INSECT-BORNE DISEASE.

In this chapter I shall be looking at three of the major diseases which are passed on by an insect vectors. Because in each case the disease is dependent on a relation between humans and a certain vector, these three are very susceptible to changes in living habits which control the relationship of the human host and the disease-carrying entity.

Plague

Plague, bubonic and pneumonic, was widely regarded as the worst of all epidemics. This was partly due to its suddenness and high case fatality. Its first impact often killed up to half a country's population and then through the centuries it constantly recurred, killing millions of humans. There had been serious outbreaks previously in history, for instance in the sixth and seventh centuries A.D., but it is the consequences of the affliction that covered much of western Europe from the fourteenth to seventeenth centuries that I shall be concerned with here.[1]

Uncertainty surrounds every aspect of the history of plague. To start with, it is not certain how it is spread. We know that it is caused by a bacillus, which was discovered towards the end of the nineteenth century. 'During the first epidemic at Hong Kong, Kitasata, a Japanese bacteriologist, discovered the plague bacillus.'[2] Almost simultaneously it was discovered by Yersin in the West, hence its name 'Yersinia pestis'. It can, however, be transmitted in various ways. Firstly it can undoubtedly be transmitted by the rat flea. But it appears that it can also be transmitted by the human flea, **Pulex irritaris**, and hence there is, in principle, no need for rats at all.[3] Furthermore it can be passed, in the pneumonic form, by way of respiratory secretions. Hence, for example, it cannot be classified as either vectorborne or non-vectorborne.[4]

This diversity of transmission has led to one of the many great disputes, namely whether the Black Death was transmitted by the black rat. A recent survey of the evidence has suggested that it was not

[1]for general description see Braudel, Capitalism, 46ff; Shrewsbury, Bubonic Plague; Creighton, Epidemics; Slack, Hollingsworth, Hist. Demog., Appdx.

[2]Burnett, Infections, 228

[3]Flinn, European (xerox), 57

[4]Ewald, Infections (xerox), 37

and that the epidemic was mainly pneumonic and perhaps partly spread by human fleas.[5] A recent study of plague in early modern England, however, supports the rat hypothesis.[6]

Having decimated populations in Europe from the time of the Black Death in 1348, plague mysteriously and almost completely disappeared from throughout western Europe with very small exceptions, within two or three years after 1665.[7] "After 1657, the plague ceased to visit Italy".[8] In England, after a high mortality in 1665 in London, it vanished without trace after three hundred years of depredations. In 1707-14 it spread from Russia and Hungary as far as Sweden, Denmark, Prussia and Bavaria, but no further west.[9] In France, the last importance epidemic was in Provence in 1720-1.[10] That it disappeared in western Europe, while remaining endemic in its central loci in Asia, is not in doubt. Nor can there be little doubt that its sudden disappearance in western Europe was of immense importance, both in itself and because of its side effects in raising confidence.

Yet we still have very little idea what lay behind this most dramatic and fortuitous development. Some years ago Zinsser concluded that "When all is said and done, we have no satisfactory explanation for the disappearance of plague epidemics from the Western countries..."[11] Forty years later after much more research we are in the same position; we do not know why the change took place. Livi-Bacci concludes that "Neither the specific explanations discussed above (social adjustment, immunity, selection) nor still others (other social or ecological transformations) are sufficient to explain this phenomenon." All we know is that "For reasons not entirely clear..." it happened.[12] The same is true of its disappearance elsewhere. For instance, plague became a very serious epidemic disease in late nineteenth century India.

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[5]Davis, Scarcity, 459-467

[6]Slack, Plague, 11, 314

[7]Ref: Colman (ed) Population Theory, 281

[8]Glass (ed), Population, 573

[9]Chambers, Encyclopedia

[10]UN Mortality, 144

[11]Zinsser, Rats, 93

[12]Livi-Bacci, Concise, 49; cf also Coleman (ed), Population Theory, 281; Flinn, European (xerox), 58

From 1896 to 1914 it is estimated that over eight million people died of the disease.[13] Then after 1921 it suddenly disappeared - for reasons as yet unknown.[14]

(APPENDIX - theories for decline of plague: a-plague)

Turning to East Asia, plague was widespread in China in the eighth and ninth centuries, when there were close trading relations with Japan. It was a time of many 'plagues' in Japan; 'the period from about 700 to about 1050 stands out as Japan's age of plagues.'[15] For this and other reasons McNeill suggested that plague might have reached Japan in 808.[16] Yet there is no description in the very full sources of a disease with plague symptoms and consequently 'the existence of plague in Japan during this period remains in doubt.'[17] The word for plague **pesuto** is of European derivation, not native Japanese.

