

PLAGUE AND CONSEQUENCES

Athens 431 – 421 BC

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Contents

Chapter 1: Introduction.....	5
1.1 The common theory of the plague.....	6
1.2 Method.....	7
1.3 Intention of the study	7
Chapter 2: Sources and Methods	8
2.1.1 Introduction	8
2.1.2 The Primary Source	8
2.1.3 The credibility of Thucydides.....	9
2.1.4 Source credibility.....	13
2.1.5 Other written sources.....	20
2.2 Method.....	22
2.2.1 Clinical Medicine	23
2.2.2 Paleo-epidemiology.....	24
2.2.3 Paleo-microbiology	25
2.2.4 Archaeology	27
Chapter 3: Risk factors for disease in Athens	29
3.1 Environment as a risk factor	29
3.1.1 Climate and landscape.....	30
3.1.2 Drinking Water	34
3.1.2.1 The terms “source, public fountain, well, and cistern”	35
3.1.2.2 Drinking water from river	37
3.1.2.3 Drinking water directly from groundwater (Source).....	39
3.1.2.4 Drinking water through pipelines	40
3.1.3 Hygienic conditions in city and homes	44
3.1.3.1 Outdoor sewage.....	45
3.1.3.2 Water and sewage inside the house.....	47
3.1.4 Overall assessment of environment as risk factor.....	48
3.2 Size of population and internal risk factors.....	49
3.2.1 What did the Athenians eat?.....	53
3.2.2 Personal hygiene and clothing	57

3.2.2.1 Use of the baths	58
3.2.2.2 Clothing.....	60
3.2.3 Overall assessment of internal risk factors.....	61
Chapter 4: Disease of the past, present diagnostic	62
4.1 The patient record.....	62
4.2 Assessment of the medical information	64
4.2.1 Quality of data from the medical record	64
4.2.2 Infectious disease	66
4.2.3 Poisoning.....	73
4.3 Paleo-epidemiological assessment	75
4.4 Bacteriological examination: is it possible?.....	77
4.5 Conclusion.....	79
Chapter 5: What is the diagnosis?	81
5.1 Infection through drinking water	81
5.2 Infection with food	85
5.3 Contagion as a result of overcrowding	90
5.4 Conclusion.....	92
Chapter 6: The consequences of the plague.....	93
6.1 Demography and plague.....	93
6.2 Plague and Society.....	101
6.2.1 Construction work.....	103
6.2.2 Cultural life.....	106
6.2.3 War and plague	108
6.2.3.1 War Cruise before the plague	108
6.2.3.2 War Cruise during the plague.....	109
6.2.3.3 War Cruise after the plague until the peace in 421 BC	112
6.2.3.4 War and plague, what was the result?.....	113
Chapter 7: Conclusion	117
7. 1 The way forward.....	119
Literature	124
Sources	124
History	126

Archeology	131
Modern medicine	133
Attachment I: A patient from Athens in the summer 428 BC. Professor dr. med. Claus Ola Solberg	134
Attachment II: Case history of an Athenian patient transferred to a modern infectious medicine department. Professor dr. med. Bjørg Marit Andersen.....	138
Attachment III: Short overview of infectious diseases caused by bacteria or viruses.....	140
Definition.....	140
1. Diseases mostly spreading from bowel to mouth.....	140
2. Diseases spread mostly by secretion from mouth or nose and inhalation or contact.....	141
3. Diseases mostly spread by vectors.....	144
Acknowledgement	

Chapter 1: Introduction

Dear Reader, I am going to tell you a story from real life, a story from the Peloponnesian war which I was told during my days at primary school and never could forget. I still remember a drawing from our history book showing Pericles lying behind the walls of Athens, seriously ill from a mysterious disease, the plague, from which he died together with a large part of the population. We were told that after his death the Athenians elected new leaders who were unwilling to follow his advice as to the strategy of the war. It all ended with a catastrophe for the people of Athens. Right or wrong, my impression was that the plague was the reason for their defeat in the Peloponnesian war.

No one has yet identified this mysterious disease, but why should we today examine a disease that happened 2,500 years ago? However, the world has obviously not closed the discussion about the Athenian plague. Scientific papers together with the current literature still discuss this disease claiming that it resulted in the death of about one-fourth to one-third of the population in Attica. And “the disease inflicted a blow on Athenian society from which it never entirely recovered. (...) Had Athens won that war, how different the subsequent political history of the Mediterranean would have been!”¹ Cunha & Cunha made a similar statement in 2007 about the importance of the plague: “the great Plague of Athens effectively altered the outcome of the Peloponnesian War, and subsequent Hellenistic and Western history.”²

Many years have passed since I left primary school, and at last, due to my professional background – both as a medical practitioner, and now also as a historian – I feel able to tell and analyze the story about the plague with as near an approach to the truth as possible. Thus, I will not discuss the background of the war, describe the different military campaigns in detail or divide the blame between the opponents, but only concentrate upon the events related to the plague.

Before I start my story I will present a short survey of the topic including historical facts to place the plague in the correct time period:

There is both a first Peloponnesian war, 460 - 446 B.C, and a second, 432/1- 404/3 B.C. The latter one is usually divided into the Archidamos war, 431 – 421 B.C., followed by the wars

¹ W.H. McNeill, *Plagues and peoples*, Basil Blackwell, Oxford 1977, 105-106.

² C.B. Cunha, B.A. Cunha, Great plagues of the past and remaining questions, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 9.

connected with Sicily, Phoenicia and Ionia, 412 – 404 B.C. However, I will concentrate on the Archidamos war because the plague occurred during the first years of that period. After the peace in 421 B.C. there was no major conflict until the catastrophe Athens experienced after the attack on Sicily in 415 – 413 BC – thirteen years after the mysterious disease had left Athens.

Thucydides is today the main and in fact the only witness to the plague³ as far as we know because he lived during the Peloponnesian war, caught the disease, and left us a written report of it. However, despite Thucydides' detailed description of the plague no one has been able to present a definitive diagnosis of the plague identifying its *cause*. This is because his description alone is not sufficient for a correct diagnosis without additional information about the Athenian society of the time. A correct diagnosis is important for estimating the mortality rate of the plague and accordingly the consequences of the disease for demography, social conditions, and the result of the war.

We have no written fragments from Sparta, which may be why we have no report of the disease among the enemy of Athens. However, Thucydides lived with them for a long period after the plague took place because “It befell me also to be banished from my own country for twenty years (...) and being conversant with affairs on both sides, especially with those of the Peloponnesians by reason of my banishment, to gain at my leisure a better acquaintance with the course of events”.⁴ Thus, it is conspicuous that he does not mention the consequences of the plague for the Peloponnesian people, though the disease no longer was present. One explanation may be that the disease had not affected the people or had not been that serious compared with what had happened in Athens. It is hard to believe that such a serious disease as described by Thucydides had not influenced the people of Peloponnesos, because contagious diseases usually affect populations living not far from each other.

1.1 The common theory of the plague

Based upon information given by Thucydides the literatures still accept that the plague came first to Piraeus and afterwards to Athens. The disease affected a tremendous number of people because Athens was overcrowded by refugees from Attica who had taken shelter behind the walls of the city.

³ I employ the word plague because this word is used for this particular disease in Athens. However, this Athenian plague must not be confused with the plague caused by the bacteria *Yersinia pestis*, the Black Death.

⁴ Thuc V 26

1.2 Method

Thucydides presents detailed information on symptoms and objective signs of the plague, which I used to work out a medical history, as is common in modern medicine. The record was then delivered to three other doctors for a diagnosis of the disease. All were given written instructions that they should not confer with one another and that the medical history should be considered without using knowledge derived from medical history.

Moreover, I benefitted from the use of paleo-epidemiology and in addition took advantage of a new research field – paleo-microbiology – which uses modern gene technology in the study of human remains.

However, archaeology is the foundation for the application of both paleo-epidemiology and microbiology. In addition to written sources, I have used knowledge from inscriptions, geography, ground plans of urban structures and objects obtained through archaeological excavations.

1.3 Intention of the study

To my knowledge there is no common evaluation of both historical and medical factors connected with the plague. It is therefore the intention of this book to analyze the plague from different angles to answer the following questions:

- Was there a plague in Athens in the period 431 – 421 BC and if so, what kind?
- Why was there a plague, i.e. the basis for the disease?
- What were the consequences of the disease for demographics, society, and warfare?

Thus, several questions are still waiting for an answer, and I thereby invite the reader to take part in this investigation of the plague, which happened a long time ago but is still important for understanding western history. At first, however, it is necessary to present in the next chapter the sources dealing with plague and society at that time to evaluate whether they can be relied upon.

Chapter 2: Sources and Methods

*there is no science which has no basis in fact*⁵

2. 1. 1 Introduction

Thucydides is the main source of information concerning events related to the plague and the Peloponnesian War. He lived ca. 460 – 400 BC and must have been a citizen of Athens because he was elected general, *strategos*, during parts of the war, and only citizens became civil servants.

Finally, he was exiled because he lost a battle, and in this connection he writes:

I lived through the whole war, (...) It befell me also to be banished from my own country for twenty years after my command at Amphipolis, and being conversant with affairs on both sides, especially with those of the Peloponnesians by reason of my banishment, to gain at my leisure a better acquaintance with the course of the events.⁶

That statement suggests that he is an important source: both well educated and with knowledge of both those, he fought with and against.

2.1.2 The Primary Source

Thucydides was eyewitness to the events both as a participant in the war and as an observer of people who were affected by fever. He even experienced the plague himself. “He began the task at the very outset of the war, in the belief that it would be great and noteworthy above all the wars that had gone before”⁷. At that time oral transmission of historical events to the public was common. Thus, knowledge and training in rhetoric had a central role in the dissemination of history. Schreiner emphasizes how important it was to captivate the Athenians and keep their attention by presenting exciting stories. This was just as important as written historical narrative, since the people were accustomed to the speeches of the National Assembly and to trial by jury, with its requirements for rhetoric and dramatic presentation.⁸ This is clearly presented in the

⁵ Hippokrates, The science of medicine, in Hippocrates, G.E.R. Lloyd, (ed), *Hippocratic writings*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, Penguin books, Middlesex 1978, 139.

⁶ Thuc V 26

⁷ Thuc I 1

⁸ J.H. Schreiner, Historieskriving, in J.W. Iddeng, (ed), *Ad fontes, Antikkvitenskap, kildebehandling og metode*, Unipub forlag – Oslo Academic Press, Oslo 2007, 40-41.

books of Herodotos as "many passages of Herodotos, in their concreteness and proliferation of contextual detail (...) seem almost to mimic the experience of an oral performance in which the audience is itself already well acquainted with"⁹. This differs from Thucydides' book which increasingly emerges as a written text.¹⁰ However, Thucydides also uses rhetoric to present the important message in Pericles's grave voice¹¹, and when Pericles defends himself against the citizens' criticism of the war¹².

Both Thucydides and Herodotos use rhetoric. However, in addition Thucydides utilizes a well written concise literary form which makes him as an historian different from Herodotos. In my opinion Kurke places Thucydides appropriately as historian when using the following headline in the description of him: "Between science and rhetoric: Thucydides"¹³.

2.1.3 The credibility of Thucydides

Thucydides states how he got information about the events he describes but takes a critical view of his sources, "For men accept from one another hearsay reports of former events, neglecting to test them"¹⁴. He is not only critical of what he has heard but also of his own role as a source:

As to the speeches that were made by different men, either when they were about to begin the war or when they were already engaged therein, it has been difficult to recall with strict accuracy the words actually spoken, both for me as regards that which I myself heard, and for those who from various other sources have brought me reports. (...) as closely as possible to the general sense of what was actually said. (...) But as to the facts of the occurrences of the war, I have thought it my duty to give them, not as ascertained from any chance informant nor as seemed to me probable, but only after investigating with the greatest possible accuracy each detail.¹⁵

⁹ L. Kurke, Charting the poles of history: Herodotos and Thucydides, in O. Taplin, (ed), *Literature in the Greek world*, Oxford university press, Oxford 2000, 131.

¹⁰ Ibid.

¹¹ Thuc II 35-36

¹² Thuc II 60-62

¹³ Kurke, Charting the poles of history: Herodotos and Thucydides, in O. Taplin, (ed), *Literature in the Greek world*, Oxford university press, Oxford 2000, 127.

¹⁴ Thuc I 20

¹⁵ Thuc I 22

Immediately he appears here as a credible source but provides no additional information about his sources. It is clear that he wants to get close to the truth and does not want to publish only "a prize-essay to be heard for the moment."¹⁶ This also helps to create confidence in his presentation. However, Woodman points out the weakness of Thucydides presentation:

In the light of the difficulties experienced by modern military writers I conclude that Thucydides' narrative can not be as accurate as is usually thought. What seems to have happened is that Thucydides has eliminated almost all traces of the difficulties he encountered and in so doing has created an *impression* of complete accuracy, in order to enhance the credibility of a narrative which is intended to demonstrate that the Peloponnesian War is the greatest of all. Yet he has thereby misled the majority of modern scholars, who have mistaken an essentially rhetorical procedure for 'scientific' historiography at its most successful.¹⁷

Woodman presents here an assessment which leads to critical questions concerning Thucydides' presentation of the story. Therefore, my essay will elucidate the circumstances of the plague in Athens, using various approaches to determine the nature of the disease.

Thucydides' motive for writing is that we can learn from history, and he reviews the two topics most important for the citizens – politics and war – without bringing in other events as Herodotos did. As a participant in the war, he had firsthand knowledge of the events. However, there is reason to believe that for a historian events can be too close, making it difficult to give an objective account of the events. It seems that he is not aware of this and seems to write with a certain arrogance; e.g. "from the evidence that has been given, any one would not err who should hold the view that the state of affairs in antiquity was pretty nearly such as I have described it"¹⁸. Despite this, there is reason to assert that he seems to be a reliable source, even if he probably is marked by the exile, and hence, by prejudice the reluctance against that part of the population which voted for his exile. This may have resulted in an account of events critical of the people of Athens.¹⁹

¹⁶ Ibid.

¹⁷ A.J. Woodman, *Rhetoric in classical historiography, Four studies*, Croom Helm Ltd, Provident House, Beckenham 1988, 22-23.

¹⁸ Thuc I 21

¹⁹ Woodman has described such a negative attitude in a letter from Dionysos, "Letter to Pompey",

Uncertainties related to his chronological account of events in the period from the battle against the Persians in 479 to the Peloponnesian war, *Pentecontaetia*, and the events in Sicily, should also be included in the overall assessment of the reliability of the source. Thus, Gomme, Andrewes, and Dover wrote following comment to Thuc VI 2-5: "We find that almost every opinion which Hellanikos is known to have expressed on the early history of Sicily is in conflict with the statements made by Thucydides."²⁰ Schreiner also expresses skepticism about Thucydides and writes that the allegation is that Thucydides created a chronology that would fit his version of the war and its causes.²¹

Thucydides gives no information about where he stayed as a patient, whether in Athens or out of town. It is unlikely that a seriously ill person would have been able even to observe the symptoms and other indicators of his fellow patients, even if he had been present in the city during the plague period. Therefore, there is reason to believe that the symptoms of the plague had been described to him at the same time as he was using his own experience as a former patient to formulate his description of the symptoms and signs. Information about the disease may also have come from doctors who were present during the plague, and this will explain the medically detailed description of the disease. No matter where this information comes from, there is reason to have confidence in the description of the plague symptoms. It is in fact a sober description of the various symptoms and signs of the disease, for what motive could he or others have had to lie about such things? Could he have presented an excessively high mortality rate as an explanation of why Athens lost the war? He writes that in the course of forty days 1,050 of a group of 4,000 hoplites died of the plague.²² However, Diodoros describes the same episode in another way: "The besiegers were dying in large numbers from the plague (...) many Athenian citizens were being slain in the assaults and by the ravages of the plague (...) having lost more than a thousand of his soldiers"²³. Contemporaneously with Thucydides lived the historians Hellanikos²⁴ and Philistos²⁵ from Syracuse, who may also have written about these events.

see A.J. Woodman, *Rhetoric in classical historiography, Four studies*, Croom Helm Ltd, Provident House, Beckenham 1988, 40-41.

²⁰ A.W. Gomme, A. Andrewes, K.J. Dover, *A historical commentary on Thucydides*, vol. 4, Oxford at the Clarendon Press 1970, 200.

²¹ J.H. Schreiner, Thucydides og hans lange Peloponneskrig, 431-404, *Historisk Tidsskrift*, 1993; 72: 413.

²² Thuc II 58

²³ Diodoros XII 46

²⁴ Born around 450 BC at Lesbos.

²⁵ He lived at Sicily around 432-356 BC

However, "No fragment referring to any event covered by Thucydides has survived from either of their works"²⁶. In this connection it is appropriate to recall what Schreiner writes in his book: "we can never know for sure what the lost Hellanikos actually said. (...) We are ill advised to start from the premise that the Thucydidean version which happens to be preserved, was superior to the one which happens to be lost."²⁷

It is difficult to explain the difference in mortality²⁸ rate of the plague reported respectively by Thucydides and Diodoros. Thucydides claims that 1,050 hoplites died of plague, while Diodoros reports that the number of fatalities as a result of the war, combined with the dead of plague, was more than 1,000 soldiers. Although the total number of dead soldiers is approximately the same, Diodoros reports a lower number who died of the plague compared with Thucydides. Perhaps the explanation is that Diodoros based his information on Ephoros²⁹ which therefore must have presented mortality figures different from those of Thucydides?

Checking historical data may have been done by people of the time familiar with what was written and having the opportunity to correct possible faults. However, there is no information that the books were read and commented on by the author's contemporaries. It is also unclear whether the work was published in one or more copies so that it would have been possible for people to read his books. Also, how could it have been possible for the people of Athens even to have knowledge of the books inasmuch as he was exiled for many years and probably wrote parts of the books at that time? He also did not complete the last book, which could also explain why his contemporaries had no knowledge of it.

Thucydides would not travel around and give lectures on what he wrote, in contrast to Herodotus, who – there is reason to believe – presented his historical material orally. Thucydides criticized Herodotus' lectures. If, however, Thucydides had done something similar, we might today have had information about how contemporary people perceived Thucydides' description of the plague.

In the time of Hippocrates³⁰ the word "epidemic", ἐπιδημία, came to mean disease affecting a

²⁶ A.W. Gomme, A. Andrewes, K.J. Dover, *A historical commentary on Thucydides*, vol. 1, Oxford at the Clarendon Press 1950, 29.

²⁷ J.H. Schreiner, *Hellanikos, Thucydides and the era of Kimon*, Aarhus University Press, Aarhus 1997, 19.

²⁸ Definition of mortality and lethality in 2.2.2 Paleo-epidemiology.

²⁹ Ephoros lived ca 405-330 BC. See G.L. Barber, *The historian Ephorus*, Cambridge at the University Press, London 1935, 3.

³⁰ Born on Kos ca 460 BC, died ca 370 BC, see A.S. Lyons, R.J. Petrucelli, (eds), *Medicine. An Illustrated History*, Harry N. Abrams, inc., publishers, New York 1978, 207.

population³¹. Therefore, there is reason to assert that Thucydides, by using the word νοσός, precisely describes the disease as it affected the individual and not as an epidemic. This is consistent usage in my version, except in connection with the interpretation of oracular answers³². However, there is reason to be cautious about placing too much emphasis on the use of the words loimos and nosos. There is in fact reason to believe that Thucydides perceived the plague in Athens in accordance with our understanding of the concept *epidemic* – not only disease in individual people.

Both words, loimos and epidemic, also illustrate the necessity to consider whether past and present understandings of the concepts are compatible or not. The confusion with regard to the various concepts of the disease may have contributed through the centuries to the different perceptions of the plague of Athens.

2.1.4 Source credibility

Uncertainty regarding the source is related not only to the author's credibility but also to what might have happened to his information in the course of 2,500 years. For what happened to the books in the period from Thucydides wrote or dictated the books to today's surviving manuscripts? I have no answer to the question, but it is reasonable to assume that his original presentation was changed to a greater or lesser degree similar with other texts from antiquity. Thus, the original texts did not survive long.³³ Moreover, a text might have survived a long period only in oral form, and over time that would also have resulted in changes of the content. However, there is no reason to assume that Thucydides's books were only known orally because his books stand as a written text.

When it comes to available manuscripts, Powell published a paper in 1938³⁴ which describes how in 1461AD a refugee scholar brought a copy of the books written by Thucydides from

³¹ M.V. Martin, E. Martin-Granel, 2,5000 - year evolution of the term epidemic, *Emerging Infectious Diseases*, 2006; 12: 977.

³² The word νοσός is used in Thuc I 23, II 47, II 49, II 50, II 54, II 58, II 59, III 3, III 87.

See H.S. Jones, J.E. Powell, *Thucydides historiae*, Oxford classical texts, Oxford 1938, book I-IV, and H.S. Jones, J.E. Powell, *Thucydides historiae*, Oxford classical texts, Oxford 1960, book V-VIII.

However, the word λοιμός is only mentioned in the discussion of the answer from the oracle which could have been misinterpreted as hunger, λιμός.

³³ L.D. Reynolds, N.G Wilson, *Scribes and Scholars. A guide to the transmission of greek and latin literature*, Clarendon Press, Oxford, second edition, 1974.

³⁴ J.E., Powell, The Cretan manuscripts of Thucydides, *The Classical Quarterly*, 1938; 32: 103.

Byzantium to Crete, where the fugitive resided thereafter. Before that, he had brought with him three other manuscripts of the books. At that time Europe had just developed the art of printing. Afterwards, it is possible that the books were changed to a modest extent over the passing centuries.

There is reason to suppose that manuscripts from Greek antiquity were highly sought after during the Renaissance in Western Europe and that they were sold at good pay. At that time Crete belonged to Venice, and Powell writes that copies were sold to people from Venice. Since few would buy books that were not complete, there is reason to assume that any lost or damaged passages were replaced with new additions. Not long before, Europe had experienced the Black Death. This was likely a disease of which most people at that time had knowledge. For this reason, it could be tempting to describe the symptoms associated with this disease if parts of Thucydides's description of the symptoms and signs were lacking. However, there is to my knowledge no text-critical analysis that documents that additions to the book were made at that time.

The edition I have chosen to use as a basis is the carefully worked out version by H.S. Jones and J.E. Powell³⁵. The authors state that their edition is based on seven manuscripts from the medieval period 900 – 1,200's. Two of these are from a different and unknown manuscript, archetype, and the remaining five from another archetype. In addition, thirty one papyrus fragments from the first to the fifth century AD were used, but none of the fragments reviews symptoms and indicators of the disease. Jones and Powell's version of the books appear to be the most original, and for that reason I have chosen to use their edition as the primary source.

The uncertainty associated with the source's credibility makes it necessary to use other sources, and such are available. Excavations in Athens have relatively recently discovered remains of people who probably died during dramatic circumstances since they are placed in mass graves. It was in connection with the construction of the Metro in Athens during the years 1992-1997 that mass graves were found at Kerameikos, one with at least 150 dead bodies and another tomb close by with twenty nine. The graves are related to events during the Peloponnesian War³⁶. This

³⁵ H.S. Jones, J.E. Powell, *Thucydides historiae*, Oxford classical texts, Oxford 1938, book I-IV.

H.S. Jones, J.E. Powell, *Thucydides historiae*, Oxford classical texts, Oxford 1960, book V-VIII.

³⁶ N.C. Stampolidis, L. Parlama, (eds), *The city beneath the city*, Abrahams, Harry N., Inc., New York 2001, 272-273.

E. Baziotopoulou-Valavani, A mass burial from the cemetery of Kerameikos, in M. Stamatopoulou, M. Yeroulanou, (eds), *Excavating classical culture, Recent archaeological discoveries in Greece*, The Beazley Archive and Archaeopress, Oxford 2002, 187-201

discovery appears to confirm events at that time that led to the sudden and fairly coincidental death of a number of people and strengthen the credibility of the source when Thucydides describes that:

Athenians suffered further hardship owing to the crowding into the city of the people from the country districts; and this affected the new arrivals especially. For since no houses were available for them and they had to live in huts that were stifling in the hot season, they perished in wild disorder. Bodies of dying men lay one upon another, and half-dead people rolled about in the streets³⁷.

The remains of the people now found in mass graves were probably plague victims. Baziotopoulou-Valavi have the same opinion after the investigation of these mass graves in Kerameikos. They both agree that this is a mass grave dating to the beginning of the Peloponnesian War and that those who were buried here are: "The dead near the temples, the sanctuaries, the fountains and in the streets, whose relatives "lacked the proper funeral material" and could not afford a proper burial, were gathered by the state and were buried in a communal shaft grave at the fringe of the cemetery of Kerameikos, under conditions of panic. This mass burial is therefore a sort of state burial."³⁸This agrees with the scanty tomb discoveries already made, because there is reason to believe that people from the country had limited possessions with them when they hastily went to Athens. However, there is no evidence of extensive use of grave possessions in Athens in the 5th century, a time when burial was far more modest than in archaic times³⁹, so this observation alone does not necessarily mean these are mass graves. However, cemeteries in "the Kerameikos area served as the most prestigious"⁴⁰ so that there is reason to believe that the modest tomb findings confirm that it was relatively poor people who were buried here, in contrast to the other areas in the Kerameikos, where probably findings are somewhat more extensive. The dead are not buried with the same care as close family members show toward their dead, as the bodies have been almost thrown into the grave. This also points in

³⁷ Thuc II 52

³⁸ E. Baziotopoulou-Valavani, A mass burial from the cemetery of Kerameikos, in M. Stamatopoulou, M. Yeroulanou, (eds), *Excavating classical culture, Recent archaeological discoveries in Greece*, The Beazley Archive and Archaeopress, Oxford 2002, 200.

³⁹ I. Morris, *Death-ritual and social structure in classical antiquity*, Cambridge University Press, Cambridge 1992, reprint 1996, Table 5, 106.

⁴⁰ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 5.

the direction of a mass grave.

But why is the plague of Athens⁴¹ not mentioned in the writings that bear the name of Hippocrates, the corpus Hippocraticum? Unfortunately it is not easy to answer such a question, as it is difficult to penetrate the writings because they "almost certainly include writings by many authors from Cos, Cnidos, Sicily, and perhaps elsewhere. The collection was assembled in the fourth century B.C. at the great Library in Alexandria."⁴² As Hippocrates little by little became well known, there is reason to believe that a number of the writings authored by others were added to the collection which later got his name.⁴³ The unique aspect of this collection is that authors are not interested in religious or mythological explanations as the cause of disease; rather they infer that disease in the individual could be related to conditions in society⁴⁴.

The oldest medical writings – seven books of which I and III are from the fifth century BC – describe disease in several patients, but the plague is not mentioned.⁴⁵ It seems strange that such a dramatic event is not described. However, one explanation is that the disease was considered incurable, because Hippocrates wrote: "First of all I would define medicine as the complete removal of the distress of the sick, the alleviation of the more violent diseases and the refusal to undertake to cure cases in which the disease has already won the mastery, knowing that everything is not possible to medicine."⁴⁶ This explanation does not fit because Thucydides writes: "For neither were the physicians able to cope with the disease, since they at first had to treat it without knowing its nature, the mortality among them being greatest because they were most exposed to it, nor did any other human art avail."⁴⁷ He documents here clearly that the doctors really tried to help the sick. Nor is there reason to assume that a physician who belonged to the school of Hippocrates, did not have knowledge of such a serious and contagious disease as the plague, because the Greeks traded with one another and thus received information about serious incidents that occurred in different places. It also seems strange that he did not write

⁴¹ The plague mentioned in *Speech of the envoy*, is not the plague described by Thucydides. See J. Jouanna, *Hippocrates*, translated by M.B. DeBevoise, The John Hopkins University Press, Baltimore and London 1999, 32.

⁴² A. Lyons, Hippocrates, in A.S. Lyons, R.J. Petrucelli, II, (eds), *Medicine. An Illustrated History*, Harry N. Abrams, inc., publishers, New York 1978, 210.

⁴³ Ibid.

⁴⁴ J.A.C.T.G.C., *The world of Athens, An introduction to classical Athenian culture*, 2.edition, revised by R. Osborne, Cambridge University Press, Cambridge 2008, 8.39-8.40.

⁴⁵ Hippocrates, Epidemics, book I, III, translated by J. Chadwick, W.N. Mann, in G.E.R. Lloyd, (ed), *Hippocratic writings*, Penguin books, Middlesex 1978, 87-138.

⁴⁶ Op.cit: 140.

⁴⁷ Thuc II 47.

about this terrible plague as he probably lived not far from Athens in Thessaly during this period.⁴⁸ Another possibility is that the doctors considered the plague a common disease, and consequently there was no reason to mention it. This does not fit if it is true that the doctors died in large numbers, since such a disease was hardly considered a common illness.

However, there is reason to believe that the doctors in Athens did not belong to the disciples of Hippocrates: A reasonable explanation may be that it was only much later that Hippocrates was considered superior and then attracted prospective doctors to travel from the big city of Athens to be trained by him. Thucydides does not mention Hippocrates, and it is reasonable to suppose that he would have done so if a famous Hippocrates or his disciples had treated the plague patients.

The Hippocrates paper *Science of Medicine* claims that medicine is a science and it represents a showdown with those who adopt a critical attitude to the subject. Critics are considered quacks, and the author wrote: "And as I describe the science I shall at the same time disprove the arguments of her traducers, whatever way each prides himself on his attack."⁴⁹ Perhaps the disease was not found worthy of mention in his writings because patients had been treated by doctors in Athens not trained by him.

Xenophon (ca. 430-355 BC) must have had knowledge of the books of Thucydides, for he continues the description of the war after Thucydides had closed his account of it. However, I have so far not been able to prove that he has commented upon the person Thucydides or his books. In particular, I have found no information about the plague in his books in spite of the fact that Xenophon was born at a time when the plague broke out in Athens. Even if he was too small to remember the plague, it is reasonable to believe that at least as a young man or adult he was told about the disease which, according to Thucydides, ravaged Athens. His father is referred to as "Gryllos, an Athenian, from Erichia",⁵⁰ and therefore it is probable that he would have told his son about the terrible plague. Is the reason for not mentioning the plague that his father – or later he himself – did not perceive the illness as more serious than other diseases at that time? Xenophon is the primary source for what he experienced during the war and how the people of his time regarded the plague, but he has no comment about the disease.

⁴⁸ J. Jouanna, *Hippocrates*, translated by M.B. DeBevoise, The John Hopkins University Press, Baltimore and London 1999, 28.

⁴⁹ Hippocrates, *The science of Medicine*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, in G.E.R. Lloyd, (ed), *Hippocratic writings*, Penguin books, Middlesex 1978, 140.

⁵⁰ Xenophon, *Hellenika I – II.3.10*, P. Krentz, (editor and translator), Aris and Phillips imprint of Oxbow Books, Oxford 1989 reprint 2004, 1

Diodoros Siculus (ca. 80 - 20 BC), Greek historian from Sicily, confirms the existence of the history books written by Thucydides when he writes: "Of the historians, Thucydides ended his history, having included a period of twenty-two years in eight Books, although some divide it into nine; and Xenophon and Theopompos {⁵¹} have begun at the point where Thucydides left off." ⁵² However, Diodoros Siculus creates uncertainty about who was his main reference, by stating: "Now the causes of the Peloponnesian War were in general what I have described, as Ephoros has recorded them." ⁵³ Unfortunately, the notes of Ephoros say that "for the years 440-427 we have no knowledge of the course of events" ⁵⁴.

When it comes to the plague, Diodoros writes: "As for the Athenians (...) within the walls, they found themselves involved in an emergency caused by a plague; for since a vast multitude of people of every description had streamed together into the city, there was good reason for their falling victim to diseases as they did, because of the cramped quarters, breathing air which had become polluted." ⁵⁵ Although the author does not specify his source, there is reason to believe that he got the information either from books of Thucydides or Ephoros, but how did he come in contact with this literature? At this time, approximately 60 to 56 BC, he started to write. ⁵⁶ He confirms that he was in Egypt at that time by writing: "down to the One Hundred and Eightieth Olympiad, the time when we visited Egypt." ⁵⁷ The introduction of the book states that "There is no evidence in his work that he travelled in any other land than Egypt, (...) The only other place where he claims to have stayed was Rome (...) and it is kinder to suppose that he never visited Athens than to think that the glory of Acropolis, if he had once seen it, was not considered important enough to deserve mention" ⁵⁸. Therefore, there is reason to believe that he came into contact with this part of Greek literature during his visit to Egypt, probably in Alexandria. However, it is also possible that he got access to the books during a stay in Rome since the Romans had carried Greek literature and art to the city. The important thing is that he confirms to

⁵¹ Greek historian born ca.380 f.Kr. See I. Delliös, *Zur Kritik des Geschichtschreibers Theopompos*, Simmel & Co. i Leipzig, Jena 1880, Nabu public domain reprint, USA 2010, 1.

No fragment about the Peloponnesian war.

⁵² Diodorus Siculus XIII 42

⁵³ Diodorus Siculus XII 45

⁵⁴ G.L. Barber, *The historian Ephorus*, Cambridge at the University Press, London 1935, 42.

⁵⁵ Diodorus Siculus XII 45

⁵⁶ Diodorus of Sicily, *In twelve volumes. Books I and II, I-34*, translated by O.H. Oldfather, Harvard University Press, Cambridge, Massachusetts, London, England 1933, reprint 1989, viii – ix.

⁵⁷ Op.cit: I 44

⁵⁸ Op.cit: xiii

have knowledge of both Thucydides and Ephoros.

However, Diodoros lacks a detailed description of the symptoms and signs of the plague. The reason may be that Diodoros found it unnecessary to mention this, as it was available to be read in Thucydides. Another explanation may be that the description was missing in the books written by Thucydides and Ephoros to which Diodoros had access. However, there is reason to believe that Diodoros used Ephoros as a source, because he indicates this in the quote from his book XII 41. Unfortunately it is not possible to identify this further because the manuscript of Ephoros is missing.

Plutarch (ca. 45-120 AD) was Greek and a priest at the oracle at Delphi with close ties to important people in both Rome and Greece. He is not regarded as a historian, but as a biographer and he makes comparisons between Greek and Roman persons with similar status in society. The purpose was to learn from great men who lived long time ago. However, he has primarily contributed to a kind of fusion of Roman and Greek culture, and he describes the plague and states that Pericles died of it.⁵⁹ However, he does not mention the historian Thucydides in this connection and does not give the source for the description of the plague. Thucydides writes that Pericles died but not that he died of plague. Therefore, there is reason to believe that Plutarch had used a different source or given incorrect information.

