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PLAGUE IN THE GRAECO-ROMAN WORLD 430 B.C. - A.D. 600

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CONTENTS

PREFACE

This dissertation concerns itself with the study of epidemics between 430 B.C. - A.D. 600, in an attempt to find positive evidence for the existence of bubonic plague in the ancient world. Most major studies on the Black Death have concerned themselves with the great pandemics of the Middle Ages and none (to my knowledge), have systematically examined the ancient records for earlier evidence of the disease. The time period chosen for this study, from the Athenian Plague to the Plague of Justinian, contains some relatively well documented epidemics, which has made it possible, in some cases, to identify the disease.

Plague is a complicated disease, dependent on numerous factors for its successful spread, but few historians have considered this. The word 'plague' was loosely used in ancient texts to denote any epidemic disease with a high mortality rate and not a specific microbial infection. Most historians however translate 'plague' as bubonic plague and make no attempt at a medical analysis of the symptoms given by a particular author. The point of this dissertation is to examine the ancient epidemics from a medical as well as a historical angle.

Our evidence for the existence of epidemic diseases comes from a variety of sources, and these are examined. Sculptures and frescoes show numerous chronic and acute disorders. Human remains have shown evidence of certain diseases, while animal and parasitic remains have helped to confirm the existence of certain species instrumental in the spread of a specific disease. However, written texts are the most reliable source for obtaining a detailed account of the symptoms and accurate interpretation of these texts is therefore important. To achieve this, the symptoms mentioned by an ancient author are compared and contrasted, through the use of tables, with the symptoms of some of the known infectious diseases of today.

This dissertation will show that epidemics which were previously labelled plague could either not be identified as such, or were misdiagnosed. Evidence does point to the existence of bubonic plague in the ancient world, but it never reached epidemic proportions until A.D. 600.

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Finally, I am grateful to my husband for his unfailing support, being a ready medical advisor and putting up with late dinners!

Elsie Truter

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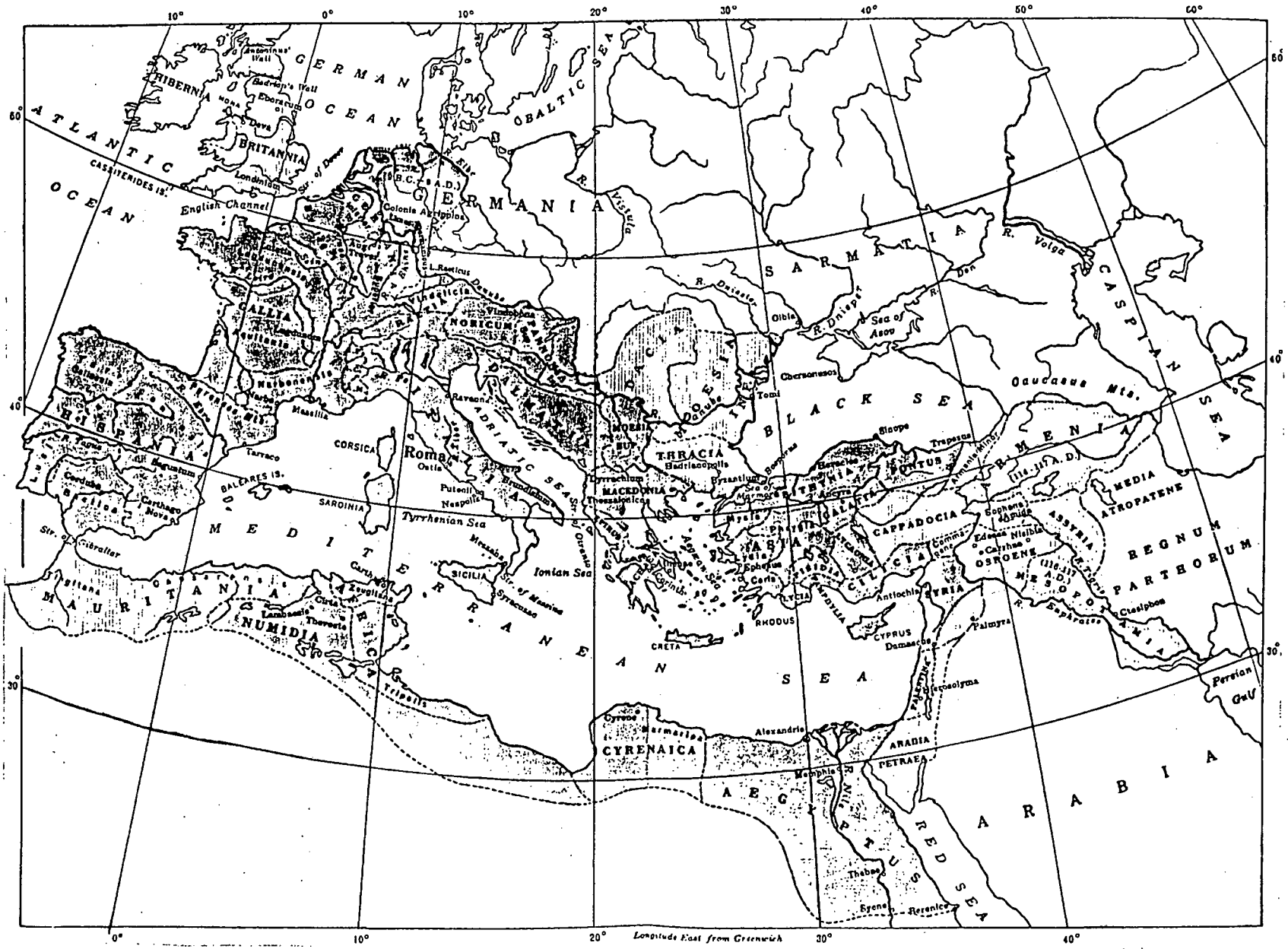
THE ROMAN EMPIRE



Adapted from Sinnigen, W.C. and Boak, A.E.R. A History of Rome to A.D. 565 1977.

CHAPTER 1.

PLAGUE - ITS MEDICAL AND EPIDEMIOLOGICAL ASPECTS

INTRODUCTION:

The word plague is derived from the Latin word plaga which originally meant blow or stroke, but in later Latin acquired the additional meaning of pestilence. It did not acquire its modern connotation of a specific microbial disease until the seventeenth century and should therefore not be accepted as having the same meaning in Latin or Greek texts. (1)

Plague may take three clinical forms: bubonic, pneumonic or septicaemic. The misleading use of the word "bubonic" [which represents lymph node swelling] has led to the misconception that true plague is bubonic and that the non-bubonic types are a different disease altogether. Both pneumonic and septicaemic plague are a more severe form of bubonic plague and therefore develop from an original bubonic plague lesion. Throughout this dissertation all 3 forms will be considered as possible manifestations of the ancient epidemics.

PATHOGENESIS OF AN EPIDEMIC:

The essential requirements for the outbreak of an infectious disease are;

i] The presence or introduction of an infectious agent into a human, animal, bird or anthropod vector, or its presence in air, water, food, soil or other environmental source.

ii] An adequate number of susceptibles.

iii] An effective means of contact and transmission between the two.

Four circumstances in which epidemics occur;

i] When a group of susceptibles is introduced into a setting where a disease is endemic.

ii] When an infectious agent is introduced into a population not previously exposed to the agent and therefore highly susceptible to infection.

iii] When an effective contact is made between a pre-existing infection of low epidemicity with susceptible persons as a result of changes in social, behavioral, sexual or cultural practices.

iv] An increased susceptibility to infection or disease or both, through immunosuppression or other factors that influence host response, such as a preceding viral infection, nutritional disorder or presence of a chronic disease. (2)

THE BACTERIUM

The organism responsible for plague was discovered and first described independently by Yersin and Kitasato, in Hong Kong in 1894.

It is a Gram-negative coccobacillus from 1 to 1.5 microns in length, showing bipolar staining with suitable dyes. It adopts a typical 'safety-pin' appearance on staining.

It is non-motile, often encapsulated and grows at an unusual optimum temperature of 30°C as an aerobe or facultative anaerobe.

It was formerly included in the genus Pasteurella but its biochemical, enzymatic properties and pathogenicity are different. The genus Yersinia was created to mark this distinction.

Two main varieties occur in nature:

i] Yersinia orientalis, the most common species in ports in the east and America.

ii] Yersinia mediaevalis, believed to have been responsible for the pandemic of 1348.

The two varieties are distinguishable by the presence or absence of certain enzymes, but are equally pathogenic for man and animals.

Bacterial Characteristics of Epidemiological Importance[a]

Epidemiological aspects	Bacterial characteristics
1. Features involved in *spread* through the environment	Number of organisms released by infected host Resistance to physical agents of environment (e.g., heat, UV, moisture) Ability to multiply within the environment Ability to infect intermediate host or insect vector
2. Features involved in initiation and development of *infection*	Host range of organisms Genetic makeup and antigenic diversity Infectivity of organism Pathogenicity of organism Number of organisms entering host and the portal of entry Enzymes involved in spread through tissues
3. Features involved in production of *clinical disease*	Most characteristics under (2) Virulence of organism Invasiveness of organism Production of endo- and exotoxins Immunopathological potential

From: A.S. Evans Epidemiological concepts in: Bacterial infections of humans. pg. 13.

The plague bacillus can survive for only a few days in putrefying corpses. It disappears rapidly from the surface soil (3), "but can survive months and sometimes even years if kept in the dark and at a constant temperature, as in a sealed test tube in a laboratory, or underground, particularly in the micro climate of rodent burrows." (4)

Y. pestis is susceptible to the action of higher temperatures but not sensitive to the action of low temperatures. Pollitzer and Meyer (5) mention that "survival periods of the organism for up to one year were noted in the dead bodies of some of the victims of the 1910 - 1911 Manchurian pneumonic plague epidemic, where bodies were interred in soil rich in salt and became frozen in winter." The chances of such organisms proving infectious would however be remote.

Prof. Isaacson points out that the plague bacillus is part of ecosystems which vary widely within countries, regions and continents. "The epidemiology of plague is therefore not uniform and among other factors varies with the local fauna and its associated ectoparasites." (6)

RESERVOIRS OF THE PLAGUE BACILLUS:

The rat was long considered to be the sole carrier of plague. In 1894 Roux and Yersin wrote; "Plague is a disease of the rat, incidentally transmitted to man." (7) Only in 1925 did Ricardo Jorge highlight the role of wild rodents in the transmission of plague.

The transmission and preservation of Y. pestis involves more than 200 species of rodents and Lagomorpha susceptible to Y. pestis by flea bite or by consuming infected rodent carcasses. Domestic pets, dogs, cats, birds of prey and even camels have been linked to some cases, either becoming infected themselves, or carrying infected fleas. (8) & (9) "There is little conformity of thought as to what constitutes a plague 'reservoir host' " according to Prof. Isaacson. "It is likely to be a highly resistant animal, which although capable of being infected, does not develop serious illness." The suggestion that the interaction of several rodent species living in close ecological association forms a plague reservoir, seems to provide the most rational approach. (10)

The reason that rodents, other than rats, do not ordinarily cause plague epidemics relates less to their inherent efficiency as vectors, than to their habits. Most do not live close to congregations of people. (11) Domestic rats ordinarily become infected by a transfer of fleas as a result of contact with diseased or recently dead field rodents. As a rule, a plague epizootic among rats precedes or parallels a plague epidemic among humans.

THE HOST

The domestic rodents implicated in plague outbreaks belong to only three subspecies of Murinae - Rattus rattus, Rattus norvegicus and Mus musculus. (12) They reveal an almost cosmopolitan distribution in the parts of the world inhabited by man.

General agreement seems to exist, that the two groups of common rats and house mice are of Asiatic descent. R. rattus was widespread in Europe before R. norvegicus arrived. (13) Though rats sometimes emigrate in large numbers over short distances, the spread over Europe must have been slow. (14) "Recent observations have confirmed that in a constant environment, urban rats and mice spend most of their lives within a very limited home range." (15)

R. rattus thrives in a warm environment and remains very lively in temperatures that prostrate R. norvegicus. In cold climates R. rattus lives only in buildings, while R. norvegicus inhabits sewers, streams and burrows, as well as human dwellings. (16)

A female rat rears six young per litter. The young are sexually mature after four months. One female can rear four litters per year, even allowing for a period of infertility that may occur in winter. Climatic factors, especially temperature and humidity, affect the fertility of rats and mice by influencing the vegetation and therefore their food supply. (17) Barnett (18) mentions an incident where a rat population was reduced by half during strenuous trapping operations. The pregnancy rate of the survivors doubled in two months.

"Rats are very active, but only at night and are hostile to others who intrude on the territory of their clan. They are individualists and never take part in concerted action in groups, but do recognise a hierarchy." (19)

The exploratory behavior of rats has the obvious function of keeping them regularly informed on the amenities in their environment - food, water, shelter and the presence of other rats. (20) All these attributes have made possible the successful survival of wild rats in a great variety of environments created by man.

Relative epidemiological importance of rats and mice:

Rats.

It has been argued that R. norvegicus is less susceptible to infection with Y. pestis than R. rattus. This however has not been proved. Laboratory investigations showed that both species were capable of acting independently as the host for infection. (21)

Mice.

Often infected during the course of rat epizootics, the domestic mouse is usually the victim of the disease rather than an agent in transmission.

The plague research commission in India found the following:-

i] Mice were less susceptible to plague than rats.

ii] The flea index of mice was lower than that of rats.

iii] "The specific flea of mice, Leptopsylla segnis, is not an efficient plague vector and hardly ever attacks man." (22)

There are however exceptions to this rule. Mice have been found to carry the infection to man. In southeast Russia the subspecies Mus musculus musculus lived in the open during summer and visited the burrows of wild rodents. In the winter they retired to human dwellings, bringing infected fleas with them. (23)

THE VECTORS OF PLAGUE:

In 1898 Simond at Bombay discovered that bubonic plague was transmitted by the bite of a flea vector, which inoculated the causative organism into the host. (24)

Y. pestis usually multiplies with great rapidity in the blood of an infected rat and quickly produces an overwhelming septicaemia, so that when a flea feeds on a diseased rat, it sucks up large numbers of plague bacilli. In about 12% of these fleas, the bacterium establishes itself in the stomach. Here it multiplies rapidly until the stomach is completely filled with a solid mass of organisms. (25) The flea in this state is technically known as a 'blocked flea'. Such a flea soon becomes ravenously hungry as no blood is able to enter the stomach. In desperation it will attack any animal within reach, including man. "A 'blocked flea' will suck human blood voraciously until its elastic gullet is distended to its utmost limit; but eventually the involuntary recoil of the walls of its gullet forces it to regurgitate some of the blood which now contains plague bacilli." (26) As the flea feeds it simultaneously defaecates and consequently excretes the bacillus in its faeces. The victim scratches to relieve the irritation of the flea bite and inoculates Y. pestis into the circulation.

Some fleas may carry the bacilli in their intestines for a long time and become blocked later. This may explain the carry-over of infection from season to season in hibernating rodents.

When a plague ridden rat dies, the fleas which it harboured move to new hosts. In rat infested human dwellings, the human occupants will serve as alternative hosts.

Which flea?

The number of wild rodent fleas is so large that it precludes any detailed discussion. Those infesting the domestic rodent are more applicable to this study and are, conveniently, smaller in number. It should however be emphasized that fleas of wild rodents may infest the domestic species. This ability of most rodent fleas to thrive on various rodent species is important for the spread and perpetuation of plague.

"A rat can harbour as many as 17 species of flea and a rat's flea population may total several score. However only two of its flea species are regularly capable of acting as vectors of plague." (27)

These are:

i] Xenopsylla cheopis able to adapt itself to a considerable range of climatic conditions.

ii] Nosopsyllus [Ceratophyllus] fasciatus a less effective plague transmitter, but present in large numbers.

Others:

Although Leptopsylla segnis is considered by most authorities to be specific to domestic mice, it should be included, as it is regularly found on domestic rats.

Pulex irritans is often found in limited numbers on domestic rodents and has a remarkable faculty for adapting to a large range of hosts. Man is one of its hosts and it has been held responsible for the spread of plague from man to man, but this has not been adequately proven.

To survive, the flea needs very strict conditions of temperature and humidity. It does well at 15-20°C with 90 - 95% humidity. Cold limits its activity and heat retards its reproduction, while humidity affects its longevity. At 20°C the flea dies if the humidity falls to 70%, and survives only 7-8 days at 80%. In natural conditions therefore, the longevity varies from two days to one year. (28)

Note:

i] While the flea transmits plague in the bubonic form, pneumonic plague is transmitted from man to man.

ii] Not all fleas become infected and only a small portion of the infected fleas transmit the infection. (29)

Other insects:

Besides the fleas of rodents and Lagomorpha and a few other flea species, the following insects have been proved or suspected of being plague vectors.

Human lice: Both Pediculus humanus capitis and Pediculus humanus corporis collected from plague patients or victims have been found to contain Y. pestis, virulent for experimental animals.

Bed bugs: General agreement seems to exist that bed bugs are undoubtedly capable of transmitting plague, but play no more than occasional or at most an adjuvant role in the transmission of infection.

Ticks: Observations by Russian workers have demonstrated the prolonged presence of Y. pestis in several species of ticks collected from naturally or experimentally infected rodents.

Mosquitoes: Observations made during plague epidemics furnished no evidence that these insects took part in the propagation of the infection. (30)

CLIMATIC INFLUENCES ON PLAGUE:

Although it was necessary to give separate consideration to the different factors involved in the causation of plague, it should be realised that the manifestations of this infection are the result of a chain of factors. Even combined factors cannot operate independently but fall under the full influence of environmental conditions. (31)

Naturally this allows for an almost infinite variety of manifestations of this infection in many countries and in vastly different environments. However the infection persists in a comparatively limited number of wild rodent foci (see map). These foci, within well-defined geographical areas, form an ecological association between the pathogenic organisms, vectors and hosts. Such a focus is completely independent of man. Humans may expose themselves to infection by entering such an area. (32)

The following general observations have been made:

i] Bubonic plague tends to be a disease of late summer and early

autumn. Outbreaks occur in temperature ranges of 10-26°C associated with a high relative humidity. "Very high temperatures may be associated with unblocking of the infected flea, while low humidities can cause flea deaths." (33)

ii] Pneumonic plague, by contrast, sometimes appears in cold weather with maximum relative humidity. "Under other circumstances, the airborne organisms have only a short survival period. It must be appreciated that pneumonic plague can occur (whatever) form of the disease is present, and that the climatic influences can be overcome by close contact." (34)

THE DISEASE:

Plague may manifest itself in man in one of three clinical forms.

1] Bubonic plague:

The pathognomonic sign of this form of disease is the bubo, a hard, painful, haemorrhagic swelling of a lymphatic gland. The English word bubo is derived from the Greek word for the groin, βουβών, and the group of lymphatic glands in the groin is generally (55-70%) the commonest site for the plague bubo. (35)

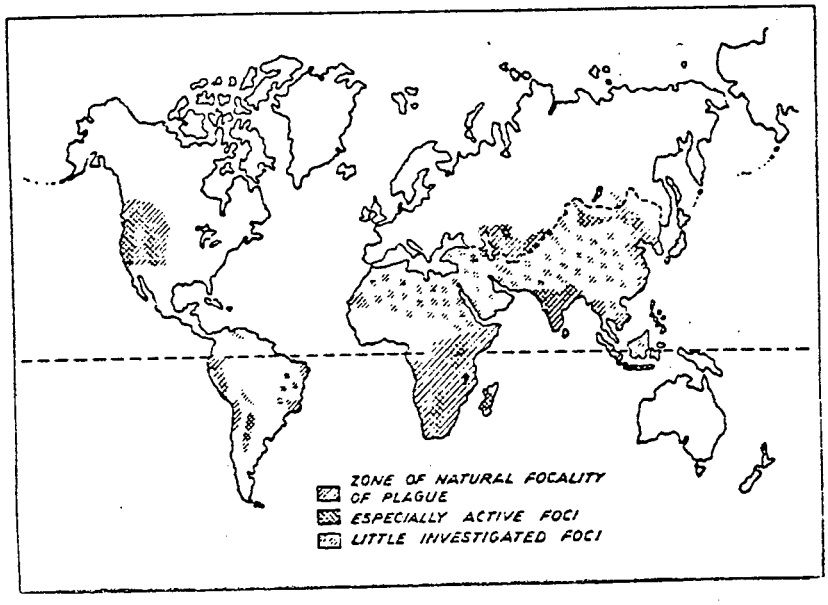
Incubation period:

For the main forms of plague, the incubation period is probably dose-dependent. The usual elapsed time between exposure and the appearance of overt bubonic plague is 3 - 6 days.

Pathology:

In man, the plague bacillus exerts a marked toxic action. It produces cell necrosis and provokes generalised inflammatory reactions, more specifically in the nervous tissues (meningitis) but also affecting the endothelial linings of lymphatic and blood vessels. Inflammatory changes occur in the lymph nodes draining the bite area, forming a bubo, which may go on to suppuration, congestion and possible haemorrhagic necrosis. The infection invariably reaches the blood stream and all the organs of the body become involved. Complications may include a haemorrhagic epicardial effusion, pulmonary oedema and haemorrhage into

SCHEMATIC MAP OF THE NATURAL PLAGUE FOCI OF THE WORLD



From; R. Pollitzer & K.F. Meyer, The ecology of plague. in; Studies in disease ecology. pg. 481

alveoli and small bronchioles as well as partial consolidation of a lobe of lung. (36)

Signs and symptoms:

a] Pestis Minor:
- In a number of cases the disease may be so mild as to allow the patient to be ambulatory.
- Swelling of lymph nodes lasting from 1-3 weeks.
- Pyrexia.
- Headaches.
- Vague pains.

b] Pestis Major:
- Sudden fever with temperatures of 39-40°C and a rapid irregular pulse.
- At the point of inoculation (almost always a flea bite), a pustule or plague blister forms, which undergoes necrosis and forms a blackish plague 'carbuncle'. Note: this carbuncle is not an invariable finding.
- From the second or third day, enlargement of lymph nodes draining the site of infection occurs. These are large, hard and very painful glands and tend to suppurate.
- Mental confusion or delirium may occur.
- Eighth or tenth day - convalescence (in 20 - 40%) OR
- Acute septicaemic stage sets in with multiple organ involvement, for example, the heart, kidneys and lungs.
- Temperature rises to 40 or 42°C.
- Spontaneous haemorrhages into the mucous membranes and viscera.
- Haematuria, purpura and large subcutaneous areas of haemorrhage develop, the colour varying between orange, blue and black. (These haemorrhages seem to have been more frequent in the past and were frequently reported in historical accounts. Hence the name Black Death.)

