circumstance that its difference from all ordinary disorders was most clearly shown. All the birds and beasts that prey upon human bodies, either abstained from touching them (there were many lying unburied, though), or died after tasting them. In proof of this, it was noticed that this kind of birds actually disappeared; they were not about the bodies, or indeed to be seen at all. But of course the effects which I have mentioned could best be studied in a domestic animal like the dog (Thuc., 2.50).

3.3 Decline of law, religion and desocialization

Thucydides wrote that people stopped caring about the laws because they lived under the death threat of the disease. Honourable behaviour ceased, since people believed that they

would not live much longer anyway.

The Athenians felt abandoned by their gods, since the plague killed without making class or gender distinctions. Piety no longer played a role and the pestilence was seen as a divine sign that the gods supported Sparta, the enemy. An earlier oracle of the god Apollo had predicted that a «Doric (Spartan) war would come and bring a plague» (Thuc., 2.54).

Since those who cared for the sick were most susceptible of infecting themselves, soon many were no longer willing to care for the infected ones. The sick died alone, the dead rotted or were thrown into mass graves. Interestingly, Thucydides was one of the first ancient authors to describe immunity in that he noted that survivors of the first wave developed some protection so that they were safe or only mildly affected by subsequent waves.

3.4 A controversial ethiological identification

Based on the described symptoms, it has been speculated that the disease might have been caused by typhoid fever. In 2005, teeth from ancient burials were investigated by Dr Manolis Papagrigorakis's team. They found DNA sequences similar to those of *Salmonella enterica*, the organism causing typhoid fever (Papagrigorakis *et al*., 2005).

The result proved controversial as a second research group found methodological flaws in the Greek study and dismissed the identification (Shapiro *et al*., 2005).

The problem lies in the fact that the technology employed in 2005 (PCR) is prone to contamination, hence producing false-positive results (Campana *et al*., 2014) The burial site was found to be significantly contaminated by animals. Also, the counter-study by Shapiro and colleagues appears to suffers from the same conflicting results as previous studies demonstrated (Boyd and Hartl, 1999). It has been argued that Thucydides, the main historical witness, mentioned that the disease sprang among the caregivers, which is more typical of viral haemorrhagic fever (like ebola or Marburg haemorrhagic fever) than typhoid fever (Qureshi *et al*., 2015).

There is also a linguistic debate whether Thucydides really described the presence of hiccups (λύγξ κενή), a common finding in Ebola (Olson *et al*., 1996; Beeching *et al*., 2014). The ancient Greek has λύγξ κενή, which is either translated as "hiccups" or "ineffectual retching". However, this is a general interpretative problem encountered when analyzing historical reports of physiological and pathological phenomena using a "philologico-clinical" approach (Galassi and Böni *et al*., 2016; Galassi and Bianucci *et al*., 2016).

With a total of about 30 different diseases suggested as the correct interpretation of the Athenian plague (with smallpox and measles being vehemently propoposed), this historic scourge has not been really deciphered as far as its etiology is concerned (Papagrigorakis *et al*., 2008).

Known illustrious victims of the disease were Pericles, leading statesman in Athens, and two of his sons.

4. The Antonine Plague

This plague is also known as the Plague of Galen (after the famous physician of the time). It spread across the Roman Empire via the Roman army and the trade routes, both ways that would recur historically as a primary spreading factor, the latter being even more topical nowadays thanks to the shortening of the time required for long-distance travels.

The plague appeared in the east of the Roman Empire in the Roman military, which returned from campaigns against the Parthians. The first cases were reported during the siege of Seleucia (Iraq) in AD 164/65. There are speculations claiming that the plague originally came from China (Han-Dynasty) (De Crespigny, 2007, p. 514).

Smallpox or measles are suspected to have caused the Antonine Plague. The Greek physician Galen left Rome for his native Pergamum in AD 165 to be summoned again in AD 168 to Aquileia, finding himself in Rome in AD 169 where he appointed physician to emperor Marcus Aurelius' heir, Commodus. Galen was an eye-witness of the pestilential outbreak in the Roman army stationed in Aquileia in AD 168/69 and described the

symptoms in his treatise *Methodus Medendi* and in various references found in his writings.

He described the "plague" as great and long-lasting. The patients suffered from fever, diarrhoea, pharyngitis, coughing, vomiting, often accompanied by cutaneous eruptions (dry or pustular) after nine days of illness. Unable to provide his patients with any effective remedies, he sought shelter in Pergamon.

4.2 Unidentified disease

Most scholars tend to prefer smallpox as the most likely disease to explain this plague (McLynn, 2009; Harper, 2017), although no definitive paleopathological and paleomolecular evidence has been provided yet. Evidence for the existence of ancient smallpox may be derived from DNA of the pathogen found in the soft tissues of mummified remains, unfortunately mummies (natural or embalmed corpses) are largely unavailable for this historical period.

4.3 Impact

Many people in despair turned to magic, the later Roman Empire saw a decline of Greek science which was more and more replaced by religion including the rise of Christianity. Reduction of international trade was a long-term result.

The Roman army was hardly able to defend the borders of the empire, and military campaigns, such as the Marcomannian war, had to be postponed. Yet Rome still had the economic assets of its heyday in the 2nd century AD (during the reign of the good emperors of Trajan, Hadrian, Antoninus Pius and Marcus Aurelius). With emperor Commodus and the following Severan dynasty the decline of Rome began.

Other researchers argue for a more direct consequence, as the reduced number of soldiers led to the inflow of Germanic barbarian tribes as buffer dwellers against the immediate

collapse (Sabbatani and Fiorino, 2009; Harper, 2017b).

It is assumed that emperor Lucius Verus died in AD 169 in the village of Altinum on his way to Rome a few days after contracting the disease. Less clear is the case of emperor Marcus Aurelius, who died on 17th March 180 either in Vindobona (Vienna), according to Aurelius Victor, or in Sirmium, according to Tertullian. It is debated among classicists if he died killed by the plague named after him or by cancer.

5. The Plague of Cyprian

This disease is named after Saint Cyprian, bishop of Carthage, an early Christian writer and eye-witness who described the disease. The Roman Empire was struck by this plague during the most delicate "Crisis of the Third Century". It caused a severe weakening of the Roman army desperately trying to defend the borders against migrating barbarians, in order to ameliorate the associated shortage of food caused by the interruption of the production chain.

We have only vague ideas about the nature of this disease, as the historical sources are scarce.