Pausanias is probably from Greek-speaking Asia Minor and is known for the travel descriptions that he wrote around 160-177 AD.⁶⁰ He visited most of the places which he writes about. After his visit to Athens, he confirms that the plague has taken place but does not specify his source: "They say the god got his name by putting an end through the Delphic oracle to the plague that scourged Athens in the Peloponnesian War."⁶¹ Levi writes in the *Introduction* that Pausanias was probably a doctor, because he was "interested in questions of anatomy and personally devoted to the healing god Asklepios."⁶² Perhaps this explains why he speaks of the plague, as there is reason to believe he had obtained knowledge from the medical community or from the books written by Thucydides much earlier. However, Pretzler is not as specific as Levi

⁵⁹ Plutarch, Pericles, in P.A. Stadter, (ed), *Greek lives*, translated by Waterfield, R., Oxford University Press, Oxford 2008, 34, 38.

⁶⁰ P. Levi, Introduction, in Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revision 1979, 1.

⁶¹ Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, 13 {4}

⁶² P. Levi, Introduction, in Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, 2.

when it comes to the education of Pausanias, for she refers to him as an educated person with a range of intellectual interests.⁶³ Pausanias reviews Xenophon and mentions Thucydides in connection with the revocation of the expulsion and the fact that he was murdered on his way home.⁶⁴ He also has another comment upon Thucydides where he confirms that he has had access to his books: "I happen to remember that in the writings of Thucydides he puts some Myoneans among the Lokrian cities."⁶⁵

2.1.5 Other written sources

Dionysos festivals were important cultural events in Athens in classical times. The largest took place in March/April, and another, *Lenaia*, was held in January in which comedies had a more central place⁶⁶. In addition, from the end of the fifth century Piraeus had a big theater with a capacity of over 5,000 spectators⁶⁷. There is no information about cessation of these activities during the Peloponnesian War, so it is probable that these activities continued as before. Among the dramatists, Sophocles and Euripides were the most popular at the time, and they wrote: *King Oedipus* approximately 427/434-2, *Medeia* 431, *Hippolytos* 428 and *Hiketidene* approximately 424. Sophocles wrote *King Oedipus* and Euripides the remaining three.

Comedies focus on current social satire, and the characters are ordinary people who rebel. These plays were performed beginning in 425. The first piece was *Acharnians* written by Aristophanes (ca 445-385). Moreover, the same author wrote the following comedies until 421: *Knights* in January 424, *Clouds* 423, *Wasps* 422, and *Peace* 421.

It is reasonable to believe that a serious incident like the plague should have lead to comments upon the disease. However, in the opening scene of *King Oedipus* the plague in Theban has a prominent place,⁶⁸ but that does not necessarily refer to the plague in Athens.⁶⁹ I have not found the plague described in other plays, not even by Aristophanes. He does, however, in *Knights*,

⁶³ M. Pretzler, *Pausanias: Travel writing in ancient Greece*, Duckworth, London 2007, 25.

⁶⁴ Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, I 23 {11}.

⁶⁵ Pausanias, *Guide to Greece: vol. 2: Southern Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, VI 19 {5}.

⁶⁶ P. Wilson, Powers of horror and laughter: The great age of drama, in O. Taplin, (ed), *Literature in the Greek world*, Oxford University Press, Oxford 2000, 82.

⁶⁷ Op.cit: 81

⁶⁸ Wikipedia claims the play was first performed ca. 429 BC

⁶⁹ Bendz, G. Gresk litteratur, in Beyer, E., Billeskov Jansen, F.J., Stangerup, H., Traustedt, P.H., (eds), *Verdens litteraturhistorie*, J.W. Cappelens forlag A.S., Oslo 1971, 327.

make a big issue of the overpopulation in Athens but says nothing about the plague. Aristophanes confirms here the information given by Thucydides that the city was crowded, but not that "Bodies of dying men lay one upon another, and half dead people rolled about in the streets."⁷⁰

But why was not the plague described in the plays except for the mention of the plague in Theban – but only the fact that the city was overcrowded? One explanation may be that the play which mentioned the disease has disappeared or that the authors considered the plague a "normal" disease not worth mentioning. At the time the plague appeared tragedians produced versions of the myths and descriptions of contemporary realities in Athens. Therefore, this can also be a possible cause why the plague was not mentioned. The plays were written to participate in competition for prizes, so the writer may not have felt free to mention events related to the ongoing war. However, there is little reason to assume that writers refrained from mentioning the plague only because it described a terrible condition which affected large parts of the population. Drama at that time revolved about tragic events, first and foremost as a universal tragedy of mythic time. Even more strange is that the comedy *Knights* only reviews the overpopulation and not the severe plague. Although this piece was written some years after the most serious outbreaks, it would be natural to describe the disease in connection with the criticism directed at perhaps the foremost citizen at that time, Cleon.

In connection with the plays, it is not primarily lack of information about the plague that is important, but how it was possible to implement large events like the Dionysos festivals while the population was badly affected by a severe disease with many dead? Therefore, the impression is that the disease might not have been as serious as Thucydides claimed it was, or that it affected mainly people whom established citizens of Athens regarded as refugees and not real inhabitants of the city. The refugees from Attica were perhaps seen as a major problem which the rest of the population tried to ignore. Thucydides confirms that the refugees are a problem but expresses also his concern for them: "But in addition to the trouble under which they already labored, the Athenians suffered further hardship owing to the crowding into the city of the people from the country districts; and this affected the new arrivals especially. For since no houses were available for them and they had to live in huts that were stifling in the hot season, they perished in wild disorder."⁷¹ Both statements are inconsistent with making arrangements for festivals while many

⁷⁰ Thuc II 52

⁷¹ Thuc II 52

dead and dying people are to be found on the square and in the fountains, while a large portion of the remaining population is also seriously ill. Dionysos festivals were big events with thousands of spectators, so it was impractical to carry out major activities simultaneously with severe and extensive disease in Athens. Thus, such reflections reduce the image of the plague as an epidemic disease with high mortality in the population.

It is strange that a dramatic event like the plague "has (perhaps surprisingly) left no trace at all on any independent piece of evidence or inscription. (...) has Thucydides magnified the plague out of all proportion to its real significance?"⁷² Such speculation is further enhanced because "the Athenian had a tradition of recording tremendous amounts of information on stone: laws, treaties, public honors, dedications, epitaphs, financial transactions, and inventories of all sorts. Well over twenty thousand inscriptions survive from Athens."⁷³ Could one explanation be that Thucydides's account of the plague is intended to highlight the "plot"⁷⁴, the moral decay in Athens? If the disease itself was not as dramatic or unusual as Thucydides portrays it, is that why it merited no inscription? Or is it that those hardest hit by the plague belonged to the lowest groups of the society and thus were not considered significant enough to achieve public inscription? However, it is not very likely that the latter explanation is reasonable because a large part of the hoplites also died of the plague, and their deaths were not officially noted either. Hoplites belonged to the upper class/middle class, and there is reason to believe that significant loss of such citizens would eventually have been officially noted in one form or another.

When it comes to the sources and their interpretation, a series of questions about the plague arises, but without sufficient answers. It is therefore my opinion that it is not possible to find the answer to the riddle of the plague only with the help of literary sources. For this reason it is necessary to supplement these with other methods in pursuit of the plague and its consequences for Athens.

2.2 Method

Thucydides left a detailed description of symptoms and indications associated with the plague,

⁷² A.J. Woodman, *Rhetoric in classical historiography, Four studies*, Croom Helm Ltd, Provident House, Beckenham 1988, 39.

⁷³ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, x.

⁷⁴ H. White, The historical text as literary artefact, in G. Roberts, (ed), *The history and narrative reader*, Routledge, 2001, 223.

and the current knowledge about various diseases should make it possible to suggest what the plague could have been. In science we usually compare things because it is the essence of scientific explanation. But it is important that we compare the same variables; i.e., the current interpretation of the various symptoms must correspond to what Thucydides had in mind. In this connection it is fortunate that he gave a general description of various symptoms and signs, so there might be reason to assume that his understanding of the concepts is largely congruent with ours. The fact that there are differing translations of same words, however, illustrates that we must be wary of misinterpretations. In any case, there is reason to be wary of adding emphasis to translation or interpretation of certain words, when it is a medical diagnosis that should be made. To illustrate this I choose Thucydides' words φλύκταιναι μικράι describing the rash. The words are often translated with *small blisters*⁷⁵. Thomas Hobbes translated the words with "little Pimples and Whelks. (...) Subsequent scholars have offered numerous translations of this Thucydides's key descriptor, including blain, blebs, blisters, bull, eruption, pustules, and vesicle".⁷⁶ In medical terminology there is a diagnostic difference between a vesicle which contains clear fluid and a pustule with opalescent fluid that reflects infection.

As there is uncertainty what Thucydides meant by the medical terms he uses, and I am not able to perform a thorough text critical analysis, I have chosen other approaches to identify the disease with the help of current medical knowledge. It involves both clinical medicine, paleo-epidemiological and paleo-microbiological methods.

2.2.1 Clinical Medicine

On the basis of symptoms the patient describes and other findings, the physician makes a tentative diagnosis. This is the clinical medical approach, and the most important tool in that respect is the patient and his or her medical records. In this study I picked up patient information from Thuc II, and linked these to an imaginary male patient of 25 years. The journal was composed in the common Western way. The question is whether the medical record provided sufficient information to make a definite diagnosis. The record was mailed to three other physicians⁷⁷, and the four of us have different clinical and academic approach to infectious

⁷⁵ Thuc II 49

⁷⁶ D.T. Durack, R.J. Littman, R.M. Benitez, P.H. Mackowiak, Hellenic holocaust: A historical clinico-pathologic conference, *The American Journal of Medicine*, 2000; 109: 396.

⁷⁷ 1. Bjørg Marit Andersen, professor in medicine, specialist in microbiology.

diseases.

The physicians were requested to perform the assessment as follows:

1. Do not discuss this with one another.
2. Use only the current medical knowledge to diagnose and "forget" the knowledge of antiquity.
3. Based on the medical history - what disease/illness may it have been?
4. What is needed to determine the diagnosis?
5. What diseases can it not have been?

The journal is in two parts and describes the patient's symptoms and disease progression, *history*, as well as a systematic, objective examination of the patient with description of clinical findings, *present status*. The journal concludes with likely, *tentative*, diagnoses based on the medical record. The conclusion was omitted from the record which was sent to the doctors, and it is thus I who am responsible for the likely diagnoses, see chapter 4.

A similar approach has been used: Durack and colleagues published in 2000 a medical history, *case presentation*, associated with the plague of Athens.⁷⁸ However, the authors also added their own medical interpretations to the medical history.

2.2.2 Paleo-epidemiology

Epidemiology is the study of the spread of disease and a systematic search for the cause of disease. The purpose is to monitor and understand the spread of disease and death in the population, not only in the individual, to prevent the disease. This is in many ways consistent with Thucydides's justification for coverage of the disease: "I shall describe its actual course, explaining the symptoms, from the study of which a person should be best able, having knowledge of it beforehand, to recognize it if it ever breaks out again."⁷⁹

However, Hippocrates was probably the first who recorded the connection between environment and disease.⁸⁰ He clarified the terms endemic and epidemic disease in order to distinguish between diseases that are always present in the population, in contrast to diseases that

2. Stig Frøland, professor in medicine, specialist in internal medicine and infectious diseases.

3. Torbjørn Iversen, professor emeritus in medicine, specialist in gynecology, obstetrics and oncology.

4. Claus Ola Solberg, professor emeritus in medicine, specialist in internal medicine and infectious diseases.

⁷⁸ Durack, D.T., Littman, R.J., Benitez, R., Mackowiak, P.A., Hellenic Holocaust: A historical clinic-pathologic conference, *Am J Med*, 2000; 109: 391 – 397.

⁷⁹ Thuc II 48

⁸⁰ Hippocrates, *On airs, waters and places*, translated by F. Adams, Kessinger Publishing, UK 2009.

only occasionally occur in large numbers.⁸¹

Epidemiological methods are traditionally divided into two main groups, descriptive (observation studies) and analytical (cohort and case-control studies). However, analytical epidemiology is difficult to perform on events in the past. When it comes to the population of Athens during the plague, it might only be possible to use the descriptive part: incidence of disease over the years, difference between: city/country, different countries, gender, age, marital status, and occupation.⁸²

However, epidemiology should not be confused with epidemic: “An epidemic is the occurrence in a community or region of a number of cases of a disease that is unusually large or unexpected for the given place and time (...) When an epidemic is described, the time period, geographical region, and particulars of the community group in which the cases occur must be clearly specified.”⁸³

Paleo-epidemiology focuses on the assessment of human remains, mostly bones, and does not represent the original living population.⁸⁴ To use such an approach it is necessary with well-documented archaeological observations to describe the hygienic conditions of water supply, sanitation, nutrition, clothing, personal hygiene and grave-findings. Such information is crucial in the search of risk factors for development of disease.

2.2.3 Paleo-microbiology

This method uses modern gene technology, *PCR (polymerase chain reaction)* technique in the study of human remains. The technique was first described in 1993 when *Mycobacterium tuberculosis* was detected in the skeleton.⁸⁵ The purpose of the method is to identify DNA

⁸¹ K.E. Nelson, C.F. Masters Williams, Early history of infectious disease: epidemiology and control of infectious diseases, in K.E. Nelson, C.F. Masters Williams, C.F.M., (eds), *Infectious disease epidemiology: Theory and practice*, second edition, Jones and Bartlett publishers, Sudbury Massachusetts 2007, 5.

⁸² Description of a disease in a population should include number of new cases, incidence, during a time period and the population at risk. Prevalence is the number who has the disease at a specific time. Mortality is the number of death during a time period in a population which includes people with and without the disease. Lethality is the number who got the disease and died from it. (Randomization is an experimental study and is not included among the analytical studies.)

⁸³ R. Beaglehole, R. Bonite, T. Kjellström, *Basic epidemiology*, World Health Organization, Geneva 1993, 97.

⁸⁴ O. Dutour, Y. Ardagna, M. Maczel, M. Signoli, Epidemiology of infectious diseases in the past: Yersin, Koch, and the skeletons, in C.I. Greenblatt, M. Spigelman, (eds), *Emerging pathogens. Archaeology, ecology & evolution of infectious disease*, Oxford University Press, New York 2003, 152-154.

⁸⁵ M. Spigelman, E. Lemma, The use of polymerase chain reaction (PCR) to detect *Mycobacterium tuberculosis* in ancient skeletons, *Int J Osteoarchaeol*, 1993, 3: 137 - 143.

sequences to the identified bacteria to compare with known bacteria in our time and determine the cause of past disease.

However, the problem is that the body's soft tissue rapidly breaks down on dead people if their bodies are not mummified or frozen, and soft tissue is necessary to detect bacteria which have not affected the skeleton. Luckily, there is still soft tissue in the dental pulp even in people who have been dead for a long time, and the dental pulp consists of "highly vascularised tissue of mesenchymal origin, located inside the tooth and naturally protected from the external environment."⁸⁶ The explanation why it is possible to detect bacteria in this area long after outbreak of a disease is that "Bacteria early in bacteremia are trapped in the dental pulp and preserved if the victim's teeth are preserved / found. To date, dental pulp DNA analysis is the only way to accurately identify microbial DNA from rapidly fatal infections of the past (Drancourt et al. 1998)"⁸⁷ The application of this tissue with PCR technique resulted in almost a revolution in the study of previous infectious diseases: for example surveys conducted of the dental pulp of human remains from the Middle Ages confirm that the plague from this period corresponds to the plague of our time⁸⁸.

A number of conditions must be observed in DNA studies of buried people: First and foremost: proper dating of the tomb; and pollution from the ground around the dead must be avoided, since a number of bacteria is a natural part of the soil. The analysis must be performed correctly and reproduced. D. Antoine has formulated a number of such requirements in his article from 2008, while he notes the uncertainty associated with the work that maintains that the *Yersinia pestis* was the etiological cause of the Black Death⁸⁹.

⁸⁶ Vu Dang La, G. Aboudharam, D. Raoult, M. Drancourt, Dental pulp as a tool for the retrospective diagnosis of infectious diseases in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 175-176. The authors give an excellent description of the technique.

⁸⁷ C.B. Cunha, B.A. Cunha, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 18.

The reference to Drancourt et al. 1998 is: M. Drancourt, G. Aboudharam, M. Signoli, O. Dutour, D. Raoult, Detection of 400-year-old *Yersinia pestis* DNA in human dental pulp. An approach to the diagnosis of ancient septicaemia, *Proc. Natl. Acad. Sci. USA*, 1998; 95: 12637-12640.

⁸⁸ M. Drancourt, D. Raoult, Molecular insights into the history of plague. *Microbes Infect* 2002; 4: 105-9.

See also M. Drancourt, D. Raoult, Molecular detection of past pathogen, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 55-68.

⁸⁹ D. Antoine, The archaeology of "Plague", in V. Nutton, (ed), *Pestilential complexities: Understanding medieval plague, Medical history*, supplement no 27, The Wellcome Trust Centre for the History of Medicine at UCL, London 2008, 101-114.

2.2.4 Archaeology

Camp has a concise and comprehensive definition of archeology as "the study of the past using physical evidence: buildings, monuments, gravesites,"⁹⁰ and these requirements have been observed in excavations since Greece became an independent kingdom in 1832. From around 1950 the excavations have also provided comprehensive knowledge of common housing and industrial areas in Athens.⁹¹ The latest major excavations took place in the period 1992-1997 in connection with the construction of the subway in Athens.⁹²

In some areas there is reason to interpret archaeological findings as a form of "answer" when it comes to the conditions in Athens at that time. However, it is necessary to point out that the use of archaeological sources of history is problematic, since archeology can reflect technology and economy but has little to say about ideology and religion.⁹³

When a society experiences a sudden onset of mass death caused by war or disease, the high number of deaths might be overwhelming and mass graves are used. In these graves the dead are usually placed in complete disarray, and the grave findings are often modest.⁹⁴ Such graves from the time of the plague have now been discovered in Kerameikos.⁹⁵ However, much of the area of Athens is not excavated, and still more mass graves in Athens from the time of the plague may be found. The custom of burying in the river bank has been around for a long time even if the risk of pollution of rivers was known among the population.⁹⁶

In addition to the information given by the mass graves, I will also use knowledge from archaeological discoveries concerning the climate, scenery, food supply, sanitation, and the structure of the city, including water supply and drainage. Construction activity and population size and density are also necessary knowledge to assess the situation in Athens at that time.

⁹⁰ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, ix.

⁹¹ R.E. Wycherley, *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 5.

⁹² N.C. Stampolidis, L. Parlama, (eds), *The city beneath the city*, Abrahams, Harry N., Inc., New York 2001, 18.

⁹³ K. Ødegård, Arkeologiske kilder, utgravninger og landskap, in J.W. Iddeng, (ed), *Ad fontes, Antikkvitenskap, kildebehandling og metode*, Unipub forlag – Oslo Academic Press, Oslo 2007, 174 -175.

⁹⁴ D. Castex, Identification and interpretation of historical cemeteries linked to epidemics, in D. Raoult, M.

Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 23-29.

⁹⁵ Stampolidis, N.C., Parlama, L., (eds), *The city beneath the city*, Abrahams, Harry N., Inc., New York 2001, 272-273.

J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 264.

⁹⁶ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 263, 8.

Chapter 3: Risk factors for disease in Athens

*Every phenomenon will be found to have some cause*⁹⁷

In humans there are three main causes of disease. The first is microbes and poisoning. The second is the external environment; i.e., the climate and sanitary conditions in which people live. The third is internal: gender, age, general health and immunity. That the Greeks placed great emphasis on health is indicated by their belief in a goddess of health, Hygeia.

The next chapter deals with possible causes of the plague during the Peloponnesian War in the form of microbes and poisoning, while this chapter focuses on the risk factors for disease: the external environment and the characteristics of the population.

“The term ‘risk factor’ is commonly used to describe factors that are positively associated with the risk of development of a disease but that are not sufficient to cause the disease. (...) Some risk factors (e.g. tobacco smoking) are associated with several diseases, and some diseases (e.g. coronary heart disease) are associated with several risk factors.”⁹⁸

Hippocrates hunted for the cause of disease, as today's health care providers still do, but he did not differentiate between cause and risk factors for disease. However, that is forgivable, since modern media to some extent neither do. Moreover, when the media report the causes of disease, they often fail to note that faulty hygiene could be behind the outbreak of disease

3.1 Environment as a risk factor

To assess the relationship between environment and the development of disease, it is necessary to obtain knowledge about the natural environment in Athens at the time of the plague. Therefore, I start by giving a brief description of climate and landscape and then review hygienic factors linked to drinking water, sanitation, urban conditions and housing. A review of nutrition is provided in section 3.2.1 *What did they eat?*

⁹⁷ Hippocrates, The science of medicine, in Hippocrates, G.E.R. Lloyd, (ed), *Hippocratic writings*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, Penguin books, Middlesex 1978, 142.

⁹⁸ R. Beaglehole, R. Bonite, T. Kjellström, *Basic epidemiology*, World Health Organization, Geneva 1993, 74.

3.1.1 Climate and landscape

In our time, climate is perceived as "the total experience of the weather at any place over some specific period of time"⁹⁹. In the course of Earth's life climate has changed and varies between different locations. However, there is a constant factor in these changes: The biggest variation in the climate occurs between north and south. The changes between east and west are much smaller: *The earth has climate bands*. In practical effect this means that scientific data related to part of a climate band generally can be used for the entire climate band. Therefore, findings made in California also shed light on climatic conditions in the eastern Mediterranean during the same period.

But how was the climate in Athens in classical times? Osborne writes in 1987 "that the broad pattern of the Greek climate has remained the same for the past three or four millennia at least. (...) the bulk of rain falling between October and May (...) the driest months in the south are July and August (...) Attica (...) receive less than 400 mm of rain a year."¹⁰⁰ However, he makes an important addition: "Within this overall pattern there may be very considerable local variations, as was recognized in antiquity."¹⁰¹ Sallares writes in 1991: "A consensus has developed among ancient historians that the climate of Greece in the fifth and fourth centuries BC was virtually identical to the present-day climate."¹⁰² Other historians, Morris and Powell, repeated the assertion in 2006.¹⁰³ Another publication also states that there is no rain within two to four months in the summer, "apart from an occasional thunderstorm or brief mist (...) in south-eastern Greece, where Athens lies, levels of rainfall vary very significantly from year to year, and more than once a decade rainfall is insufficient to sustain cereal crops."¹⁰⁴

However, is it possible to infer something about the climate during the Peloponnesian War? Lamb presents in his book fig. 52, showing the thickness of the growth rings of a conifer in California. In the fifth century BC growth rings were especially thick compared with the

⁹⁹ H.H. Lamb, *Climate, history and the modern world*, Routledge, 2. edition, London and New York 1995, 8. The book is fascinating reading and also describes methodology.

¹⁰⁰ R. Osborne, *Classical landscape with figures. The ancient greek city and its countryside*, Sheridan House, New York 1987, 29-31.

¹⁰¹ Op.cit: 33.

¹⁰² J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 391.

¹⁰³ I. Morris, B.B. Powell, *The Greeks, History, culture and society*, Pearson Prentice hall, New Jersey 2006, 14.

¹⁰⁴ J.A.C.T.G.C, *The world of Athens, An introduction to classical Athenian culture*, 2. edition, revised by R. Osborne, Cambridge University Press, Cambridge 2008, 59-60.

centuries before and a couple of centuries after.¹⁰⁵ There is reason to be cautious in interpreting this, but in any case the observation suggests both hotter summers and more rain in the fifth century BC compared with the period before and after. Thus, there is reason to believe that despite the prolonged drought in Athens during the summer there may also have been sporadic heavy rains damaging the grain crops. This fits with what Sallares writes:

“In Attica Demosthenes mentions torrential rains which caused problems for farmers around Eleusis, recalling the winter with heavy rain at the beginning of the Peloponnesian War. Rather than thinking in terms of a continuous drought for over forty years, it is better to regard the age of Demosthenes as a period marked by alternating wet and dry phases. Both could be bad for crops.”¹⁰⁶

In the note to this quotation Sallares refers to legal speech 55 written by Demosthenes (384-322f.Kr.). It deals with the case of "The son of Teisias against Callicles, regarding damage to a piece of property."¹⁰⁷ Demosthenes was at the beginning of his career and writes: "Now this particular piece of land, as it happened, was inundated after a heavy downpour had occurred."¹⁰⁸ When it comes to the scale of destruction, Demosthenes notes in the same speech: "how many people in the farm-lands have suffered from floods in Eleusis and in other places."¹⁰⁹ He also states that the event occurred a good 15 years back, so that it took place not long after the Peloponnesian War had ended. The source gives the impression that these floods were common in these areas. However, I cannot see that the source confirms the assertion Sallares makes that there was much rain at the beginning of the war, because this specific episode took place several years later.

Thucydides claims that the summer of 430 BC was warm because the people from the country districts "had to live in huts that were stifling in the hot season."¹¹⁰ However, he makes no mention of heavy rain showers. Still, there is reason to assume that there must have been rain

¹⁰⁵ H.H. Lamb, *Climate, history and the modern world*, Routledge, 2. edition, London and New York 1995, 141.

¹⁰⁶ J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 393.

¹⁰⁷ Demosthenes, Private orations LV, in T.E. Page, E. Capps, W.H.D. Rouse, (eds), translated by A.T. Murray, *Private orations*, The Loeb classical library, William Heinemann Ltd, Harvard University Press, Cambridge, Massachusetts 1939.

¹⁰⁸ Op.cit: chapter 11.

¹⁰⁹ Op.cit: chapter 28.

¹¹⁰ Thuc II 52

showers also in the summer of 430 BC because: "many of those who were not looked after did throw themselves into cisterns."¹¹¹ Moreover, it was also through plague patients in Piraeus that the disease entered the country, and in Piraeus only cisterns were filled with rainwater because there were "no public fountains there."¹¹² Therefore, it is probable that there were showers also that summer, since the cisterns were so full that the sick could throw themselves into the water.

Diodoros writes that there were heavy rains in winter 427 BC and that the quality of the grain was poor:

As a result of heavy rain in the previous winter the ground had become soaked with water, and many low-lying regions (...) turned into shallow pools. (...) Contributing also to the disease was the bad character of the food available, for the crops which were raised that year were altogether watery and their natural quality was corrupted.¹¹³

Clearly, Diodoros is familiar with the relationship between rainfall leading to poor grain quality and disease. In the discussion of the start of the war Thucydides writes:

the stories of former times, handed down by oral tradition, but very rarely confirmed by fact, ceased to be incredible: about earthquakes, for instance, for they prevailed over a very large part of the earth and were likewise of the greatest violence; eclipses of the sun, which occurred at more frequent intervals than we find recorded of all former times; great droughts also in some quarters with resultant famines; and lastly – the disaster which wrought most harm to Hellas and destroyed a considerable part of the people – the noisome pestilence.¹¹⁴

The eastern Mediterranean is an area with frequent earthquakes, and for that reason it is not easy either to confirm or deny the information about the frequency of earthquakes in the period in question. However, it is far easier to investigate the occurrence of past eclipses, where information about both the timing and the locale exists.¹¹⁵ With respect to a solar eclipse at the

¹¹¹ Thuc II 49 The war began 431 BC, but the plague started the summer 430.

¹¹² Thuc II 48 Definition of fountains, public fountains and wells in section 3.1.2.1

¹¹³ Diodorus Siculus XII 58

¹¹⁴ Thuc I 23

¹¹⁵ http://en.wikipedia.org/wiki/List_of_solar_eclipses_in_the_5th_century_BC

beginning of the war, on the third of August 431 BC an annular solar eclipse was visible in Athens.¹¹⁶ Thus, there is reason to believe that Thucydides described a real event. However, he does use the plural “solar eclipses,” although there was only one. Therefore, it is possible that he exaggerates the number of solar eclipses, and perhaps also the number of earthquakes, to reinforce the horror in the reader/listener by emphasizing the drama related to the war and what later happened to the people of Athens.

Already Hippocrates was concerned about the environment's impact on the residents of the city.¹¹⁷ The landscape is much the same today, except for changes caused by humans, and I start by describing the landscape in and around Athens before assessing environmental and disease risks in the population.

In addition to Athens, there were a number of villages in the area, and these represented *demoi* with all the obligations and rights of the polis. The city center at that time bordered on a large plain near the sea surrounded by high mountains. The top three are: northwest, Óros Aigósthena, 1,175 m going down to the sea west of Piraeus; in the north, Óros Párnitha, 1,413 m, just east of the city; Óros Pentéli, 1,109 m; and in the southeast, Óros Ymittós, 1,026 m. The terrain east of the last two mountains is hilly and was then already cultivated land. Straight through the plain where Athens is located there is a limestone ridge from the northeast to the southwest where the Acrópolis is situated. Northeast of the Acrópolis the ridge is mostly outside the site of the city walls of the Peloponnesus War era. The highest point in this area is 273m, Lykavítos (Lycabettus). The ridge ends to the west of the Acrópolis, where it forms the hills Lófos Nímfon in the north and Lófos Filopáppou (Mouseíon) in the south. Pnýx lies between these two hills. Northwest of the Acrópolis is the Agorá with a number of public buildings. The city wall at that time is estimated to have had a length of 6.5 km, and Travlos has illustrated the location of the wall in his figure 219.¹¹⁸

Three rivers run through the plain area: Kephísos from Óros Párnitha in the north flows south into the marshes that lead to Órmos Falírou, east of the three major ports of Pireas. Probably Kephísos ran below ground level before it crossed the long walls, since old literature does not

¹¹⁶ I am grateful to Torben Leifsen at The Institute of theoretical astrophysics, University of Oslo. Using a data program from NASA he simulated this solar eclipse, which was clearly seen from Athens. However, the program has a one-year discrepancy compared with the information given by Wikipedia, though day and month were the same. Thus NASA claims it happened in 430 BC, not 431. However, both years are at the beginning of the war.

¹¹⁷ Hippocrates, *On airs, waters and places*, translated by F. Adams, Kessinger Publishing, UK 2009, 3.

¹¹⁸ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 169.

mention an open river between the long walls.¹¹⁹ The Ilíssos starts in the east at the foot of Óros Ymittós and then flows south-west outside the walls without crossing them. The third river, the Eridános, comes from Lykavítos, runs north of the Acrópolis and through the Agorá in a northwest direction "exiting the city through the Sacred Gate, and disappears underground several hundred meters farther on, (...) From that point it made its way to the sea. It was canalized by the mid-fifth century B.C. for much of its length where it passed through the city."¹²⁰ According to Knigge Eridános has "not been traced further to the west; at that point it bends northward and today trickles down into the ground."¹²¹

Pausanias causes confusion when it comes to rivers, because he writes: "The rivers flowing through Athens are the ILISSOS and one which runs into it with the same name as the Celtic ERIDANOS."¹²² This conflicts with what I have written above because Ilissos never went inside the city walls during classical times. However, Levi writes the following about the statement by Pausanias:

The whole subject of water-sources of Athens is perplexed as a number of streams have opened or dried up at different periods, and the general picture has changed radically. (...) Before the Phaleron marsh was drained in this century, not even the Ilissos (now another covered drain just as the ancient Eridanos) ever reached the sea, and the Eridanos has never done so. Eighteenth-century Athens was still watered by fourteen public fountains apparently supplied from the ancient aqueducts.¹²³

3.1.2 Drinking Water

Plutarch reviews the water situation in Attica and refers to a law that Solon had written to ensure public access to water:

¹¹⁹ Personal information by dr. Jutta Stroszeck, Deutsches Archäologisches Institut Kerameikosgrabung Fidiou, Athen, October 2010.

¹²⁰ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 7.

The river was canalized in 478 BC according to U. Knigge, *The Athenian Kerameikos, History-Monuments-Excavations*, translated from German by Judith Binder, first edition 1988, Krene editions, Athen 1991, 151.

¹²¹ U. Knigge, *The Athenian Kerameikos, History-Monuments-Excavations*, translated from German by Judith Binder, first edition 1988, Krene editions, Athen 1991, 150.

¹²² Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, I 19, 6.

¹²³ Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, note 110.

Water is a scarce commodity in Attica, with its lack of constant rivers, any lakes, or prolific springs; instead most of the population used to rely on artificial wells. Solon therefore made a law to the effect that people were to make use of any public wells that were a *hippikon* or less away from their land - a *hippikon* being a unit of distance measuring four stades* - but that where the distance was greater, people should try to find their own water; however, if they had not struck water on their land after digging to the depth of ten fathoms, they could then get it from a neighbour, by filling a six-choes jar twice a day.* The idea behind this rule was to help the needy while at the same time not encouraging idleness.¹²⁴

This quote confirms that there was little water in Attica and that consequently there were wells based on the supply of surface water – *artificial wells*, as the translator of Plutarch writes. Water based upon natural sources was according to Plutarch not sufficient. Moreover, since water was of great importance to the population, the law required that everyone should have free access to water even if it was on a neighbor's property.¹²⁵

But did the houses in Athens have wells and/or cisterns? Excavations in the Agora have detected 17 wells which the Persians destroyed during the Persian War. The wells were not excavated before our time and had not been used after they were destroyed. Perhaps the population in Athens after the Persian War used mostly the public fountains and water from water pipelines, while households also used water from cisterns to meet additional needs.

3.1.2.1 The terms “source, public fountain, well, and cistern”

In the literature these terms are used interchangeably and are rather confusing: Thucydides used the word source, κρήνη, and cistern/reservoir, φρητός. Source, κρήνη is in the Loeb edition translated as *public fountain*. Today the term *well* is often used both for a source and a well dependent upon surface water.

However, Thucydides did not distinguish between cistern/reservoir and well-based surface water since he used the same word, φρητός, for all of them. Thus, he differentiated only between

¹²⁴ Plutarch, Solon, in P.A. Stadter, (ed), *Greek lives*, translated by R. Waterfield, Oxford University Press, Oxford 2008, 23.

¹²⁵ 4 stades are ca. 720m and 10 fathoms 18m. 1 Chous = 3.25 l.

κρήνη and φητός. The first is based upon groundwater which trickles up or water from the water pipelines. The second is only surface water. To avoid confusion, I will, as far as possible use the concepts “source/public fountain” and “cistern.”

Rain is distributed equally among water vapor, surface water and groundwater. Clean water is primarily water vapor that has condensed to rain but can be contaminated by the air. In Athens at that time there was little or no air pollution, and "The luminous clarity of the air, especially in Attica, is quite extraordinary, and we know how often this clarity was referred to by Greek poets, who saw it as a perfect token and symbol of the happy life."¹²⁶ Thus, rain water was clean in Athens, but contaminated if it was collected via unclean ceilings, rock walls or dirty tanks. As far as I know there is no evidence of regular cleaning of areas where the rain came down, but there is reason to believe that these were cleaned regularly for aesthetic reasons, since stagnant water begins to smell after a while. The water was collected in containers/tanks of varying size. Thucydides¹²⁷ views cisterns as a matter of course, and there is reason to assume that most families used these to collect rainwater.