BUBONIC PLAGUE

Figure 1. Enlarged, tender inguinal lymph node in child with bubonic plague. Note dark blue/black discoloration.

Figure 2. Advanced stage of inguinal lymphadenitis in bubonic plague. Nodes have undergone suppuration and the lesion has drained spontaneously.

2] Pneumonic Plague:

Under certain circumstances, Y. pestis may become localised in the lungs. This usually follows on bubonic plague, with secondary lung involvement. Infection can then be spread from man to man by the aerial route, regardless of whether or not infected rodents and/or infected fleas continue to be present. (37) "In fact, pure 'pneumonic plague epidemics', due to the arrival of patients with lung involvement, have been observed where rat populations were ordinarily free from plague and remained so even when the disease became rampant in man." (38)

Incubation period:

1 - 10 days.

Signs and symptoms:

This is the most severe form of plague, with a case mortality rate of 100%. It has been termed 'demic' plague, as it is spread from man to man by droplet infection.

- Onset of this initial 'closed' stage is sudden.
- High fever appears quickly, accompanied by rapid pulse.
- Rapid and extreme prostration, victims complain of severe headache.
- 20-24 hours after onset, signs of lung involvement become manifest; dyspnoea, chest pain, coughing or spitting of blood-stained, foamy sputum.
- Death occurs in 1 - 4 days.

3] Septicaemic plague:

This is a form of bubonic plague and is due to bubo breakdown and bloodstream invasion. It is characterised by profound septicaemia and the appearance of subcutaneous haemorrhagic patches. (See description of symptoms listed under heading 'Bubonic Plague'.)

Pneumonia may occur and blood-stained sputum contains the plague bacillus. Case mortality rate is high, usually 100%.

Primary septicaemic plague:

In this instance, the entry of the infection through the skin or mucous membranes leads merely to a slight reaction in the regional lymph nodes, followed by a rapid entrance of the causative organisms into the bloodstream.

After an extremely severe onset - high fever of 40 - 42°C, the patient falls into an immobile state and dies without any buboes being visible (or having had a chance to develop).

The functioning of the heart is affected early in the disease and deterioration occurs rapidly as the disease progresses. The whole episode can last from 24-36 hours. Perfectly healthy individuals suddenly succumb and die in the space of one or two days.

These extreme cases, far from exceptional, especially at the beginning of an epidemic, were frequently reported throughout history.

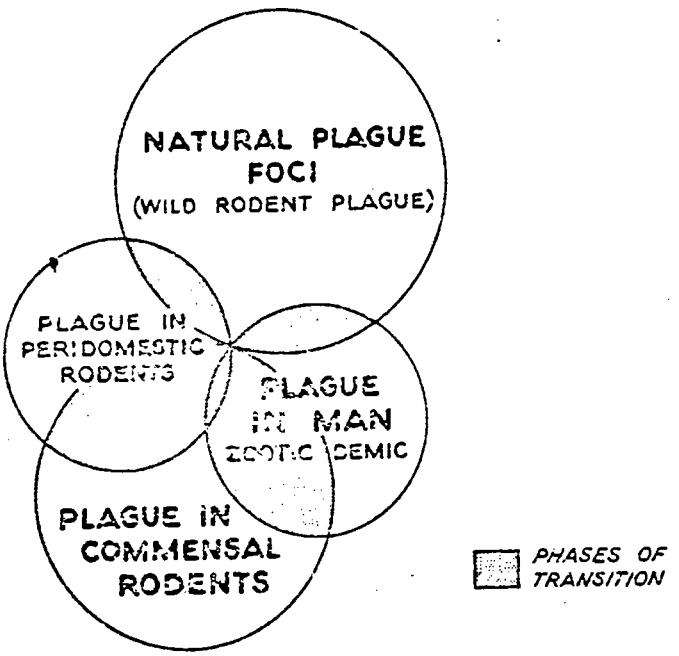
AGE AND SEX INCIDENCE:

Most authorities agree that there does not appear to be any difference between the sexes in the incidence of plague. Any apparent difference in attack rates can usually be explained by the occupations and the habits of the victims.

According to Pollitzer, "the incidence of bubonic plague was highest in adolescents and adults up to the age of 45 years." (39) Tigertt however points to incidences of bubonic plague in Madagascar (1956) and Vietnam (1967) where plague in children was not uncommon. "It may be that this alleged immunity in children is a function of the amount of disease occurring in a population." (40)

In R. norvegicus there is passive transfer of antibodies to the plague bacillus through placental and lacteal routes. The offspring are therefore protected against plague in this manner. Thus, Tigertt suggests, children born of immunised mothers may have some degree of protection. (41)

EPIDEMIOLOGICAL FEATURES OF PLAGUE



From; R. Pollitzer & K.F. Meyer, The ecology of plague. in; Studies in disease ecology. pg. 477

Pneumonic plague, however, seems to be no respecter of persons and will kill anyone of any age who inhales the infected droplets.

OCCURRENCE IN DIFFERENT SETTINGS:

A case of bubonic plague in a family generally does not place the other members at risk, unless they have been exposed to the same infected fleas. Pneumonic plague patients obviously are a threat to their families and other contacts. Transmission occurs only where there is a productive cough. (42)

SOCIO-ECONOMIC FACTORS:

Historically, the lower income groups have had a higher incidence of bubonic plague than the more affluent. Factors involved include; housing likely to harbour rats, locations near docks and granaries, and crowding of occupants.

DEGREE OF MORTALITY CAUSED BY PLAGUE:

It is generally recognised that pneumonic and septicaemic plague are almost invariably fatal. With respect to bubonic plague, opinions vary. In the case of Pestis Minor, patients without bacteraemia usually recover without treatment.

Fatality rates in cases of untreated bubonic plague are high - 60-90%. (43) According to Shrewsbury, in underdeveloped countries, urban communities commonly lose about a third of their members from severe epidemics of bubonic plague. (44)

THE DECLINE OF PLAGUE:

The reason for the decline of a plague epidemic is still uncertain. Many possible explanations have been given;

i] "A highly epidemic/epizootic infection usually burns itself out, as in due course most potential victims are either dead, or have recovered with the development of protective antibodies. This could at best protect humans for a generation (about 25 years) but the next generation would be fully susceptible again." (45)

ii] A decline in either the infectivity or the pathogenicity of the bacillus, either in rats or man or both. However, most experts doubt whether the virulence of Y. pestis varies significantly. Its behavioral pattern does not seem to have changed inherently, except where influenced by factors such as population density, socio-economic changes etc. (46)

iii] Influence of climate in reducing plague activity by influencing rat fertility, life span of the flea etc.

OTHER DISEASES WHICH HAVE BEEN MISTAKEN FOR BUBONIC PLAGUE

SMALLPOX

DEFINITION:

"An acute, infectious, formidable epidemic and highly communicable disease, characterised by toxaemia and a typical rash." (1)

CAUSATIVE ORGANISM:

Smallpox is caused by a member of the Orthopoxvirus - the Variola Virus. There are two types;

1] Variola Minor (Alastrim)

2] Variola Major.

"The range of severity of illness and varying case fatality rates observed in different outbreaks raises the question of the relative virulence of the different strains." (2)

INCUBATION PERIOD:

12 - 14 days.

RESERVOIR:

Man and some other primates. (3)

GEOGRAPHIC DISTRIBUTION:

Before the initiation of the World Health Organization Global Eradication Program in 1967; South America, Africa and Asia were important foci. Today endemic disease no longer exists anywhere.

TEMPORAL DISTRIBUTION:

No characteristic periodicity has been described for smallpox. No direct correlation with any climatic condition has been defined, although it was a seasonal disease.

The virus is known to be more stable under lower humidities and temperatures.

INCIDENCE:

1] Age; In most endemic areas, the overall incidence was highest among age group 0 - 4 years, generally because they were not vaccinated. However, age specific rates among unvaccinated groups show smallpox to have occurred most frequently among males between 5 - 14 years. (4)

2] Socio-economic status;

Most common among lower socio-economic classes. With over-crowding transmission is more likely.

METHOD OF SPREAD:

Direct contact
Droplet infection
Fomites (articles used by infected person)
The virus passes the placental barrier.

PATHOLOGY:

Through inhalation, the virus enters the tissues through the mucous membrane of the upper respiratory tract and then passes to local lymphatic tissue and via the blood circulation to the liver and spleen. "When the virus reaches the skin, lesions are caused in the deeper layers of the epidermis extending to the corium. Necrosis of the centre of the lesion causes the typical depression of the vesicle. Lesions also occur on the mucous membrane of the mouth, on pulmonary mucous membranes and in the gastrointestinal tract. On the mucous membranes the lesions are much more superficial and the vesicles rupture as they are formed. Haemorrhages are widespread in the fulminating cases." (5)

TYPES OF SMALLPOX:

1] Variola Major - unmodified smallpox.

2] Variola Minor - alastrim. The skin lesions are apart and scanty. Prognosis is good.

3] Moderate smallpox - Difficult to diagnose. Usually occurs in someone who has been vaccinated. All patients survive but are fully infectious.

4] Confluent Variola - a severe type. There is confluence of the lesions.

5] Haemorrhagic Variola - the most severe type, often fatal. Haemorrhages occur under the skin, the mucous membranes of the mouth and nose. (6)

SIGNS AND SYMPTOMS (Variola Major):

There are various stages;

First stage - invasion by the organism:
Onset sudden; signs and symptoms of severe fever.
Joint pains, especially backache.
Sore throat or cough, tongue dry and furry, breath offensive.
Conjunctivitis.
Headache, insomnia, deliriousness and rigors.
Abdominal pain, nausea and vomiting.

Patient is severely ill with marked prostration. A temporary "bathing trunk" rash may appear - this is not a specific rash.
This stage lasts from 2 - 3 days.

Second stage - eruption of rash:
Skin temperature subsides with the eruption of the rash, which usually starts on the third day.
It probably first appears in the mouth and throat. Red macules appear on the face, then arms, trunk and legs. These macules develop into pustules by about the eighth day and the temperature again rises.

Third stage - period of recovery:

In the absence of complications the temperature returns to normal on day twelve. Permanent lesions, pitted scars remain.

SIGNS AND SYMPTOMS (Haemorrhagic Variola);

Petechial rashes, with bleeding from the mucous surfaces, occur in the first stage. This may however be delayed until the pustular stage of the eruption, when the lesions become haemorrhagic. The outlook is very grave. (7)

COMPLICATIONS:

Corneal ulceration, leading to blindness.
Acute myocarditis.
Bronchopneumonia - Lobar pneumonia occurs occasionally. It is usually fatal.
Laryngitis with oedema.
Septic skin lesions.
Encephalitis.

DEGREE OF MORTALITY:

Variola Minor - 1%
Variola Major - mortality rate in children under 5 years of age is 50%. In adults it is estimated to be about 30% (8)

RICKETTSIAL DISEASES INCLUDING TYPHUS FEVER (9)

DEFINITION:

An acute communicable disease characterised by hyperpyrexia and a typical rash.

VECTOR AND CAUSATIVE ORGANISM:

Typhus fever - Epidemic (Louse borne) R. prowazekii.

- Endemic (Flea borne) R. typhi.

- Endemic (Scrub typhus, Mite borne) R. tsutsugamushi.

INCUBATION PERIOD:

7 - 14 days.

GEOGRAPHICAL DISTRIBUTION:

Australia, Southern Africa, America, Eastern Europe and Asia.

INCIDENCE:

Occurs where unhygienic conditions prevail and louse infestation is present. War and famine conditions where overcrowding occurs are a typical example.

METHOD OF SPREAD:

The body louse feeds on the infected blood of a host, usually man. Infected lice excrete the organism when feeding. Man is infected by rubbing the infected faeces and crushed lice into the bite or a skin abrasion. Inhalation of dried infected louse faeces as dust may account for some of the infections.

PATHOLOGY:

"Multiplication of the organism in the endothelial cells of the pre-capillary blood vessels of the various tissues is responsible for most of the clinical features of the various forms of Typhus." (10)

Rickettsia cause changes in the small blood vessels especially in the skin, brain, muscles and heart. Thrombosis and haemorrhage occur in the swollen endothelial cells.

SIGNS AND SYMPTOMS:

Sudden onset; pyrexia.
Pain in back and legs, severe headache.
Vomiting.
Epistaxis often occurs.
Conjunctiva are red and congested on about the third day.
Tongue is dried and furred and may be trembling.
Abdominal discomfort with constipation or diarrhoea.
A rash may appear on the 5th day, petechial type, first on the body, then on the limbs. In severe cases purpuric patches occur.
Incontinence of urine and oliguria are common.
The face is oedematous and the patient has a drunken appearance and is confused.
Coma may develop.

COMPLICATIONS:

Pneumonia, Toxaemia, Parotitis
Retinitis, Deafness, Nephritis
Pleurisy, Empyema
Myocardial failure.

MORTALITY RATE:

In the absence of specific treatment, the mortality rate varies from 19 - 40% and increases with age.

CONCLUSION:

Plague is a complex disease, the signs and symptoms of which can be mistaken for a number of other diseases, including those discussed. This confusion has undoubtedly occurred in historical accounts of epidemic diseases. Accurate interpretation of our available source material is therefore vital and it is necessary throughout this study to refer to our present knowledge of the disease.

NOTES

CHAPTER 1

(1) Shrewsbury, J.F.D. (1970) pg. 1

(2) Evans, A.S. (1982) pg. 7

(3) Isaäcson, M.

I quote from correspondence with Prof. Isaäcson; "There is no good evidence that Y. pestis can survive in dust for prolonged periods of time. If this were so it should be very easy to find the organism in the soil of natural enzootic plague foci".

(4) Biraben, J.N. (1977) pg. 26

(5) Pollitzer, R. & Meyer, K.F. (1961) pg. 434

(6) Isaäcson, M. (1984) pg. 166

(7) Biraben, J.N. (1977) pg. 31

(8) Alexander, J.T. (1980) pg. 5

(9) Isaäcson, M. (1984) pg. 165 & 166

(10) Isaäcson, M. (1984) pg. 166

(11) Alexander, J.T. (1980) pg. 5

(12) Shrewsbury, J.F.D. (1970) pg. 7

(13) The medical and historical importance of rats in antiquity will be discussed in Chapter 2.

(14) Barnett, S.A. (1967) pg. 79

(15) Pollitzer, R. & Meyer, K.F. (1961) pg. 451

(16) Barnett, S.A. (1967) pg. 79

(17) Pollitzer, R. & Meyer, K.F. (1961) pg. 450

(18) Barnett, S.A. (1967) pg. 81

(19) Biraben, J.N. (1977) pg. 32

(20) Barnett, S.A. (1967) pg. 85

(21) Pollitzer, R. & Meyer, K.F. (1961) pg. 452

(22) Pollitzer, R. & Meyer, K.F. (1961) pg. 452

(23) ibid pg. 453

(24) Biraben, J.N. (1977) pg. 29

(25) Isaäcson, M. (1984) pg. 5 quotes Cavanaugh, D.C. (1971); Cavanaugh found that temperature affected the plague transmission potential of X. cheopis. "He showed that the proventricular blocking process in infected fleas is associated with fibrin formation from ingested blood by Y. pestis

(cont'd)

NOTES CONTINUED:

coagulase and a trypsin-like enzyme in the stomach of X. cheopis. The fibrin provides the matrix for plague bacilli to become trapped and entangled in the proventriculus, thereby causing blockage. If the ambient temperature rises above 27.5°C, the fibrin is rapidly destroyed by a fibrinolytic factor of Y. pestis and the trypsin-like enzyme."

(26) Shrewsbury, J.F.D. (1970) pg. 2

(27) ibid pg. 2

(28) Biraben, J.N. (1977) pg. 30

(29) For a more detailed study of the role of the flea in the transmission of plague, see Pollitzer and Meyer (1961) pg.463. It includes a summary of experiments and conclusions made by Simond in Bombay, who was the first to describe the role of the flea in the transmission of bubonic plague.

(30) Pollitzer, R. & Meyer, K.F. (1961) pgs. 471 & 472

(31) ibid pg. 475

(32) ibid pg. 476

(33) Tigertt, W.D. (1982) pg. 408

(34) ibid pg. 408

(35) Shrewsbury, J.F.D. (1970) pg. 4
Other sites for this lesion are; the armpits - 20%, and the neck - 10%. The precise site is determined by the location of the bite, inflicted by a blocked flea on the surface of the body.

(36) Kassner, C. (no date) pg. 120

(37) Bradley, L. (1977) pg. 13 quotes Wu Lien - Teh; "Whilst admitting the existence of 'original' pneumonic plagues, we must state emphatically that they are not the rule. The rule is that the pneumonic plague arises from the bubonic plague with secondary lung involvement."

(38) Pollitzer, R. & Meyer, K.F. (1961) pg. 74

(39) Pollitzer, R. (1953) pg. 504

(40) Tigertt, W.D. (1982) pg. 408

(41) ibid pg. 408

(42) ibid pg. 408

(43) Pollitzer, R. (1953) pg. 418

(44) Shrewsbury, J.F.D. (1970) pg. 40

(45) Isaäcson, M. in correspondence with.

(46) ibid

OTHER COMMUNICABLE DISEASES - NOTES

(1) Kassner, C. pg. 141

(2) Benenson, A.S. (1982) pg. 546

(3) Deutschman, Z. (1961) pg. 3 and following for more detail.
Benenson, A.S. (1982) pg. 554

(4) ibid pg. 550

(5) Kassner, C. pg. 142

(6) ibid pg. 142

(7) Gelfand, M. (1957) pg. 254

(8) Deutschman, Z. (1961) pg. 1

(9) I have relied heavily on C. Kassner for my information on Typhus and have not included quotation marks for this reason.

(10) Audy, J.R. (1961) pg. 396

CHAPTER 2

SOURCES WHICH MAY PROVIDE EVIDENCE ON PLAGUE IN ANTIQUITY

The task of identifying plague in antiquity is made difficult because of the limited range of source material available, but recent palaeo-pathological and archaeological studies have yielded some valuable information on ancient diseases. To make the investigation adequately broad and comprehensive, it is important to examine all possible avenues. Although this may not always produce definite clinical evidence on the disease under study, certain related factors - for example fleas in the case of plague - may show up.

The available source material on diseases in classical antiquity can be divided as follows:

1] PICTORIAL REPRESENTATION, in frescoes, sculptures and pottery.

2] ARCHAEOLOGICAL REMAINS
- i] Human
- ii] Animal
- iii] Other

3] WRITTEN SOURCES
- i] Non-literary
- ii] Literary

The written sources will be examined in Chapter 3.

PICTORIAL REPRESENTATIONS:

One of the most comprehensive studies in this field was conducted by Penso. (1) His book illustrates numerous disorders, portrayed on plaques, figurines and sculptures from the Roman world. The deformities and disorders range from chronic to acute, and prove that the symptoms of some diseases have not changed much over the last few thousand years - for example polio and Pott's disease. (2) Unfortunately there is no matching range of pictorial representations from the Greek world. The potters of classical Greece might depict men wounded or vomiting from over-indulgence, but they avoided the portrayal of disease. The Egyptians, however, provide evidence from an earlier age. There are

several Egyptian figurines with hunchbacks which could indicate that the disease was relatively common (3), and this seems to have been the case in ancient Italy as well. (4) Živanović (5) lists several examples of diseases depicted in pottery, including some Indian pots found in America, on which faces deformed by leprosy are depicted; and on a terracotta bust from Pompeii (6) on which the face, neck and chest are covered with pustules, a possible example of smallpox. Other examples of this disease or one related to it - possibly measles - can be found on a male pottery figurine (7) and a fragment of either the arm or leg, of a statue found in Rome. (8) Unfortunately, nothing in this field which might be a depiction of plague has as yet been found.

ARCHAEOLOGICAL REMAINS:

Human

Pathological changes are frequently seen in the skeletal material examined by palaeopathologists, but the preservation of bony material is a chance of nature and finds are therefore relatively rare. Bones react quite differently from tissues and organs to harmful influences. Some diseases affect only bone. Other than evidence of fractures and injuries from sharp and blunt objects, the following diseases (among others) have been identified from the evidence of bones; osteoporosis, arthritis, osteitis, tumours and tuberculosis. In 25-50% of cases with skeletal tuberculosis, the vertebral column is involved and this causes the deformity known as Pott's curvature (hunchback). Missing phalanges could well be an indication of leprosy and certain changes in the joints of the feet can indicate Reiter's syndrome. (9)

Bones reveal other information too. Since muscle use affects the shape of the bones, palaeopathologists can sometimes determine the occupation and work-related accidents and disorders, as well as the age, sex, height and nutritional status of an individual. (10)

Some graves still contain traces of human hair, as well as gallstones, renal calculi and faecal remains. Evidence of diseases affecting the soft tissues can only generally be found in mummies and these include bubonic plague, which leaves no trace in bone.

Apparently up to 8000 mummies have been examined. (11) They are not all Egyptian. Many come from as far afield as Peru, Japan, Australia, North America and the Middle East. The term Mummy is now applied to all well-preserved dead bodies, but the word was originally derived from the Persian word 'mumeia' or 'mum' meaning 'pitch' or 'asphalt'. (12) 'Mumeia' was popular among the Persians as a panacea for physical ailments. (13) From Ptolemaic times onwards, it was used in the process of embalming and so popular was the belief in its healing properties, that bits of body treated with this bituminous material were quite happily swallowed for medicinal purposes! However, the custom faded in the seventeenth century, when it was discovered that any body treated to simulate a mummy was sellable. (14)

Naturally, any medical evidence attained from mummies is dependent on the state of preservation of the corpse. A closer look at the process of mummification is necessary to determine how successfully medical evidence would have been preserved. To study this ancient art, we are dependent on the actual remains, written sources and modern laboratory investigations.