According to them, once again a decline of social cohesion in the population took place. It is said by Pontius of Carthage (Cyprian's biographer) that in AD 250-252 about 5,000 people were dying in Rome each day:

Afterwards there broke out a dreadful plague, and excessive destruction of a hateful disease invaded every house in succession of the trembling populace, carrying off day by day with abrupt attack numberless people, everyone from his own house. All were shuddering, fleeing, shunning the contagion, impiously exposing their own friends, as if with the exclusion of the person who was sure to die of the plague, one could exclude death itself also. There lay about the meanwhile, over the whole city, no longer bodies, but the carcasses of many, and, by the contemplation of a lot which in their turn would be theirs, demanded the pity of the passers-by for themselves. No one regarded anything besides his cruel gains. No one trembled at the remembrance of a similar event. No one did to another what he himself wished to experience (Pontius of

Carthage and Wallis, 1885).

No obvious action was taken by the military emperors of the time, mostly occupied with fending off the invading barbarians. The Christians were regarded as inferior outcasts because of their refusal to make sacrifices for the emperor, therefore insulting the his divine status according to the Roman perspective. It was argued that they avenged themselves with the disease.

5.2 Unidentified disease

Various diseases were suggested to explain this epidemic (Harper, 2017a): Stathakopoulos suggested that both plagues, the Antonine and that of Cyprian, were outbreaks of smallpox (Stathakopoulos, 2004, 95), while Harper argued that the Antonine plague was caused by smallpox and the Plague of Cyprian may have be caused by a haemorrhagic fever (Harper, 2017a).

Only few notable victims are known: Claudius Gothicus (ca. 214-270 AD, Roman emperor from 268 to 270) died of this disease.

6. The Plague of Justinian

The Plague of Justinian is considered by some to be one of the most lethal pandemics, with an estimated death rate of 25 to 50 million victims and a recurrence over two centuries (Floor, 2018, p. 3). According to the so-called maximalist view, the social impact was similar to that seen during the Black Death of the Middle Ages. While the Roman Empire fell in the west in AD 476, the end of classical antiquity for the Eastern Roman Empire started a few decades after the pandemic, around AD 600.

The pandemic, caused by the bacterium *Yersinia pestis*, attacked the Byzantine Empire at

its peak. In the long run, the intended *restitutio imperii* remained incomplete and the decline of the Eastern Roman Empire started some decades later (but it took until almost AD 900 to decline). The plague not only affected the Byzantine Empire but also its rival in the East, the Sassanid Empire (Floor, 2018, p. 3).

The sources must be read critically, as Procopius modelled his report closely following the classic description of a pandemic by Thucydides. The historian Procopius reported the first cases in the port of Pelusium in Egypt. From there, the plague travelled on ships to other parts of the Empire.

This apocalyptic view of the Justinian Plague has been challenged. Mordechai *et al*. argued that the Justinian Plague had a lesser effect on the cultural and political turnover (Mordechai *et al*., 2019): the Roman Empire in the West had disintegrated a century before and the Eastern Roman Empire started to fall not before the 7th century. Only few confirmed cases of victims of the plague are reported archaeologically (ca. 45 cases). The authors argue that minor events like earthquakes and minor volcano eruptions left more traces in historical sources than the plague. Byzantine coinage (gold to bronze coin ratio) does not support a severe economic crisis usually following a devastating pandemic. The amount of papyri produced in Egypt was stable and does not point to an extensive loss of population. The ancient source texts in Egypt do not refer to the plague. As seen in other pandemics, some of the already scarce results were challenged as potential false positives due to outdated PCR technology.

In addition, modern research argues that the disease started much earlier and originated from a different place: in 2013, genetic analyses identified *Yersinia pestis* as the cause of the plague. Ancient strains from the Plague of Justinian and modern strains are closely related to plague samples from Tian Shan, at the borders of Kazakhstan (Eroshenko *et al*., 2017) and China (de Barros Damgaard, Marchi and Willerslev, 2018). This result led to suggestions that the Plague of Justinian may have originated in that region and travelled westwards.

A skeleton found in Tian Shan dating around AD 180 and identified as "early Hun" culture was positively tested for *Yersinia pestis* and is closely related to the basal ancestor of the Justinian plague (de Barros Damgaard, Marchi and Willerslev, 2018). Hence, the disease

existed in central Asia many centuries before the massive outbreak.

The first outbreak in AD 541-542 was extensive in Constantinople and even Emperor Justinian became sick but recovered. In AD 543 the plague arrived in the Sassanid Empire, and also reached Italy and Gaul. From there it sprang over the channel and ravaged extensively in Britain.

In AD 544, emperor Justinian declared the end of the plague. This declaration of victory was premature, as the plague returned again in AD 557 and 570. Until the 770s the plague of Justinian returned locally with a 10-to-25-year recurrence interval.

The last great outbreak was recorded in AD 746-748. The same ideological victory that was pronounced in relation to past epidemics can now be somehow observed in 2020, when China declared the pandemic over and reopened factories (see Blunschi, 2020).

This plague had a major long-term impact on Europe. It hit the Byzantine Empire at its peak, and may have affected its long-term chance to regain the whole territory of the former Roman Empire. Some decades later, the long-lasting decline of the Empire started. A new rising power in the East overran part of the Byzantine Empire and defeated the Sassanid Empire: Islam. Procopius' description of coughing with hemoptysis may point also to pulmonary plague. Another characteristic of the Plague of Justinian was necrosis of the hand.

6.2 Yersinia pestis identified

Recent genetic studies have identified the true cause to be *Yersinia pestis* (plague) and it was also suggested that the Plague of Justinian had its origin in China. The most basal (root) level of strains of *Yersinia pestis* were associated with the Chinese province of Qinghai (Morelli *et al*. 2010). Ancient strains from the Plague of Justinian and modern strains also closely relate to plague samples from Tian Shan, at the borders of Kazakhstan (Eroshenko *et al*., 2017) and China (de Barros Damgaard, Marchi and Willerslev, 2018). This result led to suggestions that the Plague of Justinian may have originated in that region and might have

travelled west. Samples from victims of the Justinian plague found in Germany are matching closely to modern strains from China (Wagner *et al*., 2014). The origin of *Yersinia pestis* can be traced to 3000 BC, as the pathogen's genome was found in skeletons in west and east Eurasia dated back to 3000-800 BC (Rasmsussen *et al*., 2015).

Famous people who suffered from the disease are Emperor Justinian I the Great, although he obviously survived without extensive health consequences, while his rival in the East, the Sassanid Emperor Khosrau I, died of the plague in 579.