Nor does the fourteenth century world pandemic seem to have reached Japan. We are told that 'If the Mongols had succeeded in their invasion of the islands, then Japan, too, undoubtedly would have suffered from the plague. But Japan remained plague-free, population continued to grow, and the condition of western Europe avoided in the plague pandemic of 1350-1450.'[18] Nor is there any evidence of plague in the early modern period. Bubonic plague seems 'not to have affected early modern Japan.'[19] As Jannetta concludes in her recent survey, "my search for epidemics of bubonic plague in pre-modern Japan went unrewarded...the Japanese sources reviewed here reveal no evidence of plague in Japan before the late nineteenth century."[20] This cannot be explained away by the absence

[13]Roberts, Hygiene, 120

[14]see McAlpin, Famines, 362

[15]Kiple (ed), Diseases, 377

[16]Kiple, Diseases, 377; McNeill, Plagues, xxx

[17]Kiple (ed), Diseases, 378

[18]Kiple (ed), Diseases, 383

[19]Kiple, (ed), Diseases, 388

[20]Janetta, xix; see also Kiple (ed), Diseases, 314

of records, for, as Jannetta shows, the records for the history of disease in Japan are superb. Plague really does seem to have been absent. Japan is the one major country in the world with a dense population which does not seem to have suffered from plague until the very end of the nineteenth century.

The absence of plague in Japan can largely be explained by the fact that the hundred miles of sea between Japan and the mainland created a **cordon sanitaire**. Since Japan was self-sufficient in cereals, ships did not carry grain from China or Korea hence infected black rats were less likely to enter the country. This natural barrier was made stronger by the Japanese realization of the connection between plague and rats. Griffis in the 1870's noted that the Japanese "have guarded their coasts against the advent of diseases from abroad. Especially feared is the pest in the form of the bubonic plague. It was discovered that rats were the carriers of contagion, and that the rodents were in many lines of analogy as susceptible to disease as man is, the bacillus being common to both." The result was a slaughter of rats. "A general slaughter was ordered. The number of rats - numerous in most old Japanese houses - killed in the large cities reached to many hundreds of thousands."[21]

It would be extremely interesting to know when the connection was made and when the slaughter was undertaken. Griffis implies that the connection was made very early, by "ancient wisdom". "Thus the latest conclusion of modern science tallies with the observations of ancient wisdom."[22] If he is talking about the ancient wisdom of medieval or earlier Japan, this known connection may be a crucial factor in explaining the absence of bubonic plague. Such knowledge, however, is not enough. We are told that "Sticker has collected a great many references to this subject from ancient and medieval literature, and has found much evidence in the folklore of medieval Europe which points to the vague recognition of some connection between plague and rats".[23] As late as 1894, the greatest world authority on the history of bubonic plague, Creighton, frequently noted the association between the death of rats and bubonic plague - yet he thought the dead rats were merely a side-effect of deadly miasma arising from corpses, which was the real cause of plague.[24] The difficulty was proving the link, and doing anything about the rats.

What is clear is that there were rats in Japan. At the end of the seventeenth century Kaempfer noted

[21]Griffis, Mikado, 662

[22]Griffis, Mikado, 662

[23]Zinsser, Rats, 191

[24]Creighton, Epidemics, i, pp.168-9, 173; for plague as a virus or miasma emanating from the soil and particulary dead bodies, see ibid, i, pp.176, 337; ii, p.35..

that 'The whole Country swarms with rats and mice. The rats are tam'd by the Natives and taught to perform several tricks. Rats thus taught are the common diversion of some poor people.'[25] In the later nineteenth century, Isabella Bird noted that 'my wretched room was dirty and stifling, and rats gnawed my books and ran away with my cucumbers.'[26] There was a 'rat snake' which lived in the rafters and who 'when he is much gorged, occasionally falls down upon a mosquito net.'[27] Hearn described how 'it is great fun to feed these birds with dead rats or mice which have been caught in traps over night and subsequently drowned. The instant a dead rat is exposed to view a kite pounces from the sky to bear it away.'[28] It would appear that the black rat, **rattus rattus** is native to Japan.[29]

Thus it was not the absence of rats that seems to have been important. This lends force to the arguments from the European case concerning the importance of quarantining. It took western Europe over three hundred years to erect a firm defence against imported plague. With its wide sea and care to screen ships, Japan seems to have kept plague at bay. The economic, social and psychological effects of avoiding this most mysterious, painful and sudden of all epidemics are obviously of great importance in understanding Japanese development.