Egyptian mummies that have been examined come from very disparate time periods, but a definite development and improvement in the art of mummification, over time, becomes evident when the finds are arranged in chronological order. The specimens range from the pre-dynastic period (c3400-3100 B.C.) to the eighth century A.D. In pre-dynastic times, the dead were buried, loosely wrapped in linen, skins or matting, in shallow graves. Despite these coverings the hot dry desert sand came into direct contact with the skin and so arrested decomposition. Smith and Dawson (15) believe that the discovery of this natural preservation by the ancient Egyptians strengthened their belief in the survival of the dead. As a result ampler provisions of food etc were added to the graves. This increased the size of the graves and the bodies now no longer came into contact with the desert sand. The need for artificial mummification arose to accommodate what had now become an issue of religious significance.

It is difficult to determine the development of mummification in the early dynastic period, as there are no remains of any significance from this era. This might well indicate an experimental phase. Remains

from the fourth dynasty (c 2500 B.C.) believed to be those of the mother of Cheops, consist of viscera preserved in a natron solution still liquid after 4,500 years. (16) By this time the technique of removing organs which were likely to decay had been developed. The body was treated with natron, by placing packs of this naturally occurring substance around the body. This caused the complete elimination of water and shrinkage. The body cavity was packed with resin impregnated linen. The body was then wrapped in linen and modelled all over with resin to resemble a living figure. Finally, a few layers of gauze were wrapped around the eyes and eyebrows were painted on the outer wrapping. (17)

By the Middle Kingdom the facial features were modelled in mask form, using glue and cloth or papyrus and plaster. Sometimes this was applied to the whole body. A notable example is the solid gold face mask of Tutankhamen. In the New Kingdom each individual part, including fingers and toes, was wrapped individually. Each larger unit in turn was covered and finally the whole mummy was wrapped. (18) Only in the New Kingdom can the sequence of steps in the process be detailed as follows:

1. Putting the corpse on the operating table
2. Extraction of the brain
3. Extraction of the viscera
4. Sterilization of the body cavities and viscera
5. Embalming the viscera
6. Temporary stuffing of the thoracic and abdominal cavities
7. Dehydration of the body
8. Removal of the temporary stuffing material
9. Packing the body cavities with permanent stuffing material
10. Anointing the body
11. Packing the face openings
12. Smearing the skin with molten resin
13. Adorning and bandaging the mummy

From W.H. Peck Mummies of Ancient Egypt pg. 19.

Cockburn notes that artificial mummification was originally limited to the pharaoh, his family and nobles, but it later became a generally applied practice. (19) Strangely, there are no worthwhile Egyptian texts on the technical process of mummification. Smith and Dawson mention two texts from the Roman period, but they are badly damaged and focus more on the ritual of the procedure than the actual materials used. (20) Good accounts are given by Herodotus (ii.85-88) and Diodorus Siculus (i.91-92), who describe the three modes of mummification available, depending on the financial status of the deceased. Herodotus (ii.86.5) mentions that the bodies are soaked in a natron bath for seventy days, but laboratory tests have proved this to be unlikely. It seems that the bodies were packed with natron and not soaked as suggested.

As already noted, during the actual process of mummification, organs were removed from the body and then returned once treated, or kept separately in canopic jars, which were buried with the body. Embalmers were often negligent. Packs were faked, filled with animal remains or wood, or the viscera were badly damaged during removal. (21) Obviously in these cases, all evidence which might have been of interest to the medical historian would have been destroyed, or at best juggled out of context.

However, some interesting abnormalities have come to light during laboratory dissection. Malaria is indicated by the frequent occurrence of splenomegaly, and leprosy from characteristically deformed extremities. The mummy of Rameses V from the XXth dynasty (1200-1085 B.C.), has a rash which looks very like smallpox on his face and pubic region (see figure 3). The possibility exists that it was smallpox, but this is only a suggested diagnosis, nothing more. As Wells points out, "... in mummified tissue the subtleties of diagnosis, not least of which is the clinical history of the case, elude the investigator and there is a bevy of other diseases with rashes like these to contest the field." (22)

Sandison (23) mentions a diagnosis of pneumonic plague, made by M.A. Ruffer in 1910 in a mummy of the Ptolemaic dynasty, based on the discovery of pleural adhesions. Although it has been suggested

Figure 3. Head of Rameses V with possible smallpox lesions.

Figure 4. Smallpox.

that plague bacilli were found in mummies (24), it seems that Yersinia pestis would not survive in the body after death, even if mummified. (25) The bacterium would self-destruct. (26) Buboes would probably still be detectable, even with hypoplasia, but none have as yet been found. For what it is worth, it seems that a large number of mummies died of acute rather than wasting diseases. Despite their dehydrated condition, many were plump or corpulent at the time of death. (27)

Some of the bog bodies found in Denmark, Germany and England, are more perfectly preserved than the finest Egyptian mummies. Most of the bodies were found immediately after World War 2, when peat was still used as fuel. Groups of bog bodies include men, women and children and have been dated as Iron Age peoples - from 600 B.C. onwards. It appears they were either punished for some crime or were victims of ritual sacrifice to Ertha or mother earth. (28) Tollund man's stomach still contained his last meal of porridge, and archaeologists have been able to determine the season in which he was killed from the seeds which made up his meal. (29) Fischer does not mention any signs of acute disease in his thorough study on bog bodies. But the reasons surrounding their death would explain this - most of the victims were probably normal healthy individuals at the time of their rather violent deaths.

It seems then that human remains have so far not revealed any evidence of plague, but the possibility of such a find may still exist. Mummies found and dissected at the turn of the century are being re-examined using the most up to date research methods and some of the finds may well produce new evidence on plague in the ancient world.

Animal

As the study is on plague, research with regard to animal remains has been restricted to those known to be most commonly involved in the transmission of the disease. Although there are numerous animals which can serve as potential carriers, few ever become domesticated. The rat survives equally well in both wild and domestic surroundings. Because of this characteristic, rats are ideal as carriers of Y. pestis from sylvatic foci to areas densely populated by man.

Figure 5. Tollund man.

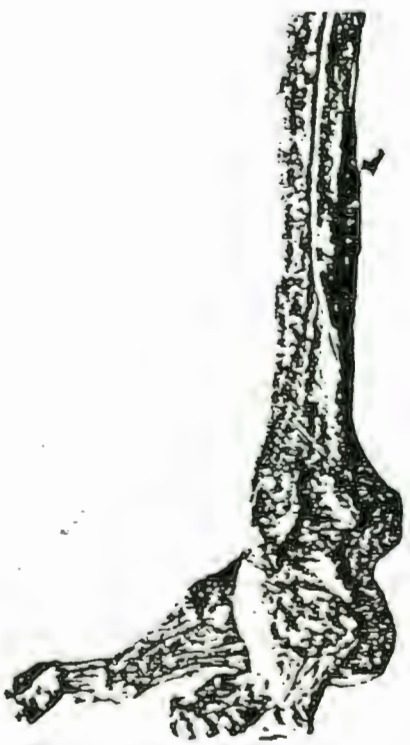


Figure 6. Probable clubfoot or anterior poliomyelitis of Pharaoh Siptah.

Figure 7. Potts curvature

Figure 8. ? Measles or smallpox

Figure 9. Pottery fragment of arm or leg showing possible smallpox lesions.

Figure 10.Possible example of Variola on a terracotta bust from Pompeii

We have noted that the two groups of common rat are probably of Asiatic descent. "The original home of Rattus norvegicus was inner Asia and that of Rattus rattus was India and Burma." (30) But when did they appear in the Mediterranean basin?

It would seem that rats existed in Europe during prehistoric times. Both Zinsser (31) and Shrewsbury (32) mention Donaldson's work in this field. Donaldson found fossil remains of R. rattus in the Pliocene (12 million years ago) in Lombardy, in the Quaternary near Pisa and in the Pleistocene (2-3 million years BPE) cave deposits in Crete. During the glacial period they must have bothered lake dwellers in western Germany. (33) Rackham and Hirst (34) mention a discovery made by Prof. Haas during the excavation of a Neolithic site in Mt. Carmel, of a rat skeleton that was indistinguishable from that of R. rattus. Then all evidence comes to an abrupt halt. The prehistoric rat seems to have become extinct in Europe and does not reappear till thousands of years later - perhaps as a result of climatic change which affected vegetation and other food sources.

R. rattus was probably reintroduced into the Mediterranean area through the active trading between Egypt and India from the third millennium B.C. (35) The black rat is a good climber and has no difficulty finding its way onto ships, hence the name 'ship rat', and it would have extended its range inland from the various ports. (36) The foothills of the Himalayas between India and China and the great lakes in central Africa are two ancient plague foci. The movement of the rat from these areas into the Mediterranean would have resulted in the simultaneous introduction of Y. pestis into a virgin population of burrowing rodents. Shrewsbury mentions a recipe listed in the Ebers Papyrus (c.1550 B.C.) "to keep rats out of the granary", a possible indication that rats had already entered Egypt as early as the second millennium B.C. (37) Bodenheimer and Hirst (38) mention that the remains of R. alexandrinus and the porcupine mouse have been found in Ptolemaic bird mummies.

But there is unfortunately no evidence that the rat was known to the ancient Greeks or Israelites. There is no mention in the Bible of rats although recent translations have incorrectly translated the

word for mouse as rat. (39) The ancient Greek language has no word for rat, only the word μῦς. Zinsser points out that "the word root (Muishi, Persian; Musa, Musi, Hindu; Musiko, Pali) indicates the world-wide ancient knowledge of mice." (40) Historians have suggested that the word μῦς and the Biblical word 'akbar', could have been a generic term used to denote both rat and mouse. Then again, the rat could have been completely undomesticated and consequently relatively unknown to the ancients. But this is pure conjecture. Neither Aristotle nor Pliny in his Natural History mention any animal identifiable as a rat. Aristotle mentions two Egyptian mice; the porcupine mouse (Acomys cahirinus) and one which moves around on two feet, the Jerboa (Jaculus jaculus).(41) Toynbee, in her work Animals in Roman life and art (42) mentions many references to mice, as well as paintings and sculptures of them, but the rat seems to have been unknown.

Medical historians generally agree, that the first evidence of bubonic plague comes from Rufus of Ephesus. He records an outbreak that occurred in the Levant about 300 B.C. and which was reported by the pupils of Dionysius the Hunchback.(43) According to Shrewsbury, this would indicate the arrival of R. rattus in the near east. By the sixth century it was well established and was responsible for the pandemic of bubonic plague during the reign of Justinian. (44) But others believe that the rat was not present in Britain before the tenth century A.D. or even till after the Norman conquest and the time of the crusades. (45) An archaeological discovery made during the excavation of a Roman well in York (in 1976), has proved beyond doubt that R. rattus was in Britain from possibly as early as the second century A.D. (46) A rodent skull and other skeletal remains, identified as those of R. rattus, was found in a Roman well, constructed in probably the late second, early third century A.D. and used till the fourth century. If this is the case, there is no reason why R. rattus could not have been present in Europe quite a few centuries before this. R. rattus "is not an active migrator, but tends to be passively transmitted by human agencies." (47) Recent discoveries have now shown that R. norvegicus too was present in Europe earlier than was previously believed - the thirteenth rather than the seventeenth century. Owing to a mass migration by R. norvegicus from the far east, R. rattus was gradually supplanted. R. norvegicus is now found in ports and their immediate vicinity, while R. rattus is widely distributed in the interior. (48)

Other

Parasites, both external and internal have shown up at various sites, and these offer an interesting field of research. Ditches surrounding a Roman fort of c. A.D. 150 in Scotland have produced evidence of roundworm and whipworm. (49) In mummies over 4000 years old, Egyptologists have found schistosoma eggs (indicating bilharzia), while on others hair still harboured nests of lice (Pediculus capitis). (50) As noted in chapter one, lice play an important role in the spread of Typhus. Literary sources back this evidence. Aristotle (51) gives a good description of lice, and Bodenheimer (52) gives various references in the Talmud to them. Herodotus relates that the men of Egypt always shaved their head and beard, and priests their entire body every other day to prevent lice infestation. (53) But while ancient sources such as I Samuel 24:14 and 26:20, and Aristotle (Hist.anim. v.31 556b) attest that fleas were a nuisance in ancient society, it appears that no evidence of fleas has as yet been discovered by archaeologists or palaeozoologists. (54)

CONCLUSION:

Palaeopathological evidence seems to confirm that certain diseases can indeed be traced back to the classical period and this would indicate that the anatomo-pathological picture of some diseases cannot have changed much since antiquity. This evidence contradicts the theory of Poole and Holladay, who believe that "...it is not possible to talk about the 'same disease' when discussing events separated in time by twenty-four centuries." (55) No direct evidence of plague has as yet been found. Ruffer's contention that signs of pneumonic plague were evident in one of the mummies he dissected has been questioned. Although the chances of finding Y. pestis in a mummy are slight, there is hope that some day archaeologists will find evidence that will confirm that plague was known in the ancient world. Already palaeopathologists have been able to trace the effects of soft tissue damage on skeletal remains - for example Reiter's syndrome - and R. rattus has now been attested on a classical site as early as the second century A.D. Should evidence of fleas be found, it would mean that all the factors necessary to produce plague were there - but, at present we still rely heavily on written sources for evidence.

CHAPTER 2

NOTES

(1) Penso, G. (1984)

(2) Janssens, P.A. (1970) pg. 49 & Wells, C. (1964) plate No. 44 Representation of a priest of Ruma XVIIth dynasty on limestone stele.

(3) Živanović, S. (1982) pg. 227 & Wells, C. (1964) plate no. 51 Predynastic wooden figurine of man.
Naturally royalty was depicted in an idealised fashion, so our study will be based on the more realistic portrayals of the ordinary man. An exception to this rule occurred in the reign of Akhenaten (1377-1358 B.C.) who is portrayed in a far from idealised manner. He has a large elongated head with acromegalic jaw and an effeminate figure. (Wells, C. 1964 plate no.68). He also has a pot belly, which could have been caused by chronic T.B. It seems that other members of his family were afflicted with the same disease, see for example; King Smenkhkare (co-regent) and Meritaten c. 1360 B.C. in a painted limestone relief (Gardner, H. 1959 pg. 89).

(4) Penso, G. (1984) pg. 260 fig.134: an Etruscan bronze figurine.

(5) Živanović, S. (1982) pg. 231

(6) Penso, G. (1984) plate xxviii, facing page 337.

(7) ibid pg. 274 fig. 146

(8) ibid pg. 268 fig. 142

(9) Rogers, J. et al (1987) pg. 189: Reiter's syndrome may arise from gastrointestinal infections such as Salmonella or Shigella dysentery.

(10) See for example the reconstruction of certain skeletons found in Herculaneum. National Geographic May 1984. pp. 557-613

(11) Cockburn, A. (1980) pg. 3

(12) ibid pg. 1

(13) Smith, G.E. & Dawson, W.R. (1924) pg. 29

(14) ibid pg. 20

(15) ibid pg. 23

(16) Peck, W.H. (1980) pg. 18

NOTES CONTINUED:

(17) Peck quotes Petrie's description of this early mummification procedure. pg. 18

(18) Peck, W.H. (1980) pg. 19

(19) Cockburn, A. (1980) pg. 3

(20) Smith, G.E. & Dawson, W.R. (1924) pg. 46

(21) Wells, C. (1964) pg. 26

(22) ibid pg. 86

(23) Sandison, A.T. (1980) pg. 40. From M.A. Ruffer, Bilharzia haematobia in Egyptian mummies of the 20th Dynasty... Brit.Medical Jnl 1,1910 16.

(24) Janssens, P.A. (1970) pg. 114 & 118

(25) Note exceptions mentioned in Chapter 1 under the heading THE BACTERIUM.

(26) This opinion was expressed by Prof. Forder, Dep. Medical Microbiology, University of Cape Town, when asked whether Y. pestis could be detected on microscopic examination of mummy tissues.

(27) Wells, C. (1964) pg. 86

(28) Fischer, C. (1980) pg. 191

(29) ibid pg. 191

(30) Pollitzer, R. & Meyer, K.F. (1961) pg. 446

(31) Zinsser, H. (1935) pg. 197

(32) Shrewsbury, J.F.D. (1970) pg. 9

(33) There is definite evidence of tool-making man in this area by 40,000 BPE.

(34) Rackham, J. (1979) pg. 115 & Hirst, L.F. (1953) pg. 8

(35) Shrewsbury, J.F.D. (1970) pg. 10

(36) According to Shrewsbury, J.F.D. (1958) pg. 29 the earliest Biblical account which might serve as an indicator for the introduction of R. rattus into Palestine, is 1 Maccabees 6.30.37. However, we know that Alexander the Great reached India well before that.

(37) Shrewsbury, J.F.D. (1958) pg. 26

(38) Bodenheimer, F.S. (1960) pg. 45 & Hirst, L.F. (1953) pg. 45

(39) For example The Good News and New English Bible.

(40) Zinsser, H. (1935) pg. 193

NOTES CONTINUED

(41) Historia Animalium 6.30

(42) Toynbee, J.M.C. (1973)

(43) Chapter 5 will deal more fully with this period.

(44) Shrewsbury, J.F.D. (1970) pg. 11

(45) Shrewsbury, J.F.D. (1970) pg. 11 & Rackham, J. (1979) pg. 116 note that the same opinion is expressed by MacArthur and Hirst, F. (1953) pg. 122 & 123. However Zinsser, H. (1935) pg. 197 suggests that R. rattus could have been in Britain by A.D. 400.

(46) See Rackham's article (1979)

(47) Rackham, J. (1979) pg. 117

(48) Pollitzer, R. & Meyer, K.F. (1961) pg. 447

(49) Knights, B.A. et al J.Arch.Sc. X 1983 pp. 139-152

(50) Živanović, S. (1982) pg. 244

(51) Aristotle Historia Animalium v.31 556b-557a

(52) Bodenheimer, F.S. (1960) pg. 73

(53) Herodotus 2.37. Bodenheimer pg. 73 incorrectly says Herodotus 2.89.

(54) According to Bodenheimer, F.S. (1960) pg. 73 Pulex irritans was well known as a human pest, affecting mainly man in settlements.

(55) Holladay, A.J. & Poole, J.C.F. (1979) pg. 286

CHAPTER 3

WRITTEN SOURCES ON DISEASES DOWN TO THE TIME OF HIPPOCRATES

There is an extensive range of literary and non-literary written evidence available, which is relevant to the study of ancient epidemics. However this study will concentrate on texts that seem to refer to plague directly. The survey of ancient epidemics will follow their chronological order, rather than the sequence in which they were recorded in our extant sources. The source material covered has to range from non-classical and classical sources earlier than 430 B.C., as it is necessary to establish whether plague was known or had occurred, if we are to consider it as a candidate for the Plague of Athens.

NON-LITERARY SOURCES:

Pre-classical texts.

Included among the relevant pre-classical texts are Egyptian papyri. Probably the best known is the Ebers Papyrus, which dates back to c. 1500 B.C. However, Dawson does not regard it as being "an authoritative Egyptian medical treatise". (1) It appears to contain lists of prescriptions for various ailments and the surgical treatment of boils and carbuncles. Injuries in general were apparently well understood and treated by rational means, but other maladies such as fevers and skin eruptions were attributed to possession. The treatment for the latter included "driving out", "banishing" or "terrifying". (2)

Most of the texts only give the treatment and the diagnosis is assumed, except for a section in the Ebers Papyrus and another in the Kahun Papyrus, where a description of the symptoms is given and a diagnosis made. (3) Dawson makes no mention of bubonic plague or any associated symptoms appearing in the medical papyri. But Hooker believes that plague was well known to the Egyptians and that the Ebers Papyrus shows that they had two words for bubo. The determinative in these two words  represented a bubo and it was eventually used to

denote medical words generally, as a bubo typified disease to the Egyptian mind.(4) Plague was therefore common and Hooker clearly implies bubonic plague. To support her argument, she points out that most of the Biblical plagues were in some way associated with Egypt. However, it appears that Hooker has fallen into the old trap of accepting that all 'plagues' mentioned were bubonic plague, however unsatisfactory the description of these 'plagues' are.

In the Amarna archives from Egypt, is a letter from the King of Alashiya (Cyprus) in the period 1379-1362 B.C. He apologises for detaining the Egyptian envoy for three years in his country, which he explains was devastated by 'plague'.(5) When Hittite troops invaded Amqa (Egyptian territory) in c.1346 B.C. they took home the 'plague' which raged for four years. (6)

The Old Testament mentions numerous 'plagues'. To attempt any medical analysis of these very vague and brief descriptions is almost impossible. In sifting through some of these 'plagues' to determine any evidence of bubonic plague, the following two points should be taken into consideration:

i] The word 'plague', as noted in chapter one, did not acquire its modern connotation of a specific microbial disease until the seventeenth century. πλᾱγά is the word used in Doric Greek for blow, stroke or wound. In Attic it is πληγή In Hebrew the words for plague (Maggefah, Negef, Naga, Makkah) indicate a blow.(7) Latin adopted the Greek word πλᾱγά and it came into English through its use in the Latin Vulgate. (8) "The metaphor of plague as a blow of a sword or the sting of an arrow is deeply ingrained not only in biblical literature but also in the literature of Greece and Rome."(9) A plague was inflicted as a form of divine punishment and this is evident throughout the ancient sources.

ii] Because of the supernatural element attached to these 'plagues', the description of the actual events is not necessarily accurate.

It is unnecessary to discuss all the 'plagues' of the Old Testament, suffice it to mention those most frequently cited by historians as examples of bubonic plague. In Exodus 8.9, pharaoh's reluctance to let the people of Israel go, led to the Lord imposing a series of 'plagues' upon Egypt. In this particular 'plague', Moses was told to take soot from the kiln and toss it into the air "...and it produced festering boils on man and beast." Again in Deuteronomy 28.27 "May the Lord strike you with Egyptian boils and emerods, scabs and itches, for which you will find no cure."(10) The boils and emerods have been interpreted as evidence for the existence of bubonic plague, but this is conjecture.

One of the most frequently mentioned 'plagues' in the Old Testament and one mentioned by almost all historians as a good example of bubonic plague, is the so called 'Plague of the Philistines' in I Sam.5 and 6. In 1190 B.C. in Canaan (11) the Israelites were defeated by the Philistines, who seized the Ark of God and brought it to Ashdod. "The Lord laid a heavy hand upon the people of Ashdod and plagued them with emerods in their secret parts and their territory was plagued with mice." There was death and destruction throughout the city, no one group was safe from the pestilence and the same occurred in the other cities to which the Ark was taken. Eventually, in desperation the Philistines returned the Ark, together with gifts in the form of five golden images of emerods and five of mice. Needless to say, the 'plague' abated, but not before claiming some victims among the Israelites.