7. The Black Death

The definition "Black Death" was not used in the Middle Ages – contemporary chroniclers spoke of the "great dying" or the "great pestilence". "Black Death" ("*Der schwarze Tod*") started to be adopted by Justus Friedrich Karl Hecker (1795-1850) in 1832 (while the second cholera pandemic was taking place) as part of his analysis of the 14th century pestilence.

This plague arrived in Europe in 1346 and, lasting until 1353, was one of the most fatal pandemics ever. According to present knowledge, the disease appeared in central Asia and moved via the Silk Road to the West. Transmitted by rat fleas, it spread over wide parts of Europe. To a certain extent, the plague became endemic in Europe, returning several times in its epidemic form that manifested locally (for instance, later great outbreaks are occurred in Italy 1629-1630, England 1665-1666 and Vienna 1678-1679) but never again so extensive as in the first wave.

7.2 Social impact

The social impact was extensive. In search for a scapegoat, minorities such as the Jewish communities were suspected of having caused the pandemic, one of the accusation being that they had poisoned town wells. In many parts of Europe pogroms of Jews (such as the

Strasbourg massacre, February 1349) and lepers took place, no matter whether such social outcasts were really thought to be responsible for the epidemic outbreak or their enemies simply capitalized on the massive hysteria during those days to liquidate them.

However, there was no lack of people who drew attention to the injustice of these murders. Pope Clement VI (1291-1352), for example, issued a bull prohibiting the persecution of the Jews on 4th July 1348. The papal bull was only effective in Avignon and, unfortunately, contributed relatively little to the protection of the Jews.

Besides these horrific short-term consequences, the plague triggered a lasting change in European society. The extensive population loss literally forced a change in the structure of society. Agricultural workers now had to be better paid and equipped with more rights. England was the first country to abolish serfdom in 1381.

The rise in labour costs led to increasing mechanisation and technology, thus to economic progress. A form of proto-capitalism emerged and resulted in more competition as less manpower was available. Consequently, it became difficult and expensive to continue to have books copied by hand, which in the long run led to the introduction of letterpress printing – an invention that revolutionized the world.

In art, the motif of the Dance of Death (*danse macabre*) and the *triumph of death* emerged, where skeletons perform a dance with each other or with typical representatives of the various feudal estates. Death spared nobody: emperor, king, pope, cardinal, nobleman, noblewoman, peasant, beggar. In Norway, the plague epidemics led to the loss of national autonomy for a long time and the disapperarance of the Old Norse language (*Norrønt*).

The plague of the 14th century decisively triggered the Renaissance. People distanced themselves from the ancient medicine based on Galen and new medical research was triggered, as the *ex cathedra* teachings of medieval medicine had proved most ineffective. This paved the way for the early changes ultimately resulting in the long-term development of modern medicine.

7.3 Cultural impact

While most works of art were created after the great plague epidemic, the work of Giovanni Boccaccio stands out as an important literary source. The *Decameron* was written in the years 1350-1353 and describes in the introduction the effects of the plague on the city of Florence (Galassi *et al*., 2018). In the story seven young women and three men flee the plague to live in a country house.

7.4 Mitigating actions

In contrast to previous pandemics, where little coordinated action is known, the plague pandemic saw attempts to contain the disease through action. King Casimir III (1310-1370) immediately closed the borders and Poland was spared.

Local municipal authorities in Milan acted by walling the sick in their houses. The extensive isolation strategy worked (only 10-15% of the population died). As a reaction to the main problems experienced in 1348, the city of Ragusa (modern-day Dubrovnik) introduced in 1377 the "quarantine" (an isolation strategy originally of 30 days, later lasting 40 days, that in those years would be adopted by Venice and other countries). In addition, Venice introduced the *lazzaretti*, a system of locals dedicated to the care of plague patients. Medical actions were also taken by specialist plague doctors tried to protect themselves with the so-called plague masks and also opened the associated ulcers to let the infection run out and reduce the bacterial load of the patients. A prominent role was also played in Italy by institutions known as *Magistrature di Sanità* that dealt with the quality of sold foods, movements of beggars and prostitutes, quality of sold drugs, hygienic conditions of low taverns, etc. including the introduction of a health passport for travellers (Cipolla, 2007).

Nonetheless, fatal errors can be observed in the history of other countries, such as Norway. Though sparsely populated, the disease has spread extensively. The reasons were social interactions with visits, social participation in funerals, distribution of the clothes of

plague-dead people among the heirs and pilgrimages with large masses of people who believed the plague was a punishment of God. No other country had so many recurrences of plague epidemics that occurred every 10-20 years (1360, 1370-1371, 1391-1392, 1500, 1506, 1521, 1525, 1529, 1547-1548, 1565-1567, 1582-1584, 1599-1604, 1619, 1625, 1629, 1636-1639 and 1654). Tax collectors contributed to the spread of the disease, but all fell victim to the disease and tax revenues collapsed in relation to the 1547 epidemic. Only when the plague spread to Denmark (1619) were precautionary measures taken, e.g. the quarantine of people associated with ships, and the isolation of sick people. The royal decree on disease control of 1625 proved revolutionary in that it ordered the use of all public authorities to control the disease and eventually led to the end of the outbreaks of plague in Norway. Actions included the appointment of responsible persons to implement the royal decree, dispatch of doctors, halt of trade and traffic associated with affected places, isolation of the burials of the victims, and finally to prevent the plague from entering at all, the coordinated closure of the borders. In the long run, this approach strengthened the state's power and laid the foundations of the modern state of Norway.

7.5 Yersinia pestis identified

The strain of *Yersinia pestis* causing the Black Death in Europe seems not to be a direct genetic descendant of the Justinian plague strain. However, it is possible that the spread of Justinian plague caused the evolutionary radiation that gave rise to the currently extant 0ANT.1 clade of strains (Bos *et al*., 2011).

The plague claimed many lives, including famous people of the time, e.g. Hans Holbein, painter, who died in London in 1543; Joan of Burgundy, Queen of France, who died in 1348; Joan of England, a daughter of Edward III of England, who died in 1348; Margaret I, Queen of Denmark, Norway and Sweden, who died in Flensburg in 1412; Giorgione, painter, who died in Venice in 1510.

8. The English Sweating Sickness

Also known as *Sudor Anglicus*, this was a mysterious disease that appeared the first time shortly after the battle of Bosworth (first cases after the landing of Henry VII in Milford Haven on 7th August 1485, certain cases are reported before the Battle of Bosworth, which took place on 22nd August 22nd 1485).