Wycherley said that the wells¹²⁸ in classical times had a diameter of about 1m, covered by small stones. From the 4th century terracotta was used as a cover: "To augment the supply, rain water was collected by means of pipes in bottle-shaped cement-lined cisterns, several of which were sometimes united by channels."¹²⁹ Whitley describes how the cistern was designed in Corinth, and findings show that intensive labor was employed in the construction of large cisterns: "around 450 BC the Corinthians constructed a double-apsidal cistern, lined with hydraulic (waterproof) cement, to collect and store rain water."¹³⁰ Similar techniques seem to have been used in Athens at the time. Water was also used in the production of silver in Laurion, and several pools covered by waterproof hydraulic cement have been excavated. It is clear that water was scarce, and it was too valuable to be used only for washing. The production of silver had the primary right to the water and with maximum utilization: "These waterproof basins and cisterns have thus been interpreted as a complex system for collecting, storing, using and then

¹²⁶ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 2.

¹²⁷ Thuc II 48

¹²⁸ The wells the author mentions are cisterns /reservoirs: R.E. Wycherley, *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 248.

¹²⁹ Op.cit: 248.

¹³⁰ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.reprint 2004, 295.

recycling rainwater."¹³¹

How can the collected rainwater in a cistern become contaminated? I have already mentioned that lack of cleaning of the catchment areas such as roofs, rock and the cistern can lead to it. Another reason is that the cistern is not water-tight, so that contaminated water can flow into it from the area around the cistern. However, primarily it is people, birds and animals that pollute the water. This can result from a lack of hygiene, such as failure to wash hands; or birds and animals can come into contact with the drinking water.

3.1.2.2 Drinking water from river

Surface water can become contaminated when it seeps through infected soil in the catchment area on the way to a creek or river. Such pollution is generally caused by humans and/or animals and applies to all three rivers I have mentioned. However, there is reason to believe that the Eridanos was particularly vulnerable to pollution as it flowed through the Agora and then out through the gate at the Kerameikos, but river water was probably not used as drinking water in classical times. In the area around the Eridanos it is probable that people collected there because a large part of the city life took place in the marketplace. It is possible there were also livestock and/or domestic animals here that further increased the risk of contamination of the water, although Osborne claims: "In Athens animals are rare - the Athenian never give pasturing right to anyone, because no one would think of using land for pasture in normal circumstances."¹³² This is in contrast to Kallimachos,¹³³ who according to Strabon¹³⁴ wrote some 100 years after the war both on the presence of animals and the contaminated Eridanos:

“so sagt z.B. Kallimachos in der Sammlung der Flüsse (...) er müsse lachen wenn jemand die Stirn habe zu schreiben dass die Mädchen der Athener reinen köslichen Trunk des Eridanos schöpfen (...) den nicht einmal das Vieh anrühren würde. In Wirklichkeit haben seine Quelle, ausserhalb des sogenannten Diochares-Tores in der Nähe des Lykeions, heute sagt man, klares und trinkbares Wasser, und Früher war in der Nähe auch ein Brunnen angelegt, der viel gutes

¹³¹ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.reprint 2004, 382.

¹³² R. Osborne, *Classical landscape with figures. The ancient greek city and its countryside*, Sheridan House, New York 1987, 49.

¹³³ Kallimachos (ca. 305-ca. 240 BC), Greek poet who worked at the library of Alexandria.

¹³⁴ Strabon (ca 64 BC-ca 25 AD) Greek historian and geographer who lived in Rome.

Wasser gab: Wenn das heute nicht so ist - was wäre wunderbar daran wenn es früher reichlich und klar war, so dass man es sogar trinken konnte, später aber eine Veränderung eintrat?"¹³⁵

One should be cautious about claiming that the river was already polluted during the Peloponnesian War, because this source reviews the conditions at a much later date. However, the existence of domestic animals in Athens in classical times is confirmed by the archaeological find of a stable close by a dwelling. In addition part of the courtyard had shelter for a bull.¹³⁶

Moreover, there were dogs in the city, for Thucydides writes: "the dogs gave a still better opportunity to observe what happened, because they live with man."¹³⁷ And dogs can contaminate water. There is also reason to believe that the cavalry horses were kept within the city walls during the siege to avoid their being captured by the enemy. The horses probably drank water from the Eridanos where it ran open through part of the city.

Both Travlos and Camp depict an inscription from the fifth century BC applicable to the Ilissos which "prohibits the washing of hides upstream of the sanctuary of Herakles."¹³⁸ This was clearly an important command, since it is an official inscription located on both sides of the river. Such a decree suggests therefore that parts of the Ilissos were already contaminated while indirectly allowing the river south of Kalliroe to be further contaminated.

There is reason to believe that when the Eridanos was channeled through the Agora, the intention was both to prevent flooding during periods of abundant precipitation and to provide easier access to water for those who manufactured pottery. At the same time the river to a certain extent became purified because surface water in a deep channel passes slowly over the underlying layers of soil, grains of sand and fine gravel. Thus, natural or artificial ponds increase the cleansing of water as waste products are shared out more easily and microbes are destroyed. The main sewage drain from the Agora fed into the Eridanos, so that there may have been several reasons for channeling the river to prevent contaminated water from flowing over the area.

¹³⁵ Strabon, *Geographika*, translated by Stefan Radt, Band 3, Buch IX-XIII, Vandenhoeck und Ruprecht, Göttingen 2004, IX 1 19

¹³⁶ W. Hoepfner, *5000 v. Chr. – 500 n. Chr.: Vorgeschichte, Frühgeschichte, Antike*, Deutsche Verlags-Anstalt, Stuttgart 1999, 241.

¹³⁷ Thuc II 50

¹³⁸ Travlos date the inscription to 420 BC: J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 340.

J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 8.

3.1.2.3 Drinking water directly from groundwater (Source)

Rainwater seeps through the porous soil layers to rock or clay, which the water does not penetrate. Even after a filtering depth of two to three meters water may be clean, and a source will appear when the groundwater pushes up through the surface. However, the usual recommendation is that the groundwater must be recovered from five to six meters in depth for the sake of purification, and the source must be at least fifteen to twenty meters away from pollution sources such as fertilizer bins or sewage systems. Thus, public fountains should have waterproof walls to a depth of at least 3m with a diameter of 1 m, and the wall should protrude at least 30 cm above the ground to prevent contamination from surface water.¹³⁹

But what about the Athenians? Did they have such sources? It is uncertain how many sources Athens had at the time in addition to Klepsydra, which Pausanias describes: "If you go down not into the city but below the formal entrance, you come to a WATER SPRING near a cave-sanctuary of Apollo."¹⁴⁰ This is on the right side on the way down Propylaea. The fountain house was built in 470-460 BC, and the bottom consisted of a large water reservoir of 4.52 x 2.23 m, depth 4m.¹⁴¹ In addition to the source, a reservoir was built for collecting surface water from the Acropolis. However, the drawings do not give the impression of a link between source and surface water.¹⁴² Thus, it is probable that the water from Klepsydra was safe to drink but that the volume was insufficient for the population.

Another source of water, but of minor importance compared with Klepsydra was Asklepieion. Located on the hillside south of the Acropolis, it was known from the 6th century BC.¹⁴³ It is also registered a third source with a hidden staircase down to the water. The knowledge of this source disappeared after the Mycenaean period, and it was rediscovered in the 1930s.¹⁴⁴

¹³⁹ Norwegian recommendations published by H. Natvig, 1964.

¹⁴⁰ Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, I 28, 4

¹⁴¹ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 323.

The water reservoir could thus contain 39 600 liter. In hot weather an adult must at least drink 2 -3 liter fluid each day supplemented by fluid in food. 100 000 adults must have at least 200 000 - 300 000 liter a day. Accordingly Klepsydra covers less than 20 percent of what is needed, even if the reservoir was filled up each day.

¹⁴² J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 323.

J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 70-71.

¹⁴³ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 138-141.

J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 123.

¹⁴⁴ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 72-75.

Thucydides reviews a fourth source southeast of the city: "the fountain now called Enneacrunus, from the fashion given it by the tyrants, but which anciently, when the springs were uncovered, was named Callirrhoe, was used by people of those days (...) it is still customary to use its waters in the rites preliminary to marriages and other sacred ceremonies."¹⁴⁵ Pausanias also describes Enneakrounos, but he locates it to the southeast of the Agora,¹⁴⁶ so that he in fact describes the southeastern fountain house in the Agora, which I review under the section on water pipelines.

Travlos writes about the source Enneakrounos-Kallirrhoe:

"The spring of Kallirrhoe is southeast of the Olympieion in the Ilissos river bed (...) two large cisterns (...) in the river-bed (...) and a system of rock-cut tunnels to collect the water which was conveyed to Piraeus. (...) The fountain house built by the tyrants, the Enneakrounos, should be on the west bank of the Ilissos very near the spring."¹⁴⁷

In my opinion, this is no source according to the definition, but only cisterns with water from Ilissos. Thus, the only drinking water in Athens based on groundwater was Klepsydra. However, it is amazing that the society at that time had a major drinking water source which generally follows the current requirements for clean water. But Klepsydra did not deliver nearly enough water, and the solution to water shortage became the lead system.

3.1.2.4 Drinking water through pipelines

The world has had knowledge of the main features relating to contemporary water supply to Athens for 100 years but it has been fragmentary and scattered. However, 16 years ago the archaeologist Tölle-Kastenbein made a comprehensive and accurate effort to collect archaeological knowledge of the water supply and put it into its context.¹⁴⁸

In the 6th century BC the tyrant Peisistratos implemented the basic project to provide a water

¹⁴⁵ Thuc II 15

¹⁴⁶ Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, 42.

¹⁴⁷ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 204, fig. 379

¹⁴⁸ R. Tölle-Kastenbein, *Das archaische Wasserleitungsnetz für Athen und seine späteren Bauphasen*, in *Zabern Bildbände zur Archäologie*, bd 19, Verlag Philipp von Zabern, Mainz am Rhein 1994.

supply, but this work is only marginally mentioned in literature from antiquity.¹⁴⁹ Why was such an impressive and important work -- which requires excellent engineering skills and precision in the manufacture of pipes, and which had a great impact on the population – not earlier described? Has it perhaps to do with the slaves who probably performed the work, or was it that the popular assembly would not honor the tyrant for having provided the population with clean drinking water? Instead, the literature has little to say about a mysterious water supply project, merely using the word “source.” I have no answer.

Tölle-Kastenbein’s definition of the source is different from mine. She writes:

eine Krene ist eine von Menschenhand geschaffene Wasser-Entnahmestelle jedweder Art, angefangen von einer Quelfassung. In diesem Sinne werden auch bei Fernleitungen und Leitungsnetzen die daran angeschlossenen Gebäude Krenai genannt, von denen das Wasser in Gefäßen geholt und verteilt wurde.¹⁵⁰

The water source comes from Ymittos, and the main water line¹⁵¹ crosses the Ilissos relatively far east, then follows the river to the north and south of Lycabettus. East of the Acropolis, it breaks into a subsidiary line northwest toward Dipylon, the Academy line, and forms the fountain/source of the Kerameikos just inside the eastern gate of Dipylon. The source is located east of the Eridanos and at a higher level, so that the fountain structure is not mixed with water from the river. In the early Hellenistic period a fountain structure was built just inside the Dipylon port. At that time an older facility with a pipeline built 460 BC was discovered in the same place.¹⁵²

The north line also leaves the main line east of the Acropolis, but later than the Academy line, swings west of the Acropolis and ends up at the southeast fountain/source of Agora. The southwest fountain/source was constructed 350-325 BC¹⁵³ as a result of increased water demand.

The main line continues under the name of the south line, and probably releases a line south of the Acropolis at the eastern foot of Mouseion in deme Kollytos within the city walls. Before the

¹⁴⁹ Op.cit: 3.

¹⁵⁰ Op.cit: 73.

¹⁵¹ Op.cit: plan 1.

¹⁵² U. Knigge, *The Athenian Kerameikos, History-Monuments-Excavations*, translated by J. Binder, first published 1988, Krene editions, Athen 1991, 74.

R. Tölle-Kastenbein, Das archaische Wasserleitungsnetz für Athen und seine späteren Bauphasen, in *Zabern Bildbände zur Archäologie*, bd 19, Verlag Philipp von Zabern, Mainz am Rhein 1994, 105.

¹⁵³ Op.cit.:105.

south line continues between Mouseion and Pnyx the west line cuts off in the direction of Pnyx. However, a source at the Pnyx came first in the period 350-325 BC.¹⁵⁴ In the valley where the west line is located, the remains of several houses have been excavated.

The south line continues in a south-westerly direction to the deme Koile located south and slightly west of the Pnyx. This pipeline was built in the 5th to 4 century BC¹⁵⁵ so I am not sure that it was finished at the beginning of the Peloponnesian War. Koile was the most densely populated deme of Athens,¹⁵⁶ and moreover, there is reason to believe that Koile during the siege was largely over-populated by refugees because the long walls from Peiraieus ended in Koile, and "Many also established themselves in the towers of the city walls, and where ever each one could find a place;(…) But afterwards they distributed into lots and occupied the space between the Long Walls and the greater part of the Peiraieus."¹⁵⁷

The excavation in connection with the construction of Syntagma station discovered pipelines crossing the river Eridanos west of the Parliament. The pipes were laid in the first half of the 400-century BC.¹⁵⁸ Perhaps the inscription No. 117 of 430/31 BC¹⁵⁹ deals with these pipelines found at Syntagma, or it may be connected with the construction of the conduit to the deme Koile. I would infer the latter, because Koile was really in need of an increased supply of drinking water.

During the excavation at Syntagma it was observed that the pipelines crossed the Eridanos. There is reason to conclude from this that the person responsible for the development of the water supply considered the water from the river unsuitable for drinking, even before it ran through the city. Otherwise, it would have been natural to let the pipeline water in this area flow into the Eridanos to increase the amount of water in the river flow. However, if the river was contaminated in this area there was a risk of contaminating the drinking water in the pipelines unless they were completely sealed off. As a result of the location of these pipes at Syntagma, it is logical to believe that they were connected to the line which went to Dipylon, or to southeastern source at the Agora.

¹⁵⁴ Ibid.

¹⁵⁵ Ibid.

¹⁵⁶ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 392.

¹⁵⁷ Thuc II 17

¹⁵⁸ N.C. Stampolidis, L. Parlama, (eds), *The city beneath the city*, Abrahams, Harry N., Inc., New York 2001, 155.

¹⁵⁹ C.W. Fornara, (ed and translator), *Archaic times to the end of the Peloponnesian war*, in R.K. Sherk, (ed), *Translated documents of Greece and Rome*, Cambridge University Press, Cambridge 2.edition 1983, reprint 1998, inscription 117.

Did private houses have a direct supply of water? Wycherley says no.¹⁶⁰ However, some houses at Olynthos dating around 450 BC have been excavated which had water via pipelines from public sources. Some of these houses also had cisterns.¹⁶¹ Quite possibly these houses belonged to the elite in the society. Moreover, several households in Olynthos had large common cisterns.¹⁶² The disagreement between Whitley and Wycherley is probably due to knowledge of the fact that the water supply to houses in Olynthos emerged after Wycherley wrote his book about Athens. Presumably Athens also had some houses with running water, though the excavations so far have not confirmed it, for why would Athens not have a convenience similar to that of a much smaller city?

The water supply was not further improved during this time, and there was clearly competition for water from Klepsydra. Therefore, it is likely that this source had the most and best water. For that reason it was probably necessary to queue early in the morning to get access to water. Aristophanes describes precisely this situation in *Lysistrata* 411 BC: "I've just come from the well with my pitcher. I could hardly fill it in the dim light of dawn, in the throng and crash and clatter of pots, fighting the elbows of housemaids and branded slaves, zealously I hoisted it onto my head."¹⁶³ This illustrates that water supply at this time was insufficient, despite the probable expansion of the line to Koile. The water system was further expanded in the period 350-325 BC.¹⁶⁴ However, it is not unlikely that the population of this overcrowded city during the Peloponnesian War had to use infected surface water as drinking water, with the risk of developing disease.

In the 4th century it was decided to elect a civil servant to be responsible for the water supply to Athens. This confirms that the assembly placed great emphasis on getting people clean water.¹⁶⁵

¹⁶⁰ R.E. Wycherley, *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 250.

¹⁶¹ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3. reprint 2004, 320.

¹⁶² W. Hoepfner, *5000 v. Chr. – 500 n. Chr.: Vorgeschichte, Frühgeschichte, Antike*, Deutsche Verlags-Anstalt, Stuttgart 1999, 256.

¹⁶³ Aristophanes, *Lysistrata*, in *Birds, Lysistrata, Women at the Thesmophoria*, editor and translation by J. Henderson, Harvard University Press, The Loeb classical library, Cambridge, Massachusetts, London, England 2000, 327.

¹⁶⁴ R. Tölle-Kastenbein, Das archaische Wasserleitungsnetz für Athen und seine späteren Bauphasen, in *Zabern Bildbände zur Archäologie*, bd 19, Verlag Philipp von Zabern, Mainz am Rhein 1994, 105.

¹⁶⁵ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, oversatt av P. Green, Weidenfeld and Nicolson, London 1965, 12.

Via the water pipeline system from Ymittos the city got surface water from the mountain region and the danger of contamination was small because the water was collected from an unpopulated area. Still, it is important to remember that when pipelines are used, the surface water is not filtrated by soil and sand inside the pipelines and flows freely to the fountain. Therefore it is necessary to have clean water from the very beginning of the pipeline. If there is a hole in a pipe, the water in the pipe may be infected. However, the population had the facility to monitor the pipes even though they were deep in the ground/rock or the streets of Athens because the system was build with shafts and tunnels along the pipeline with easy access to the water pipes for repairs and cleaning.¹⁶⁶ If those who picked up water from the source used unclean equipment or maybe even had a contagious disease, the outcome might still be infected water and risk of spreading disease.

During the siege Athens was first and foremost dependent on the water supply within the walls. The enemy could have stopped the water flow, but only by extensive work because the river courses had to be changed. The simplest for the enemy would have been to destroy the pipeline near its origin up by Ymittos. The enemy cannot have been unfamiliar with the system because it is very likely that similar water supply systems were used elsewhere in the country. What perhaps prevented the destruction of the water system were political/religious agreements between neighboring states/tribes from the archaic period, *Ἀμφικτυῶνες*. One such agreement was related to Delphi. The purpose was to defend/support the temples to Apollon and Demeter. In addition, the agreement made it illegal to block water flow to the enemy. Aeschines (390-314 BC) writes about this.¹⁶⁷

Clean drinking water is essential to prevent proliferation of a number of serious diseases, but how were the hygienic conditions in city and houses in contemporary Athens with regard to possible contamination of the drinking water? Thus, it is now time to look into:

3.1.3 Hygienic conditions in city and homes

Settlement began in archaic times south of the Acropolis in Kollytos/Limnae. From 600 BC it was scattered on the northwest, forming the working area Kerameikos. The area north/northeast

¹⁶⁶ R. Tölle-Kastenbein, Das archaische Wasserleitungsnetz für Athen und seine späteren Bauphasen, in *Zabern Bildbände zur Archäologie*, bd 19, Verlag Philipp von Zabern, Mainz am Rhein 1994, 29.

¹⁶⁷ ¹⁶⁷ Eschine, Contre Timarque sur l'Ambassade Infidèle, *Discours*, tome I, edited and translated by V. Martin, G. de Budé, Société d'édition "Les Belles Lettres", Paris 1927, 115.

of the Agora was the wealthy quarter Skambonidai. The lower classes lived southwest between Kerameikos and Kollytos/Limnae.¹⁶⁸ The houses of the lowest standard were hewn out of rock in the southwest side, where the long walls met the city's ramparts in deme Koile. According to Travlos the greatest population density was here south–southwest of Pnyx.¹⁶⁹ In addition in Athens, there were many homeless poor people who could not pay rent.¹⁷⁰

Xenophon has Socrates tell us that Athens “consists of more than 10,000 houses,”¹⁷¹ but only a few have been excavated. Therefore, we must be cautious in drawing too firm conclusions about the houses in Athens at the time. Flacelière also points out that when he speaks of the houses in Athens in Pericles' time: "Many bore a closer resemblance to hovels, and hardly any of them were large enough to allow the luxury of sanitary installations. As a result the *amis*, or chamber-pot, was in common use."¹⁷²

3.1.3.1 Outdoor sewage

To remove excrement and large amounts of surface water the residents established waste pits/sewage pits, the simplest form of toilet:

Bis zum Ende des 5. Jhs. waren in diesen Häusern Sickergruben (Bothroi) in Betrieb (...). Diese gemaureten rechteckigen Vertiefungen (0.75 mal 1.30 mal 0.60 m tief) konnten im Hofe oder auch neben dem Hause auf der Strasse liegen. Erst Anfang des 4. Jhs. wurden Kanäle in den Strassen angelegt, die diese Sickergruben überflüssig machten.¹⁷³

This may have been the precursor to today's septic tank. However, the pits were shallow with a porous bottom, most often earth. This entailed risk of contamination of the environment primarily by heavy rain when the sewage water flooded the area. Aristophanes confirms in the comedy

¹⁶⁸ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, x, 4-5.

¹⁶⁹ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 392.

¹⁷⁰ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 15.

¹⁷¹ Xenophon, *Memoirs of Socrates*, in *Conversations of Socrates*, translated by H. Tredennick, revised translation and introduction by R. Waterfield, Penguin Books, London 1990, III 6

¹⁷² R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 20.

¹⁷³ W. Hoepfner, *5000 v. Chr. – 500 n. Chr.: Vorgeschichte, Frühgeschichte, Antike*, Deutsche Verlags-Anstalt, Stuttgart 1999, 241.

Wasp from 422 BC that there were such sewage pits in the streets. He allows the characters to use light to avoid the mud when they walk in dark streets: "Whoa! Father, father, mind the mud there!"¹⁷⁴ A little later he amplifies this further: "in the dark, churning up the mud like a marsh snipe."¹⁷⁵ This was undoubtedly a situation people were familiar with and it was therefore natural for Aristophanes to use it in a comedy to get the audience to laugh. Aristophanes also implies that neither the property owner nor the public authority was responsible for the cleanliness of the streets, which was left to the gods and nature. And one of the nocturnal wanderers in Athens confirms that: "Hold on, this looks like mud I'm stepping on. No question the god's bound to make water within four days at the outside."¹⁷⁶

Construction of sewers started early in the 5th century to remove dirty water from houses and rainwater. First and foremost we are talking about a drain along the west side of the Agora to the Eridanos, and:

impressively constructed, with floor, walls, and roof of solid stone slabs, and in both depth and width it measured about 1m. (...) In the early years of the fourth century two major branches were added, one southwestward up the valley in which the "industrial district" was situated, the other turning eastward and traversing the southern part of the agora.¹⁷⁷

Still, this drainage was not sufficient to remove the sewage water, and the authorities at the time of Demosthenes handled the problem by appointing officials responsible for sanitation and to "ensure that dung-collectors (koprologoi) did not discharge their loads less than ten stades from the city-wall."¹⁷⁸ In the southwestern part of the great drain there were also constructed channels for sewage from houses on both sides of it. However, many houses still used sewage pits, and there were no public latrines.¹⁷⁹ But how were the sanitary conditions inside the houses?

¹⁷⁴ Aristophanes, *Wasps*, in *Clouds, Wasps, Peace*, edited and translated by J. Henderson, Harvard University Press, The Loeb classical library, Cambridge, Massachusetts, London, England 1998, 248.

¹⁷⁵ Op.cit: 257

¹⁷⁶ Op.cit: 259

¹⁷⁷ R.E. Wycherley, *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 250.

¹⁷⁸ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 11.

10 stades are about 1,8 km.

¹⁷⁹ R.E. Wycherley, *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 251.

3.1.3.2 Water and sewage inside the house

In Olynthos several houses from around 450 BC had latrines, bathrooms and bathtubs. In addition, there were some houses with a public water supply, and others had cisterns.¹⁸⁰ It is likely that similar conveniences existed in Athens at the time. However, it is also probable that the homes were influenced by the family's economic status so that the best-equipped houses probably belonged to the elite. In addition, most houses contained rooms for storage of grain in large pots.¹⁸¹ Such storage may result in slow drying of the contents and increases the risk of mold formation if the grain was wet at the time it was put into the jars.

Sanitary conditions must have been far worse among the poor compared with those who had their own houses, because it was not only costly but it required a high position in the society to gain direct access to public water and a sewer. Probably hygiene among the refugees during the Peloponnesian war was particularly bad because they may have had only a shed or a tent to stay in, unless they had a wealthy family or friends in Athens. There is reason to believe that refugees without connection to established *oikos*¹⁸² had a low status in society and were thus homeless. However, it was not only the refugees who were left homeless because "homelessness of one sort or another was as constant a feature of ancient Greece as it is in the early twenty-first century."¹⁸³

It was common that family members used a chamber pot to get rid of feces or urine, which were emptied into the sewage pit or maybe out on the street. Aristophanes portrays in the *Wasps* the use of the potty as a common action when one of the main characters, a judge sitting in court, exclaims: "Mr. Chairman? Where is he? Chamber pot please!"¹⁸⁴

Houses changed from the end of the fifth century and during the next. As I concentrate on the plague period 431 to 421 BC, I review only houses from that time. These houses varied in size and shape and could have two or three rooms.¹⁸⁵ Athens had no urban planning, and the houses

¹⁸⁰ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.reprint 2004, 320.

¹⁸¹ Ibid.

¹⁸² B.A. Ault, Housing the poor and the homeless in ancient Greece, in B.A. Ault, L.C. Nevett, (eds), *Ancient Greek houses and households, Chronological, regional, and social diversity*, University of Pennsylvania Press, Philadelphia 2005, 147.

Oikos, household, included everyone who lived together, also the slaves and the content of the house.

¹⁸³ Op.cit: 155.

¹⁸⁴ Aristophanes, *Wasps*, in *Clouds, Wasps, Peace*, edited and translated by J. Henderson, Harvard University Press, The Loeb classical library, Cambridge, Massachusetts, London, England 1998, 935.

¹⁸⁵ L.C. Nevett, Introduction, in B.A. Ault, L.C. Nevett, (eds), *Ancient Greek houses and households, Chronological, regional, and social diversity*, University of Pennsylvania Press, Philadelphia 2005, 4.

were designed in part for the environment. The roads in Athens were narrow and winding, and the houses were thus influenced by where they were built.

A densely populated area in this period has been discovered on the slopes of Kolonos Agoraios, Areopagus and in the valley between Areopagus and Pnyx. These houses were homes or a combination of residence and workplace. The houses were built fairly close to one another with a modest standard, regardless of the family's economic status. The residents drew water from cisterns built in the yard or into the walls. However, there is insufficient information about the sewer system beyond what I have already described.¹⁸⁶

3.1.4 Overall assessment of environment as risk factor

During the Peloponnesian War the climate was similar to nowadays, and observations indicate a slightly warmer and rainier time in the fifth century compared with the period before and after.

Drinking water from springs was mainly from Klepsydra, but in addition the city had a well-developed water system with a pipeline from the Ymittos. It seems that the water quality from both Klepsydra and the water system was satisfactory, as compared with contemporary requirements. In addition, the city had many cisterns, but there are grounds for questioning the quality of this water, first and foremost on the basis of the sewage system with its risk of spreading bacteria to surface water. Especially problematic was the overcrowding of the city in connection with the war because the already large population further increased the demand for water and exacerbated contamination of the environment.

The water in the Eridanos in the city and the Ilissos in the plain and south of the city must have been contaminated and risky to use as drinking water.

The problem for Athens was that the city did not have a sufficient amount of clean drinking water. Especially vulnerable to this lack of water were the populous area Koile, in the northwest, where also the refugees lived between the long walls. Neither of the southeastern areas of the city had access to adequate drinking water, but instead people had to walk to the southeast source in the Agora or to Klepsydra. It is therefore reasonable to assume that they also collected water from the Ilissos east of Olympeion.

¹⁸⁶ B. Tsakirgis, Living and working around the Athenian Agora: A preliminary case study of three houses, in B.A. Ault, L.C. Nevett, (eds), *Ancient Greek houses and households, Chronological, regional, and social diversity*, University of Pennsylvania Press, Philadelphia 2005, 67-74.

Sewage conditions were unsatisfactory, being based primarily on sewage pits located in the courtyards and streets. This risked spreading disease because drinking water may have been infected or people may have become ill as a result of direct contact with sewage.

3.2 Size of population and internal risk factors

Many authors have estimated the number of inhabitants in Attica and Athens. However, in my opinion it is first and foremost Gomme who has interpreted the available sources correctly.¹⁸⁷ He points out that "There is no subject of the first importance in ancient scholarship in which our thoughts are vaguer, in which we almost refuse to think (because the evidence is unsatisfactory), than that of population."¹⁸⁸ In 1933 Gomme published estimates of population size in Athens in the fifth and fourth centuries BC. However, these calculations are inaccurate because "We have no birth-rate and death-rate figures of ancient Athens and not very satisfactory ones for emigration (...) But we are reasonably sure of a considerable increase in the citizen-population between 480 and 430, in spite of much emigration (...) There was therefore an excess of births over deaths."¹⁸⁹

He calculates the figures from the number of soldiers and focuses primarily on those who served as hoplites, usually the middle or upper class citizens. Thucydides also reviews "those enrolled as hoplites"¹⁹⁰ where he includes the resident aliens, *metics*, who served as hoplites. However, it is uncertain whether – among those enrolled as hoplites – he also included the youngest and the oldest age classes, who were used as guards. Documentation is also lacking regarding the composition of the population by age groups: the number of women, children, resident aliens/*metics*, and slaves. Dutour et al reminds us that the ideal condition for evaluating the composition of the population with respect to gender and age is that the dead population reflects the living, "Pompeii model."¹⁹¹ However, we have no such information – only burial

¹⁸⁷ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933.

¹⁸⁸ Op.cit: 1.

¹⁸⁹ Op.cit: 78.

¹⁹⁰ Thuc III 87, see also S. Hornblower, *A commentary on Thucydides*, Volume I, Books I-III, Clarendon Press, Oxford 1991, 494.

¹⁹¹ O. Dutour, Archaeology of human pathogens: Palaeopathological appraisal of palaeoepidemiology, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 137.

O. Dutour, M. Signoli, G. Palfi, How can we reconstruct the epidemiology of infectious diseases in the past? in C.L. Greenblatt, (ed), *Digging for pathogens. Ancient emerging diseases – their evolutionary, anthropological and archaeological context*, Balaban Publisher, Israel 1998, 244-245.

findings related to the plague period from two confirmed mass graves¹⁹² which have not yet been completely examined.

Gomme concluded that in 431 BC the total population of Attica consisted of 315,500 individuals including women and children. Of this total number 172,000 belonged to the citizenry,¹⁹³ 28,500 metics/aliens, and 115,000 slaves. All groups include women and children.¹⁹⁴ Osborne however, estimated that "Classical Attica, which covered an area of some 2400 km² (...) will have had the capacity to support a population of around 150,000 from its own resources. The actual population of Attica is rather difficult to calculate."¹⁹⁵ However, in 2008 Osborne indicated that the population of Attica in 431 BC was 430,000 including 100,000 slaves.¹⁹⁶ The numbers of slaves calculated by Gomme and Osborne are fairly consistent. Hansen writes that "in the Periclean period the total population of Attica must have totaled 300,000 or more."¹⁹⁷ This figure is consistent with what Gomme had already mentioned.

Concerning the relationship between residents in urban and rural areas, Gomme writes: "We have no figures at all to show movement of the population of Attica between the country and the town."¹⁹⁸ He concludes finally that around a third of the citizens and their family lived in Athens and Piraeus and surroundings, as did a number of foreigners.¹⁹⁹ However, he emphasizes, "even if the probability of these figures is granted, it must be remembered that we are only at the threshold of useful statistics: only total numbers, a rough distribution between social classes, and between town and country."²⁰⁰

Uncertainty about the size of the population is primarily related to the number of slaves. Thucydides causes additional confusion when he writes that every hoplite brought with him his

¹⁹² E. Baziotopoulou-Valavani, A mass burial from the cemetery of Kerameikos, in M. Stamatopoulou, M. Yeroulanou, (eds), *Excavating classical culture, Recent archaeological discoveries in Greece*, The Beazley Archive and Archaeopress, Oxford 2002, 187-201.

¹⁹³ Gomme calculates the total number including the families by multiplying the number of men between 18 and 59 years by four: A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 75-79.

¹⁹⁴ Op.cit: 26.

¹⁹⁵ R. Osborne, *Classical landscape with figures. The ancient greek city and its countryside*, Sheridan House, New York 1987, 46.

¹⁹⁶ J.A.C.T.G.C, *The world of Athens, An introduction to classical Athenian culture*, 2. edition, revised by R. Osborne, Cambridge University Press, Cambridge 2008, 148.

¹⁹⁷ M.H. Hansen, *Three studies in Athenian demography*, Historisk-filosofiske Meddelelser 56, The Royal Academy of Sciences and Letters, Munksgaard, København 1988, 12.

¹⁹⁸ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 37.

¹⁹⁹ Op.cit: 47.

²⁰⁰ Op.cit: 48

own servant in the war. This is based upon the following information: “the hoplite received a wage of two drachmas a day, one for himself and one for his attendant.”²⁰¹ However, though Gomme probably was not aware of the uncertainty related to Thuc III 17, there is still no reason to argue that the author thus indicates too high a number of slaves in the country. It is in fact reasonable to believe that if citizens brought attendants on war expeditions, the citizens most likely brought slaves or other members of their *oikos* with them. Thus, the total number of people would be unchanged.

Morens and Littman have calculated for the same period:

the population probably alternated between about 100,000 – 200,000 and 300,000 – 400,000 as refugees entered and left the city during the siege (...) suggesting a population density ranging (...) from 25,000 persons per square mile (about the same as New York City today), to about 100,000 per square mile (like modern Delhi).²⁰²

Although it is not possible accurately to quantify the population of Athens during the siege, there can be no doubt that the city was overcrowded. This alone represents a risk factor regarding the transmission of disease from person to person as well as a strain on the city's water and sewer system at the risk of spreading disease.

There is reason to believe that in the areas of town where the refugees settled, the population density was even higher. In this connection Thucydides writes about all the refugees:

And when they came to the capital, only a few of them were provided with dwellings or places of refuge with friends or relatives, and most of them took up their abode in the vacant places of the city and the sanctuaries and the shrines of heroes, all except the Acropolis and the Eleusinium and any other precinct that could be securely closed. And the Pelargicum, as it was called, at the foot of the Acropolis, although it was under a curse that forbade its use for residence, (...) Many

²⁰¹ Thuc III 17 in the edition from 1920 and its latest reprint 1965. This section is removed from the Norwegian edition because it is a later addition that is not derived from Thucydides : Thucydides, *Peloponneserkrigen*, translated to Norwegian by H. Mørland, volume 1, H. Aschehoug & Co., in cooperation with Fondet for Thorleif Dahls kulturbibliotek og Det norske akademi for sprog og litteratur, Oslo 1962, 1999. S. Hornblower also calls attention to the difficulties with this chapter: S. Hornblower, *A commentary on Thucydides*, Volume I, Books I-III, Clarendon Press, Oxford 1991, 400-401.