Clearly this is a description of an infectious disease. It seems that men and women alike were affected and that the disease was carried from city to city, no doubt by some already infected individuals when they transferred the Ark. It is tempting to see an association between the plague of mice and the actual illness, especially as the Philistines made images of both the mice and of what was apparently a symptom of the disease.

Shrewsbury does not believe that the pestilence was bubonic plague, or that the 'plague' of mice was associated with the disease. Instead, he argues that the disease was bacillary dysentery. In his article on the Plague of the Philistines, Shrewsbury makes some very valid points against the disease having been plague.

i] There is no mention "of any unusual mortality among the mice ....the inference implicit in the record is that they must have been healthy and active in order to achieve the extent of the destruction they wrought."(12)

ii] Mice play an insignificant part in plague epidemics, as noted in chapter one.

iii] The word emerod means haemorrhoids and the 'secret parts' referred to would therefore not mean the inguinal area but rather the perianal area.

iv] It would seem that if the Philistines suffered from plague swellings, they appeared in the groin. The incidence of inguinal buboes in plague victims is 50%. Others are found in the neck and axillae.

A point not mentioned by Shrewsbury, but one which should be considered, is the assumption that the Philistines understood the association of mice with outbreaks of bubonic plague. They recognised already then, that rodents were carriers of bubonic plague, or so historians seem to imply. This seems rather ridiculous when one considers that the whole puzzle surrounding agents and carriers of bubonic plague was only unravelled in the late nineteenth and early twentieth century. Even today certain aspects of the disease are still being examined.

The above points are indeed valid and discredit a diagnosis of bubonic plague, but Shrewsbury's alternative diagnosis of bacillary dysentery is equally difficult to accept. The severe dehydration associated with bacillary dysentery would in the primitive society of the middle east have led to certain death before the individual had had the chance of developing haemorrhoids. Shrewsbury states: "In the individual the disease caused the lesions described as 'emerods' to

develop in the 'secret parts' of the body - before death in those who succumbed to it - and in those who survived it. The 'emerods' were therefore a constant concomitant of or sequel to the disease." (13)

It appears however, that haemorrhoids rarely develop, even in individuals who survive an attack of bacillary dysentery. (14) Haemorrhoids and polyps already present in the bowel may be aggravated by an attack. What then could we label the Plague of the Philistines? Considering the amount of information available, it would be unfitting to offer a modern diagnosis - there simply is not enough information. In fact this is true for all Biblical 'plagues', but Hooker still finds it "reasonable to conjecture that the epidemics of the Septuagint were outbreaks of bubonic plague". (15)

Another example of non-literary sources, are epigraphical remains. These offer a fragmented amount of information, and although certain letter forms and word usage can help date finds of this kind, the contents of the inscriptions usually convey very little information to the medical historian. Take for example a find from (probably) the Hellenistic period:

SEG XXXI, 1981 (1984) 630. Epigram of Aptos from Dion in Macedonia, says he saved many men

ἐκ τε νόσων χαλεπῶν καὶ ἀνιηρῶν ὀδυνάων

From dangerous diseases, and intolerable suffering.

More often than not, only the generic terms νόσος and λοιμός are used in inscriptions to show that the person died of some disease, but certainly no signs and symptoms of the disease are given.

From 1400 B.C. written evidence clearly attests the appearance of epidemic diseases in the ancient Middle East. According to McNeil, (16) the Middle East, North and East Africa had by then established "civilised patterns of social organisation" and population densities were sufficient to allow for the effective spread of epidemic diseases. Although these epidemics must have been of some importance in reducing population numbers and have affected the course of military events,

they did not "keep population below levels necessary for empire building". By 500 B.C. organisms and their human hosts had reached a mutually tolerable relationship (indicated by an increased population growth) and epidemic diseases usually erupted only in unusual conditions, for example during military operations. However, in the fringe areas greater instability prevailed - in the Aegean basin and more generally the Mediterranean coastlands. These areas became the arenas for future epidemics.

GREEK AND ROMAN LITERATURE:

The accounts of 'plague' in the ancient Greek writings, follow the same vein as those recorded in the Old Testament. In the first book of the Iliad, Apollo is called upon by the priest Chryses, to avenge the 'ravishing' of his daughter Chryseis of the lovely cheeks. Apollo shoots arrows into the midst of the Greeks for nine days, killing first the mules and dogs and then men. So many died of the 'plague' (i.61) that "innumerable fires consumed the dead". (17) Many historians believe Homer was describing an epidemic of plague and they use the following arguments to prove this theory; apparently, Apollo was known as the 'mouse-god' in the area of Troy and they believe Homer, in this way, linked mice with this epidemic. Strabo (xiii,1.64.613) refers to ὁ Σμινθεύς, ἐπειδὴ σμίνθοι οἱ μύες. But, Homer calls him "Phoebus Apollo" rather than 'Apollo Smintheus', and the passage in the Iliad referred to above makes no mention of mice. Mice were associated more with destruction than disease. Apollo's method of killing first the animals in the form of an epizootic, followed by an epidemic among the troops, does resemble an attack of bubonic plague, but, with no description of the symptoms available, it is impossible to give a diagnosis.

It is difficult to date this plague. We know that the Iliad and possibly the Odyssey were written in about 700 B.C. by someone in Ionia. Homer has been credited with these compositions, but of his life, date or place of birth we know nothing for certain. If Homer was referring to an historical epidemic in the context of the Trojan War, then the date would have to be c.1190 B.C. It is evident that the

author was familiar with epidemic outbreaks, but he could very well have transposed occurrences familiar to him or to the oral tradition in the Iron Age, to the Mycenaean Age.

An interesting theory on the depopulation and destruction of the Bronze Age sites in Greece about 1200 B.C. is offered by W. Williams. He believes a great epidemic was the cause of this and the Dorians were able to occupy Greece only because they found it defenceless. "The ancient world knew but one agent that at one fell blow, or lingering through the years, could destroy, over whole continents, agriculture, trade, the arts and crafts and entire framework of civilisation, life itself - bubonic plague". (18) Apollodorus the mythographer, thought to be a writer of the first century A.D., records (ii.8.2) a 'plague' that "visited the whole of the Peloponnese". This apparently occurred 80 years after the Trojan War. Thucydides (i.12.3) says the return of the descendants of Heracles and the Dorians to the Peloponnese took place at that time, and according to Apollodorus (ii.8.2) the 'plague' occurred a year after their return. The word used by Apollodorus is φθορά which means ruin or destruction, but has been translated by J.G. Frazer as 'plague'. Herodotus (vii.171) briefly mentions a 'plague' that struck Crete after the Cretans returned from Troy, which affected men and cattle, but we have no symptoms. Williams, however, proceeds to list examples of epidemics from about 2000 B.C. (including those already discussed in this chapter) through to the Middle Ages and quite happily labels them all plague. (19)

That there was a dramatic drop in population in Greece from c.1200 has been argued from the shrinking number of occupied sites, by Snodgrass (20), but he gives no reason for this. Chadwick has argued against a Dorian invasion and for an uprising of the Dorian masses against their non-Doric overlords. But Greenhalgh disputes this. (21) He agrees that archaeological evidence points to wide scale destruction of the sites in the Peloponnese during this period, but suggests that the culprits were Greeks from north-western Greece. They were motivated by a need for Lebensraum, as they themselves were being driven south by peoples to the north. The Achaeans of the Peloponnese moved to the Asia Minor coast. If the Dorians, or some other invading force, had found Greece as depopulated by disease as Williams would have us

believe, there would surely be no need for such wide scale destruction? Furthermore, Snodgrass's interpretation of the significance of the shrinkage in the number of occupied sites has to be questioned.

Post-Homeric authors continued to refer to epidemics, but the references are non-specific and cannot be firmly dated. Herodotus' account in vii,115 is only slightly more specific. He says 'plague' (λοιμός) and dysentery attacked Xerxes' army returning to Persia in 479 B.C. The 'plagues' in Italy can be dated more accurately thanks to Livy's reference to a series of 'plagues'. He offers a rather bald account of a pestilence in Rome in 463 B.C. It struck the city and country, affecting man and beast. Afraid of pillage "flocks and country folk were received into the city" which increased the virulence of the disease through overcrowding.(22) In 453 B.C. (23) two misfortunes occurred at the same time, "famine and pestilence, baneful alike to men and beasts. Fields were left untenanted, the city emptied by incessant funerals". Obviously no diagnosis is possible from these brief and non-descriptive accounts. (24)

Athens' great age as an imperial power fell within the period 480-414 B.C. and in the western Mediterranean Rome and Carthage fought for control. The instability of the Mediterranean coastline on a micro-parasitic basis made the area vulnerable to infectious diseases, but McNeil believes that Hippocrates was not yet familiar with the epidemics which ravaged the Mediterranean centuries later, such as measles, smallpox and bubonic plague. (25) But it seems that Hippocrates <u>was</u> familiar with the signs and symptoms of bubonic plague, although he may never have witnessed an actual epidemic of the disease. (26) The most significant feature is the appearance of the classical bubo. Hippocrates refers to buboes in his 'Aphorisms' (section iv.55). "οἱ ἐπὶ βουβῶσι πυρετοὶ, πάντες κακοὶ, πλὴν τῶν ἐφημέρων." "Fevers lasting for more than one day which follow on a bubo are all serious." He specifically uses the word βουβῶν here, but does not specify where on the human body they occur. In 'Epidemics' iii.7. he speaks of ἕλκωμάτα and φύματα (sores and tumours) which appear externally and internally, some as swellings in the groin. Buboes are

swellings in the inguinal and femoral areas (and elsewhere as noted) and were often termed 'fig-like' swellings in the Middle Ages. It is not clear whether Hippocrates differentiated between tumours and buboes when describing these swellings. In other words, was he aware that buboes were a symptom of a specific infection? If he was, we could indeed say that bubonic plague was known to Hippocrates, but not in epidemic form. If such an epidemic had occurred during his lifetime (conventional dates 469 - 399 B.C.) he would have described it in recognisable terms. (27)

Of course the absence of records does not necessarily prove that bubonic plague was not known or did not occur in India and Africa long before it reached the Mediterranean.(28) Perhaps its absence in the Mediterranean basin can be explained by the apparent absence or scarcity of the domestic rat. "The Egyptian land bridge, separating the Red Sea and the southern oceans from the Mediterranean waters, was obviously a significant barrier to the movement of ships' rats and their fleas. Hence an infection familiar enough for centuries among rats, fleas and people of Indian ocean ports could have dramatic and unparalleled effects when, by some accident, it surmounted the usual barrier and burst in upon virgin populations of the Mediterranean among whom acquired resistance to the disease and conventional means of coping with it were entirely lacking." (29)

CONCLUSION:

Having reviewed the source material available for the period preceding 431 B.C. one can see that there is little positive evidence of plague. In the Biblical accounts facts are obscured by the emphasis placed on divine intervention, and Greek and Roman texts have revealed nothing substantial either. It would seem then that the Hippocratic writings offer the only indication that plague was known to the ancients. It is not until the Athenian 'plague' that we have our first clear description of a highly contagious disease.

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(1) Dawson, W.R. (1953) pg. 50

(2) ibid pg. 59

(3) ibid pg. 58

(4) Hooker, E.M. (1958) pg. 82. The determinant  is rendered as 'bodily growths, disease' in A.H. Gardiner Egyptian Grammar Oxford, 1927 pg. 32 (Known to me indirectly.)

(5) Cambridge Ancient History ii 1^3 1973 pg. 491-2

(6) ibid ii 2^3 1975 pg. 18-19 and pg. 84

(7) Deaux, G. (1969) pg. 15

(8) The Oxford English Dictionary notes the use of the word plague with specific reference to bubonic plague, in 1612 in the Woodall Surgical Mate, and half a century later
Pepys makes the following entry in his diary on 22 July 1665: (note the month, this would tie in with the seasonal occurrence of plague) "His servant died of a bubo on the right groin and two spots on the right thigh, which is plague".

(9) Deaux, G. (1969) pg. 15

(10) I posed the problem of dating the various books of the Old Testament to Dr L. Sandler, Dept.of Hebrew Studies, University of Cape Town, who was kind enough to explain the various debates among scholars on this thorny issue. Orthodox Jews believe that Exodus was composed by Moses by divine inspiration, as were the other books in the Pentateuch. However, modern scholars from the latter part of the eighteenth century to the present, have queried the uniform authorship of the Pentateuch and believe it is the work of at least 4 authors. They have developed the so-called 'Documentary Hypothesis' to explain this theory. According to them, Exodus was probably written in the 9th-8th century B.C., while the author of the book of Deuteronomy was supposed to have lived in 621 B.C. in Judea (southern kingdom). In c. 450 B.C. all 4 documents were welded together by some unknown author to form the Pentateuch. Whether Moses had any part in the authorship of Exodus

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(10) cont'd is therefore questionable, but we do know that Moses was in Egypt during the reign of Rameses II and that the 'Exodus' occurred after 1300 B.C.

(11) When the book of Samuel was written is again a matter of scholarly dispute. Some scholars believe it was composed about 620 B.C. during the reign of Josiah, but the orthodox Jews believe it was composed before David's reign in 1000 B.C. Again, it was edited in c. 450 B.C. Different versions of the Book of Samuel have been found in the Dead Sea Scrolls (written between 150 B.C. - A.D. 70). Some follow the Septuagint version (c. 250 B.C.), others the Masoretic, composed in c. 200 A.D. We cannot date Samuel precisely, but the Philistines referred to in Samuel were also known as the 'sea people' who overran Palestine in the 1180's but were stopped from entering Egypt by Rameses III. The Plague of the Philistines must have occurred somewhere between 1180-1000 B.C.

(12) Shrewsbury, J.F.D. (1958) pg. 18

(13) ibid pg. 16

(14) Prof. Forder, Dept. of Medical Microbiology, U.C.T. Medical School, when questioned on the possibility of this occurring, stated that he believed that the development of haemorrhoids in bacillary dysentery was not common.

(15) Hooker, E.M. (1958) pg. 80

(16) McNeil, W.H. (1977) pg. 77-79

(17) Iliad i.43-52

(18) Williams, E.W. (1962) pg. 111

(19) Williams cleverly transposes features of epidemics generally accepted as having been bubonic plague, for example the Plague of Justinian, to earlier more vaguely recorded ones, to give greater credibility to his theory.

(20) Snodgrass, A. (1980) pg. 19 f.

(21) Greenhalgh, P.A.L. (1978) pg. 1-38

(22) Livy iii,6.

(23) Livy iii,32

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(24) Ogilvie, R.M. (1965) pg. 394 says that the nature of these "and other plagues mentioned in Livy cannot be established with certainty. They were certainly recorded in the Annales since the measures taken to avert them were of importance pontifically, but no detail of symptoms is given". Livy used these Annales when writing his history of Rome and the dates given for this early period should therefore be considered as an accurate record of what was in the state archives.

(25) McNeil, W.H. (1977) pg. 100

(26) Watson Williams (1957) pg. 102-3 argues that the disease mentioned by Hippocrates, (Epidemics iii,3-4) was in fact bubonic plague and Hooker pg. 80 agrees with him. However, Hippocrates clearly diagnoses the disorder to be erysipelas. People over sixty years of age were particularly prone to get it, as it occurred usually as a result of a neglected wound. He goes on to give a detailed description of how the inflammation spread to various other parts of the body. Areas became septic and there was destruction of underlying tissues, often laying bare whole areas, for example the arm or forearm. There was usually no crisis, or it was attained with difficulty - by crisis meaning high temperature, no doubt. Those that developed localised collections of pus recovered, but in individuals where the erysipelas disappeared with no pus collection, the disease proved fatal. It seems that in some cases generalised bacteraemia occurred, a very likely consequence in severe skin infections. Hippocrates lists several of these symptoms; bowel disorders, swellings in the throat, dental abscesses etc. Williams' diagnosis of bubonic plague, in the light of the detailed discussion of the symptoms in chapter one, seems highly unlikely.

(27) None of the so-called 'Hippocratic Books' were ever attributed in their entirety to Hippocrates and their authenticity was disputed even in ancient times. The Hippocratic corpus is the work of a great number of medical writers, belonging

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(27) Cont'd

to different schools. As a result opposing viewpoints on different matters are expressed throughout the collection. We know Hippocrates' methods and doctrines from pre-Alexandrian testimonies and as a result only two books in the Hippocratic corpus have been attributed to Hippocrates himself. Hippocrates' fame was recognised already in Plato's time, for example in 'Protagoras' 311B "Ἱπποκράτη τὸν κῷον, τὸν τῶν Ἀσκληπιαδῶν .." and 'Phaedrus' 270 C-E.

(28) McNeil, W.H. (1977) pg. 126.

(29) ibid pg. 127

CHAPTER 4

THE PLAGUE OF ATHENS 430 B.C.

It is difficult to determine just how common epidemics were in the ancient world, and whether the nature of the diseases varied greatly. The paucity of references to epidemics in the extant texts from antiquity points to very infrequent outbreaks, but these are not necessarily a reliable guideline. Many epidemics may never have been recorded, or the evidence was lost. As a result, we cannot be sure whether they were becoming more common by the fifth century B.C. Factors that could have facilitated the spread of epidemics include long-distance trade and warfare. Trade links between Egypt, South Arabia, Crete, Cyprus and the Levant were well established by 2700 B.C. (1) Mesopotamia traded with India and Ceylon from the third millennium B.C.(2) and Egypt with Somaliland and African areas below the Red Sea, for incense and myrrh. No doubt these trade routes became better established during the next centuries, allowing for a relatively fast and efficient service. Apparently, ships with favourable winds could travel an average of 100 miles a day. Pliny, in his Natural Histories xix.3-4, records some exceptionally speedy voyages. For example: it took 7 days to sail from Cadiz to Ostia and less than 9 to Alexandria from Puteoli on the Bay of Naples. In this way, infectious diseases were easily carried from port to port. For Athens maritime trade became progressively more important from Solon's day and this increased as the Athenians became more dependent on imported corn.

The period of extensive colonization by the Greeks, in Asia Minor, southern Italy and Sicily (c. 750 B.C.), had brought them into contact (and at times into conflict) with people and communities around the Mediterranean and the Black Sea. During her imperialist expeditions (from c. 480 B.C.) Greek troops and seamen were sent to Byzantium, Cyprus, Egypt and Magna Graecia. It seems that by 430 B.C. contact between Athens and her Mediterranean neighbours was well established.

In addition, Athens' ability to maintain a hold over her empire, and Rome's expansionism in the west, during the fifth century B.C., points to population sizes large enough for empire building. With increasing long-distance traffic and rising population densities, it is not surprising that a new and virulent disease - as in the case of the Athenian 'plague' - had such devastating consequences.

Athens had been involved in a conflict with the Peloponnesian states from 461-446 B.C. In the mid-summer of 431 B.C. Archidamus invaded Attica.(3) The Athenians, on the advice of Pericles, had moved family and goods from the rural areas of Attica into Athens, and their sheep and cattle to Euboea and neighbouring islands.(4) Only a few had houses in the city and the majority were forced to camp wherever they found room.(5) The high summer temperatures, poor and greatly overburdened sanitary facilities and vast overcrowding, created an ideal breeding ground for disease.

Thucydides is our primary source for that period. Born in c. 460 B.C. he was elected strategos in 424/3 B.C. and was sent to Thrace in that capacity.(6) He began taking notes for his work in 431 B.C.(7) Written in an unemotive, well-researched and objective style, his account of the Athenian 'plague' is quite unique. Thucydides himself was infected during the epidemic, but recovered. His account of the events leading up to the 'plague', start in the second year of the war, when Sparta again invaded Attica and devastated the countryside. Thucydides writes:

> " They had not been many days in Attica before the plague first broke out among the Athenians. Previously attacks of the plague had been reported from many other places in the neighbourhood of Lemnos and elsewhere, but there was no record of the disease being so virulent anywhere else or causing so many deaths as it did in Athens. At the begining the doctors were quite incapable of treating the disease because of their ignorance of the right methods. In fact mortality among the doctors was highest of all, since they came more frequently in contact with the sick. Nor was any other human art or science of any help at all. Equally useless were the prayers made in the temples, consultation of oracles, and so forth: indeed, in the end people were so overcome by their sufferings that they paid no futher attention to such things.

The plague originated, so they say, in Ethiopia in upper Egypt, and spread from there into Egypt itself and Libya and much of the territory of the King of Persia. In the city of Athens it appeared suddenly, and the first cases were among the population of Piraeus, where there were no wells at that time, so that it was supposed by them that the Peloponnesians had poisoned the reservoirs. Later, however, it appeared also in the upper city , and by this time the deaths were greatly increasing in number. As to the question of how it could first have come about or what causes can be found adequate to explain its powerful effect on nature, I must leave that to be considered by other writers, with or without medical experience. I myself shall merely describe what it was like, and set down the symptoms, knowledge of which will enable it to be recognized , if it should ever break out again. I had the disease myself and saw others suffering from it.

That year, as is generally admitted, was particularly free from all other kinds of illness, though those who did have any illness previously all caught the plague in the end. In other cases, however, there seemed to be no reason for the attacks. People in perfect health suddenly began to have burning feelings in the head; (8) their eyes became red and inflamed; inside their mouths there was bleeding from the throat and tongue, and the breath became unnatural and unpleasant. The next symptoms were sneezing and hoarseness of voice, and before long the pain settled on the chest and was accompanied by coughing. Next the stomach was affected with (9) stomach-aches and with vomitings of every kind of bile that has been given a name by the medical profession, all this being accompanied by great pain and difficulty. In most cases there were attacks of ineffectual retching, producing violent spasms: (10) this sometimes ended with this stage of the disease, but sometimes continued long afterwards. Externally the body was not very hot to the touch, nor was there any pallor: the skin was rather reddish and livid, breaking out into small pustules and ulcers. But inside there was a feeling of burning, so that people could not bear the touch of even the lightest linen clothing, but wanted to be completely naked, and indeed most of all would have liked to plunge into cold water. Many of the sick who were uncared for actually did so, plunging into the water-tanks in an effort to relieve a thirst which was unquenchable; for it was just the same with them whether they drank much or little. Then all the time they were afflicted with insomnia and the desperate feeling of not being able to keep still.