Shortly after the arrival of Henry VII in London the new disease broke out extensively and claimed many victims. *Sudor Anglicus* has a quite different etiology and can be clearly distinguished from other infectious diseases. The "English sweating sickness" has a very fast evolvement and is extremely deadly. Swift incubation time led to a quick death (only hours between the first symptoms and death). Typical symptoms are the name giving sweat, feelings of tightness, severe chills, dizziness, headache and pain in the neck, shoulders and limbs, accompanied by severe fatigue. After some hours of a cold stage, the hot phase followed with sweating, fever, headache, delirium, vomiting, tachycardia and great thirst. Complete breakdown and rapid death followed in many cases. Some people developed several fits, as there was no building up of any immunity. Most people who were in contact with sick people also became sick.

8.2 Mysterious disease

The cause of the disease has remained controversial until today. It appeared rapidly, killed quickly and often disappeared after only 2 weeks. The disease returned in 1506, 1517 and again 1528/29 and for the last time in 1551. Then it disappeared from history as quickly as it had appeared. The lethality rate was 30-50%, exact figures of victims are uncertain, typical outbreaks had ca. 40,000 affected people. Summer was the season for *Sudor Anglicus* (opposed to influenza which strikes during the winter) (Heyman, Simons, and Cochez, 2014).

One suggested cause was hantavirus-related pulmonary syndrome. But it is argued that *Sudor Anglicus* was transmitted from human to human, while hantaviruses normally do not spread that way (Bridson, 2001): the disease predominantly attacked males between 15 and 45 years of age. Bridson (2001, p. 1) described the disease as: «The incubation period was frighteningly short and the outcome normally fatal. The symptoms of acute respiratory disease and copious sweating were characteristic, providing the name "the English sweating disease". It was never in the big league of killer epidemics, such as plague and influenza, but its pockets of instant lethality in communities gave it a special ranking of horror. The infective cause of this disease remained a total mystery until it was compared with Hantavirus pulmonary syndrome (HPS) in 1994». To date, a potential rodent carrier for the dissemination of *Sudor Anglicus* has not been established.

The origin of hantavirus is suspected to be in China, the earliest case may date back to AD 900. (Heyman, Simons, and Cochez, 2014). Subsequently, other diseases were taken into account, e.g. bacterial disease (leptospirosis), pulmonary anthrax or a viral disease like a super aggressive form of influenza. To solve the mystery, some researchers suggested the exhumation of known victims. So far it was not possible to determine the exact cause of the disease. As the people died within hours and the disease often suddenly disappeared after two weeks, little is known on mitigating actions. It is reported that the sick people were wrapped in blankets to sweat out the disease according to medieval understanding - which proved fatally wrong in the case of *Sudor Anglicus*.

Some famous patients are reported, among them Queen Anne Boleyn, who survived the disease but not her husband, who had her executed; Arthur, Prince of Wales, died in 1502.

There might be a connection with the outbreaks of the Picardy sweat in France with extensive outbreaks in 1718, 1874, 1906 and 1918 showing similar symptoms.

9. Syphilis

Syphilis or *Lues venerea* (bacterium *Treponema pallidum pallidum*) was also known as

maladie française in the past. The first documented outbreak in Europe was 1494/95 in Naples (Italy) during the French invasion. It was assumed that the French carried the disease to Italy, hence the name *French disease* (Winters, 2006, p. 17). The modern name was coined in 1530 in a poem by the Italian physician Girolamo Fracastoro (ca. 1483-1553) naming it *Syphilis, sive Morbus Gallicus.* The poem tells the story of a sheep herder called Syphilus (derived from σῦς swine and φιλεῖν to love, thus Σύφιλος "swine loving"). Many other names of the disease can be found, either describing the visual appearance (*morbus pustulatus*) or the suspected cause (*lues aphrodisiaca*) or on the suspected country of origin (usually the foreigners – the classic blame game observable in many pandemics) (Adam, 2001).

Although syphilis is more difficult to spread and people can more easily protect themselves against it, it is a pandemic spreading over the world and it remains endemic.

9.2 Description

Syphilis is a chronic infection, transmitted mostly via sexual contact through mucosa1 surfaces and only between humans. It is possible that syphilis is transmitted during pregnancy and during the birth process (*Syphilis connata*). The disease is caused by the bacterium *Treponema pallidum* ssp. pallidum.

Syphilis has many medical appearances, therefore it is tricky to be diagnosed correctly: at the beginning there are often ulcers of the mucosa (painless) and swelling of the lymph nodes. In some cases, the disease evolves into the chronic form, with damages to skin and organs, and in the final stage involves the destruction of the central nervous system. Today, syphilis can be treated with antibiotics (penicillin).

9.3 Past attempts to cure syphilis

Several historical attempts were made to cure syphilis. Until the early 20th century,

treatment with toxic mercury was popular (Caspary, 1887). The side effects were often extensive such as the loss of many or all teeth or the loss of all hair. Mercury also contributed to the extensive shut-down of vital functions of the body. Most extreme treatment even saw the use of mercury(-II)-chloride injected subcutaneously (Stern, 1878).

Native South Americans used a combined therapy of decoctions of wood or bark of the guaiac tree *Guaiacum officinale* and *G. sanctum* (Eppenberger, Galassi, and Rühli, 2017) or sarsaparilla root (*Smilax regelii*) combined with sweat baths and fasting. It is argued that the disease was often less severe among Native Americans than in Europeans, as they appeared to have had no immunisation against syphilis (Harper *et al*., 2008).

The humanist Ulrich von Hutten (died 1523 of syphilis) published on his self-experiment in 1519 *De guajaci medicina et morbo gallico* leading to a temporary improvement of his syphilis. Some potential famous victims of syphilis are Friedrich Nietzsche (1844-1900); Ludwig van Beethoven, lost his hearing and later his life; Catherine II The Great of Russia, as well as Adolf Hitler and Benito Mussolini are suspected to have suffered from syphilis, although there no definitive evidence is available.

9.4 Debated origin

The origin of syphilis is a heatedly debated topic (Baker *et al*., 2020). Dental characteristics suggestive of syphilis patients are proposed as far back as classical antiquity, but also for Byzantine period and medieval England in various sites (Erdal, 2005; Hunnius *et al*., 2006), as well as other pre-Columbian proposed cases (Ioannou, Henneberg, and Henneberg, 2018).