²⁰² D.M. Morens, R.J. Littman, Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 287.

also established themselves in the towers of the city walls, and wherever each one could find a place; for the city did not have room for them (...) But afterwards they distributed into lots and occupied the space between the Long Walls and the greater part of Peiraeus.²⁰³

Particularly vulnerable to infectious disease are newborn children, pregnant women and people with hereditary or other serious, chronic illnesses. The human resistance to disease, immunity, involves innate and naturally acquired resistance as a result of earlier episodes of disease or antibodies transferred from mother to newborn child.²⁰⁴ However, attempts to calculate the number of people with reduced resistance residing in Athens are pure guesswork, and I refrain from that. There are grounds for concluding that people with inherited chronic disease resulting in health consequences, represent only a minority of adults, because those persons probably died in childhood due to lack of medical care. Other serious illness, such as disease of the heart or blood vessels, was probably not a problem, since the diet was healthy and accompanied by physical activity, which would tend to prevent these diseases. Cancer appeared to a modest extent because nearly ninety percent of all malignant diseases first appear after the age of fifty years, and the average age of the adult population of Athens at that time ranged from thirty to just above forty years.²⁰⁵

Garnsey argues in his book that "In antiquity men lived longer than women. This cannot be proved. But I am sure that this is what we would find, if the data were adequate to permit a demographic investigation."²⁰⁶ He explains this statement by saying that the woman, as a result of her lower rank in the family, had a poorer diet compared with the man and consequently an earlier death. Such an explanation of the reduced life-span seems unlikely, and in my opinion is rather related to the woman's role in reproduction: the woman goes through pregnancy at a young age involving complications during both pregnancy and delivery and a high percentage of post-natal infections which might also lead to death.

The population's nutrition plays a key role in internal risk factors because both malnutrition and inadequate food supply reduce people's resistance to disease and result in impaired work and

²⁰³ Thuc II 17

²⁰⁴ Today the population in addition obtains artificial acquired resistance by vaccination.

²⁰⁵ I. Morris, B.B. Powell, *The Greeks, History, culture and society*, Pearson Prentice hall, New Jersey 2006, 18.

²⁰⁶ P. Garnsey, *Food and society in classical antiquity*, Cambridge university press, Cambridge 1999, reprint 2002, 100.

a weakened war effort. In addition, there is need for more fluid and caloric supply in patients with infectious disease, which was the predominant form of disease at the time. In short, it is now reason to consider:

3.2.1 What did the Athenians eat?

In addition to coverage of caloric needs and supply of necessary nutrients like carbohydrates, protein, and fat, the population must also have substances that the body does not produce: essential amino acids and vitamins. Lack of these leads to malnutrition and severe illness. Also, deficiency diseases may result in unusual symptoms, making well-known diseases difficult to recognize. But what did the population normally eat during peace-time?

Homer points out that grain was essential in the diet as he writes: "At these mills twelve women in all plied their tasks, making meal of barley and of wheat, the marrow of men."²⁰⁷

Socrates tells the following about a public dinner: "Of course, everybody eats savouries with his bread if he's got any."²⁰⁸ The translator amplifies this in a footnote: "Greek diet consisted (broadly speaking) of two elements: some sort of bread and something to give it taste - especially cheese, fish, or vegetables. The latter were collectively called *opson*, translated here as "savoury". Good manners required you to take a little savoury with each bit of bread."²⁰⁹

Agricultural production at that time revolved primarily around grain, wheat, barley, and olives.²¹⁰ Garnsey has a similar view and also includes wine²¹¹ and other not so important grains such as millet, oats and rye.²¹² Morris claims that barley was the main grain²¹³ and "Bread, olives and wine made up the Mediterranean triad, the core of the Greek diets from the third millennium B.C. until the twentieth century A.D. (...) The typical diet was monotonous and protein-poor, but healthy and tasty. Garlic, onions, grape, goat cheese, and some kind of sausage were common."²¹⁴

²⁰⁷ Homer, *The Odyssey*, vol. II, translated by Murray, A.T., in Goold, G.P. (ed), The Loeb classical library, Harvard University Press, Cambridge, Massachusetts, London, England 1919, second edition 1995, XX 108.

²⁰⁸ Xenophon, *Conversations of Socrates*, translated by R. Waterfield, H. Tredennick, Penguin Books, London 1990, III 14

²⁰⁹ Ibid.

²¹⁰ R. Osborne, *Classical landscape with figures. The ancient greek city and its countryside*, Sheridan House, New York 1987, 45.

²¹¹ P. Garnsey, *Food and society in classical antiquity*, Cambridge University Press, Cambridge 1999, reprint 2002, 13.

²¹² Op.cit: 15.

²¹³ I. Morris, B.B., Powell, *The Greeks, History, culture and society*, Pearson Prentice hall, New Jersey 2006, 22.

²¹⁴ Op.cit: 23.

However, it is going too far when Morris and Powell claim that the diet was poor in protein, since people also ate legumes, which are an important source of protein.

Was Attica in peacetime self-sufficient in grain or did it have to import it? This is still a subject of discussion. Growing opportunities were not optimal, and Thucydides writes about the barren land of Attica,²¹⁵ while Flacelière asserts that "Cereals (...) the Athenians were obliged to import in large quantities."²¹⁶ Gomme suggests that Attica had to import around seventy five percent of the grain it needed.²¹⁷ Osborne, however, believes that if about 50,000 slaves were included "Attica will have had a total population of around 150,000. This would mean that the whole Athenian population *could* have been supported from the territory of Attica alone. This does not, of course, mean that it was."²¹⁸ Sallares is of the opinion that the number of slaves has been over-estimated.

If the number of slaves is reduced, he claims that the total population of ancient Attica most of the time was able to live off cereals that were grown in Attica, and thus he reduces the importance of grain import.²¹⁹ However, Sallares makes an exception for the period during the Peloponnesian War: "The Athenians would be able use their sea power to bring in massive grain imports from the Black Sea and elsewhere to make up for lost agricultural production in Attica. This strategy was probably put into effect *for the first time* during the Peloponnesian War."²²⁰ Camp notes that "Attica not could produce enough, and food had to be imported, especially grain."²²¹ Also, Xenophon comments on grain importation by way of Socrates. He has Glaucon, who wants to be an orator, answer the following questions from Socrates: "But there's another problem (...) no doubt you've investigated how long the country can be fed on home-produced corn, and how much extra is needed each year. You wouldn't like your country to incur a shortage of this kind without your realizing it," and Glaucon replies, "That's an enormous task you're suggesting."²²² This statement suggests that there were grain imports to Athens, but the

²¹⁵ Thuc I 2

²¹⁶ R. Flacelière, R., *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 169.

²¹⁷ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 33.

²¹⁸ R. Osborne, *Classical landscape with figures. The ancient greek city and its countryside*, Sheridan House, New York 1987, 46.

²¹⁹ J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 54.

²²⁰ Op.cit: 97.

²²¹ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 8.

²²² Xenophon, *Conversations of Socrates*, translated by R. Waterfield, H. Tredennick, Penguin Books, London 1990, III 6

need varied and consequently had to be regularly assessed. Garnsey does not write, however, that Athens had to import grain on a regular basis, but that they had the capability to do it because "classical Athens in its imperial prime was able to use its sizeable navy to direct grain traffic towards the Piraeus. And Athenian democratic governments, (...) put ordinary citizens in a position to purchase the grain and other supplies that they needed."²²³

On the basis of what I have written above, it is reasonable to assert that the importation of grain was well known in Athens both before and during the Peloponnesian War, and that imports rose during the war depending upon the percentage of the fields Sparta had destroyed. It is also likely that the grain supply through importation during the war was sufficient, and that the government covered the expenses.

Thucydides writes that before the war broke out, there were "great droughts also in some quarters with resultant famine."²²⁴ But when it comes to war, he does not mention famine, but says that the people died from plague, not famine.

However, it is quite probable that the homeless in Athens had a deficient diet, and Aristophanes confirms that by letting one of his characters say the following in the comedy *Wealth*, 388 BC: "And to eat, not bread but mallow shoots, not cake but withered radish leaves."²²⁵ There is reason to believe that the poor people experienced similar conditions during the Peloponnesian war.

The supply of grain is important, since grain covers the need for calories, iron, thiamin, niacin and protein. People got additional protein from legumes that have a mix of amino acids. In this way people could make do with legumes, combined with the protein in the grain, to meet protein requirements. Beans, lentils, and legumes were all inexpensive to buy,²²⁶ and therefore there was no need for expensive animal foods to obtain enough protein. The farmers of Attica even produced vegetables,²²⁷ but these were also imported, so there is reason to assume that there were leguminous seeds in Athens also under siege. People also need additional fat, but fat can be built up of carbohydrates.

²²³ P. Garnsey, *Food and society in classical antiquity*, Cambridge University Press, Cambridge 1999, reprint 2002, 33.

²²⁴ Thuc I 23

²²⁵ Aristophanes, *Wealth*, in *Frogs, Assemblywomen, Wealth*, edited and translated by J. Henderson, Harvard University Press, The Loeb classical library, Cambridge, Massachusetts, London, England 2002, 540.

²²⁶ R. Flacelière, R., *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 169.

²²⁷ Op.cit: 127.

Flacelière writes that the Spartanians' "destruction of the olive-groves was a real disaster,"²²⁸ and that is probably true from the standpoint of immediate economic loss. But it is difficult to destroy olive trees, so in the long term the damage was perhaps not particularly extensive.²²⁹ As to the health of the population, the destruction of olive trees probably played a minor role despite the fact that olive and fish oils contain polyunsaturated fatty acids which the body itself does not produce. But people can do without such acids a certain amount of time.

Although the supply of meat was modest and also expensive – except meat from pork, which was cheaper²³⁰ – the population still had a healthy nutrition in the light of other available and affordable food: They got vitamin A from oily fish, liver, milk, and fatty cheeses. Moreover, several vegetables contain carotene, which is converted to vitamin A. For this reason I doubt the veracity of the claim that diseases related to vitamin A "were widespread in ancient societies."²³¹ This could hardly have applied to Athenians in classical times, if we disregard people who lived without access to either fish or vegetables.

A vitamin C supply was also maintained by their diet. However, I am not sure that they got enough vitamin D, which is produced in the skin by exposure to sunlight or by the intake of food; e.g., fatty fishes. Lack of vitamin D can lead to deformity of the legs. Formation of vitamin D derived from sunlight should have been sufficient in Athens most of the time. However, women stayed mostly indoors,²³² and I am therefore unsure whether young children or newborns were exposed to daylight. If not, that could have led to rickets, because small children of that time would not get enough of vitamin D through their diet. Especially vulnerable were those who were nourished almost exclusively by grain, as is also mentioned by Garnsey.²³³ However, it is important to recall that rickets is not a life-threatening disease.

It is likely that the diet was monotonous, even if they had access to fish and other seafood. However, Garnsey argues that fish, especially fish that was salted, was considered as poor man's fare. He gives no explanation for that, but perhaps one reason for such an attitude among the

²²⁸ Op.cit: 126.

²²⁹ V.D. Hanson, *Warfare and agriculture in classical Greece*, University of California press, Berkeley, Los Angeles, London 1998, xiii.

²³⁰ R. Flacelière, R., *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 169.

²³¹ P. Garnsey, *Food and society in classical antiquity*, Cambridge University Press, Cambridge 1999, reprint 2002, 46.

²³² Op.cit: 48.

²³³ Ibid.

population might partly be due to their history. Homer and the stories about the heroes were well known among the population, both among those who had learned to read with the help of Homer's books and those who had listened to orally delivered narratives. The heroes were important figures for the population, and Homer reviews the diet of heroes in the *Odyssey*, stating that the heroes not only eat meat, figs, apples, pears, olives, grapes, but they gorge on meat. "So then all day long till set of sun we sat feasting on abundant flesh and sweet wine."²³⁴

Fish, however, are not mentioned as food in the *Odyssey* except for monsters who killed people. "And spearing them like fishes they bore them home, a loathly meal."²³⁵ You also lose your appetite for fish when you read or hear that "the sea fishes have eaten him"²³⁶ or that "Artemis, the archer, struck the woman, and she fell with a thud into the hold, as a sea bird plunges. Her they threw overboard to be a prey to seals and fishes, but I was left, my heart sore stricken."²³⁷ Fish as food must seem even more repellent when hearing the following after the suitors to Odysseus' wife had been killed:

But he found them one and all fallen in the blood and dust – all the host of them, like fishes that fishermen have drawn forth in the meshes of their net from the gray sea upon the curving beach, and they all lie heaped upon the sand, longing for the waves of the sea, and the bright sun takes away their life; even so now the suitors lay heaped upon each other.²³⁸

I do not claim that this alone can explain why fish were not popular food among the population, but at least it is reasonable to believe that such tales would not have increased their appetite for fish.

3.2.2 Personal hygiene and clothing

There are grounds for concluding that even in ancient times cleanliness was part of Greek culture. This also is documented in *The Odyssey*: "They sat down on chairs beside Menelaus, son of

²³⁴ Homer, *The Odyssey*, vol.1, translated by A.T. Murray, W. Heinemann, London and G.P. Putnam's sons, New York, 1919, reprint 1930, X 477.

²³⁵ Op.cit: X 125

²³⁶ Homer, *The Odyssey*, vol. II, translated by Murray, A.T., in Goold, G.P. (ed), *The Loeb classical library*, Harvard University Press, Cambridge, Massachusetts, London, England 1919, second edition 1995, XIV 135.

²³⁷ Op.cit: XV 477 – 480

²³⁸ Op.cit: XXII 383 – 389

Atreus. Then a handmaid brought water for the hands in a fair pitcher of gold, and poured it over a silver basin for them to wash, and beside them drew up a polished table. And the grave housewife brought out and set before them bread."²³⁹ Hand washing is important to avoid infection and was especially important at that time, when the food was generally eaten with the fingers.²⁴⁰ Hesiod is also concerned about cleanliness.²⁴¹ Such conduct does not necessarily mean that it was intended to avoid infection, but it is reasonable to think it had aesthetic aspects. However, people who followed this advice would benefit from it by reducing the risk of getting a contagious disease. It is likely that people tried to follow the examples of the heroes in Homer, in this case with a positive hygienic effect.

Hippocrates is clearly concerned about people's health when he claims: "A wise man ought to realize that health is his most valuable possession and learn how to treat his illness by his own judgment."²⁴²

3.2.2.1 Use of the baths

To stay healthy, in addition to maintaining good physical condition, it is necessary to observe habits of personal hygiene such as washing the body and one's clothing. In regard to this, literature from and about the nations of antiquity makes prominent reference to the cleanliness of the Romans, leaving the impression that the Greeks of the time were not concerned with personal hygiene. However, such a conclusion is wrong because the three schools/academies which Athens established just outside the city walls in the sixth century BC all had baths fed by the Eridanos and Ilissos rivers. Within these areas military training took place, together with gymnastics and theoretical teaching.²⁴³ This concerned the training of young men, mostly from the elite. As the basis for people's mental outlook is laid in one's youth, there is reason to assert that habits of personal hygiene were to characterize these people for the rest of their lives. Thus, it is reasonable to infer that such habits eventually also affected those who did not belong to this

²³⁹ Homer, *The Odyssey*, vol.1, translated by A.T. Murray, W. Heinemann, London and G.P. Putnam's sons, New York, 1919, reprint 1930, IV 51 – 54

²⁴⁰ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 170.

²⁴¹ Hesiod, *Works and days, theogony and the shield of Heracles*, translated by H.G. Evelyn-White, Dover publications, Inc, Mineola, New York 2006, 22.

²⁴² Hippocrates, A regimen for health, in G.E.R. Lloyd, (ed), *Hippocratic writings*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, Penguin books, Middlesex 1978, 9.

²⁴³ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 345.

social class and did not receive a similar education. It was natural for the rest of the population to emulate the habits of the elite.

In addition to the baths at the academies the authorities in the fifth century established public baths just outside three gates in the form of two circular bath houses at each site, one for women and one for men: One was outside gate VIII, located in the east, corresponding to today's Syntagma; the second was situated south of the city outside gate XI, i.e. towards Ilissos; and the third, northwest of the city outside the Dipylon gate.²⁴⁴ The bathrooms had both hot and cold water and may have been designed primarily for visitors. They were supervised by lifeguards, and visitors paid a modest sum of money to use the bathrooms.²⁴⁵ Presumably these bath houses made an impression on visitors from the countryside: now travelers were really experiencing the big city, where it was necessary to wash themselves before they were received. Thus, the visitors might bring this custom back home, resulting in improved hygienic conditions in their own environment as well.

When possible, both men and children took baths – often daily – in rivers or the sea, and children thus learned to swim at an early age. However, women did not bathe in public.²⁴⁶ When came to washing babies, Hippocrates gave the following important advice: "Infants should be bathed for long periods in warm water."²⁴⁷ If the family followed the advice, it could have led to a reduction of infectious skin diseases in the child.

Flacelière claims that it was customary to bathe before they ate the day's last meal. This meant that the words "to take a bath" became more or less synonymous with "to have dinner."²⁴⁸ Plato confirms that bath and dinner/symposium belonged together by telling how Aristodemus "met with Socrates fresh from the bath and wearing his best pair of slippers – quite rare events with him – and asked him whether he was bound in such fine trim. 'To dinner at Agathon's,' he

²⁴⁴ Op.cit: 180.

U. Knigge, *The Athenian Kerameikos, History-Monuments-Excavations*, translated from German by Judith Binder, First published 1988, Krene editions, Athen 1991, 159.

²⁴⁵ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 147.

²⁴⁶ Op.cit: 145.

²⁴⁷ Hippocrates, A regimen for health, in G.E.R. Lloyd, (ed), *Hippocratic writings*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, Penguin books, Middlesex 1978, 6.

²⁴⁸ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 148.

answered (...) ‘So I got myself up in this handsome style in order to be a match for my handsome host.’²⁴⁹

The impression is that cleanliness appears to have been valued, at least among the upper classes of the society. But how was it among the poor? Knowledge of this social group is almost nil, but quite likely they were living in poor hygienic conditions, without the ability to pay for a bathroom. Instead, possibly they used a river or slipped into a water fountain after dark – or simply failed to bathe?

Wycherley gives the impression that public baths were places where preferably the younger elite met and gossiped²⁵⁰ and ordinary citizens or the poor were probably not welcome. In addition, there were in fact few bathrooms to meet the need, especially after Athens became overcrowded. Could some houses have had piped water and private bathrooms? If so, it is probable that there were few such houses, and consequently they would have had little impact on the bathing capacity. Quite likely most people washed where they lived, and the water they used was probably from a cistern or from a seemingly clean river. Drinking water was probably not used for washing because most people lived some distance from public water sources, so the water had to be carried far on bad roads. In addition, there was competition for space at the sources. The population in Piraeus or others living near the sea probably also used the sea for washing.

Athens had hair salons, and after the Persian War men – but not women and children – preferred to have short hair. Slave women also had short hair.²⁵¹ This resulted in better hygiene, since head lice are easier to comb out of short hair.

3.2.2.2 Clothing

Wool, linen, and leather were the common material of the clothes. Men did not use underwear, but a tunic, which hung loosely about the body and was also used at night. In addition men used a piece of wool as a coat, *himation*, and soldiers only a short coat. Women used, in principle, similar types of clothes as men, and children wore only a short tunic. The poor used only the

²⁴⁹ Plato, *Symposium*, in *Lysis, Symposium, Gorgias*, translated by W.R.M. Lamb, London, William Heinemann Ltd, Cambridge, Massachusetts, Harvard University Press, 1925, reprint 1961, 87.

²⁵⁰ Wycherley, R.E., *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 252.

²⁵¹ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 150.

himation if they could afford it, and others were forced to use rags as clothes.²⁵² I assume that the clothes were washed but have no information about how often. The water supply was not sufficient, so I expect that the washing of clothes and house did not have a high priority. Therefore, there is reason to infer that the population was affected by both lice and fleas, at least the poor. This is confirmed by Aristophanes in the comedy *Wealth*.²⁵³

3.2.3 Overall assessment of internal risk factors

The number of residents in Athens and Attica during the Peloponnesian War is uncertain, but there is no doubt that the city was overcrowded as a result of refugees from Attica. However, it is specifically the number of slaves and poor that complicates calculations of the number of inhabitants. The large number of residents resulted in both increased risk of transmission of diseases from person to person and strain on the city's water and sewer system, thus further increasing the risk of spreading contagious diseases.

Both cereals and legumes were mostly imported during the war, and the diet was probably satisfactory both in terms of calories and composition.

Cleanliness is a part of Greek culture, and the authorities had established public baths for both men and women outside three ports. In addition, it was customary to bathe in rivers and the sea, and before the last meal of the day the men bathed if they were invited to dinner.

However, there is reason to be wary of idealizing antiquity as the Renaissance did. First and foremost we must remember the kind of life the poor lived, both with and without civil rights. The poor might be homeless or refugees without either a residence or a family in the city. There is reason to believe that these groups were particularly prone to lice and fleas as a result of unhygienic and overcrowded houses/shelters, impaired performance, and disease due to insufficient clean water and food contamination.

To assess which diseases the population at that time probably encountered, I intend in the next chapter to use a patient record, which has been my tool as a physician. This is possible thanks to Thucydides' detailed description of the disease.

²⁵² Aristophanes, *Wealth*, in *Frogs, Assemblywomen, Wealth*, edited and translated by J. Henderson, Harvard University Press, The Loeb classical library, Cambridge, Massachusetts, London, England 2002, 540.

²⁵³ *Ibid.*

Chapter 4: Disease of the past, present diagnostic

*The past is a foreign country: do they have other diseases there?*²⁵⁴

On the basis of a single patient with plague I will try in this chapter to use current medical knowledge to diagnose the disease, regardless of information about risk factors for disease presented in the last chapter.

The patient's medical history is the basis for diagnosis at individual level, and I have developed a case history for a randomly chosen sick man twenty five years of age from the time of the plague. However, in the patient record I have made use only of the information and expressions mentioned by Thucydides.²⁵⁵ The question is whether such a medical record provides sufficient information for a definite medical diagnosis. In this connection three other physicians and I²⁵⁶ with different professional backgrounds related to infectious diseases, independently assessed the journal.

4.1 The patient record

History

The patient is brought to a hospital by the family of a friend with whom the patient has lived since he became sick. He cannot alone explain the history of the illness, which thus is based on information from both the patient and those who accompany him. The physician who talks with the patient perceives what the patient and family communicate but is not sure what they mean by the words and phrases they use.

Family history: No information about previous illnesses in the family.

Social anamnesis: When he got sick a few days ago, he was working as a rower in one of Athens' war ships stationed in Piraeus. No spouse or children.

Previous illness: No information.

Current disease: Patient and relatives say that he “suddenly and while in good health was seized first with *intense heat of the head*, and *redness and inflammation of the eyes*, and the parts inside

²⁵⁴ Rewritten after the first line “The past is a foreign country: they do things differently there” in L.P. Hartley, *The Go-Between*, Penguin Books, London 1997, first published in 1953 by Hamish Hamilton.

²⁵⁵ Thuc II 49-51

²⁵⁶ See 2.2.1

the mouth, both the *throat and the tongue*, immediately became *blood-red* and exhaled an *unnatural and fetid breath*. In the next stage *sneezing and hoarseness* came on, and in a short time the disorder descended to the chest, attended by *severe coughing*. And when it settled in the stomach, that was upset, and *vomits of bile* of every kind (...) *ineffectual retching* followed producing *violent convulsions*, which sometimes abated directly, sometimes not until long afterwards." The patient says he *internally* "was consumed by such a *heat* that" he "could not bear to have" on him "the lightest coverings or linen sheets, but wanted to be quite uncovered and would have liked best to throw" (...) himself "into cold water". Relatives said they had to pull him up from the cistern he had jumped into because of the unquenchable thirst.

Natural functions: Complains of nausea and it is uncertain whether he wants food; very thirsty. He cannot sleep due to internal unrest. The stomach is in disarray. No information on diuresis or a more detailed description of urine and feces.

Status

The patient is a 25-year-old male in relatively good general condition. He is "beset by *restlessness* and *sleeplessness*," and "seems at times confused and complains of thirst. The breath is fetid. The body is "not very warm to touch; it is *not pale*, but *reddish, livid*, and breaking out in small *blisters* and *ulcers*."

Lymph node stations not investigated.

Eyes: Red

Oral: Blood-red throat and tongue.

Heart, lungs and abdomen: Not studied.

Further progress

Around seventh to ninth day he is still in relatively good general condition, at which point "the malady (...) seized upon the extremities at least and left its marks there; for it attacked the privates and fingers and toes," and he dies.

Tentative diagnosis:

1. Infectious diseases such as: epidemic typhus, typhoid fever, disease of the spotted fever group, plague (*Yersinia pestis*), smallpox, anthrax, measles or streptococcal infection.
2. Poisoning.

At this point in the report it is relevant to examine samples of blood, urine, and stools and to

make microbiological and toxicological tests of eyes, nose, throat, and blisters together with X-rays to further evaluate development of the disease. But of course we have to deviate from current diagnostic practice.

4.2 Assessment of the medical information

4.2.1 Quality of data from the medical record

What about the patient's and relatives' descriptions of the disease? Is it possible to understand what they – i.e. Thucydides and others – meant by their words and formulations compared with what would be today's interpretation? As a physician, I have often been uncertain about what foreign patients and relatives are trying to tell me. However, this has nothing to do with the translation of particular words, but rather with what people mean by different words and concepts. No doubt similar problems arise when interpreting statements from another era. In short: The difficulty is with different cultural expressions rather than linguistically correct translation. However, the only way to deal with this is to be aware of the cultural difference. People who translate texts from earlier time periods or where a cultural difference exists, must also interpret the statements so that the reader can correctly understand the original meaning of the texts.

Does Thucydides' description of the plague provide a sufficient basis for making a definite medical diagnosis of the plague? This is rather doubtful, and as the physician and microbiologist Zinsser wrote in 1935, "we must conclude that the nature of the Athenian epidemic cannot be determined with certainty."²⁵⁷ Holladay and Poole pointed out in 1979 that the nature of the plague was "in principle unanswerable if the questioner is wanting to attach to the Plague the name of some modern disease or diseases."²⁵⁸ They buttress their view by saying that the disease is probably now extinct or its clinical manifestations have changed and therefore can no longer be identified.²⁵⁹

The difficulty of establishing the diagnosis on the basis of the information given by Thucydides is illustrated by Durack and his three co-authors. Littman claimed that smallpox was

²⁵⁷ H. Zinsser, *Rats, lice and history*, Transaction publishers, New Brunswick (U.S.A.) and London (U.K.) 2008, 122.

²⁵⁸ A.J. Holladay, J.C.F. Poole, Thucydides and the plague of Athens, *The Classical Quarterly*, 1979; 29: 295.

²⁵⁹ *Ibid.*

more likely than either epidemic spotted fever or Lassa fever, while both Mackowiak and Benitez chose to await DNA analysis before they took a stand. Durack, the principal author, wrote:

I suggest three leading possibilities: Lassa fever ^{260} (...) smallpox, and epidemic louse-borne typhus fever. (...) I believe epidemic louse-borne typhus is the most likely cause of the Plague of Athens. I recognize that the diagnostic fit is not perfect, and I cannot exclude smallpox or a vector-borne arena virus infection such as Lassa fever.²⁶¹

Although he is applying his knowledge of disease risk factors, he is not sure and just *thinks* it is epidemic typhus.

There is reason to question whether diseases of the past correspond to those of the present, or whether diseases may have changed in nature and thus become unrecognizable. This may have happened in the course of 2,500 years as a result of mutations in the genetic material of viruses and bacteria. Accordingly, both symptoms and mortality may also have changed. Such transformations would probably result in difficulties in recognizing a disease. However, a period of 2,500 years is not a long time in evolutionary history. Therefore, I suggest that it is plausible to believe that the time factor does not provide a basis for claiming that the disease has essentially changed and become unrecognizable. This is in accordance with the opinion of Morens and Littman: "On genetic and evolutionary grounds, we strongly doubt that the disease could have been extinct. While most microorganisms evolve quickly, they are highly adapted to humans or other hosts that evolve slowly, thus avoiding the threat of extinction unless the hosts become extinct themselves."²⁶² We will arrive at the final answer only when multiple remains of ancient peoples are subjected to DNA analysis for contemporary viruses and bacteria, and the results are then compared with the DNA of present-day microbes.

Nutton writes that "The disease itself defies identification in modern terms,"²⁶³ and Frøland considers that it becomes only a guessing game to make a diagnosis for a specific patient when

²⁶⁰ Lassa fever is a virus disease which occurs in West-Africa and may cause serious infectious disease and spread through food and drink or by droplet infection.

²⁶¹ D.T. Durack, R.J. Littman, R. Benitez, P.A. Mackowiak, Hellenic Holocaust: A historical clinic-pathologic conference, *Am J Med*, 2000; 109: 394.

²⁶² D.M. Morens, R.J. Littman, Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 282.

²⁶³ V. Nutton, Introduction, in V. Nutton, (ed), *Pestilential complexities: Understanding medieval plague*, *Medical history*, supplement no 27, The Wellcome Trust Centre for the History of Medicine at UCL, London 2008, 1.

both adequate clinical history and clinical status are missing.²⁶⁴ Andersen also points at the incomplete patient record.²⁶⁵

I agree that it is challenging to clarify what kind of disease the plague was, and the difficulties become apparent when the patient record is examined by applying current requirements for documentation. Despite the insufficient records I will still try to evaluate how far it is possible to come based on the known record. In the following discussion of the tentative diagnosis I use a dichotomy: infectious disease and poisoning.

4.2.2 Infectious disease

Solberg wrote that the disease which “corresponds best with the medical history (...) is epidemic typhus, caused by *Rickettsia prowazekii* and transmitted by feces from infected body lice.”²⁶⁶

However, Andersen suggested that the disease is “most consistent with typhoid fever or poisoning. *Rickettsia*, leptospirosis and other infectious diseases associated with poor sanitation, rodent and insect vectors cannot be ruled out.”²⁶⁷ The reason for this apparent disagreement between these two colleagues is likely due to the medical record, which, as mentioned earlier, is incomplete in terms of today's requirement for a more specific medical history and description of clinical signs of the disease.

Morens and Littman suggest that the plague was probably only one disease because “Thucydides himself and the Athenians in general apparently believed it was one disease, because it was confined to the Athenians, and because its reappearance over a five-year period seemed to be associated with the same features.”²⁶⁸ I disagree with their argument, because it is likely that symptoms and findings related to a number of diseases have been included in the medical history even though it seemingly applies only to one acute illness, the plague. The explanation is probably that the patients’ physician at the time “concentrated, in practice, less on giving the patient a theoretical explanation of the cause of disease than on the question of its

²⁶⁴ S. Frøland, personal information October 2010.

²⁶⁵ B.M. Andersen, Attachment II.

²⁶⁶ C.O. Solberg, Attachment I.

²⁶⁷ B.M. Andersen, Attachment II.

²⁶⁸ D.M. Morens, R.J. Littman, Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 282.

outcome and particularly on the chances of recovery."²⁶⁹ The present classification of a disease, however, is primarily based on the cause of the disease and the anatomic localization. Contemporary diagnosis was about what symptoms the patient had, and the diagnosis was important for estimating the prognosis. Thus, the ancient attitude toward disease becomes confusing when different symptoms and signs such as those described by Thucydides, are interpreted by using modern medical terminology, because several symptoms and signs may occur in altogether different diseases.

However, if we use the knowledge Thucydides provides on immunity in addition to his description of symptoms and signs, the clinical picture gets more clear. For example, when speaking of immunity, he writes: "For the disease never attacked the same man a second time, at least not with fatal results."²⁷⁰ Accordingly Thucydides does not write that the plague resulted in permanent immunity: rather, he suggests that if a patient got the disease once more it would not lead to death. In this way he presents for us an infectious disease with partial immunity, and consequently there is reason to look closely at diseases that provide full or partial immunity. Thus, on the basis of this information by Thucydides about partial acquired immunity after the plague, the claim of Cunha & Cunha that "the Plague of Athens offered complete immunity in survivors"²⁷¹ does not add up.

Among the tentative diagnoses I have suggested on the basis of the medical record, only smallpox and measles provide lasting immunity. In the case of plague caused by *Yersinia pestis*, there is uncertainty about the degree of immunity. In this connection, Walløe writes:

"In my opinion, many questions remain open as regards immunity to plague, but it is clear that acquired immunity consists of both humoral immunity, which is not very effective or long lasting, and cellular immunity, which is much more effective, especially against pneumonic plague, and which is of longer duration and may give lifelong protection."²⁷²

²⁶⁹ G.E.R. Lloyd, Introduction, in Hippocrates, G.E.R. Lloyd, (ed), *Hippocratic writings*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, Penguin books, Middlesex 1978, 30.

²⁷⁰ Thuc II 51

²⁷¹ C.B. Cunha, B.A. Cunha, Great plagues of the past and remaining questions, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 7.

²⁷² L. Walløe, Medieval and modern bubonic plague: Some clinical continuities, in V. Nutton, (ed.), *Pestilential complexities: Understanding the medieval plague*, suppl. No. 27, 2008, 68.

For this reason it cannot be excluded that the plague caused by *Yersinia pestis* was an active disease in Athens at that time. However, Sallares does so, on the ground that the plague (*Yersinia pestis*) did not result in widespread epidemics in Greek classical times because the "Plague is primarily a disease of certain species of rodents, (...) especially rats, which (...) come into contact with humans mainly through rat fleas, which seek new hosts when their rats die."²⁷³ Sallares claims that *Yersinia pestis* can be excluded because rats at that time did not exist in this area, or only in a modest number. He confirms his view by stating that ancient Greek had words for mice, but not for rats.²⁷⁴ He writes: "It is hard to believe that the Greeks would not have differentiated between rats and mice if they had been familiar with both types of rodents (...) even though in zoological nomenclature the genus *Mus* encompassed both rats and mice until eighty years ago."²⁷⁵ "Mouse" in ancient Greek is μῦς, and "rat" in modern Greek is αρουραῖος. This latter word also existed in ancient Greek but is translated as belonging to the cropland. Can this word have been their term for "rat" on the ground that the rat is also found in the field where the grain is? Although it is reasonable to believe that there were rats at the time, that is not an argument against the presence of plague (*Yersinia pestis*) even if there were no rats, because there is evidence that rats are not necessary for transmission of the disease.²⁷⁶

Living through a typhus epidemic (*Rickettsia prowazekii*) may result in prolonged immunity, but not permanent. In the typhus group, this is the most serious disease because this particular *Rickettsia* is the only one that is transmitted between humans. Zinsser worked with the typhus group and was considered one of the authorities at that time.²⁷⁷ His point of view was, however, that there is:

practically no reason for assuming that the disease in question was a variety of typhus. (...) The necrosis of the extremities does suggest typhus, but this symptom is not usually prominent except in winter epidemics in armies, and the Athenian disease began early during a hot summer. This seasonal factor is also against typhus.²⁷⁸

²⁷³ J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 263.