In the period when the disease was at its height, the body, so far from wasting away, showed surprising powers of resistance to all the agony, so that there was still some strength left on the seventh or ninth day, which was the time when, in most cases, death came from the internal fever. But if people survived this critical period, then the disease descended to the bowels, producing violent ulceration and uncontrollable diarrhoea, so that most of them died later as a result of the weakness caused by this. For the disease, first settling in the head, went on to affect every part of the body in turn, and even when people escaped its worst effects, it still left its traces on them by fastening upon the extremities of the body. It affected the genitals, the fingers, and the toes, and many of those who recovered lost the use of these members; some, too, went blind. There were some also who, when they first began to get better, suffered from a total loss of memory, (11) not knowing who they were themselves and being unable to recognise their friends.

Words indeed fail one when one tries to give a general picture of this disease; and as for the sufferings of individuals, they seemed almost beyond the capacity of human nature to endure. Here in particular is a point where this plague showed itself to be something quite different from ordinary diseases: though there were many dead bodies lying about unburied, the birds and animals that eat human flesh either did not come near them or, if they did taste the flesh, died of it afterwards. Evidence for this may be found in the fact that there was a complete disappearance of all birds of prey: they were not to be seen either round the bodies or anywhere else. But dogs, being domestic animals, provided the best opportunity of observing this effect of the plague.

These then were the general features of the disease, though I have omitted all kinds of peculiarities which occured in various individual cases. Meanwhile, during all this time there was no serious outbreak of any of the usual kinds of illness; if any such cases did occur, they ended in the plague. Some died in neglect, some in spite of every possible care being taken of them. As for a recognised method of treatment, it would be true to say that no such thing existed: what did good in some cases did harm in others. Those with naturally strong constitutions were no better able than the weak to resist the disease, which carried away all alike, even those who were treated and dieted with the greatest care. The most terrible thing of all was the despair into which people fell when they realized that they had caught the plague; for they would immediately adopt an attitude of utter hopelessness, and, by giving in in this way, would lose their powers of resistance. Terrible,too, was the sight of people dying like sheep through having caught the disease as a result of nursing others. This indeed caused more deaths than anything else. For when people were afraid to visit the sick, then they died with no one to look after them; indeed, there were many houses in which all the inhabitants perished through lack of any attention. When, on the other hand, they did visit the sick, they lost their own lives, and this was particularly true of those who made it a point of honour to act properly. Such people felt ashamed to think of their own safety and went to their friends' houses at times when even the members of the household were so overwhelmed by the weight of their calamities that they had even given up the usual practise of making laments for the dead. Yet still the ones who felt most pity for the sick and the dying were those who had had the plague themselves and had recovered from it. They knew what it was like and at the same time felt themselves to be safe, for no one caught the disease twice, or, if he did, the second attack was never fatal. Such people were congratulated on all sides, and they were themselves so elated at the time of their recovery that they fondly imagined that they could never die of any other disease in the future."

Thucydides ii.47-52 trans, R.Warner

In their excellent article on the Plague of Athens, Holladay and Poole have offered a condensed version of the many conclusions reached by both medical and historical experts over the past few decades, on the nature of the disease.(12) As a result it would be superfluous to re-examine every diagnosis in detail, as some are very obviously inappropriate. It is important to remember that a group of symptoms constitute a specific disease. If some of these are not present or are misinterpreted, the

disease can easily be misdiagnosed. Therefore only a brief list of reasons as to why a certain diagnosis would be incorrect will be given.

i] Tularemia, proposed by Wylie and Stubbs (13), only has a 5% mortality rate and is not spread from man to man. As a result, the disease would never reach epidemic proportions.

ii] Ergotism, suggested by Page and seriously considered by Gomme (14), is not contagious. The Athenians did not eat rye and the symptoms in no way resemble those mentioned by Thucydides.

iii] Recent opinions offered include a) a combination of three different diseases; influenza, toxic shock syndrome and impetigo, and b) Rift Valley Fever. The former is discussed by Langmuir et al (15) but even this effort has many inexplicable loose ends. The mortality rate of influenza is low, 0.5-1.2%, and the rash described by Thucydides does not occur in influenza or toxic shock syndrome. Impetigo does not occur in epidemic form, nor is it regularly associated with the other two illnesses. Immunity to one of these three would not protect an individual from acquiring the others. Thucydides (ii.51) clearly states, that once immunity was acquired, victims never suffered another (fatal) attack.(16) Morens and Chu (17) have suggested Rift Valley Fever, but they concede that only some of the features resemble the Athenian 'plague'. Rift Valley Fever is a mosquito borne viral disease which is not spread from man to man. The disease is rarely fatal, and one of the more obvious symptoms, jaundice, is not mentioned by Thucydides.

Clearly, we must restrict this study to the three most likely candidates, and those proposed most frequently by medical historians as being responsible for the Plague of Athens: smallpox, typhus and bubonic plague.

Many of the symptoms of smallpox and typhus resemble those mentioned by Thucydides, but this is unfortunately not the case with bubonic plague. Thucydides makes no mention of buboes. Hooker (18) has argued that ἕλκος could be translated as a suppurating bubo and that it was regularly used to denote bubonic swelling. Only in the second century

A.D. is ἕλκος replaced by βουβών. But as Holladay and Poole (19) point out, if ἕλκος meant βουβών in medical writings from the fifth century B.C. to the second century A.D., as Hooker suggests, one must assume that all plagues were bubonic. In Menander (Georgos 50-52) a farmer complains of a βουβών as a result of a wound ἕλκος on his foot (a normal reaction of a regional lymph node to an infected wound). Say Poole and Holladay, "the two words are here used by a layman in their distinct and correct meanings and there is no need why Thucydides should have confused them". Besides, one could hardly translate φλυκταίναις μικραῖς καὶ ἕλκεσιν (20) as small blisters and buboes, which broke out all over the body! Finally, Hooker would have us believe that Thucydides did not describe the appearance of these ἕλκη (or, according to Hooker, buboes) as he "was probably not much conscious of their appearance" but dwells rather "on the discomforts he and other survivors would remember", such as burning eyes.(21) It is a well recognised fact that the appearance of buboes in a victim suffering from bubonic plague is accompanied by severe pain. Indeed, it has frequently been described by victims as a tearing or sharply cutting pain.

According to Holladay and Poole the only point in favour of a diagnosis of bubonic plague is the fact that animals were affected.(22) This is indeed a feature of plague but the whole issue needs to be more closely examined. Thucydides does not mention a high mortality rate among domestic animals, as do writings on the plague in the Middle Ages. In other words, the animals referred to by Thucydides - birds of prey and dogs - did not die from the same disease that affected humans. In an epidemic of bubonic plague, there is a high mortality among rats and other domestic animals (epizootic), which precedes or parallels an epidemic among humans. The animals die of bubonic plague. Thucydides mentions nothing of the kind. Instead birds of prey and carnivores avoided eating the corpses, and were otherwise seemingly quite healthy. The only peculiarity was their complete absence. Holladay and Poole (23) mention that, "modern investigations have shown that birds of prey and other animals can learn aversion to food through experience". Such acquired behaviour can be transmitted socially, even from parent to young.

The corpses were however lethal, and dogs that did eat them died (ii.50). Putrefying corpses can host the growth of numerous other lethal bacteria, such as Clostridium perfringens, which are quite unrelated to the organism which originally caused the death of the victim. Certain serotypes of Clostridium perfringens can cause food poisoning. It is therefore possible that the animals observed by Thucydides died of another infection altogether.

By contrast, Hirst (24) quotes from many records of bubonic plague epidemics made during the Middle Ages, where references to excessive mortality among domestic animals are made. During a plague outbreak in Leeds in 1645, "the air was so warm and infectious that dogs, cats, mice and rats are said to have died and that several birds dropped dead in their flight over the town".(25) We know that livestock was moved to Euboea before the first invasion of Attica, but that would still leave a good number of household pets. Thucydides' account bears no resemblance on this issue to the writings of the Middle Ages.

Perhaps it would be more appropriate to look at the evidence Thucydides does give us, and to then compare it to our present knowledge of the three diseases under discussion: (see table pg. 65)

From the table it is evident that the disease described by Thucydides in no way resembles bubonic plague. If we have to decide between smallpox and typhus, it would seem that smallpox bears the closest resemblance to the Athenian plague, with typhus running a close second.

But a few remaining issues need to be examined. First, the very obvious mental symptoms associated with typhus are not mentioned. MacArthur (26) disagrees. He believes mental derangement is indicated in the Athenian plague, because of the strong desire victims of the disease had to throw themselves into water - this was hardly a rational action. Furthermore, he believes amnesia would not occur in 'undamaged brains'. But Thucydides clearly explains the reasons for the former - victims were desperate to quench their insatiable thirst and to cool themselves, in other words, there were definite reasons for their actions. Amnesia on recovery is certainly not the same as mental derangement during

A COMPARISON OF SYMPTOMS

SYMPTOMS MENTIONED BY THUCYDIDES	SIGNS AND SYMPTOMS OF SMALLPOX	SIGNS AND SYMPTOMS OF TYPHUS	SIGNS AND SYMPTOMS OF BUBONIC PLAGUE
ii.49.2 Onset sudden	onset sudden	onset sudden	onset sudden
Headache	severe	severe	severe
Inflamed eyes	conjunctivitis	conjunctivitis	no
Bleeding from throat and tongue	bleeding from mucous surfaces in haemorrhagic smallpox	epistaxis only	no
Halitosis	very noticeable	possible	no
ii.49.3 Sneezing, hoarseness, pain in chest with coughing	cough and sore throat	none	sore throat possible with development of cervical nodes
ii.49.4 Abdominal cramps and ineffectual retching	abdominal pain, nausea and vomiting	abdominal discomfort and vomiting	no
General malaise	joint pains especially backache	pain in back and legs	pain associated with swollen glands
Skin temperature normal, core temperature high	low skin temperature with rash, but rises when pustules appear	pyrexia	pyrexia 39-40°C
Skin rash: red breaking out into small blisters and ulcers	skin red, development of vesicles that become pustules	petechial rash, does not resemble Thucydides	no rash
ii.49.5 Dypsomanic	no	no	no
ii.49.5 Patients 'mobile', agitated and insomnic	prostrate from early on, insomnia, delirium	prostration with definite mental symptoms	prostration, delirium
Patients died day 7 or 9	die by day 8	die by day 6 - 9	die day 8 - 10
COMPLICATIONS ii.49.6 Bowel disorders, diarrhoea	ulceration of mucous membranes in gastro-intestinal tract, diarrhoea	abdominal discomfort constipation or diarrhoea	no bowel symptoms
ii.49.8 Gangrene of genitals and extremities	possible, associated with viraemia	possible	no
Blindness	from corneal ulceration or panophthalmitis	from retinitis	no
Temporary amnesia on recovery	no	possible	no
OTHER FEATURES ii.51.4 Contagious	highly contagious	highly contagious	not contagious except in pneumonic form
ii.51.6 Immunity acquired	immunity acquired	immunity acquired	immunity acquired
Mortality rate 30%	15 - 40%	19 - 40%	60 - 90%

SYMPTOMS THAT DO NOT CORRESPOND WITH THOSE MENTIONED BY THUCYDIDES

the course of the disease, and finally but probably most importantly, the rash associated with typhus is very different to the one described by Thucydides. In typhus there are red spots not raised above the surface, (macules) or slightly raised (papules). (27)

Secondly, historians have pointed out that Thucydides makes no mention of scars left on victims that survived the disease - this is a feature of smallpox. In a recent article on smallpox, Benenson (28) notes the following; of the survivors examined a year after an epidemic of smallpox in Pakistan, only 65-69% had pockmarks. 30% of survivors lost their scars within five years. As Gelfand (29) points out, "the number of lesions on the skin varies greatly, being profuse in some cases and sparse in others." One does of course not wish to question Thucydides' capabilities as an observer, which were clearly excellent, but perhaps the above facts could help explain this 'omission'? If we dismiss Thucydides' point about the absence and occasional death among carnivores and domestic dogs as a red herring, the case in favour of a diagnosis of smallpox increases. Even more so, when it appears that gangrene can occur as a complication of smallpox. Any Gram-negative infection or septicaemic patient can present with this symptom.(30) Zinsser (31) concludes; "the onset, immediate respiratory symptoms, the nature of the eruption, and the sequelae might reasonably be interpreted as smallpox."

The plague was not confined to Athens. Pericles decided to launch a naval attack on the Peloponnese while Archidamus was still in Attica. (ii.56) With one hundred ships and four thousand hoplites and three hundred cavalry on board, he attacked various cities in the Peloponnese. But the disease continued to claim a large number of lives among the troops - 1050 hoplites died, and the fleet was forced to return to Athens.(ii.58) Holladay and Poole have taken this information (32) given by Thucydides on the death rate as a general indication of what the mortality rate among the population of Athens must have been - 26%. This is an acceptable figure for an epidemic of smallpox, though they do stress that this is a minimum figure. 30-33% would be an average figure. (33) But Holladay and Poole believe that a 26% mortality rate from smallpox, among men of military age, is too high, as most of the victims in a smallpox epidemic are children under the age of 5.

However, we must remember that we are considering a 'captive' group of people. The men were constantly together, and confined either on board, or within their makeshift military camps. Infectivity and mortality rates would have increased. The behaviour of a disease in these circumstances can therefore not be used as an example of a mortality rate among a specific age group.

Equally questionable is the theory put forward by Wylie and Stubbs (34). They believe a 'new' disease would afflict "...those in the prime of life, especially males. The very young, very old and otherwise frail succumb less to 'new' diseases than to those endemically well established." Surely the exact opposite is true? Immunity to a well established disease would be passively transmitted to the very young through lacteal and placental routes. The very old would have acquired immunity or died, and the very frail would be among the first to succumb to a 'new' virulent disease. Granted, the 'in-between' age groups would be affected, but there is no reason why males should suffer more than women. If one looks at the average life expectancy among Roman women of child bearing age - which is lower than men of the same age group, one could say almost the opposite is true.(35)

We will probably never know how many people died during the two epidemics. The first lasted for two years (430-429 B.C.) and the second a year (427 B.C.). Thucydides (iii.87) says the second attack was less virulent, but still severely affected Athens' strength in the ongoing war. We find no mention of a total mortality rate in Thucydides, in fact, he believed the exact figure was impossible to establish (iii.87).

According to Isager and Hansen (36), the population in Attica around the middle of the fourth century B.C. numbered 3-400,000 (this included citizens, metics and slaves). If we accept that the mortality rate was 30-33%, up to 100-125,000 people must have died.

It seems the 'plague' effected a long-term reduction in the number of citizens. In 431 B.C. there was a citizen body of 40,000 (37), in 322 B.C. it was either 31,000 (38) or 21,000 (39). This would indicate a very slow annual growth rate of 0.5-1.00 per hundred throughout the

fourth century B.C. Hansen mentions similar slow recoveries in population numbers - for example, the parish of Cloyton's population was drastically cut back c. 1640 by an epidemic of plague, from which it did not recover for over a century.(40) Naturally one cannot hold the epidemic of 431 B.C. solely responsible for this drop in numbers. Both the Peloponnesian War and Alexander's campaigns claimed numerous casualties, but it must have contributed to a large extent.(41)

The psychological impact of the 'plague' on the Athenians is well described by Thucydides. The account is almost identical to those written during the great pandemics of bubonic plague that swept Europe during the Middle Ages.

"For the catastrophe was so overwhelming that men, not knowing what would happen next to them, became indifferent to every rule of religion or law. All the funeral ceremonies which used to be observed were now disorganised, and they buried the dead as best they could. Many people, lacking the necessary means of burial because so many deaths had already occured in their households, adopted the most shameless methods. They would arrive first at a funeral pyre that had been made by others, put their own dead upon it and set it alight; or, finding another pyre burning, they would throw the corpse that they were carrying on top of the other one and go away.

In other respects also Athens owed to the plague the beginings of a state of unprecedented lawlessness. Seeing how quick and abrupt were the changes of fortune which came to the rich who suddenly died and to those who had previously been penniless but now inherited their wealth, people now began openly to venture on acts of self-indulgence which before then they used to keep dark. Thus they resolved to spend their money quickly and to spend it on pleasure, since money and life alike seemed equally ephemeral. As for what is called honour, no one showed himself willing to abide by its laws, so doubtful was it whether one would survive to enjoy the name for it. It was generally agreed that what was both honourable and valuable was the pleasure of the moment and everything that might conceivably contribute to that pleasure. No fear of god or law of man had a restraining influence. As for the gods, it seemed to be the same thing whether one worshipped them or not, when one saw the good and the bad dying indiscriminately. As for offences against human law, no one expected to live long enough to be brought to trial and punished: instead everyone felt that already a far heavier sentence had been passed on him and was hanging over him, and that before the time for its execution arrived it was only natural to get some pleasure out of life."

Thucydides ii.52-54

Thucydides makes no attempt to attribute the causes of the disease to any form of divine intervention or punishment. Nor does he support the Hippocratic theory of aerial miasmata as being the cause of the illness. In fact he is careful not to commit himself, his only mention of what/who people considered responsible for the outbreak, is carefully phrased in ii.48; "...so that it was supposed by them that the Peloponnesians had poisoned the reservoirs". There was no persecution of individuals or ethnic groups believed to be responsible, as occurred in the Middle Ages, with the persecution of the Jews and 'witches', or of the so called 'anointers of doors' during the plague of Milan in 1630. It is to the credit of Athenian society that this extremely primitive reaction did not come to the fore. Unfortunately twentieth century society does not seem to be above these sort of superstitious beliefs. One need only study the reaction to AIDS, our twentieth century 'plague', to find both alienation of victims and the belief that the disease is a form of divine punishment against homosexuals, drug users, prostitutes etc.

The long term effect of the Athenian 'plague' was to contribute to the decline of Athenian power. Athens attempted to negotiate a peace treaty with Sparta, after the second invasion of Attica, but Sparta was not interested (ii.59). As a result the angry Athenians blamed Pericles for the war and deposed him as strategos only to re-elect him shortly afterwards. Pericles died of the disease in 428 B.C., which robbed Athens of a great statesman. The war lasted 27 years. Sparta's victory can be attributed, in part, to the 'plague'. It was a blow to Athenian morale in the early stages of the war and it cost Athens two expeditions of possible political importance - Potidaea and Epidaurus. Subsequent Athenian leaders failed to measure up to Pericles. Nicias' superstitious nature led to the tragic defeat of the Athenian troops in Sicily, and Alcibiades proved an inconsistent (though colourful) leader, who died a traitor, in exile.(42)

It seems ironic that two of the most important observations in medical history - those of contagion and acquired immunity - were first clearly described by a non-medical person. Medical historians, frustrated by their inability to identify the plague of Athens positively with any

known disease, have questioned Thucydides' capabilities as an observer. As a result, his considerable contribution to the science has been overlooked.(43) Hippocrates, a contemporary of Thucydides, (44) had absolutely no concept of these facts, and, as noted, attributed epidemics to miasmata. Galen adopted the same theory, which was upheld well into the Middle Ages, and only fully discarded in the second half of the nineteenth century.(45) Unfortunately for early medicine, Thucydides' account was not heeded. Had it been, the features of an epidemic disease would have been understood much sooner, and would no doubt have changed the course of medical history.

NOTES

CHAPTER 4

(1) Casson, L. (1959) pg. 21 notes that Egyptian stone bowls found on Crete date to that period.

(2) ibid pg. 8

(3) Thucydides ii.19

(4) ibid ii.14

(5) ibid ii.17

(6) ibid iv.104.4

(7) ibid i.1.1

(8) It appears that Thucydides was familiar with medical writings. According to Gomme, A.W. 1956 pg. 150, this is indicated by "his strict use not only of technical words for the symptoms of the disease but of other words which can have a special medical significance". Parry, A. 1969 would not agree. He believes "Thucydides succeeds in giving us so physically precise a description without using the quasi-technical vocabulary..." pg. 113

(9) ὁπότε ἐς τὴν καρδίαν στηρίξειεν settled in the 'heart' and not the stomach according to Page, D.L. 1953 pg. 100, and Gomme, A.W. 1956 pg. 155 agrees with him.

(10) σπασμὸν ἰσχυρόν according to MacArthur, W.P. 1954 pg. 153 means 'violent convulsions', a translation that would tie in his typhus theory. Page, D.L. 1953 pg. 101 translates it to mean "the strong muscular reaction which occurs in vomiting.." a far more acceptable translation.

(11) παραυτίκα ἀναστάντας according to Gomme, A.W. 1956 pg. 156 means "immediately after recovery" and implies that loss of memory occurred then.

(12) Holladay, A.J. & Poole, J.C.F. 1979

(13) Wylie, J.A.H. & Stubbs, H.W. 1983

(14) Page, D.L. CQ 1954 and Gomme, A.W. 1956

(15) Langmuir, A.D. et al 1986

(16) For a more detailed debate on this issue see Holladay, A.J. 1986

(17) Morens, D.M. & Chu, M.C. 1986

(18) Hooker, E.M. 1958-9 pp. 79-83

NOTES CONTINUED

(19) Holladay, A.J. & Poole, J.C.F. 1979 pg. 288

(20) Thucydides ii.49

(21) Hooker, E.M. 1958-9 pg. 83

(22) Holladay, A.J. & Poole, J.C.F. 1979 pg. 289

(23) Holladay, A.J. & Poole, J.C.F. 1986 pg. 1172 quote from an article by Gustavson, C.R. et al.

(24) Hirst, L.F. 1953 pg. 126 following.

(25) ibid pg. 127

(26) MacArthur, W.P. 1954 pg. 172

(27) Holladay, A.J. & Poole, J.C.F. 1979 pg. 291

(28) Benenson, A.S. 1982 pg. 545

(29) Gelfand, M. 1957 pg. 254

(30) Holladay, A.J. & Poole, J.C.F. 1979 pg. 287, Page, D.L. 1953 pg. 114 and MacArthur, W.P. 1954 pg. 242. would not agree.