The conclusion of these studies is that congenital syphilis may have existed in Europe before its appearance in the New World, hence challenging the traditional view that syphilis travelled from the Americas to Europe after AD 1492 (Baker *et al*., 2020). Nonetheless, the traditional paleopathological view is still that syphilis came to Europe from the Americas.

10. Smallpox in the Americas

It is generally accepted that European *conquistadores* brought smallpox to the Americas and caused unimaginable epidemics that claimed the lives of millions of Native Americans. Estimated death rates range between one quarter to half of the total population. On the basis of historical documents and archaeological research, it is estimated that up to 90% of the native population became victims of smallpox in the centuries after the arrival of the Europeans (Dobyns, 1983; Thornton, 1990; Verano and Ubelaker, 1992; Warrick, 2003; Halverson, 2006; Tshisuaka, 2007). Smallpox contributed significantly to the destruction of the most sophisticated Meso-American cultures (Maya, Aztecs and others) as well as the fall of South American ones (Inca and others). In some cases, a veritable colonial genocide is suspected (Ostler, 2015). The smallpox epidemic on the Pacific coast of North America from 1775 onwards is scientifically well studied. The European settlers were already well infested with smallpox and therefore largely immunised. The Native Americans of the northwest Pacific coast fell victim to smallpox on a massive scale.

Researchers are debating whether Europeans have used smallpox as a biological weapon. There is evidence from June 1763 that blankets and a handkerchief from the hospital at besieged Fort Pitt were given to a delegation of Native Americans. Smallpox had broken out in the fort. Whether it was intentional or accidental is unclear. The action was unsuccessful, but later an epidemic broke out (Dixon, 2014, p. 154). The accusations of genocide employing smallpox among the Madan people in 1837 was called scientific falsification (Brown, 2005). However, it is striking that there are primarily non-English essays and encyclopaedia entries documenting smallpox epidemics among Native Americans. The 1862 pandemic suggests that at least some immigrants of European origin welcomed the smallpox disaster. This can be deduced from media articles of the time[1].

In addition to the fact that the Native Americans did not have prior natural immunities, the breakdown of food supply intensified the impact of the disease, which led to extremely

[1] See *Index of Historical Victoria Newspapers*, (http://web.uvic.ca/~hist66/vicvic/newspaper/index.php, 23/04/2020).

high mortality rates. The collapse of the social structure also led to high suicide rates. Frequently practiced Native American healing methods such as sweating proved to be counterproductive for smallpox. This lethal mix led to mass suicides among the Cherokee in 1738 and among the Madan in 1837. The indigenous populations burned down infected places and incorporated the disease in their socio-religious system (Kelton, 2004).

First the gods, animal spirits or witchcraft practiced by tribal members were blamed, until they realized the connection with the Europeans. Once accused of spreading the disease, the British and French blamed each other. Halverson (2006, 2020) includes other mitigating actions.

By the early 1700s, Native Americans had begun developing additional methods to prevent infection. Southeastern Native Americans avoided diseased villages and educated others about traveling into infected areas. Another indigenous method to avoid further infection was sending the disease to an enemy via the shaman. The Cherokees performed a Smallpox Dance (the Ahtawhhungnah) in the 1830s to avoid disease, and the Aztecs made a pilgrimage to Popocatépetl to pray to the etsá (smallpox) spirit.

It is estimated that between 80-95% of the Native American population was decimated by diseases introduced by the Europeans conquerors within the first 100-150 years following Columbus's discovery of the New World in 1492, and in some cases such as the Tainos of Hispanola nearly all of the population succumbed (Cook, 1993; Newson, 2001; Nunn and Qian, 2010). Halverson (2006, 2020) provides the following population loss estimates related to smallpox: 38.5% for the Aztecs 50% for the Piegan, Huron, Cherokee, Iroquois and other peoples; about 66% for the Omaha and Blackfeet peoples, and 90% for the Madan.

11. General observations

The following points become evident when looking at historical and modern epidemics and pandemics:

- the diseases often started in Central Asia or travelled along routes originating in Asia;
- migration and invasions spread diseases, and from a pandemic point of view the migration of people must be seen as a critical mechanism, especially when migrants arrive in great numbers as invaders (e.g. European settlers in the Americas);
- great empires with well-developed trading routes are significantly affected, and in the modern world air travel quickly spreads pandemics over the world;
- times of war and system conflicts (i.e. the confrontation between two rivalling super-powers) contribute to pandemic outbreaks;
- often the nationalistic blame game is played to make sense of the origins and catastrophic impacts of the associated diseases;
- the disaster of a pandemic often leads to the decline of the social structure of a society. Selfish behaviour spreads. Those who help infected people often become victims themselves. If too many caregivers die, there is the danger that everyone runs away and refuses to care for the sick or bury the dead. Under such circumstances anything that previously kept a society together is lost;
- in modern pandemics, depending on the incubation period of the involved diseases, it takes weeks or months until mitigating actions such as isolation and travel restrictions show the desired mitigating effects (Büchenbacher *et al*., 2020).

12. Conclusions

The hermeneutical problems revealed in the Justinian Plague show that a multiperspective approach is definitely important. Today, we observe a primacy of paleogenetics over other disciplines involved in archaeological research since that is perceived as the *non plus ultra* of bioarcheological research due to its hypertechnological nature. Nonetheless we stress how many more approaches and disciplines such as historical sources and economic data derived from numismatic and production of goods can help scientists reconstruct complex and rich phenomena such as past epidemics.

A review of nine historic epidemics and pandemics provides evidence for various mechanisms that have been employed in attempts to counter the associated diseases. The inadequate medical and logistical facilities of the past have often limited the actual efficacy of the said measures in isolating the sick or closing borders. Effective measures that have been employed in pandemics from the past to our time include:

- extensive mitigating actions taken at a very early stage: they were effective in the past and today (Büchenbacher *et al*., 2020);
- being prepared for the return of great epidemics (e.g. Denmark/Norway with their plague legislation or South Korea in the ongoing COVID-19 pandemic);
- almost complete societal lockdown;
- self-isolation of members of populations for periods of several weeks to months to interrupt the transmission of the disease (Milan during the Black Death, Italy, South Korea and Taiwan in 2020);
- closing borders almost immediately, ignoring any multilateral treaties, despite its obvious controversial nature, proves most effective. Poland closed its borders and was mostly spared from the Black Death. To date, this practice also appears to have been effective for Taiwan and Singapore in relation to the 2020 COVID-19 pandemic;
- a centralized government (e.g. Italy, Spain, France) or a powerful presidential system is more capable to act swiftly and comprehensively against an immediate communicable disease threat than federalist countries (e.g. Switzerland, Germany, the USA).