Typhus.

Typhus is usually divided into two major branches, epidemic typhus, which is carried by infected lice, and 'scrub typhus' which is carried from its reservoir of rodents through mites into the human blood. Here I will deal only with epidemic typhus. It is often a major killer alongside bubonic plague and the two are often difficult to differentiate.

The disease is caused by one of the groups of micro-organisms called rickettsia, which are "small cocci or coccobacilli which occupy a position between the viruses and the bacteria. Rickettsias differ from bacteria in that they require the presence of living cells for growth."[30] We are told that 'The body

[25]Kaempfer, History, i, 201

[26]Bird, Travels, 145

[27]Bird, Travels, 144

[28]Hearn, Glimpses, p.379; other references to the uniquity and attitudes to rats see Rein, Travels, p.414; Scidmore, Jinrikisha, p.325.

[29]Kodansha, Encyclopedia, ii, 1248

[30]Merck, Manual, 866

louse is the vector from patient to patient. It takes up rickettsiae from the blood and is itself fatally infected in the process. However, it has about a week in which to transfer the infection to another subject before it dies. In view of this method of transmission, typhus can flourish only in circumstances of poverty, overcrowding and filth.'[31]

It is not certain where and how typhus originated. We are told that 'In all probability typhus is an ancient disease of rats and mice, perhaps an even more ancient disease of the fleas that live on the rodents.'[32] But the 'typical louse-spread typhus is a modern development.'[33] Zinsser states that "...there are no records of typhus fever in recognizable form in the ancient Oriental, Chinese, and classical literatures, and none in the chronicles and histories of the early Middle Ages".[34] "We can thus conclude with some confidence that, as an epidemic disease, typhus did not exist in Europe until the fifteenth century".[35] It was "well launched in an epidemic form in Europe during the last decade of the fifteenth century and throughout the sixteenth..."[36] It is possible that it originated in America. "There is much in the historical evidence which suggests the existence of typhus fever among the South American nations in pre-Columbian days".[37] "In rats, the disease can be kept going indefinitely, and may easily have survived voyages even longer than those of the Spaniards".[38] It appears that it can be transmitted directly from rat fleas.[39]

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[31]Burnett, Infections, 146

[32]Burnett, Infections, 146

[33]idem

[34]Zinsser, Rats, 214

[35]Zinsser, Rats, 218

[36]Zinsser, Rats, 246

[37]Zinsser, Rats, 258

[38]Zinsser, Rats, 263

[39]Burnett, Infections, 146

Whatever its origins, it began to spread rapidly through Europe. The ideal conditions were those of "famine, abject poverty, homeless wandering and constant warfare";[40] "no encampment, no campaigning army, and no besieged city escaped it".[41] The wars of the seventeenth and eighteenth centuries encouraged its spread in Europe. For instance, we are told that "The wars of the Spanish, Polish, and Austrian Successions" in the eighteenth century led to an "almost uninterrupted succession of typhus epidemics which spared no byway and corner of Europe throughout the eighteenth and a large part of the nineteenth century."[42] Hence epidemic typhus "had an enormous impact on mortality in early modern Europe".[43] It is another disease which grows directly proportionate to the degree of crowding. It is well known to be particularly virulent in crowded and insanitary conditions, in gaols, armies, dormitories, towns. It may also have been encouraged by changes in clothing.

The louse which causes typhus does not actually live on the human skin, it clings to the clothes the human is wearing. Wool is a particularly appealing medium for this louse. Thus Nikiforuk suggests that "As the continent's supply of sheep grew, plague survivors wore more wool, supported greater lice colonies and became more lousy. Typhus took advantage of the wool craze and spread across Europe in the fifteenth century".[44] This, if true, is an important point to remember in relation to its demise.