(31) Zinsser, H. 1935 pg. 122

(32) Holladay, A.J. & Poole, J.C.F. 1979 pg. 287

(33) Langmuir, A.D. et al 1985 pg. 1028, take the number of hoplites mentioned in Thucydides ii.13 - 13,000, and a death rate of 4,000 mentioned in ii.87, and conclude that the mortality rate was probably 33%.

(34) Wylie, J.A.H. & Stubbs, H.W. 1983 pg. 11

(35) Burn, A.R. 1953 pp. 10-13

(36) Isager, S. & Hansen, M.H. 1975 pg. 19

(37) Hansen, M.H. 1982 (1985) pg. 173

(38) Diodorus Siculus xviii.18.4-5

(39) Plutarch Phocion 28,7

(40) Hansen op cit. pg. 175

(41) See A.B. Bosworth's article in JHS 1986

(42) Major, R.H. 1941 pg. 15 following

(43) Holladay, A.J. & Poole, J.C.F. 1979 pg. 299 and 300

(44) There is no truth behind the 'myth' that Hippocrates succeeded in curing the Athenian 'plague' through the use of fire. No contemporary account mentions Hippocrates' involvement in the event. For a more detailed study of this issue see Pinault, J.R. 1986 pp. 52-75

(45) As prophylactic treatment in an epidemic the following was recommended: a change of climate and rest. This would limit the amount of miasmata inhaled by the patient.

CHAPTER 5

PLAGUE IN THE PERIOD 427 B.C. - A.D. 540

Thucydides' detailed account of the Athenian 'plague', is unfortunately the last of its kind for several centuries. Instead, we are now obliged to piece together fragmentary bits of evidence, to obtain some idea of when and where epidemics occurred. We depend almost exclusively on written sources for this information and although they may not necessarily provide us with facts on the nature of the disease, they do help to illustrate just how widespread epidemics were becoming in this period.

The focus of our study first moves from the eastern Mediterranean to Sicily, but once again we find that the Athenians are involved. In a brief paragraph, both Diodorus Siculus (xiii.12.1) and Thucydides (vii.47) mention a 'plague' that struck the Athenian camp while they were battling to capture Syracuse in 413 B.C. The nature of the disease is not given, but both authors believe the marshy environs were responsible for the outbreak (it is quite possible that Diodorus used Thucydides' account of this event, when composing his history on Sicily in c. 56 B.C.). It is unfortunate that we have no further information, as the possibility exists that this pestilence was an off-shoot of the original Athenian 'plague'. This, along with numerous other setbacks, decided the Athenians to abandon the campaign and return to Greece, but they were severely defeated by the Syracusans before they could do so. (Diodorus xiii.13) Within a few decades, Syracuse was again under threat - but this time the threat came from Carthage.

By the fifth century B.C. Carthage had extended her area of control along the coast of Algeria and Morocco by establishing new settlements. However, Greek intrusion had diminished her hold over Sicily and Carthage remained confined to the south-west corner of the island. From 409 B.C. war between Syracuse and Carthage raged almost unabated for a century. During a Carthaginian seige of Syracuse in 396 B.C. an epidemic attacked the Carthaginian forces.

Diodorus (xiv.70.4.6) describes it as follows:

> Now the plague first attacked the Libyans, and, as many of them perished, at first they buried the dead, but later, both because of the multitude of corpses and because those who tended the sick were seized by the plague, no one dared approach the the suffering. When even nursing was thus omitted, there was no remedy for the disaster. For by reason of the stench of the unburied and the miasma from the marshes, the plague began with a catarrh (κατάρρους) ; then came a swelling(οἰδήματα) in the throat ; gradually burning sensations ensued, pains in the sinews of the back, and a heavy feeling in the limbs; then dysentery supervened and pustules (φλύκταιναι) upon the whole surface of the body. In most cases this was the course of the disease; but some became mad and totally lost their memory; they circulated through the camp, out of their mind, and struck at anyone they met. In general, as it turned out, even help by physicians was of no avail both because of the severity of the disease and the swiftness of the death; for death came on the fifth day or on the sixth at the latest, amidst such terrible tortures that all looked upon those who had fallen in the war as blessed. In fact all those who watched beside the sick were struck by the plague, and thus the lot of the ill was miserable, since no one was willing to minister to the unfortunate. For not only did any not akin abandon one another, but even brothers were forced to desert brothers, friends to sacrifice friends out of fear for their own lives.
>
> Diodorus xiv.71. Trans. C.H. Oldfather

The symptoms closely resemble those of smallpox, especially the pain in the back and heavy limbs, a characteristic sign of the disease. (1) The high death rate, description of the rash and the fact that it was highly contagious, further confirm this diagnosis. Zinsser (2) believes the disease resembles the Athenian 'plague', and the fact that the two outbreaks were less than forty years apart makes it very likely that it was the same disease, as this time gap would have allowed for a fresh generation of susceptibles. There is no evidence of an epidemic outbreak in Sicily till 212 B.C., to which we shall return, save for a pestilence at Poetelium in 313 B.C. mentioned in passing by Livy (ix.28.6).

Of some significance, however, is the epidemic which occurred in the Levant about 300 B.C. It was recorded by Dionysius the Hunchback and

mentioned by Rufus of Ephesus 400 years later. His account in turn, was preserved by the Christian physician of the Emperor Julian (A.D. 361-363), Oribasius, in his work Synagogue Medicae(xliv.14.1-2). This is probably the earliest definite evidence that bubonic plague existed in the ancient world. Here is what Rufus wrote:

> *"The buboes that are called pestilential are most acute and very often fatal, especially in those which one may encounter unexpectedly in Libya, Egypt and Syria, and which are mentioned by those who follow Dionysius the Hunchback. Dioscurides (3) and Posidonius (4) give a detailed description of them in their treatise on the plague which, in their time was prevalent in Libya, and which they say was accompanied by high fever, agonising pain, severe constitutional disturbance, delirium, and the appearance of large, hard buboes that did not suppurate, not only in the usual regions of the body, but also at the back of the knee and in the bend of the elbow, where as a rule, similar fevers do not cause their formation".(5)*

In fatal cases of bubonic plague the buboes do not suppurate, and this phenomenon was correctly observed by the ancient medical experts. The unusual parts in which these swellings occurred are almost certainly an indication of bubonic plague. Unfortunately we have no indication of the mortality rate, which might give us some idea of whether the disease developed into the pneumonic form. As a result we must assume that the disease remained localised and did not become epidemic. Rufus appears to have assumed that all three authors were talking about the same disease. It seems that Dioscurides and Posidonius lived about 400 years after Dionysius. Rufus merely brought together the various sources that mention plague under the same 'heading' in his corpus,(6) but he probably never experienced an outbreak of the disease himself. In his chapter Περὶ λοιμοῦ (about plague)(7), Rufus gives a general rundown of the symptoms which occur in various 'plagues' and summarises the contemporary state of knowledge in this field of study. The only possible reference to bubonic plague occurs in lxxxxv.1 "... ἕλκη, καὶ ἀνθρακώδη " but this is very vague and is thrown in

among a list of very general symptoms. The rest of the chapter is devoted to climate and its effects on the body, how to diet accordingly, the beneficial use of emetics, blood letting and the treatment of various symptoms as they present themselves. Unfortunately, not much can be deduced from this as regards specific infections, or just how aware medical practitioners of that period were, that a group of symptoms constituted a specific illness. It seems therefore, that the passage preserved by Oribasius, and quoted on the previous page, is the only place in which the term bubo is used by Rufus in a sense relevant to bubonic plague.(8)

Our next account of an epidemic comes from Livy (xxv.26.7-15). It occurred in 212 B.C. during the Second Punic War, when the city of Achradina (in Sicily) was besieged by the Roman general Marcellus.(9) Livy writes:

> *"At first it was climate and locality only that caused the sickness and death; but soon the disease spread by contagion and the mere act of nursing the sufferers, until those who caught it were either left to die alone or took with them to the grave whoever sat at their bedside and tried to tend them."(26.8)*

Livy goes on to describe the decline in morale, the inability of the population to keep up with the normal funeral procedures, and how some chose suicide as a way out. Again, we have no symptoms and clearly no diagnosis is possible, but it does seem at least that Livy was aware of contagion, as were the troops involved - the Sicilians in the Carthaginian army dispersed and returned to their various towns, for fear of catching the disease. The Romans too were affected, although not as severely as the Carthaginians, the reason for this according to Livy was because they were used to "the moist and steaming climate" (xxv.26.13). The Carthaginian general Himilco and the Syracusan rebel, Hippocrates, died of the 'plague', and this no doubt contributed to Marcellus' successful capture of Syracuse in 211 B.C.

Livy briefly mentions a 'plague' in Italy in 205 B.C. (xxviii.46.15) and again in 178 B.C. (xli.5.11) and 174 B.C. (xli.21.5). On the latter 'plague' he gives us a little more information. A 'plague' that had killed cattle the previous year, now began to attack man also. "Those who were assailed by it did not easily survive the seventh day, those who had survived that length of time suffered from a lingering disease, usually quartan. The slaves especially died; and all along the roads there were piles of their unburied bodies".(10) The corpses remained untouched by dogs or vultures. A similar attack occurred in Cyrene in 125 B.C.(11) Anthrax immediately springs to mind, especially as slaves were infected more readily than others - they herded, slaughtered and treated the skins of the diseased animals and would have been prime targets. Ziolkowski (12) suggests that the disease resembled "... the bubonic plague of medieval and modern times ...". Unfortunately there is very little to substantiate either diagnosis, as Livy gives us insufficient information.

Strabo, writing in the Augustan era, (iii.4.18.165) notes that the Iberians were frequently plagued by mice "from which pestilential diseases often ensued". Much has been made of this by medical historians, who believe that this is proof that bubonic plague existed in ancient Spain. But Strabo was commenting on the destruction wrought by the rodents and the methods employed to keep their numbers down. These 'mouse-plagues' frequently produced famines, because of large scale crop damage, and undernourished individuals would have been particularly susceptible to infectious diseases. There is no reason to suppose that the mice were carriers of a disease, but rather that their activities predisposed man to disease. The mice were in no way affected by the disease, and as noted in Chapter 1, mice are usually victims of a disease such as bubonic plague rather than carriers. The Romans, in an effort to control the situation, were forced to increase the reward for the number of mice caught.

For the first century A.D. we have no information with regard to the nature of the recorded epidemics. During the reign of the Emperor Nero, Suetonius (Nero.39; Tacitus.Ann.xvi.13.1-3) writes that "in a single autumn 30,000 deaths from 'plague' were registered at the temple of Libitina". After the eruption of Vesuvius (A.D.79), Campania experienced "... one of the worst outbreaks of 'plague' that had ever been known". Titus did his best to prevent the spread of the disease "by every imaginable means, human as well as divine - resorting to all sorts of sacrifices and medical remedies"(Titus.8.3-4). In the reign of Hadrian, according to the Historia Augusta (Hadrian.21.5) a 'plague' occurred with which he dealt as far as he could. It is probable that these 'plagues' consisted of several coincidental infections, which have been obscured in historical record "in the general undifferentiated mess of 'pestilence' ".(13)

The first pestilence after the birth of Christ of which we have a relatively reliable account is the 'Plague of Marcus Aurelius' (also known as the 'Plague of Galen' and the 'Plague of Antoninus'). It is reported to have started in the east in A.D. 165 among Verus' troops. The Parthian king Vologaeses had revolted against Rome, invaded Syria and had managed to defeat the Roman forces stationed there. Marcus Aurelius despatched his co-regent Verus to deal with the problem, and unfortunately sent Avidius Cassius, a capable war veteran, along too, as Verus was soon preoccupied with other more pleasurable pastimes. Cassius managed to push back the Parthians and Rome annexed Mesopotamia, further extending the boundaries of the empire. While in Mesopotamia, a pestilence struck the Roman troops. According to the Historia Augusta (Verus.8.2) it started in Babylon, when a pestilential vapour escaped from a golden casket in the temple of Apollo, which a soldier had by chance cut open. The death toll was high, and soldiers returning to Rome for the triumphal march carried the disease back with them, infecting large numbers along the way. A variant of the casket story occurs in Ammianus xxiii.6.24.

Rome was badly affected by the pestilence. According to the SHA (Marcus Aurelius.13.3-5) "the corpses were carried out on wagons and carts ... thousands were carried off by the pestilence, including many nobles, for the most distinguished of whom Antoninus set up statues. So great was his mercifulness that he ordered funeral ceremonies to be carried out for the common people at public expense." At the same time, Rome faced increasing problems along the Danube frontier, where Quadi and Marcomanni had started pushing their way into the empire, sometime between A.D. 161-167. Only in A.D. 169 could Marcus afford to launch an attack to drive them back. The epidemic continued to rage during the war, killing many German and Roman forces. Many Germans were found dead with no evident battle injuries, having fallen victim to the disease instead. In A.D. 180, Marcus Aurelius himself allegedly died of the disease.(14) He refused to let his son visit him on his deathbed, as he feared Commodus might be infected. His last words to his friends would seem to confirm this: "why do you weep for me and do not rather think of the plague and of the death which is common to all?"(15)

When the 'plague' broke out in Rome in A.D.166, Marcus' physician, the illustrious Galen, left the city. Throughout his works, only scattered references to this pestilence appear.(16) But he did leave us with some description of the disease. The first symptom of the disease was foul breath, associated with inflammation of the pharynx. High fever, diarrhoea and deliriousness were followed a few days later by a skin eruption, which was sometimes pustular, sometimes dry.(17) Accurate interpretation of the rash is difficult, but taken in conjunction with the other symptoms, the disease would seem to have been smallpox, or a disease closely related to it. Certainly the symptoms resemble the Athenian plague in description. (See table pg 88)

Bubonic plague should be excluded, although this has again been suggested.(18) In fact it is very doubtful whether Galen was familiar with the symptoms of bubonic plague. He uses the word βουβών for various swellings (19) not associated with plague - in ii.8 (20) he

speaks of a bubo that developed after an accidental wound - presumably in the leg or lower abdomen. As pointed out, this is a normal lymphatic reaction. In Chapter VII (21) he quotes Hippocrates: "febres ex bubonibus omnes malae, excepta ephemera." There is no specific description of bubonic plague, and we must assume that the disease was unknown to Galen. Alternatively, the symptoms of a specific epidemic disease were perhaps not sufficiently important to Galen to warrant accurate recording. His theory on miasmata did not allow for such inconvenient diversions. In fact the only time Galen does mention symptoms is to support this very theory. For example, buboes were formed from bad blood - skin eruptions and tumours developed because of a flow of body humours to these parts and they served as a way of getting rid of excess humour.(22)

Health depended on the proper balance of one's humours, any disturbance thereof, could lead to mental or physical illness as individuals became more susceptible to the 'seeds' of disease.(23) It is unlikely that Galen understood how disease was transmitted, although he did attempt an explanation. Some, he says, believe that certain substances can alter things close to them. This was similar to the electric current a torpedo fish transmitted through the (metal) trident of a fisherman, or a strong magnet that attracts objects to it and then transmits the magnetic field through these objects to attract others.(24) This hypothesis is put forward as a possible mode for transmission of disease, but Nutton does not believe it is of any great significance, and considers it to be an "isolated guess" which is in no way integrated into Galen's general system.(25)

This theorising was of little value to the medical practitioners of his day. They concerned themselves with treating the symptoms of a disease and ensuring that the balance between the body humours was once again restored. Neither can one detect any real progress in this way of thinking. Take for example the writings of Celsus on this issue,

(born c. 25 B.C. and practised in Rome A.D. 14-37) who lived well over a century before Galen:

> There are also observances necessary for a healthy man to employ during a pestilence, although in spite of them he cannot be secure. At such a time,then,he will do well to go abroad, take a voyage; when this cannot be, to be carried in a litter, walk in the open before the heat of the day, gently, and to be anointed in like manner; further as stated above he should avoid fatigue,indigestion, cold, heat, venery, and keep all the more to rule, should he feel any bodily oppression. At such a time he should not get up early in the morning nor walk about barefoot, and least so after a meal or bath. Neither on an empty stomach nor after a meal should he provoke a vomit, or set up a motion; indeed if the bowels tend to be loose, they are to be restrained. The fuller his habit of body, the more abstinence; he should avoid the bath, sweating, a midday siesta, and in any case if food has been taken previously; at such times, however, it is better then to take only one meal a day, and that a moderate one, lest indigestion be provoked. He should drink, one day water, the next day wine; if he observes these rules, there should be the least possible alteration as to the rest of his accustomed dietary. Such then are the things to be done in pestilence of all sorts, and particularly in one brought by south winds. And the same precautions are needed by those who travel, when they have left home during an unhealthy season, or when entering an unhealthy district. Even when something prevents observance of other rules, yet he ought to keep up the alternation, mentioned above, from wine to water, and from water to wine.
>
> Celsus i.10. Trans. W.G. Spencer

The mechanisms of contagion, it appears, were something of an intellectual exercise, a pastime which had no great influence on medical teachings of the time. It was not considered to have any relevance with regard to the prevention of a disease. Unfortunately, Galen's work formed the basis of medical teachings for many centuries, and the unquestioning acceptance of his theories did much to hamper any further research into the field of epidemiology.

The 'plague' of Marcus Aurelius remained epidemic for more than 15 years, sometimes recurring in cities that had previously been affected. Such was the case in Rome. We have an example of a funerary inscription commemorating the death of three members of a family, "who died because

of a plague (per luem) in the consulship of Mamertinus and Rufus" (A.D. 182).(26) In A.D. 189, during the reign of Commodus, the disease struck again. Considering the amount of 'traffic' that passed through Rome, the capital of a vast empire, this was hardly surprising. Dio Cassius (lxxiii[lxii].14.3-4) reports that 2000 deaths occurred every day. Herodian (i.12.2) says man and beast were affected. Commodus was advised by his doctors to retire to Laurentum, where he surrounded himself with sweet smelling scents, in the belief that this prevented the inhalation of polluted air. There is no information on how the authorities handled the 'plague', but given the medical theories prevalent at the time, it seems unlikely that any measures would have been effective.

It is difficult to establish just how great an impact the Antonine 'plague' had on population numbers within the empire. Opinions on this issue seem to vary greatly. Boak believes the 'plague' signalled the beginning of the decline of the empire. Population numbers dropped in urban and rural areas, and the subsequent decrease in production led to generalised impoverishment. This became especially evident during the reign of the Severi.(27) Although it is extremely difficult to obtain reliable statistics, it has been possible to obtain some evidence of population patterns, for example, from Roman census figures, tomb inscriptions recording the age of the deceased and aging skeletal remains.(28) According to Boak, there was never any population pressure, as the total population was never very big. Annexations were made for military or political reasons, but not to relieve overpopulation, (29) and newly conquered areas were settled by veterans and their families. If this was indeed the case, the effects of a pandemic the size of the one Boak had in mind would have been very far reaching. It would have taken several generations to make good the loss, as was the case after the Athenian 'plague'.

Gilliam's thorough article on the plague of Marcus Aurelius examines sources other than literary for possible information on this plague. But other than a few papyri, there is nothing that really casts a new

light on the subject. This has prompted Gilliam to suggest that the fame of this particular epidemic was partly due to accident and even more to exaggeration. Because it was vaguely mentioned by the great Galen and preserved for prosperity, medical historians have frequently mentioned it as the next great epidemic after Thucydides' as if none other occurred in the interim years.(30) Perhaps Galen's lack of emphasis on this epidemic indicates that on the whole, its impact was nowhere near as devastating as historians have made it out to be. Alternatively, Galen may have preferred to keep the whole issue very 'low key' as his contribution to finding a cure of some kind proved completely ineffective. He was not exactly the type to go on about his failures! Boak's study of the population pattern of the village of Karanis in Egypt contradicts Gilliam's assumption. During the period A.D. 171-174 (at the height of the Antonine 'plague') the village experienced a drop in population of 33.8 - 40%.(31) Boak believes the epidemic could have been the only possible cause for such a decline. Several other nomes in Egypt experienced more acute losses - some lost between 81-86% of their male population.(32) The Historia Augusta (Marcus 18.6) mentions the "burdensome plague that destroyed many thousands of civilians as well as soldiers". The toll in lives seems to have been great, and it appears Marcus was forced to train slaves and arm gladiators (Marcus 22.1). He recruited brigands from Dalmatia and Dardania and trained them as soldiers, armed the Greek paramilitary police and hired German auxiliary units to fight Germans, all in an effort to make up lost numbers. But, at the same time, Marcus managed to raise two new legions - the II and III Italica, recruited in Italy itself.(33) Clearly there is no simple answer to the demographic effects of the 'plague'.

Marcus obviously needed a large force to drive back the German invaders across the Danube. He had recently suffered enormous losses on the Persian frontier and the epidemic had resulted in further losses. If we believe Boak's theory with regard to population numbers in the empire, (34) this loss would certainly have set Marcus back. However, few men were willing to commit themselves to 25 years of military

service, and in 'emergency' situations Rome was forced to resort to other measures. This was certainly nothing new - Augustus freed slaves to prop up the military, after a plague and famine had depleted numbers. (35) The same had occurred during the Hannibalic wars. Conquered areas often supplied Rome with auxiliary troops, which, according to Gilliam (36) ensured useful and inexpensive soldiers. In the later empire, it became the norm to embark on vigorous recruiting drives, before a major campaign of some kind.

At most, the plague made Marcus' job more difficult but it certainly did not require him to resort to completely new and drastic measures to overcome this problem. Gilliam estimates a mortality rate of 2% which amounts to about a million deaths throughout the empire. It can certainly not be equated with that of the middle ages, when the great pandemics of bubonic plague struck Europe and caused a mortality rate of 20-25%.(37) But be this as it may, it would still have taken several decades to recoup losses, especially in Egypt, where the population growth seems to have remained static from the second century A.D. onwards.(38)

From A.D. 198-250, the Roman world was seemingly free from epidemics, but the threat to her frontiers increased. Repeated pressure was placed on Rome to defend her borders against barbaric incursions. In A.D. 250 the Goths defeated the Emperor Decius and this signalled the end of effective resistance against the presence of Goths in the Danubian provinces.(39) At about this time an epidemic struck. It was described by the bishop of Carthage, St. Cyprian, and has subsequently become known as the 'plague' of Cyprian. As with the 'plague' of Athens, this 'plague' is said to have originated in Ethiopia. It spread over the whole known world, from Egypt to Scotland and lasted for about 16 years. Cyprian writes:

> *Now that the bowels loosened into a flux exhaust the strength of the body, that a fever contracted in the very marrow of the bones breaks out into ulcers of the throat, that the intestines*

are shaken by the continual vomiting, that the bloodshot eyes burn, that the feet of some or certain parts of their member are cut away by the infection of diseased putrefaction that, by a weakness developing through the losses and injuries of the body, either the gait is enfeebled, or the hearing impaired, or the sight blinded. (40)

At its height, the 'plague' allegedly killed 5000 people a day in Rome, but again the nature of the disease is difficult to determine. Cyprian mentions no rash, but Zinsser (41) quotes from the Patrologia Graeca Gregorius III, who refers to that specific epidemic:

"When once the disease attacked a man, it spread rapidly over all his frame. A burning fever and thirst drove men to the springs and wells, but water was of no avail when once the disease had attacked a person. The disease was very fatal. More died than survived and not sufficient people were left to bury the dead."