However, a final verdict cannot be made, as the COVID-19 pandemic has but recently begun.

On the other hand, many useless actions associated with epidemics and pandemics are identified at all times and involving many countries:

- denial and cover-up of the disease to prevent an image damage;
- not listening to scientists, including the primacy of political ideology and agenda over common sense and medical counselling;
- spread of false information and misinterpretation of correct information;
- religious explanations for the cause or course of the diseases (the former especially in the past, the latter still seen in some countries, e.g. Indonesia);
- uncoordinated actions by local municipalities or regions, contradicting the overall effectiveness of implemented national or supernational strategies.

Epidemic/ Pandemic	Suspected origin	Most affected country	Disease (and etiology)	Mitigating actions
Late Bronze Age "plague"	Unknown	Hittite empire Egypt	unclear (several hypotheses)	isolation of the ruling class and burning of a village (?)
Plague of Athens	Athens (?)	Athens (Greece)	unclear (several hypotheses)	negligible
Antonine Plague	Asia	Roman Empire	unclear (several hypotheses)	negligible
Plague of Cyprian	Europe?	Roman Empire	unclear (several hypotheses)	negligible
Plague of Justinian	Asia	Byzantine Empire, Sassanid Empire	bubonic plague (*Yersinia pestis*)	negligible (notion of "political end" of an epidemic emerging)
Black Death	China	Europe	Bubonic plague (*Yersinia pestis*)	*lazzaretti*, quarantine, *magistrature di sanità* as a result of the devastating effects of the plague
English Sweating Disease (*Sudor Anglicus*)	England (due to lack of other reports)	England	Leptospirosis / anthrax ?	unknown (mention of medical approaches)
Syphilis	America? Europe?	worldwide	Venereal syphilis	turning point with the introduction

			(*Treponema pallidum*)	of antiobiotic therapy
Smallpox in the Americas	Europe	the Americas	Smallpox (variola virus)	unknown, paradoxically potentially favoured by invading Europeans
COVID-19	China (first observed)	worldwide	COVID-19 (SARS-CoV-2)	lockdown, quarantine

Table 1. Overview of selected historical diseases and pandemics from Antiquity to the Modern Era

Reference List

Adam B. (2001). *Die Strafe Der Venus. Eine Kulturgeschichte Der Geschlechtskrankheiten*. München: Orbis.

Baker B.J., Crane-Kramer G, Dee M.W., Gregoricka L.A., Henneberg M., Lee C., Lukehart S.A., et al. (2020). Advancing the Understanding of Treponemal Disease in the Past and Present. *American Journal of Physical Anthropology*, 171, Suppl 70: 5. DOI: 10.1002/ajpa.23988.

Beeching N.J., Fenech M., Houlihan C.F. (2014). Ebola virus disease. *British Medical Journal*, 349: g7348. DOI: 10.1136/bmj.g7348.

Blunschi P. (2020). Die Epidemie Muss Jetzt Beendet Sein, Sonst Wird Es Für China Gefährlich. *Watson*, March 14. Retrieved from: https://www.watson.ch/international /interview/921997310-interview-mit-sebastian-heilmann-ueber-chinas-kampf-gegen-das-coronavirus (22/04/2020).

Bos, K. I., Schuenemann, V. J., Golding G. B., Burbano H. A., Waglechner N., Coombes B. K., McPhee J.B, DeWitte S,N,, Meyer M., Schmedes S., Wood J., Earn D.J.D., Herring D.A., Bauer P., Poinar H.N. (2011). A Draft Genome of Yersinia Pestis from Victims of the Black Death. *Nature*, 478: 506. DOI: 10.1038/nature10549.

Boyd E.F., Hartl D.L. (1999). Analysis of the Type 1 Pilin Gene Cluster Fim in Salmonella: Its Distinct Evolutionary Histories in the 5' and 3' Regions. *Journal of Bacteriology*, 181, 4: 1301.

Bridson E. (2001). The English 'Sweate' (Sudor Anglicus) and Hantavirus Pulmonary Syndrome. *British Journal of Biomedical Science*, 58, 1: 1.

Brown T. (2005). Assessing Ward Churchill's Version of the 1837 Smallpox Epidemic. Retrieved from: http://www.freerepublic.com/focus/f-news/1353232/posts (22/04/2020).

Büchenbacher K.C., Kleeb A., Kohler A., Oesch J. (2020). Mit Diesen Massnahmen Gelingt Es, Die Kurve Abzuflachen. *Neue Zürcher Zeitung,* April 9. Retrieved from: https://www.nzz.ch/visuals/coronavirus-diese-massnahmen-flachen-die-kurve-ab-nzz-ld.1547962 (28/03/2020).

Campana M.G., García N.R., Rühli F.J., Tuross N. (2014). False Positives Complicate Ancient Pathogen Identifications Using High-Throughput Shotgun Sequencing. *BMC Research Notes* 7 (January): 111. DOI:10.1186/1756-0500-7-111.

Caspary J. (1887). Ueber Chronische Quecksilberbehandlung Der Syphilis. *Vierteljahresschrift Für Dermatologie Und Syphilis* 19, 1: 3.

Cipolla C.M. (2007). *Contro un nemico invisibile. Epidemie e strutture sanitarie nell'Italia del Rinascimento*. Bologna: Il Mulino.

Cook N.D. (1993). Disease and depopulation of Hispanola, 1492-1518. *Colonial Latin American Review* 2, 1-2: 213.

de Barros Damgaard, P., Marchi, N., Rasmussen, S., Peyrot, M., Renaud, G., Korneliussen, T., Moreno-Mayar J.V., Pedersen M.P., Goldberg a., Usmanova E., Baimukhanov N., Loman V., Hedeager L., Pedersen a.G., Nielsen K., Afanasiev G., Akmatov K., Aldashev A., Alpaslan A., Baimbetov G., Bazaliiskii V.I., Beisenov A., Boldbaatar B., Boldgiv B., Dorzhu C., Ellingvag S., Erdenebaatar D., Dajani R., Dmitriev E., Evdokimov V., Frei K.M., Gromov A., Goryachev A., Hakonarson H., Hegay T., Khachatryan Z., Khaskhanov R., Kitov E., Kolbina A., Kubatbek T., Kukushkin A., Kukushkin I., Lau N., Margaryan A., Merkyte I., Mertz I.V., Mertz V.K., Mijiddorj E., Moiyesev V., Mukhtarova G., Nurmukhanbetov B., Orozbekova Z., Panyushkina I., Pieta K., Smrčka V., Shevnina I., Logvin A., Sjögren K.-G., Štolcová T., Taravella A.M., Tashbaeva K., Tkachev A., Tulegenov T., Voyakin D., Yepiskoposyan L., Undrakhbold S., Varfolomeev V., Weber A., Wilson Sayres M.A., Kradin N., Allentoft M.E., Orlando L., Nielsen R.,

Sikora M., Heyer E., Kristiansen K., Willerslev E. (2018). 137 Ancient Human Genomes from across the Eurasian Steppes. *Nature*, 557, 7705: 369. DOI: 10.1038/s41586-018-0094-2.