Nor is it, unlike other vector-born diseases, the bite of the animal that causes the disease but rather, "the dejecta of arthropods", in other words it is parts of the body and faeces of the louse that become absorbed by the human. This can be done through food or "In rare instances, infection may be sustained by pulmonary inhalation or conjunctival absorption of air-borne suspensions of the organisms."[45] This latter process is well described by Post. "Faeces dust remains infectious for years, and it is either inhaled or enters through the eyelids. Desiccated infected louse faeces shaken out as dust from winter or cold-weather clothing may explain the seasonal incidence of typhus. The inability to keep warm and clean increases the number of lice, and then families huddling together under heavier textiles, possibly

[40]Zinsser, Rats, 238

[41]Zinsser, Rats, 283

[42]Zinsser, Rats 286, 282

[43]Jannetta, 194

[44]Fourth, 61

[45]Merck, 866

infected with louse faeces, or wandering in crowds, facilitates the spread of the contagion".[46]

The pattern of epidemic typhus in England can be seen through the overview given by Clarkson. "By about the middle of the seventeenth century fevers of the typhus type...had become well established as more or less regular visitors in England causing more deaths, year in and year out, than plague. The increasingly endemic nature of typhus is perhaps one explanation of the greater unhealthiness of England in the later seventeenth and early eighteenth centuries."[47] Hence "In post-Restoration England typhus fever was practically a part of everyday life."[48] A number of typhus epidemics affected England in the sixteenth to eighteenth centuries. There is very little doubt that "the disease which decimated both the parliamentary and the Royal armies at the siege of Reading in 1643 was typhus".[49] Chambers draws attention to typhus outbreaks in 1679-80 and again in 1741-2.[50]

After 1750 typhus remained one of the very few diseases which could reach epidemic proportions. It grew more serious in eighteenth-century London.[51] During the period between 1770 and 1815, according to Creighton, it was generally absent.[52] But then there were particularly severe outbreaks in 1816-8, when more than 100,000 people caught the disease, of whom about 10% probably died.[53] The epidemic was even worse in Ireland, at this time, when some 700,000 of the six million or so inhabitants were affected.[54] Typhus finally declined rapidly from the 1870s, but this decline "should be

[46]Post, Modernization, 30

[47]Clarkson, 45

[48]Clarkson, 46

[49]Zinsser, Rats, 281; for a description, see Creighton Epidemics, i, pp.549,553.

[50]Chambers, Economy, 102

[51]Landers, Death (xerox), p.347.

[52]Creighton, Epidemics, ii, p.215.

[53]Post, Modernization, 31

[54]Kiple (ed), Diseases, 1082

seen in the context of long-term decline in the death rate from fevers from the mid eighteenth century".[55] Creighton believed that typhus and relapsing fevers disappeared in England after the 1870s due to an improved standard of living, in particular as a result of better housing, food and fuel.[56] 'The last great epidemic in Eastern Europe after the First World War, is estimated to have affected 30 million people and killed three million of them.'[57]

The connection with clothing and washing, which affects the lice which spreads it, is shown in its seasonal incidence. We are told that "Epidemic outbreaks of typhus usually begin in winter, when the cold discourages bathing and changing clothes, and disappear with the coming of warm weather."[58] At the end of the nineteenth century, it was thought to be a 'disease for the most part of temperate climates. At the present day Ireland, Russia, Italy, Persia and North China are its chief seats.'[59] A century later its location had shifted to less temperate climes. It now seems to have been reduced to three main areas, 'the Himalayan region of Asia, the Andean regions of South America, and the horn of Africa, especially famine-ridden Ethiopia.'[60]

Since typhus is associated with crowding, but also with clothing, bathing and personal hygiene, it is particularly interesting to turn to Japan. We know that it was an immensely crowded country. Does the incidence of typhus reflect this fact, or is there an exceptional pattern which would fit with the absence of bubonic plague? In her monograph on epidemics in Japan, Jannetta notes that "One of the most important findings of this study is that two of the most disastrous epidemic diseases of premodern Europe - bubonic plague and epidemic typhus - do not appear in premodern Japanese accounts."[61] There are no descriptions of anything like epidemic typhus before it was brought into Japan by westerners in the later nineteenth century. The word for typhus in Japan is **chifusu**, the Japanese approximation of the word "typhus", which was written in **katakana**. This suggests that it was regarded

[55]Mercer, Disease, 89

[56]Creighton, Epidemics, ii, p.214.

[57]Busvine, Insects (xerox), 11

[58]Appleby, Famine, 103; cf also Kiple (ed), Diseases, 1080

[59]Chambers, Encyclopedia, 35

[60]Kiple (ed), Diseases, 1081

[61]Jannetta, 191; cf Kiple (ed),Disease 384, 388

as a new disease. It is not one of the diseases treated in Fujikawa's **History of Disease in Japan.** "What is clear is that Japanese accounts written before the arrival of Western trade contain no descriptions of epidemics similar to typhus." It seems to have been a "new and imported" disease in the late nineteenth century.[62]

Thus we find in relation to epidemic typhus, as with bubonic plague, that a disease so intimately related to crowding and dirt, which we would have expected to expand rapidly in Japan, appears to have been totally absent until towards the end of the nineteenth century.