The fact that the disease spread over the whole frame could be interpreted as a rash, but we cannot be sure. Again, the symptoms seem to tie in with the Athenian plague, but they are not presented in the same chronological order by Cyprian. Gottfried believes it could have been measles (42) and bubonic plague has again been suggested. Certainly the latter is excluded as there is no mention of swellings, and gangrene is not a symptom of bubonic plague. The disease spread rapidly from personal contact as well as from clothing and other fomites.(43) Vast areas of farmland once again became overgrown, areas were vacated and swamps developed. "The human race was almost destroyed and the earth was returning to desert and forest."(44)

Between A.D. 235-285 the internal political structure of the empire was in turmoil. In this period no less than 26 Augusti were acknowledged in Rome. Franks, Saxons, Alemanni and Vandals repeatedly pushed across the boundaries of the empire, raiding and sacking as they went.

Diocletian (A.D. 285-305) briefly re-established a measure of stability through a series of political, military and economic reforms. However, the tetrarchy he had established to ensure a stable form of succession to the principate, collapsed soon after his abdication and the empire was once again plunged into civil war. Constantine the Great (A.D. 324-337) managed to slow down the process of decline momentarily, and decided to establish a new capital in Constantinople. The city technically became the second Rome. In the late fourth, early fifth century A.D. Goths overran the western empire, sacked Rome (A.D. 410) and established a Gothic kingdom in Italy. Undoubtedly, this 'Völkerwanderung' of three centuries was responsible for numerous epidemics. The continuous movement by tribes from 'foreign' regions into the empire, served as a means of carrying in new diseases. The constant war-like conditions caused overcrowding and inadequate food supplies, making individuals more vulnerable to the ravages of disease.

A case in point was the 'plague' at Amida, of which Ammianus Marcellinus offers an eyewitness account.(xix.5) As a military man, Ammianus was involved in countering the Persian invasion of Mesopotamia in A.D. 359.(45) In the same year, Ammianus found himself besieged in the city of Amida, surrounded by an enormous Persian force. Several days of intense battle resulted in huge losses on both sides, and conditions within the city walls deteriorated, as fatigue and continuous fighting prevented proper disposal of the dead. According to Ammianus, the numbers within the city walls totalled 20,000 souls.(xix.2) The crowded conditions provided an ideal environment for a pestilence, which was not long in coming. Unfortunately, Ammianus is more preoccupied with the possible reasons for the outbreak and gives us absolutely no symptoms of the disease. Consequently, it is impossible to determine the nature of the disease - one can only speculate. Ammianus was obviously well read, and uses the 'plague' that struck the Greeks in the Trojan war and the Athenian 'plague' as examples of 'plagues' that occurred in similar war-like conditions. By the tenth day, the force of the epidemic seems to have subsided, and Ammianus reports no further losses from the disease. The pestilence probably weakened the resistance

of the Roman forces in the city, as Amida was taken by the Persians not long afterwards. Ammianus and a few others barely managed to escape the ensuing massacre.(xix.8.5)

The next known epidemic struck Britain in A.D. 444. Its effect was apparently devastating and it is believed to have been in part responsible for the successful conquest by the Saxons. But Todd (46) questions the scale of the epidemic and points out that there is no reason why the Germanic invaders would have been immune to the disease. In all probability the epidemic was one of many minor outbreaks that occurred in the fifth century throughout the Roman provinces. Both Saxons and Vandals seem to have fallen victim to infectious diseases in the last few decades preceding Justinian's reign, but alas, we have no details of the symptoms.

So far then, attempts at finding any evidence of bubonic plague have yielded little. But suddenly in A.D. 540, we are presented with a clear and irrefutable account of an outbreak of bubonic plague - one that can almost certainly be considered one of the key factors responsible for the death of our ancient Mediterranean civilization.

THE SAME DISEASE? A COMPARISON OF SYMPTOMS

The plague of Athens from 430 B.C.	The plague at Syracuse 397 B.C.	The plague of Marcus Aurelius A.D.165/16	The plague of Cyprian A.D. 250
1. Headache	*	*	*
2. Inflamed eyes	*	*	blood shot eyes
3. Bleeding from throat and tongue	swelling in throat	Inflammation of pharynx	ulcers of the throat
4. Halitosis	*	halitosis	*
5. Sneezing,hoarsness coughing.	catarrh	-	-
6. Abdominal cramps and vomiting.	-	-	vomiting
7. General malaise	backache and heavy limbs	*	*
8. Fever, dipsomatic	*	high fever	fever,pts. dipsomatic
9. Skin rash-small blisters and ulcers	pustules on whole body	skin eruption,pustular or dry	possibly accompanied by rash.
10.Patients mobile and agitated.	patients agitated,mobile delirious.	patients delirious	patients mobile
11.Patients died day7-9	patients died day 5 or 6	-	-
12.Bowel disorders,diarrhoea	dysentry	diarrhoea	diarrhoea
13.Gangrene of extremities	-	-	gangrene of feet or genitals
14.Blindness	-	-	blindness,hearing often impaired
15.Contagious	contagious	contagious	contagious

* Not mentioned in the sources, but very probable, if other symptoms are taken into consideration.

NOTES

CHAPTER 5

(1) Kassner, C. (c.1981)

(2) Zinsser, H. (1935) pg. 126

(3) Exactly which Dioscurides Rufus is referring to here is not clear. According to Smith, W.D. (1979) pg. 235 & 240 Dioscurides produced scholarly editions of the Hippocratic works at the beginning of the second century A.D. This would make him roughly contemporary with Rufus of Ephesus (c. A.D. 110-180). Another Dioscurides is mentioned in Caesar's Civil War iii.109, c. 50 B.C.

(4) The identity of the Posidonius referred to by Rufus is also uncertain. Kudlien, F. (1962) discusses some of the possible candidates and points out (pg. 429) that Posidonius could have lived at a different time to Dioscurides, even though Rufus mentions them in the same context.

(5) I used Shrewsbury's translation (1964) pg. 30, who quotes from Oeuvres d'Oribase Bussemaker & Daremberg Vol. 3 book 4 Paris 1851.

(6) Recent material recovered from the Arabic may cast a new light on Rufus' work. Smith, W.D. (1979) pg. 240 Note 89.

(7) Ruelle & Daremberg (eds) 1879 (Extracts from Aetius, chapter 95 pg. 351 f.)

(8) Even in the Hippocratic Corpus the word βουβών is rarely used to denote a tumour. See the Index Hippocraticus for further evidence of this.

(9) Diodorus Siculus xiv.71 also records the event. Diodorus was born in Sicily in the first century B.C. and started writing his Library of History in 56 B.C. He used ancient Sicilian authors for his work, for example Timaeus and Agatharchides. Although he is often accused of plagiarism, his work is the best and often the only existing record of Sicilian history, and for this reason alone, he constitutes an important source.

(10) Ziolkowski, A. (1986) pg. 70 f. believes that the enormous death rate among slaves led to a severe shortage of slaves, which affected the economy. As a result new sources of manpower had to be found, and the attack on and subsequent plundering of Epirus in 167 B.C. occurred because of this. Apparently, about 150,000 inhabitants were sold into slavery.

(11) Julius Obsequens, Prodigiorum Liber 30 found in the Loeb Edition of Livy Vol.14.

(12) Ziolkowski, A. (1986) pg. 76 note 49.

(13) Zinsser, H. (1935) pg. 241

(14) Dio (lxxii.33.4) states that he was told that Marcus was killed by his own doctors to curry favour with Commodus. Herodian (i.4.6-5) mentions no such scandal or that Marcus took 7 days to die. SHA Marcus.28.8). Of the three sources, Dio's account is probably the most reliable - if only because he was a contemporary of Marcus and Commodus. He was born about A.D.163 or 164 and may have entered the senate in about 188 or 189 and offers an eyewitness account of Commodus' reign, bringing his account up at least to his own second consulship in A.D. 229. Herodian was probably born during Commodus' reign and uses Dio's account for that period. (See Géza Alföldy's article on Herodian in Anc.soc. 2. (1971) pp.204 f.) According to A. Cameron, (JRS 1965) the HA was written by one author only in about A.D. 390, although the author would have us believe it was written in the reigns of Diocletian (A.D. 285-305). Sir Ronald Syme, in Historia Augusta: Ammianus and the Historia Augusta Oxford. (1968), and Emperors and Biography: studies in the Historia Augusta Oxford. (1971), argues that the HA was written about A.D. 396. The earlier lives are considered more accurate and of better historical value, while the later lives contain a greater percentage of fiction.

(15) SHA Marcus 28.4

(16) For example in the Galeni Scripta Minora II pg. 98-99 - Galen reports more deaths because the pestilence occurred in the middle of winter. He refers to the 'plague' as a great one and says it lasted a long time. He was present in Aquileia when the disease broke out in A.D. 168/9. (From Gilliam, J.F. 1961 pg. 228)

(17) De Methodo Medendi XII (From a footnote in McNeil (1977) pg.321 & Zinsser, H. pg.137)

(18) Ziegler, P. (1969) pg. 69

(19) For example, Galen, Claudii Galeni Opera Omnia Vol II pg. 77 - and elsewhere in the Corpus of Galen's writings.

(20) On the natural faculties ii.8 (Kühn, Vol.II pg. 119) (Loeb edition pg. 185)

(21) Kühn, Vol. 7 pg. 296

(22) From a lecture given by Dr Brain at U.C.T. Medical School on 22.9.1986.

(23) Nutton believes Galen may have mentioned 'seeds' as an explanation of disease to prove he was well read. It seems Galen wanted to combine two existing theories; disease spread through putrified air, which occurred as a result of these 'seeds'. (1983 pg.9) He was familiar with Lucretius' On the nature of things VI. 1090-1286. Seeds were carried in putrified air, and a way of protecting oneself was either to move somewhere healthier, or surround oneself with sweet smelling herbs (see Herodian i.12.2. on this). This 'remedy' was still popular in the nineteenth century. During a plague in Bombay in 1896, people wore lockets containing camphor and other aromatic substances. (Hirst, L.F. 1953 pg. 44) The famous Eau de Cologne was developed during the search for an effective plague water in A.D. 1700.

(24) Galen On affected parts (Loeb edition)

(25) Nutton, V. (1983) pp. 3-5

(26) Corpus Inscriptionum Latinarum iii.no. 5567

(27) Boak, A.E.R. (1955) pg. 18

(28) Funeral epitaphs that record the age at death are not always reliable. Illiterates tend to magnify their age; thus evidence of longevity in more remote areas of the empire is dubious. Furthermore, evidence from this source is probably selective, as the erection of epitaphs may well have been dependent on the financial status of the deceased and family. Certain age groups, especially babies and small children, may be underrepresented.

(29) ibid pg. 10

(30) Gilliam, J.F. (1961) pg. 24

(31) Boak, A.E.R. (1959) pp. 248-250

(32) ibid pg. 250

(33) There is no exact date for their creation, but it is possible they were recruited between A.D. 166-170, when the pestilence had reached Italy. Gilliam, J.F. pg. 247 footnote 76.

(34) Boak, A.E.R. (1955)

(35) Pliny's Natural Histories vii.149

(36) Gilliam, J.F. (1961) pg. 246

(37) ibid pg. 250

(38) Boak, A.E.R. (1959) pg. 250

(39) Sinnigen, W.G. & Boak, A.E.R. (1971) pg. 390

(40) As translated in Gottfried, R.S. (1984) pg 6.

(41) Zinsser, H. (1935) pg. 138

(42) Gottfried, R.S. (1984) pg. 6

(43) Cartwright, F.F. (1972) pg. 15

(44) Zinsser, H. (1935) pg. 141 quotes from Hieronymus

(45) Ammianus was still a staff officer in the Roman army during the siege.

(46) Todd, M. (1977) pg. 322

CHAPTER 6

THE PLAGUE OF JUSTINIAN

As Rome slowly collapsed under the pressure of barbarian incursions, (1) Byzantium in the eastern empire maintained its position of power. On the death of his uncle Justin I (A.D.518-527), Justinian became emperor. His reign was conspicuous for its wars. In A.D.533 and 535, his brilliant general Belisarius recaptured Africa and Italy from the Vandals and Ostrogoths, but the conquests proved a financial drain. Byzantium's hold over the west was extremely tenuous and the situation demanded a constant military presence. The Persian monarch Chosroes took advantage of Justinian's preoccupation with the west, and managed to gain control over the eastern provinces, taking Antioch in A.D.540. At the same time, the Moors were beginning to make their presence felt in Africa and Spain. It is against this background of almost constant war and population movement, that we must examine the pandemic which began in A.D.540.

Our main source for the reign of Justinian is Procopius of Caesarea (A.D.500-562), secretary to Belisarius.(2) Procopius delivers an eye-witness account of the epidemic and it is from his account that we know that Justinian too was infected, but survived (II.xxiii.20). The plague reached Byzantium in A.D.542.(3) Procopius immediately discounts the theories held by the various experts, that the disease was influenced by local climate or lifestyle (II.xxii.3). The symptoms and the spread of the disease were too inconsistent to allow for any valid explanation and Procopius believes the only sensible approach would be to "refer it to God" (II.xxii.2). But despite this theocratic view, he nevertheless offers a scientific account of the symptoms and spread of the disease, which has enabled medical historians to determine the nature of the epidemic. The following account by Procopius has been edited to include relevant details only:

II.xxii.6

"It started from the Egyptians who dwell in Pelusium. Then it divided and moved in one direction towards Alexandria and the rest of Aegypt, and in the other direction it came to Palestine on the borders of Aegypt; and from there it spread over the whole world, always moving forward and travelling at times favourable to it.

II.xxii.8

... it left neither island nor cave nor mountain ridge which had human inhabitants; and if it had passed by any land, either not affecting the men there or touching them in an indifferent fashion, still at a later time it came back; then those who dwelt around about this land, whom formerly it had affected most sorely, it did not touch at all, but it did not remove from the place in question until it had given up its just and proper tale of dead...

II.xxii.9

...this disease always took its start from the coast, and from there went up to the interior. And in the second year it reached Byzantium in the middle of spring, where it happened I was staying at the time. (xxii.9 - xxii.15 omitted)

II.xxii.15

And they were taken in the following manner. They had a sudden fever, some when just roused from sleep, others while walking about, and others while otherwise engaged, without any regard to what they were doing. And the body shewed no change from its previous colour, nor was it hot as might be expected when attacked by a fever, nor indeed did any inflammation set in, but the fever was of such a languid sort from its commencement and up till evening that neither to the sick themselves nor to a physician who touched them would it afford any suspicion of danger. It was natural, therefore, that not one of those who had contracted the disease expected to die from it. But on the same day in some cases, in others on the following day, and in the rest not many days later, a bubonic swelling(βουβών) developed; and this took place not only in the particular part of the body which is called 'boubon' that is, below the abdomen, but also inside the armpit, and in some cases also beside the ears, and at different points on the thighs. Up to this point then, everything went in about the same way with all who had taken the disease. But from then on very marked differences developed; and I am unable to say whether the cause of this diversity of symptoms was to be found in the difference in bodies, or in the fact that it followed the wish of Him who brought the disease into the world. For there ensued with some a deep coma, with others a violent delirium, and in either case they suffered from the characteristics of the disease. For those who were under the spell of the coma forgot all those who were familiar to them and seemed to be sleeping constantly. And if anyone cared for them, they would eat without waking, but some also were neglected, and these would die directly through lack of sustenance. But those

who were seized with delirium suffered from insomnia and were victims of a distorted imagination; for they suspected that men were coming upon them to destroy them, and they would become excited and rush off in flight, crying out at the top of their voices. And those who were attending them were in a constant state of exhaustion and had a most difficult time of it throughout. For this reason everybody pitied them no less than the sufferers, not because they were threatened by the pestilence in going near it (for neither physicians nor other persons were found to contract this malady through contact with the sick or with the dead, for many who were constantly engaged either in burying or in attending those in no way connected with them held out in the performance of this service beyond all expectation, while with many others the disease came on without warning and they died straightway); but they pitied them because of the great hardships which they were undergoing. (xxii.24 - xxii.28 description of a delirious patient's actions)

II.xxii.28.

And in those cases where neither delirium nor coma came on, the bubonic swelling became mortified and the sufferer, no longer able to endure the pain, died. And one would suppose that in all cases the same thing would have been true, but since they were not at all in their senses, some were quite unable to feel the pain; for owing to the troubled condition of their minds they lost all sense of feeling...

II.xxii.30.

Some died at once; others after many days; and the bodies of some broke out into black blisters the size of a lentil. These did not live after one day, but died at once; and many were quickly killed by the vomiting of blood which attacked them. (xxii.30-xxii.37 Procopius records several strange phenomena that occurred during the epidemic, but they are of no medical importance)

II.xxii.37.

Now in those cases where the swelling rose to an unusual size and the discharge of pus had set in, it came about that they escaped from the disease and survived. for clearly the acute condition of the carbuncle had found relief in this direction, and this proved to be in general an indication of returning health; but in cases where the swelling preserved its former appearance there ensued those troubles which I have just mentioned. And with some of them it came about that the thigh was withered, in which case, though the swelling was there, it did not develop the least suppuration. With others who survived the tongue did not remain unaffected, and they lived on either lisping or speaking incoherently and with difficulty."

Procopius History of the Wars II.xxii Trans. H.B. Dewing.

According to Hirst, the epidemic originated in south-west Asia. Pelusium, being one of the major commercial ports of the ancient world, served only as a centre from which the infection was distributed throughout the Mediterranean.(4) Alexandria too was a major departing point for the great fleets of grain ships that fed the ancient world and any infectious disease was easily carried further in this manner. This is especially true for the carriers of the plague flea - Rattus rattus or the 'ship rat'. Procopius confirms the fact that the disease spread from the coast to the hinterland (II.xxii.9). An infected or 'blocked flea' in favourable conditions can survive for up to 50 days without food.(5) The spread of the disease was however gradual and this would discredit the theory that the plague developed into the pneumonic form.(6) Furthermore, Procopius,to his credit, clearly states that the plague did not attack the attendants of the sick (II.xxii.23). This is the remarkable feature of bubonic plague, it is not contagious (as it is spread through the bite of a flea), whereas pneumonic plague is spread from man to man through droplet infection (without the rat as an intermediary) and is consequently highly contagious. Because the disease was new to the Mediterranean (in epidemic form) and the population highly susceptible, the organism was incredibly virulent, causing a high mortality. Procopius (ii.xxii.30) describes a general eruption of black blisters on some of the victims, which has led Zinsser and Deaux (7) to postulate a concurrent smallpox epidemic. But this is improbable. Although individuals that survived the attack of bubonic plague had acquired an immunity (xxii.8 and xxiii.16) it would not have protected them against smallpox as well. In addition, victims of smallpox do not die after one day. The blisters may very well have been a symptom of septicaemic plague (8) and Procopius (xxii.23) seems to confirm this. In cases of septicaemic plague, the infection is so severe that victims can die within 24 hours. Agathias, in his Histories (v.10), mentions that some individuals died immediately.

A suppurating bubo usually meant recovery and this is mentioned by Procopius (xxii.37). Where this did not occur complications developed, and Procopius notes that in some cases the tongue was affected (II.xxiii.39). This was very possibly caused by a bubo behind the ear

or in the neck, that led to secondary infection of the hypoglossal nerve and paralysed either part of, or the whole tongue.

Procopius' account shows first hand experience of the epidemic. For someone unfamiliar with the characteristics of the disease, he describes the very obvious symptoms accurately, especially the various sites on the body where buboes can occur. The sudden onset, high fever and delirium, are typical of bubonic plague. In contrast, Thucydides emphasises such symptoms as burning eyes, bleeding throat and pustular skin rash. The two epidemics clearly do not resemble one another.

The plague spread gradually over the whole known world, leaving no part untouched (II.xxii.8). "... it fell upon the land of the Persians and visited all the other barbarians besides" (II.xxiii.21). The mortality rate was enormous:

> *"Now the disease in Byzantium ran a course of four months, and its greatest virulence lasted about three. And at first the deaths were a little more than the normal, then the mortality rose still higher, and afterwards the tale of dead reached five thousand each day, and again it even came to ten thousand and still more than that."*
>
> Procopius History of the Wars II.xxiii. trans. H.B. Dewing

Most virulent epidemics adopt a similar pattern to the one described above by Procopius. The disease starts off fairly slowly, claiming few victims, but gains momentum as it establishes itself more firmly in a population. All age groups were affected, but according to Agathias (Histories v.10), young adults, especially women, were particularly prone to the disease.

The inhabitants of the city found themselves unable to cope with the vast number of corpses and resorted to several macabre measures, such as filling the fortification towers in Sycae with bodies and setting ships heaped with corpses adrift (II.xxiii.10). As during the Athenian plague, certain individuals resorted to lawless behavior (II.xxiii.16)

while others became overly pious "by sheer necessity" of circumstance (II.xxiii.14). But the plague was indiscriminate in choosing its victims. What the exact mortality rate was is difficult to determine. The psychological impact of those terrifying months may have caused Procopius to overestimate the number of deaths. He was even willing to believe and report several superstitious tales (II.xxii.10-15) in an attempt to find some explanation for this horrendous event. Many too would have died from hunger (II.xxiii.18). But as the plague moved across Europe, each major city that was affected reported mortality rates closely resembling those of Procopius.