De Crespigny R. (2007). *A Biographical Dictionary of Later Han to the Three Kingdoms (23-220 AD)*. Leiden: Brill.

Dixon D. (2014). *Never Come to Peace Again: Pontiac's Uprising and the Fate of the British Empire in North America*. Norman: University of Oklahoma Press.

Dobyns H.F. (1983). *Their Number Become Thinned: Native American Population Dynamics in Eastern North America*. Knoxville: University of Tennessee Press.

Eppenberger P.E., Galassi F.M., Rühli F.J. (2017). A Brief Pictorial and Historical Introduction to Guaiacum - from a Putative Cure for Syphilis to an Actual Screening Method for Colorectal Cancer. *British Journal Clinical Pharmacology*, 83, 9: 2118. DOI: 10.1111/bcp.13284.

Erdal Y.S. (2005). A Pre-Columbian Case of Congenital Syphilis from Anatolia (Nicaea, 13th Century AD). *International Journal of Osteoarchaeology*, 16, 1: 16. DOI: 10.1002/oa.802.

Eroshenko G.A., Nosov N.Y., Krasnov Y.M., Oglodin Y.G., Kukleva L.M., Guseva N.P., Kuznetsov A.A., Abdikarimov S.T., Dzhaparova A.K., Kutyrev V.V. (2017). Yersinia Pestis Strains of Ancient Phylogenetic Branch 0.ANT Are Widely Spread in the Highmountain Plague Foci of Kyrgyzstan. *PloS One*, 12, 10: e0187230. DOI: 10.1371/journal.pone.0187230.

Floor W. (2018). *Studies in the History of Medicine in Iran*. Odenton, Maryland: Mage Publishers.

Galassi F.M. (2018). Boccaccio e La Paleopatologia. *Heliotropia*, 15: 267. Retrieved from: https://www.brown.edu/Departments/Italian_Studies/heliotropia/15/galassi.pdf (08/06/2020).

Galassi F.M., Bianucci R., Gorini G., Paganotti G.M., Habicht M.E., Rühli F. J. (2016). The sudden death of Alaric I (c. 370-410 AD), the vanquisher of Rome: A tale of malaria and lacking immunity. *European Journal of Internal Medicine*, 31: 84. DOI:

10.1016/j.ejim.2016.02.020.

Galassi F.M., Böni T., Rühli F.J., Habicht M.E. (2016). Fight-or-Flight Response in the Ancient Egyptian Novel 'Sinuhe' (c. 1800 BCE). *Autonomic Neuroscience: Basic and Clinical*, 195: 27. DOI: 10.1016/j.autneu.2016.02.006.

Halverson M.S. (2006). *ABO Blood Group Frequencies in Pre-European Contact America: An Ancient DNA Analysis*. Unpublished Master of Arts thesis. Department of Anthropology, University of Texas, Austin.

Halverson, M.S. (2020). Native Americans and The Smallpox Epidemic. *The Early America Review*, 11, 2. Retrieved from: https://www.varsitytutors.com/earlyamerica/early-america-review/volume-11/native-americans-smallpox (22/03/2020).

Harper K. (2017a). Pandemics and Passages to Late Antiquity: Rethinking the Plague of c. 249-70 Described by Cyprian. *Journal of Roman Archaeology*, 28: 223. DOI: 10.1017/S1047759415002470.

Harper K. (2017b). *The Fate of Rome: Climate, Disease, and the End of an Empire*. Princeton: Princeton University Press.

Harper K.N., Ocampo P.S., Steiner B.M., George R.W., Silverman M.S., Bolotin S., Pillay A., Saunders N.J, Armelagos G.J. (2008). On the Origin of the Treponematoses: A Phylogenetic Approach. *PLoS Neglected Tropical Diseases*, 2, 1: e148. DOI: 10.1371/journal.pntd.0000148.

Heyman P., Simons L., Cochez C. (2014). Were the English Sweating Sickness and the Picardy Sweat Caused by Hantaviruses? *Viruses*, 6, 1: 151. DOI: 10.3390/v6010151.

Huber D. (2020). Von Der Attischen Seuche Bis Ebola – 13 Pandemien, Die Angst Und Schrecken Verbreiteten. *Watson*, April 12. Retrieved from: https://www.watson.ch/wissen/international/449147169-13-seuchen-die-vor-der-corona-pandemie-angst-und-schrecken-verbreiteten (24/04/2020).

Ioannou S., Henneberg R.J., Henneberg M. (2018). Presence of Dental Signs of Congenital Syphilis in Pre-Modern Specimens. *Archives of Oral Biology*, 85: 192. DOI: 10.1016/j.archoralbio.2017.10.017.

Kelton P. (2004). Avoiding the Smallpox spirits: Colonial Epidemics and Southeastern

Indian Survival. *Ethnohistory*, 51, 1: 45. DOI: 10.1215/00141801-51-1-45.

Kimball S.E., Slocum J. *The Plague Prayer of Mursilis II (Neo-Hittite)*. The University of Texas at Austin, Linguistic Research Center. Retrieved from: https://liberal arts.utexas.edu/lrc/resources/ietexts/anatolian/hittite/the-plague-prayer-of-mursilis-ii-neo-hittite.php (08/06/2020).

Littman R.J. (2009). The plague of Athens: epidemiology and paleopathology. *Mount Sinai Journal of Medicine*, 76, 5: 456. DOI: 10.1002/msj.20137.

McLynn F. (2009). *Marcus Aurelius, Warrior, Philosopher, Emperor*. London: Vintage Books.

Mordechai L., Eisenberg M., Newfield T.P., Izdebski A., KayJ.E., Poinar H. (2019). The Justinianic Plague: An Inconsequential Pandemic? *Proceedings of the National Academy of Sciences*, 116, 51: 25546. DOI: 10.1073/pnas.1903797116.