²⁷⁴ Ibid.

²⁷⁵ Ibid.

²⁷⁶ L. Walløe, Medieval and modern bubonic plague: Some clinical continuities, in V. Nutton (ed.), *Pestilential complexities: Understanding the medieval plague*, suppl. No. 27, 2008, 69.

²⁷⁷ G.N. Grob, Introduction, in H. Zinsser, *Rats, lice and history*, Transaction publishers, New Brunswick (U.S.A.) and London (U.K.) 2008, ix – xxxi.

²⁷⁸ H. Zinsser, *Rats, lice and history*, Transaction publishers, New Brunswick (U.S.A.) and London (U.K.) 2008, 123.

His opinion may well have assisted in influencing later views, because Sallares writes in 1991: "The environmental conditions at that time are also unfavorable to the hypothesis of typhus, which prefers cold climates and usually peaks in winter, while the Athenian epidemic began at the end of spring, a good time for smallpox, and continued into a usually hot summer."²⁷⁹

However, Nutton in her book of 2004 moderated the importance of warm climate as an argument against typhus by emphasizing hygiene as an important factor for the disease:

A modern epidemiologist, called in to diagnose a mass outbreak of disease in a military encampment in the Mediterranean region, would immediately suspect some form of transmissible disease, such as shigellosis or another type of bacillary dysentery. The notorious 'camp fever,' typhus, would probably be excluded from its first consideration, as it requires a cooler climate for its vectors, lice, to flourish. (...) But an explanation would be forthcoming in terms of insanitary living conditions, infected water or some form of pollution.²⁸⁰

But is it really true that, even if the plague appeared in the warm season, a typhus epidemic must be excluded? It does not seem so to me, and in a recent textbook of microbiology the authors reviewed a study of typhus from Africa without mentioning the relation between climate and typhus.²⁸¹ Thus, I find it quite possible that typhus did appear in summertime in Athens during the Peloponnesian War in an overcrowded city with failing hygiene and thus with increased risk of typhus. However, the disease also appeared in winter, and Thucydides writes: "In the course of the following winter the plague again fell upon the Athenians."²⁸²

Diphtheria does not always give full immunity. However, patients with diphtheria have no rash, and I infer that Thucydides knew that rash was an important sign of the disease plague. Thus, the plague can hardly be identical with diphtheria.

The rash of measles differs from what Thucydides describes as the plague, because measles causes neither small blisters on the skin with clear liquid, or vesicles, or blisters with pus, or

²⁷⁹ J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 265.

²⁸⁰ V. Nutton, *Ancient medicine*, Routledge, Taylor & Francis group, London and New York 2004, digital print 2005, 25.

²⁸¹ P.R. Murray, K.S. Rosenthal, M.A. Pfaller, *Medical microbiology*, 6.edition, Mosby Elsevier, Philadelphia 2009, 432.

²⁸² Thuc III 87 The year is 427 BC

pustules. However, there is reason to warn against too much emphasis on the usefulness of a detailed description of the rash.²⁸³ Shrewsbury concludes in an article in 1950 that the plague was measles because the population had not previously been exposed to this disease.²⁸⁴ However, his presentation of the plague is insufficient, since gangrene in the limbs does not occur in measles. Another argument against the diagnosis of measles is that the disease was already known in antiquity as a childhood disease. Though this information applies to measles in Egypt, it is likely that such a contagious disease as measles would have spread to Athens, given the extent of communication between Athens and Egypt. Due to that it is likely that measles among the adult population of Athens was not a dangerous disease since most of them had probably had the disease in childhood and then developed immunity.

On the basis of permanent or long-lasting immunity both smallpox and typhus are still in play as constituting the plague; nor can typhoid fever be ruled out because the disease provides partial but not safe and permanent immunity.²⁸⁵ Zinnser, who has argued that the plague was smallpox, writes: "In general, there seems to be considerable unanimity on the part of learned writers that smallpox was absent from Europe during the Greek and Roman classical periods. In spite of this, however, the description of Thucydides seems to us to point directly to a disease of this general type."²⁸⁶ However, it is not difficult to argue against Zinnser because scars of the face are an important sign in patients who have undergone smallpox, and Thucydides does not mention facial scars after the disease. For this reason and because smallpox does not cause gangrene of the limbs and the uncertainty whether it was smallpox in this part of the world, it is difficult to accept that smallpox was the plague. Sallares however, appears to perceive the disease as smallpox but believes that the disease died out in Greece and Italy because "what was left of the Athenian and Roman populations was not large enough to maintain it endemically as a disease of childhood."²⁸⁷ Retief concluded in 1998 that today's smallpox is the disease most consistent with Thucydides' description. Absence of scars on the face the author explains by stating that scars occur only after the acute phase which Thucydides describes.²⁸⁸ However, even Thucydides

²⁸³ See 2.2 Method

²⁸⁴ J.F.D. Shrewsbury, The plague of Athens, *Bulletin of the history of medicine*, 1950; 24: 1-25.

²⁸⁵ B.M. Andersen, *Bakterier og sykdom, epidemiologi, infeksjoner og smittevern*, Gyldendal Akademisk, Oslo 2005, 230.

²⁸⁶ H. Zinnser, *Rats, lice and history*, Transaction publishers, New Brunswick (U.S.A.) and London (U.K.) 2008, 124-125.

²⁸⁷ J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 254.

²⁸⁸ Retief, F.P., The epidemic of Athens, 430 – 426 BC, *S Afr J*, 1998; 88: 53.

underwent the plague, so why would he not describe the scars on his face when he presents, in detail, other signs and symptoms? I still claim that no information about facial scars among patients who survived the plague in fact excludes smallpox as the plague.

Thucydides also notes that “some lost their eyes also.”²⁸⁹ Injuries of the eyes are described in smallpox, but not in typhus. The bacteria in typhus disseminate through blood vessel walls causing vascular stenosis and gangrene. Therefore it is reasonable to suggest that blindness may also occur in typhus as a result of vascular stenosis in the retina.

Another observation which fits with typhus is that Thucydides writes that the disease arrived at Piraeus and then migrated through densely populated areas in Piraeus and Athens which were then in a state of siege. Accordingly, people lived close together and it was probably difficult to maintain personal hygiene, especially since the plague raged in the summer when there was probably reduced access to water. Therefore, we can reasonably conclude that these conditions paved the way for migration of infectious body lice from person to person resulting in a typhus epidemic. Cunha & Cunha also believe that the plague fits best with typhus: “By analysing the clinical features described by Thucydides it seems that it was in fact epidemic typhus that caused the great Plague of Athens (...)However, a definite etiology can not be determined with certainty by clinical / historical means alone.”²⁹⁰

Patients suffering a typhus epidemic, however, have no initial symptoms in the oral cavity and pharynx, accompanied by bad breath, but they often have cough and respiratory symptoms. It is first and foremost diphtheria and anthrax in the oral cavity and throat which lead to extensive local symptoms. In this connection it is important to remember that Thucydides writes: “And while the plague lasted there were none of the usual complaints, though if any did occur it ended in this.”²⁹¹ It is possible that both diphtheria and anthrax occurred and that it may be these ailments he here describes. What argues against these two diseases, especially diphtheria, is that he does not describe the often life-threatening breathing problems caused by diphtheria. Anthrax in the mouth and throat was probably only a minor part of the illness and did not result in a major epidemic.

Langmuir and colleagues wrote about the plague in 1985: “We now believe that all the clinical

²⁸⁹ Thuc II 49

²⁹⁰ C.B. Cunha, B.A. Cunha, Great plagues of the past and remaining questions, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 8.

²⁹¹ Thuc II 51

and epidemiologic findings described by Thucydides can be attributed to infection with influenza virus complicated by a toxin-producing strain of noninvasive staphylococcus."²⁹² In another work using an epidemiological approach, other authors reject that the plague might have been the flu.²⁹³ Instead, they suggest typhus, rare viral disease, plague (*Yersinia pestis*), anthrax or smallpox, because they believe that the disease most likely has a reservoir outside of humans in the form of animals, insects or the environment.

Thucydides writes that:

the birds, namely, and the fourfooted animals, which usually feed upon human bodies, either would not now come near them, though many lay unburied, or died if they tasted of them. The evidence for this is that birds of this kind became noticeably scarce, and they were no longer to be seen either about the bodies or anywhere else; while the dogs gave a still better opportunity to observe what happened, because they live with man.²⁹⁴

This is an unusual observation, and may have more to do with poetic license than accurate observation. However, recent literature notes that the plague, *Yersinia pestis*, may affect different species, both mammals and birds.²⁹⁵ As for our 25-year-old patient from the Piraeus, he could not have had plague, (*Yersinia pestis*), because that particular disease usually has a more dramatic progression.²⁹⁶

That birds and animals neither fed upon nor approached dead bodies seems unlikely. Even if, to a certain degree, it might be habitual to act in such a way, it is probable that such changes would have taken a long period to develop. The plague appeared over a relatively short period of time, and therefore there is no reason to believe that such habits developed among birds and animals. On the other side the reduced number of birds and dogs could have been caused by

²⁹² A.D.Langmuir, T.D. Worthen, J. Solomon, C.G. Ray, E. Petersen, The Thucydides syndrome. A new hypothesis for the cause of the plague of Athens, *N Engl J Med*, 1985; 313: 1027.

²⁹³ D.M. Morens, R.J. Littman, "Thucydides Syndrome" Reconsidered: New Thoughts on the "Plague of Athens", *American Journal of Epidemiology*, 1994; 140: 621 – 628.

Morens, D.M., Littman, R.J., Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 271-304.

²⁹⁴ Thuc II 50

²⁹⁵ L. Walløe, Medieval and modern bubonic plague: Some clinical continuities, i V. Nutton, (ed.), *Pestilential complexities: Understanding the medieval plague*, suppl. No. 27, 2008, 68.

²⁹⁶ See *plague* in Attachment III.

eating poisoned food: e.g., eating grain poisoned by the fungus *Claviceps purpurea*. I will review such poisoning in the next section.

Although bird flu probably also existed at the time, there is no reason to believe that it acted on a large scale, since it usually does not spread among humans. Moreover, this disease does not contain all the symptoms described by Thucydides.

Leptospirosis (Weil's disease) is a disease in rats, mice and dogs, and there may be grounds for suggesting that this disease had something to do with the plague. However, it is unlikely that Weil's disease was the plague, because those suffering from it have both high fever and jaundice, which does not fit Thucydides' description.

4.2.3 Poisoning

Mental changes in the form of delirium may occur in typhoid fever, but they can also be a result of intoxicating substances. It is not unlikely that conditions in Athens at that time, with war and siege, led to increased use of drugs or alcoholic fluids to escape from the strains of everyday life, and we know that they drank wine and probably also used opium and cannabis.²⁹⁷ Thucydides explains indirectly why drugs may have been used to a greater extent than usual when he describes a society falling apart:

for the calamity which weighed upon them was so overpowering that men, not knowing what was to become of them, became careless of the law, sacred as well as profane.(...) the pleasure of the moment and whatever was in any way conducive to it came to be regarded as at once honourable and expedient. No fear of gods or law of men restrained.²⁹⁸

Thus, the probable use of stimulants makes it difficult to include the patient's mental state among the symptoms of a somatic disorder.

Alkaloid from the fungus *Claviceps purpurea* or *Claviceps fusiformis*,²⁹⁹ leads to spasms of blood vessels and eventually gangrene of fingers and toes, *ergotism*. The fungus grows on rye,

²⁹⁷ B. Qviller, Statsdannelse og symposier hos grekerne, in Ø. Andersen and T. Hägg (eds), *I skyggen av Akropolis*, Det norske institutt i Athen, John Grieg AS, Bergen 1994, 45-68.

²⁹⁸ Thuc II 52-53

²⁹⁹ Alkaloids are produced by plants, fungus or bacteria, and several are still in use as medical drugs. The fungi *Claviceps purpurea* and *fusiformis* produce ergot alkaloid derived from LSD leading to hallucinations. These fungi are part of a group including more than 100 which produce more than 300 mycotoxins.

wheat and barley. Symptoms vary depending on the type of fungus that causes poisoning. The symptoms might be hallucination, convulsions, paralysis, itching, tingling in the body, muscle pain and burning pain in the feet. Moreover, there is reason to believe that the putative witchcraft occurring in Finnmark county in Norway in the 17th century might have been due to symptoms associated with ergotism.³⁰⁰ Such poisoning, causing spasms of blood vessels may explain why "Externally, the body was not so very warm to the touch; it was not pale, but reddish, livid, and breaking out in small blisters and ulcers. But internally it was consumed by such a heat that the patients could not bear to have on them the lightest coverings or linen sheets."³⁰¹

In The Middle Ages the disease got the name "St. Anthony's sacred fire," and such epidemics have been described from ancient³⁰² times to the present.³⁰³ According to Sallares there are grounds for believing that rye was not an important food in Athens at the time, but regarded as a weed. Consequently, the population was rarely exposed to ergotism when rye was not common in use as food.³⁰⁴ However, Athens was under siege and therefore probably had difficulty obtaining a sufficient amount of food. Thus, it seems likely that people also ate rye introduced by sea from Thrace, Macedonia, or Anatolia, even if the main grain imports came from Euboea during the Peloponnesian War.³⁰⁵ However, it is not necessary to use the theory of rye imports to assert the existence of ergotism at that time, because the fungus *Claviceps* also grows on other cereals such as wheat, barley, and oats though these are more resistant to the fungus compared with rye.

The fungus *Fusarium* growing on wheat produces another mycotoxin that causes alimentary toxic aleukia with damage of the bone marrow, but without gangrene.³⁰⁶ Thus poisoned wheat alone may explain ergotism. According to Bellemore et al such a poisoning has never been described in the Mediterranean region. They argue, however, that the population of Athens may

See MR Lee, The history of ergot of rye (*Claviceps purpurea*) III: 1940-80, *J R Coll Physicians Edinb*, 2010; 40: 77.

³⁰⁰ T. Alm, The witch trials of Finnmark, Northern Norway, during the 17th century: Evidence for ergotism as a contributing factor, *Economic Botany*, 2003; 57: 403-416.

³⁰¹ Thuc II 49

³⁰² J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 364.

³⁰³ Lorenzen, I., Bendixen, G., Hansen, N.E., (eds), *Medicinsk Kompendium*, vol. 2, 15. edition, Nyt Nordisk Forlag Arnold Busck, København 1999, 2915.

M.R. Lee, The history of ergot of rye (*Claviceps purpurea*) I: From antiquity to 1900, *J R Coll Physicians Edinb*, 2009; 39: 179-80.

³⁰⁴ J.R. Sallares, *The Ecology of the Ancient Greek World*, Cornell University Press, Ithaca, New York 1991, 364.

³⁰⁵ R. Osborne, *Classical landscape with figures. The ancient greek city and its countryside*, Sheridan House, New York 1987, 101.

³⁰⁶ J. Bellemore, I.M. Plant, L.M. Cunningham, Plague of Athens – fungal poison? *The Journal of the history of medicine and allied sciences*, 1994; 49: 533-534.

have been poisoned by grain imported from the Ukraine, where the disease was endemic. A similar hypothesis was presented in 1994.³⁰⁷

Holladay and Poole claimed in 1979: "it would be very difficult to believe that the Plague was not a contagious disease when Thucydides seems to make it so very plain that it was."³⁰⁸ It is correct that ergotism is not contagious between people. But what is crucial is how people at that time considered contagious disease: they had none of the current knowledge about microbes, toxins or ways of dissemination of infectious diseases. They just registered that a large number of people went sick at approximately the same time, and very likely this was perceived as caused by a contagious disease. Grain imported for Athens during the siege arrived mainly through the port of Piraeus and was then transported up to Athens. Thus, there should be no reason to reject ergotism on the ground that "it would be necessary to postulate a series of imports of contaminated grain to various places at various times for which there is no collateral evidence."³⁰⁹ Large parts of the population were gathered within the walls of Athens during the outbreak of the plague, and they would therefore turn ill depending upon when they ate the grain.

Longrigg argues against ergotism as the plague by pointing out that the disease, according to Thucydides, spread from Ethiopia to Egypt, Libya, and Persia. The author believes that this supports the theory that the plague was an infectious disease.³¹⁰ However, Thucydides does not claim that the plague passed through these countries, but cites what *others* have observed: "The disease began, it is said, in Ethiopia beyond Egypt."³¹¹ However, it would be well to emphasize that even if we do accept this path of dissemination, it is not an argument against ergotism *concurrently* with other diseases in Athens. Thus, poisoned grain might have played some part of the symptoms of the plague such as gangrene and hallucinations.

4.3 Paleo-epidemiological assessment

So far in the quest for the plague diagnosis I have used the description of symptoms and signs given by Thucydides, comparing them with diseases today. Thus it is possible to limit the number of diseases that may have been the plague. However, now I will analyze the plague from a

³⁰⁷ R. Schoental, Mycotoxins in food and the plague of Athens, *Journal of nutritional medicine*, 1994; 4: 83-85.

³⁰⁸ A.J. Holladay, J.C.F. Poole, Thucydides and the plague of Athens, *The Classical Quarterly*, 1979; 29: 293.

³⁰⁹ *Ibid.*

³¹⁰ J. Longrigg, The great plague of Athens, *Hist Sci*, 1980; 18: 217-218.

³¹¹ Thuc II 48

different point of view; namely, by using epidemiology in lieu of paleo-epidemiology.³¹²

Because the composition of the dead and the living population usually is different, "The ideal situation in paleo-epidemiology is encountered when the dead population has the same structure as the living one, (...) this is what we call the 'Pompeii model.'"³¹³ But unfortunately in Greece there are no grave findings from that time to define the composition of the population.

Morens and Littman in 1992 have in my opinion done substantial work in the epidemiology of the plague. They used mathematical models combined with information provided by Thucydides and report:

Our method tries to identify, or at least limit, candidates for the Athenian disease by epidemiologic means in two suggestive stages: first we attempt to determine the mode of its transmission, and thereby to exclude diseases transmitted by other, inconsistent means; and secondly we attempt to find a 'best fit' from the remaining candidate diseases, using (a) established mathematical models for respiratory disease transmission, and (b) data on premodern epidemics in characterized populations.³¹⁴

However, the authors dismiss ergotism as the cause of the plague because:

there is no reasonable explanation for such massive and simultaneous contamination of all grain sources. (...) Contamination of harvests in so many successive years, from such varying sources, is difficult to imagine. The same grains were also presumably consumed by others who did not experience epidemic disease, including the Spartans, who had appropriated the Athenian crops.³¹⁵

³¹² See 2. 2. 2

³¹³ O. Dutour, Archaeology of human pathogens: Palaeopathological appraisal of palaeoepidemiology, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 137.

See also: Dutour, O., Signoli, M., Palfi, G., How can we reconstruct the epidemiology of infectious diseases in the past? Greenblatt, C.L., (ed), *Digging for pathogens. Ancient emerging diseases – their evolutionary, anthropological and archaeological context*, Balaban Publisher, Israel 1998, 241-263.

³¹⁴ D.M. Morens, R.J. Littman, Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 272. The authors also discuss this topic in a later publication: D.M. Morens, R.J. Littman, "Thucydides Syndrome" Reconsidered: New Thoughts on the "Plague of Athens", *American Journal of Epidemiology*, 1994; 140: 621 – 628.

³¹⁵ D.M. Morens, R.J. Littman, Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 283.

The last part of the quotes is fairly consistent with what Holladay and Poole claimed in 1979.³¹⁶ Neither do I find a basis for arguing that ergotism was the plague. I merely express the possibility that ergotism might have been present in addition to other coexisting diseases.³¹⁷

On the basis of mathematical calculations Morens and Littman concluded that "none of these diseases (e.g. influenza, measles, smallpox) would have persisted two to five years, as did the Athenian epidemic."³¹⁸ As the final conclusion they write: "We believe that our approach has already limited the possible causes of the Athenian epidemic to a plausible few. Of these, typhus and smallpox may share the most clinical similarities with the Athenian epidemics."³¹⁹ This is consistent with the conclusion I drew on the basis of clinical data with special emphasis on immunity, but then I removed smallpox from the list of tentative diseases, mainly because there was no information about facial scars in patients who survived the plague.

4.4 Bacteriological examination: is it possible?

In the discussion of tentative diagnoses I pointed out the need for further investigations. However, amazingly enough this can still be performed to a certain extent if remains of former human beings exist in the form of bones, teeth or fossilized feces. Such remains may then be examined by different methods while DNA analysis describes the genetic characteristics.³²⁰

X-ray examination of bones is important for detecting earlier skeletal injuries, deformities, chronic infections such as tuberculosis and syphilis, or metastatic cancer spreading to bone. However, such studies are useless in order to examine patients who died relatively abruptly after a short illness, because infectious skeletal changes develop after a long period of infection in the bone.

Today new technology has been developed in the form of the paleo-microbiological examination.³²¹ However, cremation will damage the dental pulp, and the presence of residual germs accordingly cannot be ascertained. The burial practice in Athens in classical times

³¹⁶ A.J. Holladay, J.C.F. Poole, Thucydides and the plague of Athens, *The Classical Quarterly*, 1979; 29: 293

³¹⁷ I will discuss this topic in 5.2

³¹⁸ D.M. Morens, R.J. Littman, Epidemiology of the plague of Athens, *Transactions of the American Philological Association*, 1992; 122: 291.

³¹⁹ Op.cit: 300-301.

³²⁰ This is illustrated in a published study of the family of Tutankhamun: Z. Hawass, Y.Z. Gad, S. Ismail, R. Khairat, D. Fathalla, N. Hasan, A. Ahmed, H. Elleithy, M. Ball, F. Gaballah, S. Wasef, M. Fateen, H. Amer, P. Gostner, A. Selim, A. Zink, C.M. Pusch, Ancestry and Pathology in king Tutankhamun's family, *JAMA*, 2010; 303: 638-647.

³²¹ See 2. 2. 3

consisted either of cremation or burial of the whole body,³²² but during the time of the plague it appears that cremation was widely used. Thucydides writes:

And the customs which they had hitherto observed regarding burial were all thrown into confusion, and they buried their dead each one as he could. And many resorted to shameless modes of burial because so many members of their households had already died that they lacked the proper funeral materials. Resorting to other people's pyres (...) would put on their own dead and kindle the fire; others would throw the body they were carrying upon one which was already burning and go away.³²³

Three samples of dental pulp in three randomly chosen individuals from mass graves at the Kerameikos have been investigated by DNA technology. Cremation had probably not been used, and the researchers identified *Salmonella typhi* which can result in typhoid fever.³²⁴ However, the discovery very likely must be confirmed by another independent laboratory before it is accepted. Moreover, it should also be stated how many individuals with intact teeth were found in the mass graves and why not all were studied.

Cunha & Cunha write: "The recovery of *Salmonella typhi* in areas endemic for enteric fevers as well as malaria and a variety of other infectious diseases, does not necessarily imply that the organism was causally related to the patients' demise."³²⁵ The cause of death for the three people with proven *Salmonella typhi* did not have to be typhoid fever. The reason is that people are the only reservoir for *Salmonella typhi*, and "the phenomenon of gall bladder colonization would allow *S. typhi* to persist (...) until new susceptibles are encountered in the course of travel or warfare. Thus we infer that early human civilizations may have tolerated a low-level endemic

³²² R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by Green, P., Weidenfeld and Nicolson, London 1965, 82.

³²³ Thuc II 53

³²⁴ M.J. Papagrigorakis, C. Yapijakis, P.N. Synodinos, E. Baziotopoulou-Valvani, DNA- examination of ancient dental pulp incriminates typhoid fever as a probable cause of the plague of Athens, *Int. J. Infect. Dis.*, 2006; 10: 206-14. This is also described in M.J. Papagrigorakis, C. Yapijakis, P.N. Synodinos, Typhoid fever epidemic in ancient Athens, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 161-173.

³²⁵ C.B. Cunha. B.A. Cunha, Great plagues of the past and remaining questions, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 3.

burden."³²⁶ However, the very fact that the *Salmonella typhi* is demonstrated has significance for knowledge of the diseases at that time, even though the three persons did not die from typhoid fever. Although these people may not have been ill, they were at least carriers of the disease.

Unfortunately, even modern medical technology is not sufficient to establish a definite diagnosis of the plague in Athens, but is only one tool in a comprehensive assessment of the disease.

4.5 Conclusion

The medical history based on Thucydides' knowledge of the plague is deficient in relation to today's requirements for describing symptoms and signs. Consequently it is hard to make a definite – rather than – tentative diagnosis of the plague based upon Thucydides' information. Longrigg expresses the situation by pointing out that different physicians and scientists conversant with ancient culture emphasize various diseases they believe consistent with the plague in Athens, but "Each and every case, however, shares the same underlying common denominator in that, no matter how eloquently it is pressed, there remains at least one vital factor stubbornly irreconcilable with the Thucydidian evidence."³²⁷

The problem of identifying only one main disease which includes all the symptoms and signs is not resolvable because Thucydides apparently presents the total picture of serious diseases in Athens at the time. Moreover, Thucydides could not have observed the course of disease among a large group of the plague patients, partly because he was sick and partly because the number of patients was too great to include in his research. Therefore it is very likely that he obtained knowledge about the various symptoms and signs from different sources. Thus, his written observations cannot have been consistent, and that will necessarily further complicate interpretations of the symptoms and signs.

The risk of stressing the immunity of the various diseases to elucidate what kind of disease the plague might have been could unfortunately rule out other possible diseases if the point is to diagnose a single predominant disease. Diseases in question first and foremost include typhoid fever and intoxicants i.e. drugs or alcohol. Moreover, one should consider whether diphtheria,

³²⁶ J.P. Nataro, O.C. Stine, J.B. Kaper, M.M. Levine, The archaeology of enteric infection: *Salmonella*, *Shigella*, *Vibrio*, and diarrheagenic *Escherichia coli*, in C.L. Greenblatt, M. Spigelman, (eds), *Emerging pathogens. Archaeology, ecology & evolution of infectious disease*, Oxford University Press, New York 2003, 170.

³²⁷ Longrigg, J., The great plague of Athens, *Hist Sci*, 1980; 18: 217.

streptococcal infection, and leptospirosis³²⁸ occurred in the city. Bubonic plague and smallpox were hardly present because Thucydides does not describe large abscesses or facial scars.

However, it is not improbable that behind this diverse panorama of diseases lurks the most severe and predominant disease of the time – typhus, caused by *Rickettsia prowazekii*. This diagnosis is also substantiated by epidemiological methods.³²⁹ In addition, I suggest that poisoned grain by mycotoxin is an important element of the panorama. Such poisoning may well have influenced the symptoms of patients with other diseases such as typhoid fever.

Holladay and Poole have presented a balanced discussion of the different diagnoses of the plague without opting for one specific disease. The authors illustrate their view with the following statement, which I endorse:

If the principal fruit of previous work on Thucydides' account of the Plague of Athens seems to be a confusing mass of doubt and contradiction, no one should suppose that the inability of the medical profession in the past to reach a consensus of opinion on the identity of the Plague casts doubt on Thucydides' capabilities as an observer and interpreter of passing events. On the contrary, his understanding of contagion and immunity showed remarkable insight.³³⁰

The reason to hunt further for the cause of the plague is that only by knowing what kind of disease or diseases it was can one assess the impact it had on society. For this reason I discuss in the next chapter the risk factors for disease in Athens at the time, together with likely diagnoses based on the medical record presented in this chapter.

³²⁸ Weils disease

³²⁹ D.M. Morens, R.J. Littman, "Thucydides Syndrome" Reconsidered: New Thoughts on the "Plague of Athens", *American Journal of Epidemiology*, 1994; 140: 621 – 628.

³³⁰ A.J. Holladay, J.C.F. Poole, Thucydides and the plague of Athens, *The Classical Quarterly*, 1979; 29: 299.

Chapter 5: What is the diagnosis?

*As a result of jumping to conclusions, the truth may escape them*³³¹

So far I have moved slowly forward to determine the diagnosis of the plague in modern medical terminology. Thus, chapter three evaluated risk factors for transmission of disease in contemporary Athens, because drinking water, food, and a variety of pests can transmit infectious diseases to the population. The fourth chapter analyzed the disease based on a medical record which included all the symptoms stated by Thucydides. This chapter evaluates the diseases in Athens based upon an overall assessment of chapters three and four.

5.1 Infection through drinking water

Although the main water system and Klepsydra gave the people of Athens adequate drinking water, the supply was inadequate for the population. Therefore, to meet the need for water part of the population had to use water that entailed risk of contagious disease due to unclean cisterns or from the river Ilissos, which was contaminated, at least in the lower part. At worst some might have used water from the Eridanos, which was heavily contaminated where it ran through the city.

Is it possible that the poor, perhaps first and foremost the poor refugees, who literally stood in the back in the water line, were forced to use contaminated water sources in contrast to the rest of the population? This is unlikely because the democratic attitude of Athens' citizens gave virtually all the same rights, at least the same access to drinking water. Therefore it is likely that both the elite and the poor used the same water sources with equal risk of infection from it. The difference between rich and poor was more related to the places in which they lived and consequently to the water sources of their neighborhood. Also, quite probably people tried to avoid carrying water over long distances in the summer heat if there was a closer option. A number of poor people lived in densely populated areas with both reduced access and quality of drinking water

³³¹ Hippocrates, Tradition in medicine, in G.E.R. Lloyd, (ed.), *Hippocratic writings*, translated by J. Chadwick, W.N. Mann, I.M. Lonie, E.T. Withington, Penguin books, Middlesex 1978, 21.

compared with water near the wealthy district. Nevertheless, for the poor the risk of infection through drinking water was increased, compared to that of the rich people.

But is it possible to confirm or deny that the poor were particularly vulnerable to water-borne disease? Indirectly Thucydides confirms that the poor were exposed to such infection, for he writes about the plague among refugees in Athens: "Bodies of dying men lay one upon another, and half-dead people rolled about in the streets (...) The temples, too, in which they had quartered themselves were full of the corpses of those who had died in them."³³² Thucydides' description of the dead combined with the knowledge that infection via shared water sources resulted in many simultaneously ill people may also strengthen the suspicion of infected water among the refugees. The refugees whom Thucydides reviews obviously must have been ill at about the same time because the incubation period of a disease varies relatively little from person to person.³³³ The course of the disease in those who died had according to Thucydides a relatively short duration, also indicating a similar disease.³³⁴

However, it was not just the poor who were sick and died, because Thucydides also describes an epidemic among the more wealthy citizens, *hoplites*. When the plague broke out in 430 BC, 4,000 hoplites traveled to Thrace and besieged Poteidaia. Thucydides relates:

the plague broke out and sorely distressed the Athenians there, playing such havoc in the army that even the Athenian soldiers of the first expedition, who had hitherto been in good health, caught the infection from Hagnon's troops.(...) Hagnon took his fleet back to Athens, having lost by the plague in about forty days one thousand and fifty out of a total of four thousand hoplites.³³⁵

Presumably the men were healthy before they traveled north: otherwise, the hoplites would not have been sent away because sick soldiers cannot make themselves useful. The fact that the Athenian soldiers already in Thrace were infected by those who came from Athens probably

³³² Thuc II 52

Dead people in the temple area were a violation of the norms. Therefore, there may be reason to assume that Thucydides in this way described the plague worse than it really was, to bring out the moral resolution that is the core of the story, the plot. See 2.1.5 and 7.2

³³³ The incubation period is also related to the quantity of microbes or toxin which affects a person, and in typhoid fever is usually between 10-14 days.

³³⁴ See 5.2 and 5.3

³³⁵ Thuc II 58

indicates that the original source of the infection must have been in Athens.

The duration of the incubation period – ten to fourteen days for typhoid fever and about seven days for epidemic typhus/lice-borne typhus – may indicate what kind of disease the hoplites died from. If the disease is poisoned grain, the length of the incubation period is uncertain. Bellmore and colleagues suggest, however, an incubation period of two to three weeks of illness caused by the fungus *Fusarium*. Patients die six to eight weeks after ingestion of poisoned grain.³³⁶

Evidence from ancient times indicates a travel time of 13 days by boat from Ascalon to Thessaloniki at a speed of 2.6 knots.³³⁷ The distance is 800 nautical miles.³³⁸ However, the travel distance probably took a longer time to cover, so the wind conditions during these thirteen days must have been particularly favorable.³³⁹ From the map I have calculated the sea route from Athens to Poteidaia³⁴⁰ to be about 770 nautical miles, suggesting a journey time of eleven to twelve days. However, the condition for that would be a favorable wind and around-the-clock sailing. The hoplites were probably transported aboard special transport ships³⁴¹ needing a longer travel time than a fast-sailing ship. Therefore, the journey to Poteidaia probably lasted around fourteen to fifteen days, maybe a few more.

If the hoplites were infected by epidemic typhus, it is likely that the disease would have broken out during the crossing after an incubation period of seven days. Typhus is acute from the start, with high fever, headache, flu, and rashes. Thus some hoplites might already have been sick and disabled on arrival. Thucydides writes, however, that the soldiers were apparently healthy when they arrived, for they were able to perform hard physical work: "on their arrival they brought siege-engines to bear upon Potidaea, and tried every way to take it."³⁴²

Poisoning is also unlikely, even if they had eaten poisoned grain during the journey, because death occurs later than the forty days described by Thucydides. If during the travel they had been

³³⁶ J. Bellemore, I.M. Plant, L.M. Cunningham, Plague of Athens – fungal poison? *The Journal of the history of medicine and allied sciences*, 1994; 49: 534.

³³⁷ 1 knot = 1852 m/hour, 1 nautical mile/hour

³³⁸ L. Casson, *Ships and seamanship in the ancient world*, The John Hopkins University Press, Baltimore and London 1995, 289.

³³⁹ Op.cit: 291.

³⁴⁰ Poteidaia is located on the western peninsula in Chalkidiki. The city was destroyed in 357 BC, but rebuilt and given the name Kassandreia.

³⁴¹ Thuc VI 43

³⁴² Thuc II 58

infected with *Salmonella typhi* or related bacteria also resulting in typhoid fever, the timing would fit. Although some hoplites might have had symptoms of illness during the last part of the journey or shortly after arrival, the symptoms are relatively vague during the first week. For this reason, it would have been possible to work the first few days after arrival.