Gregory of Tours makes several references to a plague that caused "swellings in the groin" (iv.4.5). In A.D.571 an epidemic killed off so many people that the dead could not be counted. There was such a shortage of coffins that 10 or more bodies were buried in the same grave (iv.31). Gregory describes the disease;

> *"Death came very quickly. An open sore like a snakes bite appeared in the groin or armpit, and the man who had it soon died of its poison, breathing his last on the second or third day. The virulence of the poison made the victims unconscious". (iv.31)*

The plague spread to Lyons, Bourges, Chalon and Dijon. Marseilles experienced an outbreak of what may have been plague as a result of a ship docking at the port with merchandise from Spain (ix.22). People who brought the merchandise died - possibly as a result of being bitten by plague infected fleas that had infested the cargo. In A.D.590 Pope Pelagius II died as a result of an epidemic which caused swellings in the groin (x.1).

Although Gregorius' description is not as detailed as that of Procopius, the mention of buboes is good evidence that the disease was very possibly bubonic plague, and therefore the same disease as the one referred to by Procopius.

No doubt individuals in densely populated areas would be at a greater risk than those in rural settings, with the flea having a better opportunity of infesting dwellings over a large area, as well as overcrowded

conditions supplying numerous hosts. It seems possible that there was a mortality rate of 40% of the total population of Byzantium (200,000 in 4 months) and there is no reason why other cities should not have been similarly affected. Gottfried believes that by the time the plague had finally spent itself, "between a fifth and a quarter of Europe's population south of the Alps had perished".(9) This certainly dealt Justinian's plans of reconquering the west a death blow, as well as weakening both the eastern and western empire sufficiently to make it vulnerable to Moorish conquests. The plague probably disrupted trade patterns and routes during outbreaks, negatively affecting the economy and social structure of the Mediterranean basin.

The plague of Justinian temporarily established a reservoir of Yersinia pestis among the fleas and rodents in the Mediterranean and Europe. This resulted in a 10-24 year recurrence of bubonic plague epidemics until approximately A.D.700.(10) After this the plague foci seem to have become depleted, for reasons which will be discussed later, and the disease would not strike again en masse until 1347, when Yersinia pestis was once again introduced into Europe.

THE PLAGUE OF JUSTINIAN AND BUBONIC PLAGUE - A COMPARISON

SIGNS AND SYMPTOMS OF BUBONIC PLAGUE	SIGNS AND SYMPTOMS OF THE PLAGUE OF JUSTINIAN.
1. Sudden fever	Sudden fever.(Procopius II.xxii.15.)
2. Pustule or blister at point of inoculation	Open sore like a snakes bite (Gregory of Tours iv.31)
3. Enlarged lymph nodes from second or third day.	Bubonic swellings appearing day one onwards (Procopius II.xxii.17) Swellings in the groin (Gregory of Tours iv.4-5 and x.1)
4. Nodes very painful and may suppurate	Nodes extremely painful (Procopius II.xxii.28) Nodes suppurating (Procopius II.xxii.37)
5. Mental confusion or delirium	Deep coma or violent delirium (ProcopiusII.xxii.19) Victims unconscious (Gregory of Tours iv.31)
6. Day 8-10, death or convalesence	Victims died after many days(ProcopiusII.xxii.30)
7. Not contagious	Not contagious (Procopius II.xxii.23)
8. Immunity acquired	Immunity acquired (Procopius II.xxii.8 &xxiii.16)
9. Mortality rate 60-90%	Mortality rate estimated at 40% (Proc.II.xxiii.1-3)

NOTES

CHAPTER 6

(1) The last emperor of the west, with the rather hopeful name of Romulus Augustulus, abdicated in A.D. 476 allowing the barbarians full control of the western empire. Sinnigen, W.G. and Boak, A.E.R. (1971) pg. 760

(2) Procopius History of the Wars. Other sources that mention that same plague are: Gregory of Tours The history of the Franks, Agathias Histories and The Chronicle of John Malalas.

(3) John Malalas' book 18.90 confirms that by A.D. 541/2 the plague was widespread in Egypt and says the emperor sent his cubicularius to Egypt to learn about the epidemic.

(4) Hirst, L.F. (1953) pg.10

(5) The plague broke out in Byzantium in spring. As noted in chapter one, spring and summer are the seasons in which bubonic plague commonly occurs and during which the flea is therefore most active.

(6) Deaux, G. (1969) pg. 30 contends that Procopius described all three forms of the disease, although Poole,J.C.F. & Holladay, A.J. (1979) pg. 299 and Hare, R. (1966) pg. 86 disagree that pneumonic plague was described by Procopius.

(7) Deaux, G. (1969) pg. 30 and Zinsser, H. (1935) pg. 147

(8) Hare, R. (1966) pg. 86

(9) Gottfried, R.S. (1984) pg. 11

(10) ibid pg. 11 & 12

CHAPTER 7

CONCLUSION

Although we have ample archaeological proof of other diseases in antiquity, there is no concrete evidence of plague. Plague leaves no trace in bone, one of our most valuable sources of evidence. Quite revolutionary methods of analysing remains have been produced in recent years and although these have not been particularly helpful in detecting plague, they have allowed for a certain amount of verified theorising on the subject. For example, certain links in the complicated chain of events needed to produce plague can be traced. We can be almost certain that fleas were well known in antiquity, even though we have no archaeological remains. Fleas would however prove difficult to find, as they are known to desert a cooling corpse (be it animal or human) for a new host, unlike lice. But written sources (biblical and Greek) support the theory that fleas were known.

We are able to speculate as to the existence of rats in the ancient world, from remains dating to the period before and towards the end of our period of study. The find of a Rattus rattus skeleton in a well from the second century A.D. in Britain has brought the estimated date for the arrival of the rat in Britain forward, from the tenth century A.D. to the second. As yet we have no evidence that the rat was on the continent even before this date. Many historians, among them Hirst (1) and Morris (2), insist on citing Hinton's (3) evidence of two bronze statuettes of rats from the first century A.D. Rome and the discovery of rat skeletons at Pompeii. Unfortunately this evidence has proved to be tenuous, to say the least, with one author citing the other and not giving any definite (archaeological) reference. However, it is highly probable that Rattus rattus was present in first century Rome. If the rat had managed to get to Britain by the second to third century A.D., with evidence pointing to minimal active migration by the species, this would seem a reasonable assumption.

Trade links with the east were well established by then, Strabo (17.1.13) writes; "In earlier times, at least not so many as twenty vessels would dare to traverse the Arabian Gulf ... but at the present time even large fleets are despatched as far as India and the extremities of Aethiopia, from which most valued cargoes are brought to Aegypt ..." This would have allowed for passive transportation of rats from their area of origin to the rest of the civilised world. If one assumes that they were present and had become domesticated, one still lacks any evidence by which to determine just how concentrated rat populations in urban areas would have been.

But it seems from written sources, that Yersinia pestis had not as yet been introduced into the Mediterranean. This would mean that existing rat populations and other lagomorpha would not have been potential carriers. Written sources for the period preceding 430 B.C. have not produced much on plague. There are ample recordings in Biblical, Greek and Roman texts of 'plagues' and 'pestilences', but the only indication of plague pre 430 B.C. occurs in Hippocrates (Aphorisms sec iv.55).(4) Bubonic plague was known to the ancients, but certainly not in epidemic proportions. It seems that isolated cases of the disease occurred - individuals bitten by chance by a plague infected flea - and these were recorded by Hippocrates and later by Rufus of Ephesus. Interestingly, these cases occurred in the middle east and north Africa (Egypt and Ethiopia). With trade connections becoming more firmly established between India and Egypt in the second and first centuries B.C. it seems likely that outbreaks of plague would occur in these areas first. However, Yersinia pestis did not establish itself among the wild and domesticated rodents till much later. Why this took as long as it did is not clear. Fluctuations in rodent populations could have made the establishment of a Y. pestis reservoir difficult. Animals that had survived epizootics could temporarily have transmitted their acquired immunity onto their offspring. Climate and economic factors could have influenced the progress of Y. pestis among the rodents in the Mediterranean. In short, it is a complicated disease dependent on various factors for its successful spread and any break in this chain of events would hinder its progress.

With smallpox we are looking at a different series of factors. Smallpox is rapidly passed from man to man through droplet infection and does not need the flea or rodent to facilitate its spread.(5) The 'plague' of Athens was quite possibly an outbreak of smallpox, although many historians have proposed diseases ranging from tularemia to toxic shock syndrome.(6) It is quite remarkable how many medical historians have ignored what Thucydides actually wrote. Frequently one or two of the symptoms he mentions are plucked out of context and used to fit one or other proposed illness. The rest are conveniently ignored or brushed aside with only a brief mention. It must be emphasised, that a group of symptoms constitutes a specific disease and if some of these are absent or misinterpreted, the picture can change dramatically. Smallpox fitted the symptoms mentioned by Thucydides most closely but not totally. Given the available evidence, we are forced to work by a system of elimination but this should not allow for misinterpretation of the facts.

The epidemic that struck Athens did not disappear from the Mediterranean, but probably lay dormant for a few decades. It may very well have been responsible for some of the 'plagues' described by Livy and Diodorus Siculus, but we are on shaky ground here. Other than Diodorus' description of the epidemic of 396 B.C. (xiv.71) we have no details of signs and symptoms till the 'plague' of Marcus Aurelius in A.D.165 described very briefly by Galen. Even so, it is difficult to give a definite diagnosis. Smallpox or an associated disease could serve as a reasonable suggestion and this would hold true for the 'plague' of Cyprian in A.D.250.

Definite evidence of bubonic plague for the period preceding A.D.540 is extremely scant. That Hippocrates was familiar with the disease has been discussed. However, the symptoms mentioned by Dionysius the Hunchback, Dioscurides and Posidonius, and recorded by Rufus of Ephesus (c. A.D.110-180) give us indisputable evidence that bubonic plague was known.(7) But why do we have no other records of plague? Perhaps some of the pestilences recorded through the centuries were plague, but as we have no symptoms we cannot be sure. Some written records may have been lost. Some outbreaks of plague may never have been

recorded. The various schools of medical doctrine prevented for centuries any deviation in interpretation of presented symptoms. The prevailing preoccupation with the theory of miasmata and the four bodily humours coloured medical analysis of the facts. Symptoms were categorised to fit this theory and disallowed any objective interpretation. "In their theorising, the physicians in the Hippocratic tradition were handicapped not only by their lack of knowledge of the functions of the major organs ... but also by the absence of an appropriate theoretical framework for carrying on their logical analysis".(8)

Sometimes religion and superstition influenced accurate depiction, accounts became emotive and exaggerated. This is especially true for the Biblical 'plagues', where God's wrath or other reasons for divine intervention was seen as the causative agent for the outbreak of a pestilence. No other possible factors were considered. Finally, it is a fact that a new disease introduced into a highly susceptible community is usually extremely lethal. Signs and symptoms of the disease would be more severe and may not completely resemble the signs and symptoms of the same disease once it settled towards endemicity. As a result, ancient medical records of epidemics may (to a certain degree only) have been misinterpreted by modern scholars to represent a different disease from the one experienced by the ancient physicians.

From A.D.540 a pandemic of bubonic plague swept through the Mediterranean. There is no doubt, from Procopius' account, that the disease was plague. Several centuries of turmoil and vast population movement had preceded this period and the political events that occurred in Justinian's reign did much to sustain this milieu. There was movement of Byzantine troops into Persia and the west and Moors raided into northern Africa from the Arabian peninsula - the latter may very well have brought the plague into Pelusium. Through this troop movement the disease spread rapidly. Loss of life was extremely high and there is no doubt that this caused the eventual collapse of ancient western civilization.

By A.D. 700 the pandemic had spent itself and it seems that the reservoir of Y. pestis in Europe had disappeared. Six hundred years later, the bacterium was reintroduced into the western world, with devastating results. In the following centuries, plague gained a secure foothold in Europe. It continued to play havoc till well into the twentieth century in certain parts of the world, but the number of plague epidemics began to decrease. The reason for this is not clear. Certainly the virulence and infectivity of Y. pestis has not changed. Factors such as improved housing, that provided less harbourage for rats, and improved hygiene, may have contributed to this decline. Displacement of R. rattus by R. norvegicus has been another suggested reason for a decrease in plague, but this is debatable (see Chapter 1). A recent and very interesting explanation is given by Bottone (9) in his article on Yersinia enterocolitica and pseudotuberculosis: "The sharing of antigenic components between Y. pestis and Y. pseudotuberculosis has led to the speculation that the broad emergence of Y. pseudotuberculosis in European countries may have provided cross reacting immunity to the plague bacillus. It is conceivable that the alteration of plague epidemic and quiescence may actually be related to the level of protective antibody acquired as a result of contact with Y. pseudotuberculosis".

Plague remains endemic in several parts of the world today and occasional outbreaks still occur. Timely treatment with antibiotics can reduce the mortality rate quite dramatically, but the disease is frequently misdiagnosed. However, it is doubtful whether the world will ever experience another pandemic of plague. We have a completely new range of infectious diseases to deal with today, caused by viruses and bacteria that have developed effective resistance to our antibiotics, or for which we have not as yet found a cure. It is quite paradoxical that we can still feel today, with all our modern technology, as helpless as ancient man did when confronted with a new infectious disease.

NOTES

CHAPTER 7

(1) Hirst, L.F. (1953) pg. 124

(2) Morris, D.M. & Chu, M.C. (1986) pg. 213

(3) Hinton, M. Rats and Mice as enemies of mankind 1918

(4) As noted in Chapter 3, note 27, the Hippocratic books were never attributed entirely to the writings of Hippocrates and their authenticity was disputed even in ancient times. The Hippocratic Corpus is the work of many medical writers from different schools of thought - see W.D. Smith The Hippocratic tradition 1979 for a more detailed discussion on the various schools of medical thought in the ancient world. Most of the treatises that make up the Hippocratic Corpus were apparently written between 430 and 330 B.C.(G.E.R.Lloyd introduction pg. 9 to The Hippocratic Writings)
Although they may not have been written by Hippocrates himself, this should not detract from their value and importance as an ancient medical source.

(5) The same is true for pneumonic plague but it is generally regarded as a complication of bubonic plague. Primary pneumonic plague is introduced into a community by an individual that has developed the pneumonic form of plague or was infected by someone with pneumonic plague. There is always a bubonic plague focus somewhere.

(6) Again, Dan, D. in his article 'Toxic shock syndrome: back to the future' in JAMA (1987) pp. 1094 & 5, does not consider factors such as mortality rate and the complications of the disease mentioned by Thucydides.

(7) Rufus' account is referred to by Oribasius in his Synagogae Medicae (xliv.14.1-2)

(8) Kee, H.C. (1986) pg. 29

(9) Bottone, E.J. (1981) pg. 1235

TERMS AND DEFINITIONS

Antigen: Any substance, bacterial or otherwise, which stimulates the production of an antibody.

Antibody: Specific substances formed in the body which counteract the effects of bacterial antigens or toxins.

Carrier: An infected person or animal that harbours a specific infectious agent in the absence of clinical disease and is a potential source of infection in man.

Disease: If a number of people are similarly affected in respect of certain identifiable characteristics, they are said to be suffering from the same disease. The name of a disease is the label attached to a category of sick persons. The naming of a disease is a matter of convenience rather than consistency.

Endemic: A disease or infectious disease which is habitually present in a certain area.

Enzootic: Disease prevalent in certain areas among wild animals.

Epidemic: An outbreak of a disease of a similar nature amongst a great number of people, at the same time and in a certain area.

Fomites: Any article which has been used for or by a person suffering from an infectious disease.

Immunity: A highly developed state of body resistance to any infectious agent.

Incubation period: The period from entry of the disease causing organism into the body until signs and symptoms of disease occur.

TERMS AND DEFINITIONS cont'd

Sylvatic/Wild Rodent Plague: Plague in species other than the common rat or mouse. Sylvatic plague is as a rule responsible only for the occurrence of sporadic cases in humans who have entered the haunts of the species concerned, as opposed to collective human cases when the commensal rats become infected.

Virulence: Used as a quantitative expression of the disease producing potential of a pathogenic organism. A highly virulent organism can cause no more than mild disease if the host has naturally or artificially acquired immunity. At the same time it can eliminate communities with no specific immunity.

Note: I have relied heavily on C. Kassner c. 1981 pp.6-8 for the above list.

ILLUSTRATIONS

FIG 1 Enlarged tender inguinal node in child with bubonic plague.
Lambert, H.P. & Farrar, W.E. (1982) Fig.10.21.

FIG 2 Advanced stage of lymphadenitis in bubonic plague. Nodes have undergone suppuration and lesion has drained spontaneously.
Lambert, H.P. & Farrar, W.E. (1982) Fig.10.22.

FIG 3 Head of Rameses V Sandison, A.T. (1980) Fig.2.2.

FIG 4 Smallpox Lambert, H.P. & Farrar, W.E. (1982) Fig.4.35.

FIG 5 Tollund Man Fischer, C. (1980) Fig.10.5.

FIG 6 Clubfoot/Anterior poliomyelitis of Pharoah Siptah.
Sandison, A.T. Fig.2.1.

FIG 7 Abnormal vertebral column, spinal T.B. Potts Curvature.
Penso, G. (1984) Fig.135.

FIG 8 Male pottery figurine with skin lesions.
Penso, G. (1984) Fig.146.

FIG 9 Pottery fragment of arm or leg possibly showing confluent smallpox.
Penso, G. (1984) Fig.142.

FIG 10 Possible example of smallpox on terracotta head from Pompeii.
Penso, G. (1984) Plate XXVII

LIST OF TABLES

CHRONOLOGY

1379-1362 B.C.	'Plague' in Cyprus
c. 1300 B.C.	'Plagues' in Exodus
c. 1200 B.C.	Possible 'plague' in the Peloponnese - contributed to the downfall of Bronze Age civilization
c. 1190 B.C.	'Plague' of the Philistines and the 'plague' at Troy
479 B.C.	'Plague' and dysentery among Persian troops
463 B.C.	Pestilence in Rome
453 B.C.	Pestilence in Italy
c. 440 B.C.	A Hippocratic writer records the symptoms of plague
431-427 B.C.	'Plague' of Athens
413 B.C.	Epidemic among the Greeks beseiging Syracuse
396 B.C.	Epidemic among the Carthaginians beseiging Syracuse
313 B.C.	Pestilence at Poetelium
c. 300 B.C.	Plague in the Levant
212 B.C.	Epidemic in Sicily during the Second Punic War
205 B.C. 178 B.C. 174 B.C.	Epidemics in Italy
125 B.C.	Pestilence in Cyrene

CHRONOLOGY CONTINUED

c. 50 B.C.	Pestilence in Spain
c. A.D. 64	Pestilence during the reign of Nero
A.D. 79	Pestilence in Campagna
c. A.D. 81-96	Pestilence during the reign of Domitian
c. A.D. 117-138	Pestilence during the reign of Hadrian
A.D. 165-180	'Plague' of Marcus Aurelius
A.D. 189	Pestilence during the reign of Commodus
A.D. 250	'Plague' of Cyprian
A.D. 359	Epidemic at Amida
A.D. 444	Pestilence in Britain
A.D. 540	'Plague' of Justinian

Repeated outbreaks of the disease occurred throughout Europe until c. A.D. 700.

ABBREVIATIONS

A Class	Acta Classica
AJAH	American Journal of Ancient History
AJPh	American Journal of Philology
Anc Soc	Ancient Society
BHM	Bulletin of the History of Medicine
BICS	Bulletin of the Institute of Classical Studies of the University of London
Bull World Hlth Org	Bulletin of the World Health Organization
CAH	Cambridge Ancient History
CQ	Classical Quarterly
G&R	Greece & Rome
Hist Journ	Historical Journal
HSPh	Harvard Studies in Classical Philology
JAMA	Journal of the American Medical Association
JArchSc	Journal of Archaeological Science
JHM	Journal of the History of Medicine and Allied Sciences
JHS	Journal of Hellenic Studies
JRS	Journal of Roman Studies
N Engl J Med	New England Journal of Medicine
P&P	Past and Present
SEG	Supplementum Epigraphicum Graecum

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Ammianus Marcellinus	The later Roman empire; trans. W. Hamilton Penguin Classics. 1986
Apollodorus	The library; trans. J.G. Frazer Loeb edition. 1921
Caesar	The civil war; trans. J.F. Gardner Penguin Classics. 1976
Celsus	De Medicina; trans. W.G. Spencer Loeb edition. 1935-8
Dio Cassius	History of Rome; trans. E. Cary Loeb edition. 1914-27
Diodorus Siculus	Library of history; trans. C.H. Oldfather Loeb edition. 1933-54
Galen	Galeni Opera Omnia; ed. C.G. Kühn Reprinted Hidesheim. 1965
Galen	On the natural faculties; trans. A.J. Brock Loeb edition. 1916
Galen	Galeni Scripta Minora; ed. I. Marquardt et al Leipzig. 1884-93
Gregory of Tours	History of the Franks; trans. L. Thorpe Penguin Classics. 1974
Herodian	Books I-IV; trans. C.R. Whittaker Loeb edition. 1969
Herodotus	The histories; trans. A. de Sélincourt Penguin Classics. 1972
Hippocrates	Hippocratic writings; trans. J. Chadwick & W.N. Mann Penguin Classics. 1986
Hippocrates	Selected works Volume 1; trans. W.H.S. Jones Loeb edition. 1923
Index Hippocraticus	Thesaurus Linguae Graecae K. Alpers et al Gottingae
Homer	The Iliad; trans. E.V. Rieu Penguin Classics. 1950
John Malalas	The chronicle of John Malalas; trans. E. Jeffreys et al Melbourne. 1986

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Livy	The war with Hannibal; trans. A. de Sélincourt Penguin Classics. 1972
Plutarch	The rise and fall of Athens; trans. R. Warner Penguin Classics. 1981
Polybius	The histories; trans. W.R. Paton Loeb edition. 1922-27
Procopius	The Persian Wars; trans. H.B. Dewing Loeb edition. 1914
Scriptores Historiae Augustae	Lives of the later Caesars; trans. A. Birley Penguin Classics. 1982
Strabo	The geography of Strabo; trans. H.L. Jones Loeb edition. 1917-1932
Thucydides	The Peloponnesian War; trans. R. Warner Penguin Classics. 1972
Xenophon	A history of my times; trans. R. Warner Penguin Classics. 1981

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