Morelli G., Song Y., Mazzoni C.J., Eppinger M., Roumagnac P., Wagner D.M., Feldkamp M., Kusecek B., Vogler A.J., Li Y., Cui Y., Thomson N.R., Jombart T., Leblois R., Lichtner P., Rahalison L., Petersen J.M., Balloux F., Keim P., Wirth T., Ravel J., Yang R., Carniel E., Achtman M. (2010). Yersinia Pestis Genome Sequencing Identifies Patterns of Global Phylogenetic Diversity. *Nature Genetics*, 42: 1140. DOI: 10.1038/ng.705.

Norrie P. (2016). *A History of Disease in Ancient Times: More Lethal than War*. New York: Palgrave Macmillan. DOI: 10.1007/978-3-319-28937-3.

Nunn N., Qian N. (2010). The Columbian exchange: A history of disease, food, and ideas. *Journal of Economic Perspectives*, 24, 2: 163. DOI: 10.1257/jep.24.2.163.

Olson P.E., Hames C.S., Benenson A.S., Genovese E.N. (1996). The Thucydides Syndrome: Ebola Déjà vu? (Or Ebola Reemergent?). *Emerging Infectious Disease*, 2, 2: 155. DOI: 10.3201/eid0202.960220.

Ostler, J. (2015). Genocide and American Indian history. In *Oxford Research Encyclopedia, American History*. Oxford: Oxford University Press.

Papagrigorakis M.J., Yapijakis C., and Synodinos P.N. (2008). Typhoid Fever Epidemic in Ancient Athens. In Raoult D., Drancourt M., eds., *Paleomicrobiology: Past Human Infections*. Berlin-Heidelberg: Springer Science & Business Media.

Papagrigorakis, M.J., Yapijakis C., Synodinos P.N., Baziotopoulou-Valavani E. (2005). DNA Examination of Ancient Dental Pulp Incriminates Typhoid Fever as a Probable Cause of the Plague of Athens. *International Journal of Infectious Diseases*, 10, 3: 206. DOI: 10.1016/j.ijid.2005.09.001.

Pontius of Carthage, Ernest Wallis (1885). *The Life and Passion* of *Cyprian, Bishop and Martyr*. Christian Classics Ethereal Library. Retrieved from: https://www.ccel.org/ccel/schaff/anf05.iv.iii.html (20/04/2020)

Qureshi A.I., Chughtai M., Bah E.I., Barry M., Béavogui K., Loua T.O., Malik A.A. (2015). High Survival Rates and Associated Factors Among Ebola Virus Disease Patients Hospitalized at Donka National Hospital, Conakry, Guinea. *Journal of Vascular and Interventional Neurology*, 8, 1.5: 4.

Rasmussen S., Allentoft M.E., Nielsen K., Orlando L., Sikora M., Sjögren K.G., Pedersen A.G., Schubert M., Van Dam A., Kapel C.M., Nielsen H.B., Brunak S., Avetisyan P., Epimakhov A., Khalyapin M.V., Gnuni A., Kriiska A., Lasak I., Metspalu M., Moiseyev V., Gromov A., Pokutta D., Saag L., Varul L., Yepiskoposyan L., Sicheritz-Pontén T., Foley R.A., Lahr M.M., Nielsen R., Kristiansen K., Willerslev E. (2015). Early Divergent Strains of Yersinia Pestis in Eurasia 5,000 Years Ago. *Cell*, 163: 571. DOI: 10.1016/j.cell.2015.10.009.

Reinhardt V. (2020). So, Wie Es Ist, War Es Noch Nie – Warum Historische Vergleiche Zur Corona-Krise in Die Irre Führen. *NZZ Online*, March 18. Retrieved: https://www.nzz.ch/feuilleton/coronavirus-kann-man-aus-historischen-vergleichen-etwas-lernen-ld.1546841 (25/04/2020).

Sabbatani S., Fiorino S. (2009). La peste antonina e il declino dell'Impero Romano. Ruolo della guerra partica e della guerra marcomannica tra il 164 e il 182 d.C. nella diffusione del contagio. *Le Infezioni in Medicina*, 17, 4: 261.

Shapiro B., Rambaut A., Gilbert M., Thomas P. (2005). No Proof That Typhoid Caused the Plague of Athens (a Reply to Papagrigorakis et al.). *International Journal of Infectious Diseases*, 10, 4: 334. DOI: 10.1016/j.ijid.2006.02.006.

Stathakopoulos, D.C. (2004). *Famine and Pestilence in the Late Roman and Early*

Byzantine Empire. Routdlege.

Stern E. (1878). Ueber Das Quecksilberchlorid-Chlornatrium und seine subcutane Anwendung. *Berliner Klinische Wochenschrift*, 15: 59.

Thornton R. (1990). *American Indian Holocaust and Survival: A Population History since 1492*. Norman: University of Oklahoma Press.

Tshisuaka B.I. (2007). Pocken (Variola, Blattern). In Gerabek W.E., Haage B.D., Keil G., Wegner W., eds., *Enzyklopädie Medizingeschichte*. Berlin & New York: Walter de Gruyter.

Verano J.W., Ubelaker D.H., eds. (1992). *Disease and Demography in the Americas*. Washington, D.C.: Smithsonian Institution Press.

von Hunnius T.E., Roberts C.A., Boylston A., Saunders S.R. (2006). Histological Identification of Syphilis in Pre-Columbian England. *American Journal of Physical Anthropology*, 129, 4: 559. DOI: 10.1002/ajpa.20335.

Wagner D.M., Klunk J., Harbeck M., Devault A., Waglechner N., Sahl J.W., Enk J., Birdsell D.N., Kuch M., Lumibao C., Poinar D., Pearson T., Fourment M., Golding B., Riehm J.M., Earn D.J.D., DeWitte S., Rouillard J-M., Grupe G., Wiechmann I., Bliska J.B., Keim P.S., Scholz H.C., Holmes E.C., Poinar H. (2014). Yersinia Pestis and the Plague of Justinian 541-543 AD: A Genomic Analysis. *Lancet Infectious Diseases*, 14, 4: 319. DOI: 10.1016/S1473-3099(13)70323-2.

Warrick G. (2003). European infectious disease and depopulation of the Wendat-Tionontate (Huron-Petun). *World Archaeology*, 35, 2: 258.

Winters A. (2006). *Syphilis*. New York: Rosen Publishers.