The source of infection was probably contaminated water drunk along the way, since the hoplites died more or less simultaneously. It is probable that drinking water had been brought on board the boats in clay jars before the departure from Piraeus, or was kept on board since the last cruise, and exposed to sunlight during the journey, so that bacteria had multiplied further.³⁴³ As previously mentioned Piraeus had no water sources but relied on cisterns, which in this case were probably infected. That all the soldiers were infected prior to departure is unlikely because they most likely came from different places in Athens and Piraeus and had not used the same drinking water. If they had been infected at different times, they would not have been sick more or less simultaneously. The overall mortality rate of twenty six percent among the hoplites fits well with typhoid fever.

Among the likely diseases my patient probably had,³⁴⁴ typhoid fever is the one that spreads through drinking water contaminated by sewage water shared by a person with typhoid fever. However, the source of infection does not have to be ill, and some are chronic carriers for many years. The typical carrier is a middle-aged or elderly woman, and if untreated some ten to thirty percent of the ill will die. Upon conclusion of this disease there is partial – but no safe and permanent – immunity.

On the basis of knowledge from modern bacteriological research, it must have been typhoid fever in contemporary Athens. Thucydides' description of the deaths among refugees also indicates such a disease. Although there is reason to believe that typhoid fever may have been the cause of death in many of the refugees in Athens and hoplites in Thrace, that does not necessarily mean that the plague of Athens was typhoid fever, which does not have the symptoms and signs of gangrene which are important according to Thucydides' description of the plague.

³⁴³ L. Casson, *Ships and seamanship in the ancient world*, The John Hopkins University Press, Baltimore and London 1995, 90. See also 6.2.3.2

³⁴⁴ See 4.1

5.2 Infection with food ³⁴⁵

Typhoid fever spreads from drinking water, food, or directly from a sick person. The bacterium attacks people but not animals, so the disease always comes from sick people. And contamination of water or food is the most common infectious path for typhoid fever.

In Athens, grain was basis of nutrition,³⁴⁶ and people can be poisoned by fungi that grow on grains where they form toxins, *mycotoxins*. First and foremost we are talking about the fungi *Claviceps purpurea* and *Claviceps fusiformis*³⁴⁷ which preferably grow on rye but also thrive on other grains. The fungus grows as wet grain is poured on the ground or stored wet.

Poison causes the disease *ergotism*, resulting in gangrene in fingers and toes. This has been and remains a serious illness: An epidemic in 994 AD in a part of France resulted in 40,000 deaths. In Russia, 1,100 people were stricken in the years 1926-27, and about 100 died. As late as 1951 another epidemic occurred in France.³⁴⁸

But how can poisoning have occurred during the Peloponnesian War in an area with hot and dry summers and consequently adequate drying of grain in the fields? Fields were plowed and sown between September and November, and the grain was harvested from the beginning of May.³⁴⁹ As a result of the fighting it was not possible to harvest the grain at the right time, and the enemy also destroyed fields of it. The grain was therefore likely to remain on wet ground for several weeks after a storm or heavy rain.³⁵⁰ When the Athenians finally came out to the fields after the enemy had left the area, the grain was probably already infected by fungi. Therefore, it is likely that the grain they brought to the city and stored in large jars was a health hazard.

³⁴⁵ Meat may also be source of infection for *Yersinia pestis*, but is far from being the main mode of transmission. Diphtheria may disseminate through food, but the important path is by droplets.

³⁴⁶ P. Garnsey, *Food and society in classical antiquity*, Cambridge University Press, Cambridge 1999, reprint 2002, 119.

³⁴⁷ See 4.2.3 *Claviceps fusiformis* must not be confused with *Fusarium* which also produces mycotoxin resulting in areas with dead tissue and necrosis.

See also J. Bellemore, I.M. Plant, L.M. Cunningham, Plague of Athens – fungal poison? *The Journal of the history of medicine and allied sciences*, 1994; 49: 536.

³⁴⁸ I. Lorenzen, G. Bendixen, N.E. Hansen, (eds), *Medicinsk Kompendium*, vol 2, Nyt Nordisk forlag Arnold Busck, 15. edition, København 1999, 2915.

³⁴⁹ Hesiod, *Works and Days, Theogony and The shield of Heracles*, translated by H.G. Evelyn-White, Dover publications, Inc, Mineola, New York 2006, 13.

R. Osborne, *Classical landscape with figures. The ancient Greek city and its countryside*, Sheridan House, New York 1987, 13-15.

³⁵⁰ See 3.1.1

Harvesting grain which has lain long on the ground is not uncommon and understandable in times of famine. Bellmore and colleagues write that as late as the beginning of the Second World War, a communicable illness with a mortality rate in some places of sixty percent appeared in the Soviet Union and central parts of Asia. Death occurred six to eight weeks after the sick had eaten grain that had been lying in the fields through the winter. In the same article they write: "In 1948 and later, when food supplies were abundant, the disease was absent."³⁵¹

But how does the theory of poisoned grain fit in with the actual events? Farming was an important part of the society, both in Athens and Sparta. This was also reflected in the strategy of the Lacedaemonians because they discussed whether the crops of the enemy should be destroyed or not. King Archidamos argued against such damage because:

when they see our preparations (...) they will be more inclined to yield, for they will both have their land unravaged and their deliberations will concern goods that are still theirs and as yet not ruined. (...) You should therefore spare it as long as possible, instead of making them desperate and thus having a more intractable foe to deal with.³⁵²

When the war broke out, Archidamos arrived with the army in Attica "when it was midsummer and the corn was ripe."³⁵³ This confirms that that year's crop had not been harvested before the enemy arrived in Attica. Arable land was then destroyed. The army stayed only one month in Attica, and it is unclear how much of the fields were destroyed. Kagan writes in his book that "Archidamos had not yet destroyed the rich fields of Attic plain, but persisted in his plan to hold it hostage as long as possible. (...) The Athenians were essentially unharmed and were even now engaged in avenging what damage had been done."³⁵⁴ However, it is unclear what Kagan really means, because he writes later in the book:

³⁵¹ The fungus was *Fusarium*:

J. Bellemore, I.M. Plant, L.M. Cunningham, Plague of Athens – fungal poison? *The Journal of the history of medicine and allied sciences*, 1994; 49: 533-534.

³⁵² Thuc I 82

³⁵³ Thuc II 19

³⁵⁴ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London third edition 1990, 57.

The damage to Athens had been considerable. In addition to the psychological price of watching their crops cut down, their vines and olive trees destroyed, their houses torn or burned down, the Athenians had lost grain needed for food. (...) The Peloponnesians (...) would return the next year with spirit destroy the large portion of Attica they had left untouched.³⁵⁵

Hanson, who has written about The Peloponnesian War and the destruction of agricultural areas, is critical of the description of the damage as significant and long-lasting.³⁵⁶ It is particularly difficult to destroy olive trees.³⁵⁷ However, I understand Kagan's statement that the physical destruction was not comprehensive with respect to cultivated land but that it did result in a psychological burden for the population.

What kind of food were the refugees able to bring with them? Very likely those who still had grain from last year's crop brought it to town. Other refugees had probably used the crop or part of it because they were ready to start harvesting the current year's crop when they had to flee. Moreover, it is also probable that a number of citizens had not anticipated that the war would damage the country, inasmuch as former invasions had destroyed only part of Attica.³⁵⁸

The plague did not break out the first summer of war, but began the next, 430 BC. A possible explanation for a year without plague might be due to there having been only modest damage to the fields and accordingly a harvest without wet grain and the growth of fungi. The crop was probably smaller than usual because some fields were destroyed, and in others grain perhaps had fallen because it was overripe. However, one can reasonably assume that the population before the second year of the war had enough grain in addition to what was imported. Thus it was not necessary to eat grain that had been lying on the ground and was vulnerable to attack by fungi. In 430 BC the situation was different, because now the enemy invaded Attica:

At the very beginning of summer (...) and establishing themselves proceeded to ravage the country. And before they had been many days in Attica the plague began for the first time to show itself among the Athenians. It is said, indeed, to have broken out before in many places,

³⁵⁵ Op.cit: 68-69.

³⁵⁶ V.D. Hanson, *Warfare and agriculture in classical Greece*, University of California press, Berkeley, Los Angeles, London 1998, 176.

³⁵⁷ Op.cit: xiii.

³⁵⁸ Thuc II 21

both in Lemnos and elsewhere though no pestilence of such extent nor any scourge so destructive of human lives is on record anywhere.³⁵⁹

This was a far more devastating enemy attack than the first time, because "In this invasion, however, they remained in Attica longer than at any other time, and also ravaged the entire country; indeed they were in Attica almost forty days."³⁶⁰ There is no mention of burning the grain fields, so perhaps the fields were just trampled by horses and soldiers. Importation of grain was now probably well established, and the people got the grain they needed.

But who paid for the grain? I have no information that the state paid for the grain that was imported. If it was purchased directly from merchant ships in Piraeus or from merchants on Agora, it is probable that the poor had no money to pay for it. Instead, they probably had to go to the fields once the enemy had left the country. There they gathered as much as possible of damaged and perhaps also poisonous grain lying on the ground. However, this does not fit the information that the plague appeared only a few days after the enemy had invaded the country. Therefore, it is this time unlikely that the cause of the plague may have been infected grain.

Another possible explanation is that the grain was wet when it was loaded aboard cargo ships bound for Athens. Perhaps the merchant suddenly had to deliver a larger amount of grain than he had planned and accordingly had no time to dry it. The population at that time was undoubtedly not aware of the relationship between wet toxic grain and disease so that wet grain could be sold with a clear conscience. Infection with *Claviceps* is indeed visible, but the people probably could not understand the connection between such findings and poisoning. But even if they had such knowledge, it is important to remember that the fungus *Fusarium* is quite invisible to the naked eye. Thus people could have been poisoned by mycotoxin produced by the fungus *Fusarium*, a toxin which is even more toxic than the mycotoxin produced by *Claviceps*.

A third possibility is that Thucydides uses the term "plague" to express the tragedy connected with the conflict. However, this explanation does not fit, because in that case he would probably have claimed that the plague had already started with the first invasion, not the second one.

As is apparent from what I have described above, it is difficult to argue that toxic grains are the cause of the plague. First, it does not match with the observation that the plague broke out shortly

³⁵⁹ Thuc II 47

³⁶⁰ Thuc II 57

after the enemy invaded Attica, unless imported toxic grain already existed in Athens. Second, why was there no toxin in the grain probably imported the first year of the war? Despite these contradictions, I suggest that ergotism also existed at that time because its existence is well documented in later periods, and the patient record clearly includes symptoms and signs that match such poisoning. Thucydides describes the plague as one disease, while it may instead have consisted of several different diseases known to us today. In that case, the disease that began shortly after the invasion in 430 BC was probably not ergotism but one of the other possible diseases.

In the summer of 429 BC the enemy did not invade Attica, but the plague was still in Athens after the invasion of 430 BC.³⁶¹ Of this new invasion in the summer of 428 BC³⁶² Thucydides writes that they "proceeded to ravage the land. And sallies were made as usual by the Athenian cavalry wherever opportunity offered, thus preventing the great mass of light-armed troops from going beyond their watch-posts and laying waste the districts near the city."³⁶³ He mentions again the plague winter 427 BC and writes that "the plague again fell upon the Athenians; and indeed it had not died out at any time entirely, though there had been a period of respite. And it continued the second time not less than a year, having run for two full years on the previous occasion."³⁶⁴

Afterwards Thucydides does not write about the plague. Why not? Had the disease disappeared, or was he committed to writing about other events related to the war? A hypothetical explanation may be that the fields of Attica were no longer being destroyed because the war was going on elsewhere, and people could move back to their farms and once again grow grain. However, there was another invasion of Attica in 425 BC, and Thucydides writes: "About the same time that spring, before the grain was ripe, the Peloponnesians and their allies made an invasion of Attica, (...) and encamping there they ravaged the land."³⁶⁵ However, it is possible that they did not destroy large areas because "the Peloponnesians, who were in Attica, when they heard that Pylos had been occupied, returned home in haste (...) for they remained there only fifteen days."³⁶⁶

³⁶¹ Thuc III 87

³⁶² Thuc III 1

³⁶³ Thuc III 1

³⁶⁴ Thuc III 87

³⁶⁵ Thuc IV 2

³⁶⁶ Thuc IV 6

Most of the refugees must now have moved home, since the enemy seemed to have stopped the invasions in Attica. Thus, the population of Athens at this time must have been reduced, and people living in the city or rural area could eat once more grain treated in the usual way. Imports were probably also reduced because Attica was once more producing grain. Thus the amount of possibly toxic imported grain must have declined.

The country population was living again over a large area with a reduced risk of spreading infectious diseases. In addition they used their own cisterns, which were not so easily contaminated as the water tanks in an overcrowded city with sewage pits in the streets.

5.3 Contagion as a result of overcrowding

The lowest social classes in Athens lived mainly in an area from the Kerameikos in the northwest down southwest to Koile and Kollytos/Limnae. It is plausible that poor refugees without family in the town settled in these areas and between the long walls because they were more apt to be accepted among other poor people than by the rich living in another region of the city. Before the war the poor part of town was already densely populated, and it thus became overcrowded when the refugees also moved in. In addition, the refugees lived on the northern slope of Acropolis, Pelargikon. Thucydides seems to connect the plague to such overcrowded areas when he writes: "it devastated Athens most of all, and next to Athens the places which had the densest population."³⁶⁷

Tentative diagnoses based on residence in densely populated areas, and thus lack of personal hygiene, point to typhus as the primarily epidemic disease. The explanation is that this disease is dependent on body lice to transmit infection from person to person, and lice thrive and multiply where personal hygiene is inadequate. People in such an environment are then infected in a short time resulting in rapid and extensive spread of the disease. Accordingly, there is little variation in the timing of infection, and many will die at relatively the same time. When the disease has a high mortality rate – up to forty percent of those who get the disease – the result will be as Thucydides describes: "the crowding into the city of the people from the country districts; and this affected the new arrivals especially (...) they perished in wild disorder. Bodies of dying men lay one upon another and half-dead people rolled about in the streets."³⁶⁸ Moreover – next to

³⁶⁷ Thuc II 54

³⁶⁸ Thuc II 52

intake of toxins from fungi infested grain – typhus is the only infectious disease which leads to gangrene in external body parts such as fingers, toes and external genitalia.³⁶⁹

It is very likely that epidemic typhus occurred to a much greater degree among the poor than among the wealthy because the poor lived in cramped and poor houses close to one another and therefore quickly infected one another. In comparison with the poor the rich had more space and greater opportunity to wash regularly and change clothes because they had better access to clean water and money to buy clothing. This would prevent the rich people from body lice. Since the bacteria die quickly outside the body, a thorough body wash and clean clothes will avoid recurrence of the disease. The mode of dress of the time was conducive to avoiding body lice, which mostly lay eggs in seams and folds of clothing, preferably in cotton and wool, less so in silk. And of the main garments neither tunic nor himation has folds and seams. Therefore, it is possible to avoid epidemic typhus and get rid of it by regularly cleaning the body and clothing. For that reason, the elite in Athens were probably not appreciably affected by this disease in contrast to the poor, who may have walked around in rags with lice everywhere.

Accordingly one can assume that typhus was the predominant disease among refugees and the poor, while typhoid fever was not linked to particular social groups and thus appeared among the entire population. However, the mass graves excavated in Kerameikos have demonstrated *Salmonella typhi*, with no indication of either epidemic typhus (*Rickettsia prowazekii*), plague (*Yersinia pestis*), or anthrax (*Bacillus anthracis*).³⁷⁰ However, that study does not disprove the existence of epidemic typhus at the time because the lack of *Rickettsia prowazekii* may be due to the fact that the discovery was made in a mass grave northwest of the Acropolis. Admittedly, there were also refugees in this area, but most of them stayed south and southwest of the Acropolis. There is reason to believe that the dead were buried in reasonable proximity of where they lived and not transported to mass graves at the Kerameikos, due to the long distance with narrow, winding, and steep roads through a densely populated area. Therefore, it is quite possible that in this particular area unidentified mass graves exist outside the city walls.

Flies thrive in poor hygienic conditions both outside and inside a house, and there must have

³⁶⁹ Diseases in the Spotted fever group may also lead to gangrene, but they will mostly affect individuals, not leading to an epidemic such as presented by Thucydides. These diseases are therefore omitted from the discussion of the plague.

³⁷⁰ M.J. Papagrigorakis, C. Yapijakis, P.N. Synodinos, E. Baziotopoulou-Valavani, DNA examination of ancient dental pulp incriminates typhoid fever as a probable cause of the Plague of Athens, *International Journal of Infectious Diseases*, 2006; 10: 206.

been swarms of flies in the densely populated areas of Athens. When the flies can also transmit plague disease (*Yersinia pestis*), the rat flea is not necessary for its spread.³⁷¹

5.4 Conclusion

The most serious risk factor for disease in Athens during the war was overpopulation. This is also indirectly suggested by Thucydides when he writes about the plague and the overcrowding,³⁷² and it resulted in insufficient clean drinking water, an overloaded sewage system, and contaminated water sources supplementing the public water system.

Water and sewer conditions resulted in the spread of typhoid fever, which consequently affected the whole society and explains why the hoplites were sick. Refugees with poor housing and without the opportunity for adequate daily hygiene had body lice, which in turn led to the spread of epidemic typhus. Poisoning in the form of mycotoxin from fungi-infected grain may have caused disease, primarily among the poor, but the extent of such poisoning is uncertain and cannot have been the plague.

Thus, there is ample ground for the conclusion that the plague described by Thucydides consisted of the typhoid fever that affected the whole population, together with epidemic typhus primarily among the poor and the refugees.

In the next chapter I discuss the consequences of the plague for city and population. This assessment may also provide additional information about what kind of disease the plague was: for different diseases result in different mortality rates and therefore different consequences for the entire community.

³⁷¹ L. Walløe, Medieval and modern bubonic plague: Some clinical continuities, in V. Nutton, (ed), *Pestilential complexities: Understanding medieval plague*, *Medical history*, supplement no 27, The Wellcome Trust Centre for the History of Medicine at UCL, London 2008, 71.

³⁷² Thuc II 54

Chapter 6: The consequences of the plague

*The son of Leto and Zeus; for he in wrath against the king roused throughout the host an evil pestilence, and the folk were perishing*³⁷³

If a large proportion of the population died of plague during relatively few years, it should be possible to identify events that confirm or refute the reduction in population numbers. For this reason, this chapter attempts to describe the impact of the disease on society at the time until peace was declared in 421 BC, by surveying facts related to the consequences of the plague for demography, society, culture, and warfare.

However, I omit reflections about possible impacts the plague may have had on our society because this would overly expand the framework for presentation of the topic.

6.1 Demography and plague

I have written about the demographic conditions in Attica and Athens before the plague came to the country. Might it be possible to find traces of the plague in population statistics? That requires comparing the population in 431 with that of 425 BC and the following few years; i.e., after Thucydides no longer wrote about the plague. The basis of the figures is first and foremost from the information Thucydides gives about hoplites who died of the disease.

Thus, Pericles stated in 431 BC:

as to heavy armed infantry, (...) there were thirteen thousand, not counting the sixteen thousand men who garrisoned the forts and manned the city walls (...) composed of the oldest and the youngest citizens and of such metics as were heavily armed. The cavalry, Pericles pointed out, numbered twelve hundred, including mounted archers, the bow men sixteen hundred, and the triremes that were seaworthy three hundred.³⁷⁴

Each of these ships had about 200 rowers, some officers and hoplites. No plague that year.

During a forty-day period in 430 BC the plague claimed "one thousand and fifty out of a total of

³⁷³Homer, *The Iliad*, books I – XII, translated by A.T. Murray, in G.P. Goold, (ed), *The Loeb classical library*, Harvard University Press, Cambridge, Massachusetts, London, William Heinemann Ltd, 1924, reprint 1988, 19-10

³⁷⁴ Thuc II 13

four thousand hoplites."³⁷⁵ This represents a mortality rate of twenty six percent. Lethality, the number of diseased who die is not disclosed. Diodoros writes about the same event: "Many Athenian citizens were being slain in the assaults and by the ravages of the plague (...) sailed back to Athens, having lost more than a thousand of his soldiers."³⁷⁶ Thus, there is a basis for the belief that among the hoplites Thucydides presents as dead of plague, an unknown number were killed or wounded and died after the skirmishes because he gives no information about how many were killed in action, which he customarily describes with respect to other campaigns..

During the discussion of the second attack of the plague he says that "no fewer than four thousand four hundred of those enrolled as hoplites died and also three hundred cavalry, and of the populace a number that could not be ascertained."³⁷⁷ But how many were included in the group *enrolled as hoplites*? Gomme argues that in 431 BC it included 17,500 hoplites (14,500 citizens and 3,000 metics);³⁷⁸ i.e., those not of the hoplite class. These soldiers were drafted for such service, and 4,400 of them died of the plague, resulting in a mortality rate of twenty five percent. But what about the 1,050 hoplites who died in 430 BC? Are they included in or additional to these 4,400 hoplites? Gomme claims without discussing this further that the plague led to the death of a total of 4,400 hoplites and 300 cavalrymen.³⁷⁹ Thus, he seems to accept that about twenty five percent of the soldiers in the first line died of the plague.

When it comes to the number of hoplites who were killed or died because of injuries, Gomme concludes: "Thucydides often ignores all casualties of a campaign except those actually recorded for a battlefield; yet this only means that we are not dealing with exact figures(...) a margin of error of at least 5% either way is understood."³⁸⁰

As Gomme remarks, Thucydides cites the number killed on the battlefield during war expeditions; e.g. against the Chalcidians in Thrace and the Bottiaeans, where the Athenians were defeated and "lost three hundred and thirty men and all their generals."³⁸¹ However, this time he writes about the number of fatalities without any allusion to the plague. Thus, I believe that the vast majority of the 1,050 hoplites he asserted died of the plague actually did so.

³⁷⁵ Thuc II 58

³⁷⁶ Diodoros Siculus, *Books XII 41- XIII*, translated by C.H. Oldfather, Harvard University Press, Cambridge, William Heinemann Ltd, London 1950, reprint 1976, XII 46.

³⁷⁷ Thuc III 87

³⁷⁸ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 6.

³⁷⁹ Ibid.

³⁸⁰ Op.cit: 4

³⁸¹ Thuc II 79

The fact that three hundred of 1,200 knights died is often used to support the estimate that around 25-30 percent of the population of Athens died of plague. It would seem that this number has been pretty much accepted as a truth in modern research literature. One example of this is that of Papagrigrorakis and colleagues, who state that the plague "ended fatally for most of the affected persons, decimating about one-third of Athenians, including their charismatic leader, Pericles."³⁸² Morris & Powell also state as a fact that "One in four Athenian died (...) Pericles died of the Plague in 429."³⁸³

Hansen writes that "if we accept Gomme's total of 47,000 adult male Athenian citizens in 431, the plague which descended upon Athens in 430/29, 429/8 and 427/6 must have caused the death of some 15,000 adult male Athenians."³⁸⁴ Gomme estimated that when the plague ravaged Athens, the whole population of Attica was reduced by approximately 97,000 (thirty percent): 315,000 to 218,000 during the period 431-425 BC.³⁸⁵ However, it must be noted that all deaths regardless of cause must have been included in this number, because "while the plague lasted there were none of the usual complaints, though if any did occur it ended in this."³⁸⁶ Thus, even if the reduction of thirty percent is correct, there is still no basis for claiming that the reduction was attributable only to the plague. That would have meant that almost the majority of the people in Attica should have had the plague sometime during the three years³⁸⁷ it ravaged the population, but is that likely? In addition, many of the residents must have had sequelae after illness or injury resulting in work disability for a long time, since there was no rehabilitation process to take care of them.

However, it should be pointed out that because the path of spread differs between diseases, both typhoid fever and epidemic typhus primarily result in local epidemics. Thus, these two diseases will result in a lower mortality rate among the total population compared with that of

³⁸² M.J. Papagrigrorakis, C. Yapijakis, P.N. Synodinos, Tyfoïd fever epidemic in ancient Athen, in D. Raoult, M. Drancourt, (eds), *Paleomicrobiology, Past Human Infections*, Springer-Verlag, Berlin Heidelberg 2008, 168. The authors give as reference Thuc II 47 – II 54, but Thucydides neither mentions in these chapters that one third of the Athenians died of the plague nor the death of Pericles. However, the report of his death is in Thuc II 65, but Thucydides does not write that the plague was the cause of death.

³⁸³ I. Morris, B.B. Powell, *The Greeks, History, culture and society*, Pearson Prentice hall, New Jersey 2006, 335-336.

³⁸⁴ M.H. Hansen, *Three studies in Athenian demography*, Historisk-filosofiske Meddelelser 56, The Royal Academy of Sciences and Letters, Munksgaard, Copenhagen 1988, 14.

³⁸⁵ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 26.

³⁸⁶ Thuc II 51

³⁸⁷ Thuc III 87

people living in an area with a local epidemic. In addition, previous illness with epidemic typhus protects against new, serious infection; accordingly, the number of dead is lower when the disease occurs again.

It is likely that the reduction in number of hoplites from 17,500 in 431 BC to 9,500-10,000 in 424 BC³⁸⁸ is also partly attributable to deaths related to war, not just the plague. Hansen argues that it is unlikely that the plague affected hoplites and knights to a greater extent than other social groups.³⁸⁹ If the plague is epidemic typhus, the disease will rage among soldiers living extra close to one another and will result in higher mortality compared with that of the general population. Therefore, I believe we should be cautious in suggesting that soldiers were not more susceptible to the plague than the national average.

A thought experiment: If the disease occurs more frequently among hoplites compared with the rest of the population, the hoplites – with respect to transmission of the disease – must in some way stand out from the other people who lived in Athens and Attica. The reason can certainly not be that they are more susceptible to the disease than other people. The hoplites were both younger and in better physical condition than the rest of the population. Besides, belonging to the upper class/middle class they had adequate nutrition, drinking water, housing and clothing. What is special about the hoplites, however, is that they gather in Piraeus and embark on war expeditions from there. Piraeus had no water sources other than cisterns, so the risk of transmission through infected drinking water must have been greater than in Athens. This also fits Thucydides' statement that the people in Piraeus were primarily attacked by the plague; thus the people suspected poisoning from the cisterns.³⁹⁰ In my opinion this is probably correct, but the cause was typhoid bacteria in the water, not poison. Hoplites most likely used the drinking water in Piraeus, and there is also reason to believe that water from the same place was the drinking water used during the campaign, when 1,050 hoplites died of the plague after arrival. This may explain why the plague affected hoplites to a greater extent than the national average.

Gomme argues that for the years 431 to 423 BC "the decline in the birth-rate due to losses between 431 and 423 was further affecting the number of new recruits."³⁹¹ This mainly affects

³⁸⁸ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 6.

³⁸⁹ M.H. Hansen, *Three studies in Athenian demography*, Historisk-filosofiske Meddelelser 56, The Royal Academy of Sciences and Letters, Munksgaard, København 1988, 14.

³⁹⁰ Thuc II 48

³⁹¹ A.W. Gomme, *The population of Athens in the fifth and fourth centuries B.C.*, Basil Blackwell, Oxford 1933, 7.

later periods in the area of military recruitment, but it was already contributing to a reduction of the population. However, calculating the number of births during this period would be pure guesswork, which I will not attempt.

It is probable that the population for relatively short periods was trapped behind the walls of Athens; also, that soldiers and war ships were out cruising. Such dispersion of the population also reduces the risk of infection. Therefore, it is unlikely that plague in the form of typhoid fever or epidemic typhus alone explains the thirty percent population loss.

But how did writers and the elite in ancient times perceive the consequences of the plague of Athens? Plutarch expressed this opinion: "the plague struck for the first hour and ravaged the best of Athenians' youth and resources. The people of Athens were afflicted by the plague not only physically, but also mentally; they became completely wild in their behaviour towards Pericles."³⁹² In contrast to the current research he does not suggest how many died of the plague. Plutarch says that it was primarily the young people who were ravaged by the plague. Therefore, he may be suggesting implicitly that the disease primarily affected hoplites, of which young people constitute an important group. In addition, he argues that the plague inflicted psychological damage on the population.

Drancourt and Raoult write as late as 2002 that the disease "decimated the general population with an estimated 300,000 death (one in every three people) and contributed to the decline and fall of classical Greece."³⁹³ However, the authors do not mention how they reached the number of 300,000, since there were only about 315,000 people living in Attica, and according to Thucydides it was here that the plague mostly raged.

Langmuir and colleagues claim in 1985:

"The Plague of Athens, 430 to 427 BC, was perhaps the most disastrous and fateful epidemic of recorded ancient generations. It fell upon a city that had in just two generations created and nurtured such basic pursuits of Western culture as philosophy, history, tragedy, comedy, and of course, democracy. (...) But within three decades Athens had been defeated in the Peloponnesian War against Sparta (...) The beginning of her downfall can be directly connected to the outbreak of the epidemic, which killed tens of thousands of her 300,000 inhabitants and thereby created

³⁹² Plutarch, Pericles, in P.A. Stadter, (ed), *Greek lives*, translated by R. Waterfield, Oxford University Press, Oxford 2008, 34.

³⁹³ M. Drancourt, D. Raoult, Molecular insights into the history of plague, *Microbes and Infection*, 2002; 4: 105.

numerous military disadvantages, chief among which was the death of the great Athenian leader, Pericles."³⁹⁴

Hyman refutes the description by Langmuir and co-workers of conditions at that time but agrees that the plague had "a terrible effect on the populace of Athens. (...) Indeed, the Sicilian debacle had a greater influence in Athens than the plague, (...) The connection between the plague and the decline of Athens is more than temporal but less than causal."³⁹⁵

Shrewsbury writes in 1950 that the plague of Athens helped to change history's direction, but he qualifies the statement:

The two events that appear to have exerted the greatest influence upon the outcome of that protracted struggle were the pestilence that ravaged Athens in 430 BC, and the disastrous Athenian expedition to Sicily in 415 BC (...) The pestilence was probably less decisive than the annihilation of the Athenian fleet and army at Syracuse, (...) through the death of Pericles – who was one of the victims – it molded the subsequent Athenian policy and possibly led indirectly to the fatal Sicilian venture.³⁹⁶

Zinsser's opinion is: "The Plague of Athens (...) had a profound effect upon historical events. It was one of the main reasons why the Athenian armies (...) did not attempt to expel the Lacedaemonians, (...) Athenian life was completely demoralized, and a spirit of extreme lawlessness resulted."³⁹⁷ In addition, he claims: "The Peloponnesians left Attica in a hurry, not for fear of the Athenians (...) but because they were afraid of the disease."³⁹⁸ Zinsser provides no reference, but there is reason to believe that he refers to Thucydides, who writes: "the plague was making havoc among the Athenians (...) The statement was therefore made that the Peloponnesians left Attica in haste because they were afraid of the disease, since they not only heard from deserters that it was in the city, but also could see them burning their dead."³⁹⁹

³⁹⁴ A.D. Langmuir, T.D. Worthen, J. Solomon, C.G. Ray, E. Petersen, The Thucydides syndrome. A new hypothesis for the cause of the plague of Athens, *N Engl J Med*, 1985; 313: 1027.

³⁹⁵ D. Hyman, The plague of Athens, *N Engl J Med*, 1986; 314: 855.

³⁹⁶ J.F.D. Shrewsbury, The plague of Athens, *Bulletin of the history of medicine*, 1950; 24: 1.

It was during the siege that 10 000 died on Sicily in 413/412.

³⁹⁷ H. Zinsser, *Rats, lice and history*, Transaction publishers, New Brunswick (U.S.A.) and London (U.K.) 2008, 121.

³⁹⁸ Ibid.

³⁹⁹ Thuc II 57

However, Zinsser does not refer to what Thucydides writes in his next sentence: "In this invasion, however, they remained in Attica longer than at any other time, and also ravaged the entire country; indeed they were in Attica almost forty days."⁴⁰⁰ In my opinion Thucydides does not claim that Lacedaemonians hurried home because they feared the plague. He refers only to what someone has said, without taking a position on the veracity of that statement. What is important is that Thucydides states that the enemy both stayed longer than at any other time and that he plundered. Thus, his presentation of the events seems to be in contrast to Zinsser's. This is an example of how important it is to attend to the subtleties of Thucydides' arguments, in contrast to statements others have attributed to him.

Woodman is generally critical of the presentation Thucydides gives of the plague and calls for corroboration.⁴⁰¹ Hornblower counters Woodman and cites the purification of Delos as an argument that there had been a plague.⁴⁰² Thucydides writes indirectly that it was the plague that was the cause of the cleaning: "During the same winter the Athenians purified Delos in compliance with a certain oracle."⁴⁰³ Thucydides perhaps had the following in mind:

the Athenians were sore pressed, their people dying within the walls and their land being ravaged without. And in their distress they recalled, as was natural, the following verse which their older men said had long ago been uttered: 'A Dorian war shall come and pestilence with it.' A dispute arose, however, among the people, some contending that the word used in the verse by the ancients was not *λοιμός*, 'pestilence,' but *λιμός*, 'famine,' and the view prevailed at the time that 'pestilence' was the original word; and quite naturally, for men's recollections conformed to their sufferings.(...)Those, too, who were familiar with it, recalled that other oracle given to the Lacedaemonians, when in answer to their inquiry whether they should go to war, the god responded that if they 'warred with all their might victory would be theirs,' adding that he himself would assist them.⁴⁰⁴

⁴⁰⁰ Thuc II 57

⁴⁰¹ A.J. Woodman, *Rhetoric in classical historiography, Four studies*, Croom Helm Ltd, Provident House, Beckenham 1988, 39.

⁴⁰² S. Hornblower, *A commentary on Thucydides*, Volume I, Books I-III, Clarendon Press, Oxford 1991, 318.

⁴⁰³ Thuc III 104

⁴⁰⁴ Thuc II 54

Diodoros also claims that the removal of dead from Delos was conducted to satisfy Apollo.⁴⁰⁵ "The Athenians, however, because the disease was so severe, ascribed the causes of their misfortune to the deity. Consequently, acting upon the command of a certain oracle, they purified the island of Delos, which was sacred to Apollo."⁴⁰⁶ Although Diodoros does not specify his source, compared with Thucydides, there is reason to believe that the plague is the explanation for the purification. Accordingly, the purification confirms that there was a serious illness in Athens during the Peloponnesian War. For this reason I disagree with Woodman but agree that it is striking that traces of the plague have not been observed, except for the newly found mass graves, nor have there been mentions in inscriptions. Pausanias describes, however, from his visit to Agora, a painting which shows: "Of the two Apollos in front of that temple, one is by Leochares, but the other, the Preserver from Evil, by Kalamis. They say the god got his name by putting an end through the Delphic oracle to the plague that scourged Athens in the Peloponnesian War."⁴⁰⁷ To a certain extent this lost painting described by Pausanias confirms that during the war there had been a plague in Athens.

More than 7,500 inscriptions from the Agora have been found.⁴⁰⁸ But strangely, none reviews the plague, which many authors claim destroyed a third of the population of Attica. Has an inscription been destroyed, or did one ever exist? The latter is difficult to accept when Thucydides describes large loss of lives. However, mass graves have now been discovered that may be linked to the plague. These graves were unknown to Woodman when he wrote his book.