Malaria.

Malaria is probably the most complex and deadly of all human diseases. Nikiforuk estimates that 'Since the beginning of history malaria has killed half of the men, women and children that have died on the planet. It has outperformed all wars, all famines and all other epidemics.'[63] Burnett gives a brief sketch of its devastating effects in history. 'There is good reason to believe that malaria played a major part in the decline and fall of the Roman Empire, of Greece, and of the ancient civilization and power of Ceylon.'[64] He writes that 'It was the great devitalizer of the tropics - much of the backwardness of the Indian peasant has been ascribed to malaria - and it was the main agent of infantile mortality all through history till the end of the Second World War.'[65] This is a view supported by the finding that 'Before the post-war era virtually everyone in South Asia was suffering in some manner from malaria.'[66] More precisely 'In India it was calculated that in 1930 about a hundred million people were infected with the parasite, and that about two million deaths per annum were directly due to malaria.'[67] Burnett concludes that 'Of all the infectious diseases there is no doubt that malaria has caused the greatest harm to the greatest number.'[68]

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[62]Jannetta, 195

[63]Nikiforuk, Fourth, 14

[64]Burnett, Infections, 232; cf also Boserup, Scarcity (xerox), 393

[65]Burnett, Infections, 232

[66]Myrdal, Asian 3, 1561

[67]Burnett, Infections, 232

[68]Burnett, Infections, 232

Human malaria is a very ancient and very complex disease. It seems certain that it is an 'Old world disease in its origins' and it can be traced back to the 'earliest civilizations.'[69] There are many different forms of malaria and it has 'shown no signs of evolving towards benignness.'[70] Furthermore, 'Because the malaria organisms can reproduce sexually during its transmission cycle, it has a great potential for evolving around barriers that we place in its way. This potential is well illustrated by its responses to antimalarial drugs.'[71] In trying to understand its history, we are faced with all the complex interactions which I sketched in the previous chapter. 'Malaria transmission in any locale depends upon the complex interactions of parasites; vector mosquitoes; physical, socioeconomic, and environmental factors; and human biology, demography, and behavior.'[72]

It is because of its immense complexity and continued virulence that malaria poses one of the greatest threats to world health today. It was believed in the 1960s that it would be conquered, but now it is regaining ground in many parts of the world. 'Reported cases of malaria are increasing from year to year, especially in areas of Asia and the Americas undergoing agricultural colonisation with forest clearing and pioneering of unexploited lands.'[73] Given the terrible debilitating effects it has, 'destroying blood, weakening physical resistance and ruining mental energy and moral determination'[74], this makes an analysis of this disease particularly important. Its virulence in England and Japan in the past will be an important key to their economic and social development.

The history of malaria in Europe and England is only just becoming clear. After the devastations caused by malaria in the early Greek and Roman periods, malaria seems to have receded in importance. But as population built up again after the Black Death, it began to spread from those areas in the Mediterranean where it had always been endemic. We are told that 'By the Middle Ages, plasmodia occupied most of temperate Europe.'[75] But 'It is not until the seventeenth and eighteenth centuries that

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[69]Kiple (ed), Diseases, 860; Ewald, Infections, 41

[70]Ewald, Infections (xerox), 51

[71]Ewald, Infections (xerox), 51

[72]Kiple (ed), Diseases, 857

[73]Kiple (ed), Diseases, 856

[74]Celli quoted in Nikiforuk, Fourth, 15

[75]Nikiforuk, Fourth, 20

malaria became resurgent in Europe, not only in the south but, in periodic outbreaks, as far north as the Netherlands, Germany, southern Scandinavia, Poland, and Russia (Bruce-Chwatt and Zulueta 1980).'[76] England fitted into this pattern.