Camp connects the construction of the Stoa Brauron southeast of Athens ca. 425 BC to the plague. He also refers to an inscription in connection with the repair at a later stage of the seven shrines in Brauron: "which the city, having built them, dedicated to the goddess for the saving of the people of Athens."⁴⁰⁹ Both Artemis and her brother Apollo could bring plague to humans.⁴¹⁰ It is likely that the building in Brauron was erected to appease Artemis. Thus, this building activity in Brauron may be interpreted as a form of "inscription" related to the plague. Apollo had already received attention from the people a year earlier when they purified Delos; now it was

⁴⁰⁵ Apollo was able to cause [the] plague.

⁴⁰⁶ Diodoros Siculus, *Books XII 41- XIII*, translated by C.H. Oldfather, Harvard University Press, Cambridge, William Heinemann Ltd, London 1950, reprint 1976, XII 58.

⁴⁰⁷ Pausanias, *Guide to Greece: vol. 1: Central Greece*, translated by P. Levi, Penguin Books Ltd., Middlesex 1971, new edition with revisions 1979, I 3 [4].

⁴⁰⁸ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 257.

⁴⁰⁹ Op.cit: 126.

⁴¹⁰ Op.cit: 124.

time for his sister to receive a similar honor.⁴¹¹

According to Camp both the god Asklepios⁴¹² and the hero Amfiaraos⁴¹³ were considered, so "the plague may have induced the Athenians to ingratiate themselves with a healing deity."⁴¹⁴ The healing gods obtained thus some monumental attention. The sanctuary associated with Amfiaraos is dated to the second half of the 5th century BC.⁴¹⁵

Is it possible that a third of the population of Attica died within a few years? I find it appropriate to express some doubt, for there is still no evidence of large mass graves from that time. If it is true that many people died during a limited period of time, it is logical to believe that mass graves must exist. In addition, we should reflect on how it was possible for the society to function despite a significant reduction in population within a few years, accompanied by many sick and disabled people. During the Black Death in The Middle Ages numerous farms were laid waste and parts of society ceased to exist. If it is true that there was a disease with a mortality of around thirty percent during those years in Athens, it would be reasonable to conclude that the plague in Athens would lead to fairly similar consequences for society, but did it happen? That is the next topic.

6.2 Plague and Society

Thucydides describes the consequences of the plague for Athenian society, as follows: a society in decay:

For where men hitherto practiced concealment, that they were not acting purely after their pleasure, they now showed a more careless daring. (...) And so they resolved to get out of life the pleasures which could be had speedily and would satisfy their lusts, (...) the pleasure of the moment and whatever was in any way conducive to it came to be regarded as at once honourable and expedient. No fear of gods or law of men restrained.⁴¹⁶

⁴¹¹ Diodoros Siculus, *Books XII 41- XIII*, translated by C.H. Oldfather, Harvard University Press, Cambridge, William Heinemann Ltd, London 1950, new reprint 1976, XII 58.

⁴¹² J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 122.

⁴¹³ Op.cit: 126, 322 – 323.

⁴¹⁴ Op.cit: 127.

⁴¹⁵ Op.cit: 323

⁴¹⁶ Thuc II 53

According to Thucydides the death of Pericles (ca. 493-429 BC) also changed the development of society and the outcome of the war, because:

after his death his foresight as to the war was still more fully recognized. For he had told the Athenians that if they would maintain a defensive policy (...) or do nothing to imperil the existence of the state, they would prove superior. But they not only acted contrary to his advice in all these things, but also in matters that apparently had no connection with the war they were led by private ambition and private greed to adopt policies which proved injurious both as to themselves and their allies; (...) but when they failed proved detrimental to the state in the conduct of the war.⁴¹⁷

But was it the plague that caused Pericles' death? Thucydides only writes that Pericles "lived two years and six months beyond the beginning of the war"⁴¹⁸ and it is Plutarch about 500 years later who states: "It was at this hour, apparently, that Pericles caught the plague. He did not suffer the usual acute or intense attack, but one which gradually wore out his body and undermined his proud spirit by means of a lingering and protracted illness that came and went."⁴¹⁹ However, this illness is not consistent with Thucydides' description of the plague.

Pericles dies at about sixty years of age, an advanced age at that time, and the cause of death is impossible to determine on the basis of the information given by Plutarch. It is also striking that Thucydides does not write that Pericles died of the plague, which would have been natural inasmuch as Thucydides describes his own disease. Thus, it is possible that the plague was not the cause of death of Pericles,⁴²⁰ and that consequently the plague cannot be blamed for the impact the death of Pericles had on both society and the outcome of the war. Generally speaking, we all should be cautious about claiming that the outcome of a war depends on whether a particular person is alive or not.

Did people develop a negative attitude towards religion and morality due to the plague which

⁴¹⁷ Thuc II 65

⁴¹⁸ Ibid.

⁴¹⁹ Plutarch, i P.A. Stadter, (ed), Pericles, *Greek lives*, translated by R. Waterfield, Oxford University Press, Oxford 2008, 38.

⁴²⁰ Textbooks still inform that Pericles died of the plague, e.g. I. Morris, B.B. Powell, *The Greeks, History, culture and society*, Pearson Prentice hall, New Jersey 2006, 335-336, and J.A.C.T.G.C., *The world of Athens, An introduction to classical Athenian culture*, 2. edition,, revised by R. Osborne, Cambridge University Press, Cambridge 2008, 30.

resulted in the dissolution of the society, as Thucydides might have it? I doubt that a direct analysis of their attitudes is possible with the information we have, but it may be feasible to obtain an indirect view of the consequences of the plague by judging whether Athens came to a standstill or not. It may be possible to answer such a question by addressing some practical aspects of Athenian society of the time. Thus, it might also be possible to specify the population's attitude towards religion in terms of its involvement in the construction of religious institutions. Afterwards I shall discuss the cultural life, and finally how the people handled their military duties.

6.2.1 Construction work

It is likely that a sick population combined with the high mortality of the plague during the Peloponnesian War led to reduced working capacity, and consequently inadequate performance of practical tasks for the society. Therefore, I am going to compare the construction business in the city just before the war broke out with similar activity during the war until 421BC.

In accordance with a decision of the National Assembly in 460 BC Pericles started an extensive building program at the Acropolis which lasted until 430 BC.⁴²¹ After the Parthenon,⁴²² the house of Athena Parthenos, was completed in 438, construction of the Propylaia began and lasted from 437-432 BC. The work stopped at the outbreak of the war and was probably never completely finished.⁴²³ Camp argues that the public construction on the Acropolis changed character after 430 BC:

During the war, work on most of the great marble temples of the Periklean program seems to have been halted or curtailed. Religious monuments, however, continued to be built, though not on the lavish scale we have just been studying. A major impetus for cult activity seems to have been the outbreak of the plague; its apparently random choice of victims left the Athenian searching for additional sources of divine help.⁴²⁴

⁴²¹ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 117.

Athens used money from the Delian League to finance the construction work. See Plutarch, in P.A. Stadter, (ed), Pericles, *Greek lives*, translated by R. Waterfield, Oxford University Press, Oxford 2008, 12.

⁴²² Homer gave Athene the byname *pallas*, young girl? and Athene is looked upon as a virgin, *parthenos*. Thus, *Parthenon* is the house of the virgin.

⁴²³ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 83.

⁴²⁴ Op.cit: 117.

When construction work on the Acropolis over a timeframe of 30 years is compared with the next nine years, it is understandable that the construction in the latter period appears to be less extensive than in the first. However, the work on the Acropolis continued after the war began. Construction of the marble temple of Athena Nike began in 427 BC after the decision to build was taken in 448 BC, and it was completed in 425/424 BC.⁴²⁵ Camp writes that the construction period was from 430 to 424/423 BC.⁴²⁶ Travlos and Camp cite different years for the start of construction, but it can be argued that both scholars indirectly confirm that construction continued during the plague period.

The Erechtheion⁴²⁷ is the last temple built on the Acropolis. The work started probably late in 430 BC or even later and continued with interruptions during the entire war.⁴²⁸ Travlos, however, claims that it was begun in 421 BC and completed in 406 BC after a short interruption.⁴²⁹ The temple burned around 406/5 right after it was finished, but was repaired.⁴³⁰

Moreover, other religious buildings were built. The Temple of Hephaistos was started 460-450 BC, and it is likely that construction stopped because labor was directed to the Acropolis.⁴³¹ However, construction of the temple continued from about 425 BC,⁴³² during the war but after the waves of the plague.

A large stoa was built in Brauron southeast of Athens around 425 BC: "an unusual time for building activity in Attica. The impetus for this stoa must therefore have been strong, and clearly the plague would represent a suitable motive."⁴³³ Camp claims the stoa was built in Brauron because this place was the main shrine of Artemis, sister of Apollo.⁴³⁴ Camp points out that the plague led the population to experience a need for spiritual help and support, and in this connection he refers to the purification of Delos and the construction of Brauron and

⁴²⁵ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 148-149.

⁴²⁶ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 92.

⁴²⁷ Here lived Athena Polias who protects Athens, and this is the most holy building on Acropolis.

Op.cit: 93.

⁴²⁸ Op.cit: 95.

⁴²⁹ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 213.

⁴³⁰ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 99.

⁴³¹ Op.cit: 103.

⁴³² Ibid.

⁴³³ Op.cit: 126.

⁴³⁴ Op.cit: 124.

Amphiareion.⁴³⁵ Thus the result was increased construction activity related to religion.⁴³⁶ More than likely these construction projects demonstrate that the population was in need of religion, which conflicts with what Thucydides writes about the plague: "for the calamity which weighed upon them was so overpowering that men, not knowing what was to become of them, became careless of all law, sacred as well as profane."⁴³⁷ Thucydides' statement came, however, at the beginning of the war, when the plague raged in the land, so the population could well have changed its approach to both religion and morality, since the purification of Delos and the construction of Brauron came some years later.

Camp claims: "For the most part, there is little sign of building activity in Attica during the war, hardly surprising since the Athenians had abandoned the countryside for the city."⁴³⁸ Apart from construction related to religion Camp writes that the Athenians continued to build through the war to cover the population's needs for other public buildings.⁴³⁹ And he adds: "The buildings are much more modest structures than the great marble temples of the Acropolis, with walls of sun-dried mudbrick and floors of packed clay."⁴⁴⁰

But what took place in terms of secular building activities during the war? In contrast to Camp Whitley emphasizes that the war did not reduce the construction business: "A yet more splendid stoa, the Stoa of Zeus Eleutherios, was constructed between 430 and 420 BC. This had two wings, and like the painted stoa was decorated with pictures. (...) it seems to have been used simply as an all-purpose public amenity, there just for pleasure and convenience for the Athenian citizens."⁴⁴¹ Travlos suggests start of construction around 430 BC⁴⁴², but he does not say when it was finished. Camp, however, writes that the building took place from 430 to 420 BC,⁴⁴³ which matches the perception of Whitley. Accordingly, they agree that all or part of the construction was going on while there was plague in Athens.

Whitley also mentions the construction of a new Bouleterion.⁴⁴⁴ However, he did not specify

⁴³⁵ Op.cit: 322 – 323.

⁴³⁶ Op.cit: 117.

⁴³⁷ Thuc II 52

⁴³⁸ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 124 – 125.

⁴³⁹ Op.cit: 127.

⁴⁴⁰ Ibid.

⁴⁴¹ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.edition 2004, 334.

⁴⁴² J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 527.

⁴⁴³ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 104.

⁴⁴⁴ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.edition 2004, 334.

the year it was built, but it is clear that it happened during the war. Travlos only writes that "from the end of the 5th century BC (...) a new Bouleterion was built."⁴⁴⁵ Camp on the other hand places the building to the time period 416-409 BC,⁴⁴⁶ so it is possible that it was built after the plague ravaged Athens. Moreover, Whitley says that "The 'Royal Stoa' too was refurbished. On its two wings, a complete code of laws was inscribed and set up towards the end of the fifth century BC, a code which, in theory, every citizen could consult."⁴⁴⁷ However, it is not possible to determine whether this renovation occurred while there was plague in Athens.

Another public building, South Stoa I, was built in 430-420 BC while the plague probably was in Athens: "It is clearly a public building (...) It is modest in construction, composed in part of reused wall blocks supporting a superstructure of mudbrick. It was properly maintained."⁴⁴⁸ Travlos dates the building back to "the last quarter of the 5th century BC,"⁴⁴⁹ while Whitley writes that it was built during the last years in the fifth century BC.⁴⁵⁰ This was the last stoa which was built in the Agora before Hellenistic times.⁴⁵¹

On the basis of archaeological findings, there is reason to suggest that the plague had little effect on the building business and this part of the community. This could mean that the economic situation in Athens was relatively good and that a number of construction workers were not exposed to plague – perhaps because they were neither hoplites nor poor refugees in Athens?

But to what extent were other parts of the society, such as culture and warfare, affected by the plague?

6.2.2 Cultural life

Plays were performed at the Agora probably until around 450 BC,⁴⁵² and afterwards a modest theater was built where the Dionysus Theater remains. The theater we look at today is from the end of the fourth century BC.⁴⁵³ Thus, there is reason to believe that acting did not take place in the Agora during the war because the population at that time already had the Dionysus Theater

⁴⁴⁵ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 191.

⁴⁴⁶ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 127.

⁴⁴⁷ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.edition 2004, 334.

⁴⁴⁸ J.M. Camp, *The Archaeology of Athens*, Yale University Press, New Haven and London 2001, 127 – 128.

⁴⁴⁹ J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 534

⁴⁵⁰ J. Whitley, *The archeology of ancient Greece*, Cambridge University Press, Cambridge 2001, 3.edition 2004, 335.

⁴⁵¹ R.E. Wycherley, *The Stones of Athens*, Princeton University Press, Princeton, New Jersey 1978, 45.

⁴⁵² J. Travlos, *Pictorial dictionary of ancient Athens*, Praeger Publishers, New York, Washington 1971, 537.

⁴⁵³ Op.cit: 538.

south of the Acropolis. Therefore, an overcrowded Agora with refugees, where probably several also were seriously ill, did not interfere with performances of plays, which had a central role in the community because: "All of them helped, simultaneously, to boost religious feelings and patriotism, belief in the gods and national pride. Only war could temporarily suspend the cycle of these great periodical festivals."⁴⁵⁴ Likely, in a critical situation such as war and pestilence, the people simply needed the Dionysus festivals, where the individual could contribute by participating in the festivals and thus mitigate and seek support from the gods against war and pestilence. The purification of Delos⁴⁵⁵ illustrates just such an attitude. Besides, the festivals created cohesion in the population, important during a war. Therefore, the authorities probably did all they could to sustain the festivals, and only dramatic events could prevent performances. It may therefore be possible to assess the severity of the plague on the basis of our current knowledge about performance of tragedies and comedies during the Archidamos war.

The Dionysos festivals required 12 plays each year. Regarding the period 431-421 BC, we have knowledge of the performance of King Oedipus in 427 BC or maybe 434-2,⁴⁵⁶ Medeia 431, Hippolytos 428 BC – won the first prize - and Hiketides 424 (?) BC. Five comedies were written by Aristophanes and recorded in the period 425-421BC. In the opening scene of King Oedipus the plague in Thebes has a prominent place,⁴⁵⁷ but that does not necessarily refer to the plague in Athens.⁴⁵⁸ I have not found the plague described in other plays, not even by Aristophanes, but it could have been featured in plays that are missing.

Facts about whether the festivals were maintained or not during the war are sparse so there are grounds for caution in the interpretation of events. However, there is no doubt that Hippolytos was first performed in 428 because the play won the first prize. At that time the plague raged in Athens and at least this time did not prevent the presentation at the Dionysos Theater. Thus, the implementation of the festival shows that Thucydides probably exaggerated the impact of the plague when he wrote: "Bodies of dying men lay one upon another, and half-dead people rolled about in the streets and, in their longing for water, near all the fountains."⁴⁵⁹ I do have problems

⁴⁵⁴ R. Flacelière, *Daily life in Greece at the time of Pericles*, Librairie Hachette 1959, translated by P. Green, Weidenfeld and Nicolson, London 1965, 197.

⁴⁵⁵ Thuc III 104

⁴⁵⁶ Wikipedia ca 429 BC

⁴⁵⁷ Wikipedia claims the play was first performed ca. 429 BC

⁴⁵⁸ Bendz, G. Gresk litteratur, in Beyer, E., Billeskov Jansen, F.J., Stangerup, H., Traustedt, P.H., (ed), *Verdens litteraturhistorie*, J.W. Cappelens forlag A.S., Oslo 1971, 327.

⁴⁵⁹ Thuc II 52

imagining people of Athens participating in festivals where they literally had to straddle the dead and half-dead human beings to get to the plays.

6.2.3 War and plague

Thucydides' perception of decisions of the National Assembly is expressed in what he writes about Pericles:

convinced that his judgment was right about refusing to go out, would not convoke a meeting of the assembly or any gathering whatever, for fear that if they got together there would be an outbreak of passion without judgment that would end in some serious mistake; moreover he guarded the city, and as far as he could, kept it free from disturbances.⁴⁶⁰

Thus, Thucydides reveals his rather low opinion of citizens' ability either to assess or make decisions in difficult cases; in this case, war strategy.

Since my purpose is to assess the effect the plague had on the outcome of the Archidamos war, there is no need to discuss either war strategy or all the skirmishes, but I will briefly mention the most important actions. Thus I divide the sections on war expeditions chronologically by the presence or absence of the plague.

6.2.3.1 War Cruise before the plague

After the initial invasion of Attica in the summer of 431 BC, the population was no doubt gathered behind the walls of Athens. The beginning of the war led to minor skirmishes; some were killed, and Pericles did "constantly send out detachments of cavalry to prevent flying parties from the main army from raiding the fields near the city and ravaging them."⁴⁶¹ After a while, the Athenians chose to counter-attack deep within hostile territory, and they "sent out on an expedition round the Peloponnesus the hundred ships which they had been equipping, and on

⁴⁶⁰ Thuc II 22

⁴⁶¹ Ibid

them a thousand hoplites and four hundred archers.”⁴⁶² They raided various parts of the coast⁴⁶³ and simultaneously sent thirty ships to protect Euboea.⁴⁶⁴

The war continued, and:

Toward the autumn of this year the Athenians with all their military forces, drawn both from the citizens and the resident aliens, invaded Megaris under the command of Pericles (...) This was the largest army of Athenians that had ever been assembled in one body, for the city was still at the height of its strength and not as yet stricken by the plague; the Athenians themselves numbered not less than ten thousand heavy infantry, not including the three thousand at Potidaea, and there were three thousand heavy-armed aliens who took part in the invasion, and, besides, a considerable body of light-armed troops. After they had ravaged most of the Megarian country they retired.⁴⁶⁵

Thucydides also writes in the same chapter that until 424 BC Athenians annually invaded Megaris every year "both with the cavalry and with the whole army, until Nisaea was captured.”⁴⁶⁶ The Athenians later also fought in this area while the plague ravaged Athens.

6.2.3.2 War Cruise during the plague

The plague came to Athens after the invasion in 430 BC. Just before the disease broke out, Pericles equipped and directed 100 ships with 4,000 hoplites from Athens and cargo ships with 300 cavalry. The force devastated coastal areas of the Peloponnese.⁴⁶⁷ After they returned in the summer to Athens, where the plague ravaged, the same expedition went under the leadership of Hagnon to Thrace and Poteidaia.⁴⁶⁸ Now, for the first time Thucydides writes about plague among the soldiers, reporting that 1,050 of 4,000 hoplites died of the disease. There is reason to believe that the hoplites used the same vessels to both war raids, for the hundred ships were ready

⁴⁶² Thuc II 23

⁴⁶³ Thuc II 25

⁴⁶⁴ Thuc II 26

⁴⁶⁵ Thuc II 31

⁴⁶⁶ Nisaea was captured in 424 BC, see D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 64.

⁴⁶⁷ Thuc II 56

⁴⁶⁸ Thuc II 58

to sail. Drinking water that might still be aboard stored in jars was hardly thrown out when there was reason to assume that water in the summer would be scarce. If the drinking water was initially infected, the bacterial growth would increase due to prolonged storage in the summer heat and consequently create risk of infection during the second cruise. Afterwards Thucydides does not mention the plague in connection with the individual war expeditions. This presumably is why the hoplites did not become ill in large numbers compared with the expedition under leadership of Hagnon. A hypothetical explanation is that the other naval expeditions did not last as so long as these two first campaigns together, so the bacterial content of drinking water in later cruises did not have time to rise high enough to result in disease.

The summer 429 BC the Lacedaemonians did not invade Attica but besieged Plataea.⁴⁶⁹ However, they failed to take the city⁴⁷⁰ even though it was defended by a small force "against assault by the entire Peloponnesian army."⁴⁷¹ "During the same summer, when the corn was in full ear, while the expedition against Plataea was in progress, the Athenians with two thousand hoplites of their own and two hundred cavalry marched against the Chalcidians in Thrace and the Bottiaens."⁴⁷² The Athenians were forced to flee and lost 330 men and all their generals.⁴⁷³ Thucydides mentions neither the plague nor the size of the force, but states the losses. However, it is probable that the Athenians had a large force because it was led by three men.

Despite inferior strength, the Athenians won an important naval battle in the summer 429 BC.⁴⁷⁴ Kagan reviews the event: "The first Peloponnesian effort at an amphibious offensive had resulted in humiliating failure."⁴⁷⁵ Lacedaemonians also tried a surprise attack against Piraeus. Although the Athenians were first aware of an incipient attack at night, they responded quickly, went out at dawn, and the Lacedaemonians disappeared.⁴⁷⁶ Further sea battles followed, and the Athenians prevailed in the end.⁴⁷⁷

In the summer of 428 BC the Lacedaemonians once more invaded Attica, "And sallies were

⁴⁶⁹ Thuc II 71

⁴⁷⁰ Thuc II 78

⁴⁷¹ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 105.

⁴⁷² Thuc II 79

⁴⁷³ Ibid

⁴⁷⁴ Thuc II 84

⁴⁷⁵ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 111.

⁴⁷⁶ Thuc II 94

⁴⁷⁷ Thuc II 92

made as usual by the Athenian cavalry wherever opportunity offered, thus preventing the great mass of the enemy's light-armed troops from going beyond their watch-posts and laying waste the districts near the city."⁴⁷⁸ Thucydides reviews the plague again and mentions that the Athenians were in trouble due to the plague and the war.⁴⁷⁹

There were riots on Lesbos, and Athens quickly sent forty ships which were originally planned to be sent around the Peloponnesus, to Lesbos.⁴⁸⁰ Kagan interprets the number of only forty ships to the Peloponnesus to suggest impairment of the resources of Athens because in the previous year they had used 100 ships for a corresponding expedition.⁴⁸¹ However, in the same summer they sent thirty ships round Peloponnesus and ravaged the coast.⁴⁸² Later the admiral ordered most of the ships back to Athens, which Kagan also interprets as an expression of lack of resources.⁴⁸³ The Mytilenaen had a similar opinion: "the Athenians have been ruined by pestilence as well as heavy expenses. Part of their fleet is cruising about your coasts, part is arrayed against us; so that it is not likely that they have any ships to spare if you attack them this coming summer a second time, by sea as well as by land."⁴⁸⁴ However, the Athenians dismissed lack of resources because "without moving the fleet at Lesbos they could easily ward off the new force coming from the Peloponnesus, manned one hundred ships, the citizens, – except the knights and the highest class – embarking as well as the resident aliens. Then putting out to sea they displayed their strength along the coast of the Isthmus and made descents upon the Peloponnesus wherever they pleased. As for the Lacedaemonians, when they saw how greatly they had miscalculated, they concluded that the reports of the Lesbians were untrue."⁴⁸⁵

However, there is reason to believe that Athens gradually began to suffer financial problems, and that may be one of the reasons why fewer ships were equipped. Thucydides confirms in connection with the war on Lesbos that Athens was in financial difficulties: "Now the Athenians, finding themselves in need of additional funds for the siege, having then for the first time resorted

⁴⁷⁸ Thuc III 1

⁴⁷⁹ Thuc III 3

⁴⁸⁰ Thuc III 3

⁴⁸¹ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 136.

⁴⁸² Thuc III 7

⁴⁸³ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 139.

⁴⁸⁴ Thuc III 13

⁴⁸⁵ Thuc III 16

to a property tax upon themselves to the amount of two hundred talents, also sent to the allies twelve ships (...) to collect money from them."⁴⁸⁶

After taking Lesbos, the Athenians started a raid at Minoa, out of Megara.⁴⁸⁷ All this shows that the Athenians had a military capacity to implement operations more or less simultaneously in different places. For they also sent twenty ships to Sicily: "they established themselves at Rhegium in Italy and proceeded to carry on the war in concert with their allies."⁴⁸⁸ Next summer, they continued the war together with their allies and were able to gain control over the Messina Strait.⁴⁸⁹

In the same summer 427 BC Athens outfitted thirty ships which sailed around the Peloponnesus, and sixty ships and 2,000 hoplites were sent to the Melos.⁴⁹⁰ During the expedition around the Peloponnesus the Athenians fell into an ambush, and "Many of the allies were slain, and of the Athenians themselves about one hundred and twenty hoplites. (...) and Procles, one of the two generals, perished also."⁴⁹¹

In the winter of 426 BC there were battles in the northwest, at Ambrakia, where the Athenians won, but "the victory of the Athenian was not complete."⁴⁹²

6.2.3.3 War Cruise after the plague until the peace in 421 BC

In the spring of 425 BC the Athenians defeated the Lacedaemonians in the battles of Pylos and Sfakteria on the northwest coast of the Peloponnesus, and the Lacedaemonians asked for a cease-fire which the Athenians agreed to.⁴⁹³ However, the Athenians did not trust the negotiators from the opponents when they wanted to make it permanent. Therefore, the cease-fire became short-lived.⁴⁹⁴ "During the same summer and directly after these events the Athenians made an expedition into Corinthian territory with eighty ships and two thousand Athenian hoplites,

⁴⁸⁶ Thuc III 19

⁴⁸⁷ Thuc III 51

⁴⁸⁸ Thuc III 86

⁴⁸⁹ Thuc III 90

⁴⁹⁰ Thuc III 91

⁴⁹¹ Thuc III 98

⁴⁹² D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 216.

⁴⁹³ Thuc IV 15-16

⁴⁹⁴ Thuc IV 22-23

together with two hundred cavalry on board horse-transports.”⁴⁹⁵ And the Athenians won the battle.

However, they lost the battle of Delium in 424 BC: "And there were slain in the battle, of the Boeotians a little more than five hundred, of the Athenians a little less than one thousand, including Hippocrates their general, besides a great number of light-armed troops and baggage-carriers.”⁴⁹⁶

During the summer of 424 BC the Athenians made an expedition against Cythera “with sixty ships, two thousand hoplites and a small detachment of cavalry, taking with them also some Milesians and others of their allies.”⁴⁹⁷ The Athenians won the battle.

In the years until the conclusion of peace, there were clashes mainly in Thrace, where both Brasidas, commander to the Lacedaemonians, and Cleon, the Athenians’ commander, were killed.⁴⁹⁸ Athens lost the battle of Amphipolis.⁴⁹⁹ The entire army of Athens was forced to flee,⁵⁰⁰ and 600 Athenians were killed.⁵⁰¹

Both generals, Brasidas and Cleon, had opposed peace. However, the new generals on each side, Pleistoanax of the Lacedaemonians and Nicias of the Athenians, “had most zealously supported the cause of peace (...) urged this course with greater zeal than ever.”⁵⁰² Their peace conferences ended with the following agreement: “they should make peace, each party to restore to the other the territories which they had gained by war, though the Athenians were to keep Nisaea.(...) ratifying it by libations and oaths with the Athenians, and the Athenians with them.”⁵⁰³ Thus, it can be said that the treaty states that the parties agreed that both had won the war.

6.2.3.4 War and plague, what was the result?

When the war is considered on the basis of the foregoing description -- with and without concomitant plague in Athens – in my opinion it is scarcely possible to verify any negative effect

⁴⁹⁵ Thuc IV 42

⁴⁹⁶ Thuc IV 101

⁴⁹⁷ Thuc IV 53

⁴⁹⁸ Thuc V 10

⁴⁹⁹ Thucydides was now exiled.

⁵⁰⁰ Thuc V 10

⁵⁰¹ Thuc V 11

⁵⁰² Thuc V 16

⁵⁰³ Thuc V 17 However, Thuc V 18 describes in details the agreement.

of the plague:

The Athenians had already been on war expeditions with large forces when the plague struck in 430 BC, but they did experience the disease in the campaign against the Chalcidians in Thrace, Potidaea where 1,050 out of 4,000 died of the disease. However, it is difficult to analyze how important this loss became for the further warfare because there is reason to believe that they had no need for additional recruitment that year.

Next summer with the plague in Athens, they were able to both organize and implement a comprehensive attack directed against Chalcidians. Thus, the Athenians were probably not so affected by illness and death that they had to go on the defensive. On the contrary, they performed a counter-attack far from the city and probably with a large military force. Certainly, the attack was no success – they were forced to flee, 440 men fell, and all the generals – but Thucydides does not blame the plague for the loss. The same summer they gained victory in naval battle in spite of inferior strength. Therefore, one can infer that these hoplites and rowers could not have been seriously ill.

The fighting spirit is present and is confirmed next summer when the Athenians, by quickly manning warships, prevent an unexpected attack on the Piraeus. In 428 BC they fought both at Lesbos and Peloponnesus with a total of 70 ships.

Thucydides writes that the Athenians were in trouble due to the plague and the war. Mytilenaens claims the same, according Thucydides. But the Athenians disprove the claim by manning 100 ships as a pure demonstration of power and showing that both the morale and resources are present.

One incident, however, may indicate that the plague affected the war because a force of 1,000 hoplites rowed to Lesbos.⁵⁰⁴ Experienced rowers are important during an attack in order to maneuver quickly. It does not need much imagination to understand how complicated it is to maneuver a ship with oars at three different levels. The task as rower was reserved to the lowest level of citizens and the metics, and the hoplites probably had almost no such training. So why did the Athenians use hoplites as rowers on this occasion despite the fact that they probably were unfamiliar with the task? One reason may be that the general was already confident there were going to be no naval battles, and therefore the hoplites on board were sufficient. Unfortunately Thucydides provides no information about the type of ships they used. Maybe it was only

⁵⁰⁴ Thuc III 18

transport ships carrying hoplites, not battleships, and rowers were therefore unnecessary. The questions are many, but perhaps the most reliable explanation may be that they simply lacked rowers and had to use hoplites instead. Too few qualified rowers are quite possible if the plague was, e.g. epidemic typhus, which especially attacks people who live close together; i.e., the lower social strata, where the rowers were recruited. However, Kagan gives the following explanation for why ordinary rowers were not used: "There can be no doubt that the attempt to save money was the cause of their double duty."⁵⁰⁵ He estimated that Athens thus could save about 13 talents for a three-week cruise with 100 ships and 4,000 hoplites.⁵⁰⁶ By comparison Athens received 600 talents annually from their allies.⁵⁰⁷ Therefore, it is unlikely that they used hoplites as rowers just to save a relatively modest amount of money. In my opinion, the fleet at that time probably had too few rowers, the possible explanation being disease and death among rowers as a result of the plague, rather than lack of money.

Athens also launched an expedition all the way to Sicily and occupied the Messina Strait, and simultaneously in the summer 427 BC sailed around the Peloponnesus with thirty ships. Moreover, Athens sent sixty ships and 2,000 hoplites to Melos. They achieved their greatest victory at Pylos and Sfacteria just after the plague came to an end.

Altogether these events suggest that the sea power of Athens was not significantly weakened by the plague and that the disease probably did not affect the outcome of the Archidamos war. Kagan expresses a similar opinion when he writes: "The plague, an unanticipated but powerful ally sent by the gods, had come and apparently gone without bringing the Athenians to their knees."⁵⁰⁸

But how did contemporaries consider the military strength of Athens at the end of the Archidamos war? Unfortunately there are no written sources about this from the Lacedaemonians. However, Thucydides gives an indirect indication of their opinion, noting that already in the spring of 425 BC the Lacedaemonians had proposed a short-lived cease-fire, which in the event proved permanent. If they had believed they had a military advantage over the Athenians, it is unlikely that the Lacedaemonians would have put forward such a proposal,

⁵⁰⁵ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 143.

⁵⁰⁶ Op.cit: 142.

⁵⁰⁷ Thuck II 13

⁵⁰⁸ D. Kagan, *The Archidamian war*, Cornell University Press, 1974, new edition with corrections 1987, Ithaca and London 3.edition 1990, 171.

because both parties were intent on winning the war. Thus, it is reasonable to see in this proposal that the Lacedaemonians still regarded Athens as a strong military force.

The peace treaty in 421 BC suggests that both parties thought they had won the war and consequently regarded themselves as equal partners. Despite the fact that the Lacedaemonians had probably avoided the plague, this did not result in a military advantage. Thus, if the plague had been as severe and extensive as Thucydides depicts, it is likely that the Lacedaemonians and their allies would have held out as the stronger party, rather than accept an equivalency with Athens.

Chapter 7: Conclusion

Dear Reader: I do hope you have found the search for the plague and the consequences for the Athenians, exciting. Personally I had no idea what I was to find. So it is with regret I acknowledge that I am not able to penetrate the topic further by using my knowledge of the ancient Greek language and conceptual history. However, in evaluating hygienic risk factors in the society and the potential diseases of that time I have benefitted from knowledge of both medicine and history. Thus, I do believe I have reached an understanding of the nature of the plague and its consequences as near the truth as possible.

There was serious illness in Athens during the Archidamos war, and with a reasonable degree of certainty I assert there were two dominant diseases, typhoid fever and epidemic typhus. My opinion is that the best evidence of serious illness Thucydides himself presents when he writes that 1,050 hoplites of 4,000 died of plague. For this is the only time he mentions the plague in conjunction with a single war cruise. Later, he provides the number who fell on the battlefield, but without adding that plague during the missions also resulted in loss of human life. There is reason to believe that a military loss as high as 1,050 hoplites compelled General Hagnon to explain what happened to the public assembly. If he had tried to blame the plague in order to conceal that the hoplites actually had been killed in combat, there is reason to believe that several of the hoplites who survived the war mission would have come forward during the meeting and disclosed the facts. In addition, Thucydides describes serious illness and death, first and foremost among the refugees, without assessing the actual extent of the disease.

Typhoid fever and epidemic typhus often lead to local epidemics as a result of the path of diffusion of these diseases. Therefore usually there are not large groups of people sick at about the same time. The deaths of these 1,050 hoplites – who constituted a local community on board ship and later during the siege – describe just such a local epidemic. From Thucydides we also have information about earlier local epidemics of the plague: “It is said, indeed, to have broken out before in many places, both in Lemnos and elsewhere, though no pestilence of such extent nor any scourge so destructive of human lives is on record anywhere.”⁵⁰⁹

Thucydides relates that at the same time there must have been different diseases, not just one because: “And while the plague lasted there were none of the usual complaints, though if any did

⁵⁰⁹ Thuc II 47

occur it ended in this.”⁵¹⁰ When today's medical knowledge is used to evaluate diseases described long ago, it is important to remember that at that time diseases were classified on the basis of symptoms and prognosis. Today's medicine is, however, focused on the actual cause of the disease, anatomical localization and severity. The symptoms of the individual diseases are therefore today linked to the actual cause of the disease.

That it was typhoid fever and epidemic typhus that probably constituted the plague is not strange. For there is reason to believe that typhoid fever – which is primarily spread by drinking water – already existed in the society at that time in the form of chronic carriers. When the city was overcrowded, the result was both increased consumption of drinking water and strain on the sewer system. Therefore, the disease then appeared to a greater extent than before, and many became ill. Typhoid bacteria were also detected in three dead people buried in a mass grave from that time. This does not necessarily mean that the three themselves had typhoid fever and died of it, for it is possible to be a carrier without having active disease.

However, the typhoid fever diagnosis does not explain why patients developed gangrene. But this does happen in epidemic typhus among people who live close together under unsanitary conditions, just as the poor and many of the refugees did.

In addition to bacterial infection, it is likely that poisoning, *ergotism*, occurred due to grain infected by fungi. Birds and dogs also eat cereals and can therefore be seriously poisoned in the same way as humans. Both patients with ergotism and typhoid fever hallucinate, which may explain the strange behavior of some of the patients.

I doubt that it is possible to calculate the number of people who died from the plague of Athens and Attica, because we lack a reliable estimate of both the total number of people who lived at that time and the composition of the population with birth rates, number of women, children, metics, slaves and visitors who stayed in the country for a while. However, there are grounds for suggesting that the number of sick and dead was not so high that it became significant, either for society or for warfare. Therefore, I say there is a basis for questioning the assertion that a third of the population died of the plague. This estimate is mostly based upon the number of hoplites that died from the plague, and in my opinion it is of little or no value in calculating the mortality of the plague among the whole population of Attica, since the plague likely was a number of local epidemics. Although this estimate is still repeated in various publications, often without reference

⁵¹⁰ Thuc II 51

to the sources, it is in my opinion unlikely. If it represented the truth, almost everyone during the years with plague would some time have had the disease, and society would have dissolved even if the patients had not all been sick at the same time.

However, there is no reason to make Thucydides responsible for the statement that such a large proportion of the population died of the plague. He only presents the story as it was customarily presented at that time without either mentioning number of people who died of the plague – except among hoplites and cavalry – or that the disease affected the war. We may reasonably infer that the plague was experienced as a part of everyday life, the ordinary panorama of the diseases in the society, with a resulting from the overcrowding in Athens. This explains why the contemporary drama writers, the historian Xenophon, or the Hippocratic writers all are silent about the plague.

However, Thucydides probably also uses the plague to explain the moral and religious dissolution of society. Therefore, I argue that there are writers – first and foremost in recent times – who are responsible for the description of the dramatic consequences of the plague.

The war continued after a few years' break, and we can conclude that it was this further warfare that ultimately resulted in disaster for the community. Also, during that period the plague is not mentioned, so there is reason to argue that it had little or no effect on the outcome of the Peloponnesian War.

7. 1 The way forward

Answers to scientific questions are often subject to review and modification. So also here for: what purpose/motive had Thucydides to present the plague in the way he does, although we may certainly believe that he describes real and serious diseases? Modern times are characterized by rational and concrete explanations of various events. This is fine, but it may also lead people today to misconstrue what our ancestors are really saying. Personally I have experienced this situation, and I have tried to be conscious of my own scientific background while interpreting historical data. The difficulty arises as soon as I read Thucydides' convincing factual description of the plague.

It is here important to tread carefully, and Hayden White explains why when he writes about the similarities between history and literature: "there has been a reluctance to consider historical narratives as what they most manifestly are: verbal fictions, the contents of which are as much

invented as found and the forms of which have more in common with their counterparts in literature than they have with those in the sciences."⁵¹¹ He also explains how the historian creates his work, since:

no given set of casually recorded historical events can itself constitute a story; the most it might offer to the historian are story *elements*. The events are *made* into a story by the suppression or subordination of certain of them and the highlighting of others, by characterization, motific repetition, variation of tone and point of view, alternative descriptive strategies, (...) all of the techniques that we would normally expect to find in the emplotment of a novel or a play.⁵¹²

By interpreting the plague in that manner I will immediately point out that this does not mean that the plague of Athens at the time was a fictional event. It may instead be reasonable to assume that Thucydides set the plague before the reader and posterity, and maybe even made it worse than it really was just to bring out the essence of the story, the *plot/emplotment*. Maybe Thucydides used the plague to explain why the society of his time was approaching dissolution, when he relates:

for the calamity which weighed upon them was so overpowering that men, not knowing what was to become of them, became careless of all law, sacred as well as profane.⁵¹³ (...) the plague first introduced into the city a greater lawlessness. (...) the pleasure of the moment and whatever was in any way conducive to it came to be regarded as at once honourable and expedient. No fear of gods or law of men restrained.⁵¹⁴

Thus, in my opinion Thucydides blames the plague for all the contemporary misery instead of the war, which in fact contributed to the development of the disease. The author is probably also influenced by the elite where he belongs, and accordingly by the fact that the misery primarily occurs among the lower classes because they arrived in Athens in large quantities without any place to live. However, the elite who fled to the city probably already had living accommodations

⁵¹¹ H. White, The historical text as literary artefact, in G. Roberts, (ed), *The history and narrative reader*, Routledge, 2001, 222.

⁵¹² H. White, The historical text as literary artefact, in G. Roberts, (ed), *The history and narrative reader*, Routledge, 2001, 223.

⁵¹³ Thuc II 52

⁵¹⁴ Thuc II 53

in Athens. Therefore, in his opinion it might have been the lowest classes of society who were responsible for the potential disintegration of society. He found no error either in Pericles, or strategy, or in the military forces. No, according to Thucydides, the people together with the new leaders they had elected were responsible for the decline.

In fact, Thucydides is using the plague as a literary tool based on a historical event to describe a plot/employment, which also fits with the impression I have of Thucydides both as a part of the elite and at the same time, critical to democracy. Thus, he writes in connection with the complaints the people aimed at Pericles: "they did not give over their resentment against him until they had imposed a fine upon him. But not long afterwards, as is the way with the multitude, they chose him again as general and entrusted him with the whole conduct of affairs."⁵¹⁵

Hornblower, however, describes the performance of the population in the following way: "with the usual fickleness of the mob."⁵¹⁶ Thus, a certain skepticism of democracy appears in Thucydides in his use of the translated word "mob/multitude" when speaking of the citizens as members of the public assembly, the highest body in Athens. Thucydides seems to support the decision of Pericles at the beginning of the war "not to convoke a meeting of the assembly or any gathering whatever, for fear of that if they got together there would be an outbreak of passion without judgment that would end in some serious mistake."⁵¹⁷ He is also critical of the people, who – after the death of Pericles – according to Thucydides had not elected the best leaders. For that reason he might have exaggerated the importance of the plague when in reality he wanted to express his criticism of social groups he considered unfit to make decisions on behalf of the state. At the same time, he is ambivalent toward the lowest social groups, for he clearly shows empathy with refugees who die in summer heat on top of one another. But he also speaks of them with some irritation by writing that the residents "suffered further hardship owing to the crowding into the city of the people from the country districts; and this affected the new arrivals especially."⁵¹⁸ We should remember that these people had been asked to seek protection in Athens, and consequently there was no basis for his negative opinion.

However, it is clear that he is primarily concerned about the fate of the hoplites. He specifies

⁵¹⁵ Thuc II 65

⁵¹⁶ S. Hornblower, *A commentary on Thucydides*, Volume I, Books I-III, Clarendon Press, Oxford 1991, edition 2003, 341.

⁵¹⁷ Thuc II 22

⁵¹⁸ Thuc II 52

the number who died of the plague but does not even try to present such figures when it comes to soldiers from the lowest social classes who fought together with the hoplites. For he says that 4,400 hoplites of the armed crew and 300 knights died of plague and “of the populace a number that could not be ascertained.”⁵¹⁹

Thucydides writes similarly when discussing the Battle of Delion: "And there were slain in the battle, of the Boeotians a little more than five hundred, of the Athenians a little less than one thousand, including Hippocrates their general, besides a great number of light-armed troops and baggage-carriers."⁵²⁰ This creates the impression that he considered this part of the population of less importance, because it is first and foremost the hoplites – landowners war. Women and children are not discussed at all.

We can hypothesize that Thucydides' childhood was influenced by the stories of Homer, since his work was also a children's reader from which they learned to read and write. As to Thucydides' mention of the plague, we can reasonably conclude that he was influenced by the literary genre of the time. Homer reviews pestilence immediately in the first song in *The Iliad*, and he also writes that Apollo shot his arrows and "The mules he assailed first and the swift dogs, but thereafter on the men themselves he let fly his stinging arrows, and smote; and ever did the pyres of the dead burn thick."⁵²¹ Thucydides reinforces this by writing that the number of birds decreased because

the birds, namely, and the fourfooted animals, which usually feed upon human bodies, either would not now come near them, though many lay unburied, or died if they tasted them. The evidence for this is that birds of this kind became noticeably scarce, and they were no longer to be seen either about the bodies or anywhere else; while the dogs gave a still better opportunity to observe what happened, because they live with man.⁵²²

In such a description of the birds and animals he forges another link with Homer, and it may be that he believes that severe disease belongs in a dramatic literary work. In this connection Iddeng

⁵¹⁹ Thuc III 87

⁵²⁰ Thuc IV 101

⁵²¹ Homer, *The Iliad*, books I – XII, translated by Murray, A.T., in Goold, G.P. (ed), *The Loeb classical library*, Harvard University Press, Cambridge, Massachusetts, London, William Heinemann Ltd, 1924, reprint 1988, 150 – 52.

⁵²² Thuc II 50

points out that the distinction between fiction and poetry and non-fictional texts is vague and cannot be defined satisfactorily, and that the literature of Antiquity does not reflect even such a clear distinction between fact/fiction and non-fiction writing.⁵²³

From my point of view it is purely hypothetical when I suggest that Thucydides tried to compete with Homer by describing his own war, which he lets contain all necessary ingredients for a comprehensive and devastating major war, far larger than the war Homer describes. Why Thucydides exaggerates the importance of the plague is interesting to reflect on. However, that must be another story.

⁵²³ J.W. Iddeng, Antikk litteratur: Tekst og kontekst, in J.W. Iddeng, (ed), *Ad fontes, Antikkvitenskap, kildebehandling og metode*, Unipub– Oslo Academic Press, Oslo 2007, 63.

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Attachment I: A patient from Athens in the summer 428 BC. Professor dr. med. Claus Ola Solberg⁵²⁴

1. Based on medical history - what disease/diseases may this have been?

The disease I believe corresponds best with the medical history mailed to me 04th January 2010 is epidemic typhus, caused by *Rickettsia prowazekii* and transmitted by feces from infected body lice (*Pediculus humanus var. corporis*). This is a disease which occurs in epidemic form, especially in time of distress (war, natural disasters, famine), like the situation during the Peloponnesian War. The lice suck blood, defecate it, and the patient inoculates himself when he/she scratches the bite site. The microbes spread by the blood stream from these sites to the endothelial cells in capillaries throughout the body and breed there, causing inflammation with thrombus and necrosis in most organs. Set forth below are the common symptoms and signs of epidemic typhus as stated in the larger textbooks on infectious diseases and review-articles. For purposes of comparison they are presented with corresponding symptoms⁵²⁵ in parentheses described in the submitted medical history.

After incubation period of one to two weeks the temperature rises to thirty-nine to forty degrees Celsius, and the patient suffers a headache, general aches and severe malaise ("heat in the head, burning inside, best to go naked, would throw themselves into cold water, strong thirst"). From the fifth to the seventh day a generalized red – later brown-red – confluent rash occurs; most prominent on the body but also on the arms and legs. The rash can be petechial and necrotic ("general rash: red to blue-black with small wounds and boils"). Photophobia with a significant injection of the conjunctiva and severe pain in the eyes is common ("red eyes, burning eyes, some lost their vision"). The tongue is often dry, brown and furrowed ("tongue and throat, bloodshot, offensive"). Symptoms from the respiratory tract can range from mild upper respiratory tract infections to severe pneumonia ("wheezing, hoarseness") and from the digestive tract loose or bloody stools ("nausea, hiccups, vomiting, loose stools/diarrhea"). Symptoms in the central nervous system are common, and at the end of the

⁵²⁴ I have translated the attachment from Norwegian to English.

⁵²⁵ The original medical history was written in Norwegian and professor Solberg uses the Norwegian words which I have translated to English

first week of the disease: confusion, coma, signs of meningitis, delirium and /or manic state ("turbulent and confused in periods, cramps, seemed at times vague," and "some survivors had amnesia"). Finally, untreated typhus is a very serious disease with an approximately forty percent mortality rate ("1,050 of about 4,000 hoplites died"). Incurring the disease gives – see later Brill-Zinsser's disease – possibly life-long immunity ("Never was a former patient attacked by the disease"). In the case history it is noted that some patients developed marks on the genitalia, hands and feet. This could mean that these parts of the body were gone. Others lost their sight. This may be due to thrombus with subsequent tissue necrosis. Necrosis of the skin and gangrene of the fingers is described in patients with severe epidemic typhus.

A disease that shows great similarities with epidemic typhus is scrub typhus. This disease is caused by a Gram-negative bacterium – *Orientia tsutsugamushi* (much like *Rickettsia*) – transmitted by rats and mice to humans by the bite of mites (genus *Leptotrobidium*). From the site of the bite the bacteria spread through the lymph and blood vessels to a variety of organs (skin, lungs, heart, brain, kidneys, etc.). The disease occurs today mostly in Southeast Asia but is also reported in Central Asia and Australia. The clinical picture varies considerably from a frequent occurrence of mild cases – fever, headache, muscle pain, cough, local/general lymphadenopathy and gastrointestinal symptoms which disappear within a few days – to more rare occurrence of serious/fatal cases: massive pneumonia, meningitis-encephalomyelitis, pericarditis, myocarditis, large retinal bleeding, serious gastrointestinal symptoms and acute renal failure. According to the Harrison's textbook *Principles of Internal Medicine*: "The case-fatality rate for untreated classic cases is seven percent; however the figure would probably be lower if all relatively mild cases (which are underdiagnosed) were included."

I believe that the following factors indicate that the "plague" in ancient Athens most likely was epidemic typhus, not scrub typhus: 1) A case of typhus usually provides lifelong immunity (patients never get the disease several times, in contrast with Brill-Zinsser's disease), while scrub typhus provides short-term immunity (a patient can get the disease several times, with possibly 1-3 years immunity), 2) typhus occurs in epidemic form, scrub typhus in endemic/hyper endemic form (depending on the extent of the local mite population), 3) there is significantly higher mortality in untreated epidemic typhus (approximately forty percent) than in endemic/hyper endemic scrub typhus (below seven

percent), and 4) localization today of scrub typhus mostly in Southeast Asia, unlike epidemic typhus, which may occur in all parts of the world in time of distress (also reported from northern Norway during the Second World War).

2. What is needed to determine a diagnosis?

Epidemic typhus is diagnosed serologically by using the Weil-Felix agglutination test (frequent cross-reactivity with *Rickettsia typhi*), IFA and ELISA. Detection of DNA sequences using PCR is described and applied to the detection of *R. prowazekii* in the cerebrospinal fluid.

Scrub typhus is also diagnosed serologically (Weil-Felix reaction, IFA and hemo agglutination reaction) and by PCR technique in blood (high sensitivity).

3. What diseases could it not have been?

Other micro-organisms (except *R. prowazekii*) which have been cited as possible causes of the severe epidemic in Athens about 430 BC include *Yersinia pestis* (causing plague), and variola virus (causing human smallpox). The mortality rate of both diseases is high – the plague above fifty percent and smallpox twenty-five to thirty percent. Characteristics of the plague are large, swollen lymph nodes with fistulas especially in the groin ("bubonic Plague") and therefore often leading to sepsis (blood poisoning) with severe pneumonia. Rash is uncommon. These symptoms and the absence of rash are clearly against *Yersinia pestis* as the cause of the epidemic in ancient Athens.

Smallpox has a characteristic rash (synchronous appearance of macules, and papules and then vesicles, pustules and crusts) that is essentially localized to the face and extremities (i.e., centrifugal localization). The characteristic appearance of the rash with the synchronous behavior of the elements and the peripheral localization clearly differentiates the rash from other serious diseases. Red eyes, painful vomiting, "internal combustion," loose stools/diarrhea and loss of genitalia, hands or feet are also unusual in smallpox. Accordingly, smallpox is unlikely. (In addition, smallpox is believed to have come to Europe for the first time in Rome in 165 AD; i.e., when Emperor Marcus Aurelius ruled the Roman Empire.)

Endemic typhus, also called murine typhus, is caused by *Rickettsia typhi* (closely related to *R. prowazekii*) and is transferred by the rat flea *Xenopsylla cheopsis*. The disease occurs today throughout the world, but particularly in developing countries where there is often close contact between humans and rats. The symptoms (fever, headache, rash, etc.) are similar to

those of epidemic typhus but are far less severe, with a low mortality rate, less than five percent. The disease significantly affects the old and/or immune-compromised individuals. Thus, the epidemic in ancient Athens was not endemic typhus.

Finally, the submitted medical history stated that "birds of prey and four-legged animals stayed away from the corpse. If the animals ate the bodies, they died. The number of birds in the area declined." Whether this is consistent with epidemic typhus, I do not know. These symptoms may be consistent with West Nile virus infection, a flu-like illness which has a rash similar to that of measles (a minority of the patients), vomiting, lymphadenopathy, retro-orbital pain, and consequently meningitis encephalitis with Guillain-Barré symptoms in a small number, less than one percent of the patients. The mortality of this disease is far lower than in epidemic typhus and is for this reason considered inconsistent with the "plague" in ancient Athens.

Attachment II: Case history of an Athenian patient transferred to a modern infectious medicine department.⁵²⁶ Professor dr. med. Bjørg Marit Andersen

A number of issues arise when making such a conversion from 428 BC to 2010 AD:

1. *The medical record* of 2010 is not complete because a description of symptoms is lacking.

Thus today we would expect that the patient (and relatives) on admission to a medical department treating infectious diseases would be asked about symptoms such as: freezing (fever symptoms), cough (different from hiccups), difficulty breathing, secretions from the respiratory tract, pain, diarrhea (frequency of bowel movements, etc.), blood from natural openings and/or skin, etc.

A more detailed *status* is also mandatory because examination of lymph nodes, edema, blood pressure, pulse, lungs, temperature, abdomen etc., are all lacking.

Normal temperature on the body surface tells nothing about the actual temperature, e.g. if the patient has a low blood pressure.

2. *What does the patient suffer from?*

Typhoid fever, *Salmonella typhi* or *S. paratyphi A*?

On admission the patient was in relatively good general condition, but perhaps somewhat dehydrated and complaining of thirst. Later, he developed diarrhea. Typhoid fever has a relatively long incubation period and few symptoms of diarrhea – which often comes late in the course of the disease, and roseola of the skin. The disease is divided into stage incrementi with increasing temperature and increasing bradycardia, often with upper respiratory symptoms (as with the current patient), stage typhosus with bradycardia and temperature around forty degrees Celsius, and stage decrementi with fluctuating and falling temperature with danger of perforation. The patient's unclear mental state (typhus = "fog") – may fit with stage typhosum or decrementi. Insomnia and agitation may also be characteristic, together with respiratory symptoms in the beginning. Ulcers and abscesses are usually not associated with typhoid fever, but the bacteria can form abscesses. I believe I have read that hiccups may occur in typhoid fever but do not remember where.

This disease has been the constant companion of all wars all the way up to the 1914-1918 war, when new knowledge about etiology of the disease, epidemiology and prophylaxis showed that

⁵²⁶ I have translated the attachment from Norwegian to English.

the disease could also be counteracted during the adverse conditions of war. (Thjøtta's old Norwegian textbook in microbiology).

Bubonic, pulmonary or septic plague? The relatively slow development and progress of the plague in Athens do not fit with the plague caused by *Yersinia pestis*.

Poisoning of drinking water or food? A number of toxins were probably known at this time, and intoxication cannot be ruled out (burning inside).

Anthrax does not fit with the patient's history. But the wounds of the skin can be compatible with Anthrax of the skin.

Could the plague have been some form of leptospirosis? Such diseases may act as epidemics during wars, disasters, etc. High fever, "red eyes" due to vasodilation of conjunctiva and symptoms of flu in the beginning may indicate this disease. However, jaundice and bleeding are not described in this patient.

Rickettsia? There are many variations and subgroups, known for several centuries, but I do not know whether such diseases have been cited in Antiquity. *Rickettsia typhi* – mouse typhus – is probably a very "old" disease and is associated with rodents and poor sanitation. A typical "microbe of war and catastrophe." Neurological symptoms are common – and rash. However, no abscesses of the skin. *Rickettsia prowazekii* exhibits similar symptoms. Within the family R there are multiple types that cause skin ulcer (eschar) due to injury of vessels and bleeding.

Tetanus - seizures, hiccups?

Conclusion and tentative diagnosis:

The clinical diagnosis of the 428 B.C. Athenian is most consistent with typhoid fever or poisoning.

Rickettsia, leptospirosis and other infectious diseases associated with poor sanitation, rodents and insect vectors cannot be excluded.

Attachment III: Short overview of infectious diseases caused by bacteria or viruses

Definition

Bacterium: A single-celled organism with its own metabolism which propagates outside the cells of the body, *extracellular*.

Rickettsia: Small bacteria which propagate inside the cells of the body, *intracellular*. The reservoir does not include humans except for *Rickettsia prowazekii* where humans can be a host. Vectors such as ticks, mites, lice, fleas are required.

Virus: Genes that are transmitted from cell to cell and codes for proteins that enable the cell to form virus.

1. Diseases mostly spreading from bowel to mouth.

Typhoid fever

Cause: The bacteria *Salmonella typhi* or *Salmonella paratyphi*.

Transmitted via contaminated water, food or directly from human to human.

Incubation period is usually 10-14 days.

Symptoms: Increasing fever first week accompanied by abdominal discomfort, headache, back pain, decreased appetite, fatigue, insomnia, constipation, diarrhea, or normal stools. Respiratory symptoms such as sore throat, cough, and flu-type discomfort.

High fever second week and the patient may suffer a psychotic delirium. Red spots in 30% of patients on the chest and abdomen. Typhoid fever can also include a herpes-like rash resembling chickenpox.

During the next two weeks the temperature decreases. Holes in the bowel, intestinal bleeding, injury of the heart as well as infection of the bones may occur.

Prognosis: Without treatment 10-30 % dies. Recurrence of the disease in 10-20% of the patients, and former patients can again be infected.

Dysentery

Cause: *Shigella*, consisting of one group of bacteria.

The disease was described by Hippocrates and occurs especially in conditions of war,

malnutrition, and poor hygiene. Infection through direct or indirect contact with: infected flies, drinking water, food and milk.

Incubation period: 1-6 days.

Symptoms: Fever with abdominal pain followed by watery diarrhea. Fever declines followed by increasing diarrhea which is painful with mucus and blood. No rash.

Prognosis: Untreated, 1-40% die. Immunity is brief.

Cholera

Cause: *Vibrio cholerae*, which can live a long time in water. Spread of infection is mostly through water but also by direct or indirect contact with patients.

Incubation period: 1-18 days.

Symptoms: Acute diarrhea with vomiting. Thirst, interrupted production of urine, muscle cramps, hoarseness, dry mouth, impaired muscles. No fever or rash. The patient is conscious until death.

No rash.

Prognosis: Untreated, 40-80% die. Immunity is brief.

2. Diseases spread mostly by secretion from mouth or nose and inhalation or contact.

Smallpox

Cause: *Variola virus*. Droplet infection via the respiratory tract. The disease attacks only humans neither animals nor other vectors constitute a reservoir of the virus. Infection from skin rashes is rare.

Incubation period: 14 days.

Symptoms: Initial stage includes three days with respiratory symptoms, general discomfort, lethargy, severe headache, vomiting, and back pain. Then a drop in temperature, and rash occurs in the form of red spots (macules) and photophobic. During three days the macules develop into vesicles, first in the mouth and face and then above the wrists, hands, feet, arms, and legs and eventually the torso. After a further three days the patient again experiences fever, and the vesicles are transformed into pustules, with secretion occurring a few days later. Crusts are formed and fall off after a couple of weeks leading to scars of the skin, especially the face. Axilla and groin are without rash. Within the same anatomical area the rash is at the same stage of development.

Alternate diagnosis: Measles after the onset of rash. However, in measles the rash appears simultaneously with a new rise in temperature in contrast to smallpox, where the rash is related to a drop in the fever. Chickenpox is also an alternate diagnosis, but the patient with smallpox is far more seriously affected. The rash in chickenpox exhibits a different development in the same area, and the patient is not scarred.

Prognosis: Untreated, 5-80% die, and many of those who survive are disfigured or blind. Lifelong immunity.

Measles

Cause: A *virus* with a susceptibility of almost 100%. Droplet infection via the respiratory tract, conjunctiva, or direct contact from person to person. Like smallpox, measles has no animal reservoir. There is no chronic carrier of the disease, and the virus therefore remains dormant in a population on which it depends to infect susceptible individuals.

Incubation period: 8-14 days.

Symptoms: Starts with fever, symptoms of cold and conjunctivitis that causes red eyes. Fever declines, followed by a new rise in temperature simultaneously with a macular rash and gradually emerging small bumps on the skin. The rash begins in the hair bordering the ears, spreading to the face, neck, torso, arms, and legs. The tongue is red. The patient feels very ill with reduced consciousness, eventually accompanied by vomiting and diarrhea. The rash subsides after four days with a drop in temperature.

Secondary bacterial infection can cause lung and ear infections, *otitis media*. One among 1,000 patients develops inflammation of the brain, *encephalitis*, accompanied by fever, somnolence, or coma, convulsions, and paralysis 1-7 days after start of the rash.

The diagnosis should never be made solely on the rash, but on the total development of the disease.

Prognosis: The mortality rate for encephalitis due to measles is about 10%. Some of those who survive develop epilepsy, mental retardation, or paralysis.

Lifelong immunity.

Influenza

Cause: A *virus* with droplet infection via the respiratory tract.

Incubation period: 1-4 days.

Influenza epidemics with a high mortality have occurred, such as the 1918-20 Spanish flu, when

maybe 100 million people died, but it has been claimed that the high mortality rate of influenza in the past was caused by secondary bacterial infections.

Symptoms: chills, muscle aches and headaches. A few days later, dry cough with nasal stenosis, conjunctivitis, and fever for up to 4 days, accompanied by listlessness.

Death can be caused by influenza when the virus causes pneumonia. However, far more often death is caused by secondary infections with streptococci, staphylococci, or *Hemophilus influenzae*.

Prognosis: Short immunity, i.e. only a few months or few years.

Diphtheria

Cause: *Corynebacterium diphtheriae*. This disease is also described as occurring around 400 BC.

The source of infection can be either ill or healthy carriers of the bacteria, and it is spread by droplet infection, direct contact, or via food.

Incubation period: 2-15 days.

Symptoms: Infection of the throat resulting in sore throat, moderate fever, and an impaired general condition with development of gray-white to black coatings, *membranes*, in the throat.

Toxin is formed and will damage heart muscle and nerve tissue. It is first and foremost the toxin that makes the disease dangerous. This toxin is one of the most poisonous extant. Severe problems with respiration leading to stridor. Due to extensive toxin production the patient may go into coma and die within 10 days. Diphtheria can also result in ulceration of the conjunctiva, middle ear, face, fingers, vulva, and vagina.

Prognosis: Mortality around 5-10%. Diphtheria does not always result in full immunity.

Streptococcus infection

Cause: *Streptococcus bacteria* with direct contact with infected person or by droplets.

Incubation period: 2-5 days.

Symptoms: Acute pain in swallowing, headache, moderately reduced general condition, and high fever. Grey/white coating in the throat. The disease can result in ear infections, meningitis, sepsis, and possible rheumatic fever or kidney inflammation, *glomerulonephritis*. Streptococcus can also cause scarlet fever, where the bacteria form a toxin that produces a local or general rash which starts the second to the fourth day after the throat infection. The rash exhibits red facial skin, paleness around the mouth, and gray coating on the tongue. The skin peels off after 10th to 14th day and may be the only diagnostic finding.

Prognosis: The mortality of a fulminant scarlet fever may be 30-80%, but is otherwise low.

Meningococcal meningitis.

Cause: *Neisseria meningitidis*. Infection source can be either patients or healthy carriers. Only a minority of those infected becomes ill.

Incubation period 1-5 days.

Symptoms: High fever, seriously reduced general condition, possibly with mild symptoms in the respiratory tract, and conjunctivitis.

The course of the disease is dramatic with falling blood pressure, bleeding under the skin and necrosis.

Prognosis: Despite appropriate treatment the mortality rate is high – 10-15% in Northern Europe.

Untreated, the mortality approaches 100%.

3. Diseases mostly spread by vectors

Rocky Mountain spotted fever

Cause: *Rickettsia rickettsi*, which occurs among ticks and wild rodents, transmitted by ticks. Man is an accidental host.

Incubation period: 2-14 days.

Symptoms: Starts with high fever with headache, muscle pain together with nausea, vomiting, abdominal pain, and diarrhea. After 3-5 days a macular rash appears and can cause bleeding in the skin, petechial form. The rash usually starts around the wrists and ankles, spreading to the palms and soles. Complications such as respiratory and cardiac failure, encephalitis, and renal failure may develop. It causes meningitis in 30% of those affected, and some have injuries of major vessels that lead to gangrene in parts of the limbs.

Prognosis: Untreated, the mortality is 20%.

Epidemic typhus/typhus

Cause: *Rickettsia prowazekii* occurs among humans, fleas and squirrels, and the vector is lice. This is the only *Rickettsia* transmitted between humans.

Incubation period: 7 days.

The disease occurs when poor hygiene results in increased formation of body lice. The microbes are transmitted from person to person with the lice, get into the bloodstream, and are spread through the walls of the blood vessels. This may result in clogged blood vessels, and

accordingly damaged skin, heart, muscle, kidney, and nerve tissue. Gangrene in the extremities can thus result from insufficient blood supply.

Symptoms: Sudden high fever with headache, muscle pain, low blood pressure, and delirium.

About the fifth day of the disease a red, macular rash spreads from axillae and upper body.

Eventually, the rash develops into petechial but without rash on the face, palms, or soles. The

patient coughs, experiences tinnitus, and may lose his hearing. Other complications include

inflammation of the heart muscle – myocarditis – and damage of the central nervous system –

meningitis-encephalitis. The fever lasts for 1-2 weeks with a convalescence period of 2-3 months.

Prognosis: Without treatment, lethality about 40%. Long-term immunity.

Murine typhus

Cause: *Rickettsia typhi* transmitted by the rat flea from rats, cats, and dogs with the disease.

Incubation period: 1-2 weeks.

Symptoms: High fever and rash in 50% of the patients accompanied by flu symptoms, headache, muscle pain and nausea. The rash is red macular, located on the torso. Neurological symptoms are common.

Prognosis: Mortality 4%.

Scrub typhus.

Cause: *Orientia* in the *Rickettsia* family. The source of infection is sick rodents. The disease is transmitted by the bite of mites.

Incubation period: 6-18 days.

Symptoms: High fever, flu symptoms, dry cough, headache, muscle pain, drowsiness, and nausea, and conjunctivitis with pain behind the eyes. After five days, a red, macular rash appears on the body. Neurological symptoms occur in a few patients.

Prognosis: Mortality 0-30%.

Plague

Cause: The bacterium *Yersinia pestis*, which has three main forms: Bubonic plague, the most common, often localized in the groin; sepsis; or pulmonary plague. Rodents and domestic animals are reservoirs for the bacteria, which are transmitted from animal to animal via flea bites.

If many rats or rodents die, the fleas move to humans. Thus, before an epidemic occurs among humans it appears as an epidemic among rats. Flies and mosquitoes can also transmit the disease, as can water, meat, and droplet infection primarily in pulmonary plague.

Incubation period: 2-10 days.

Symptoms: Bubonic plague usually occurs after insect bites. Then the patient suffers high fever, severe malaise, seizures, altered mental status, and low blood pressure. The lymph nodes are painful, and the patient is almost unable to move. The microbes enter the bloodstream to the lungs and result in sepsis. Thrombosis and inflammation in blood vessels cause bleeding under the skin and gangrene in the limbs.

Prognosis: 50% mortality. Most people who survive the plague develop lasting immunity.

Lung plague has an incubation period of 1-6 days after inhaling the bacteria. The disease begins acutely with severe general symptoms, fever, chills, headache, muscle aches, cough, and bloody sputum. When respiratory failure develops, the result is cyanosis of the skin and shock. Without treatment all with pulmonary plague will die.

Primary septicemia is rare and develops fast without local symptoms and signs. Meningitis, inflammation of the throat, and gastro-intestinal symptoms may also occur.

Anthrax

Cause: *Bacillus anthracis*. The disease is known from ancient times and occurs in humans after contact with ill animals that are the source of infection. The main reservoir of the bacteria is infected soil. The animals become infected when they graze in areas with bacteria in the soil. When the bacteria are exposed to air, they form spores that survive for many years in the wild and can also be spread through water. Transmission to humans is probably a mixture of contact, respiratory infection, and ingestion of contaminated food.

Symptoms: Direct contact may cause anthrax of the skin, usually on the hands. This represents 90-95% of all anthrax. After an incubation period of 12-36 hours a swelling and itchy spot develops on the skin. It becomes a vesicle, then a pustule, and finally a dark, necrotic crust. The crust falls off after 12-14 days, leaving no scars.

Anthrax in the throat results in pain when swallowing and necrotic ulcers in the mouth or throat, bleeding from the mouth and hoarseness, together with diarrhea. Anthrax in the lungs is a rare condition and occurs after inhalation of spores.

Transmission via food and drink can cause nausea, poor appetite, swelling of the throat, abdominal pain, diarrhea, vomiting of blood, and headache. The patient has moderate fever. Holes in the intestine can occur. Infection by inhaling the spores leads to pneumonia, infrequent transmission from person to person.

Prognosis: It is possible for humans to acquire immunity after incurring the disease. About 20% of patients die if the disease is localized to the skin. When holes occur in the intestines around 50% die, all exhibiting anthrax in the lungs.

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