Dobson believed that the introduction of malaria into England may have been related to the drainage of south-eastern England and the immigration of Dutch settlers. The large amount of water in the Netherlands and Holland had provided a breeding ground for the anopheles mosquito and the malarial parasite **Plasmodium vivax** from at least the fifteenth century. Similar conditions began to be created in the coastal regions of south-east England with the drainage of tidal water, thus 'creating an ideal breeding place for the local mosquito population.' Dobson suggests that 'The parasite, itself, may have been introduced from the malarial-infested polderlands of Holland by sixteenth-century Dutch settlers who came to England to help reclaim the fens and marshes.'[77]

The extent of malarial infection in England was largely hidden from both contemporaries and historians. The main strain of malaria was one which did not lead directly to a high case fatality among adults but rather to persistent debilitating illness, the famous 'agues', and to infant and child deaths which were disguised among the numerous other causes of death. 'Case-fatality rates of the most common form in the temperate zone, **Plasmodium vivax**, are low except in infants and children and except among new migrants to an area of endemic malaria.'[78] Thus the effects were muddled up with the many other causes of fevers. The problem was noted by Greenhow in the middle of the nineteenth century. 'When death results from malaria in this country it usually arises from some secondary affection, and is not registered under the name of ague. For this reason the death-rates shown in the tables must by no means be received as correct indications of the amount of mortality caused by malarious poisoning. The total mortality from this cause is probably much larger than is usually believed...'[79] Greenhow believed that even so 'it will in this climate constitute but a very small proportion of the general death rate.'[80] Yet this may well not have been the case in the second half of the seventeenth and first half of the eighteenth century.

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[76]Kiple (ed), Diseases, 86

[77]Dobson, Hiccup (xerox), 413

[78]Riley, Insects (xerox), 846

[79]Greenhow, Papers, 105

[80]idem

The detailed work by Dobson has shown the seriousness of the situation. 'Approximate estimates of crude burial rates for 560 south-east England parishes also point repeatedly to the high mortality levels in the marshland parishes during this period.'[81] This was a period when there was a temporary rise in mortality in England and much of it was put down to 'fevers'. They 'assumed particular prominence in the epidemiological sources for this period and, indeed, seem to have contributed to the most extensive and prolonged regional mortality peaks of the late seventeenth century.'[82] Many of these 'fevers' may have been related to the spread of malaria. Nor was the situation limited to East Anglia, but extended to the southern counties of Kent, Surrey, Middlesex and so on.[83]

Indeed it seems likely that even northern England was seriously affected. Chadwick described the prevalence of malaria round the city of Durham[84] and Riley notes that 'recent research establishes malaria as a leading cause of death in the eighteenth century in northern England and Sweden.'[85] Malaria was found in southern Scotland up to the nineteenth century.[86] As Riley points out, 'European latitudes and temperatures are not important factors in the existence of this disease, only in its seasonality, which is a function of when factors carrying the plasmodium are numerous and active.'[87] Most of western Europe was potentially a malarial area. 'An average isotherm of 60 degrees Fahrenheit, 15.6 degrees centigrade, is sufficient for the activity of most strains of the malarial mosquito, and some strains, **Anopheles claviger**, for example, known to be resistant to cold, tolerate lower temperatures.'[88] McKeown's view that England was basically too cold for the reproduction of anopheles and hence it is 'likely that malaria was uncommon in Britain' is certainly wrong. (refXXX). Burnett was closer to the

[81]Dobson, Hiccup (xerox), 411/12

[82]Dobson, Hiccup (xerox), 418

[83]cf Howe, Environment, 109

[84]Chadwick, Report, 94

[85]Riley, Insects (xerox), 846/47

[86]Bruce-Chwatt, Malaria (xerox), p.136.

[87]Riley, Insects (xerox), 847

[88]Riley, Insects (xerox), 847

mark when he wrote that 'Although malaria is preeminently a tropical disease, it was once very prevalent in England and certain coastal districts of the Netherlands.'[89]

Burnett also puts his finger on the ensuing problem. If malaria was widespread and important in England from the early seventeenth century, why does it seem to have receded rapidly after about the first third of the eighteenth century, not only in England, but, somewhat later, from much of Europe? As he says, it is difficult 'to understand why malaria had so largely disappeared from Europe' before any new methods of malaria control were introduced. (REF XXX) The rapidity of the change was well summarized by Place at the start of the nineteenth century.[90] Yet there were resurgences, for 'ague' was widespread in England and also in Scotland, Holland and parts of Germany in 1826-8.[91]

A solution to this puzzle is important for several reasons. Firstly, it looks as if malaria is one of those density-dependent diseases which Malthus predicted would emerge to cut back human populations, hence preventing their further growth. Part of the European 'high-level trap' in the seventeenth century was manifested in the form of increased malaria. Yet somehow first England and then most of Europe passed out of this malarial phase - without introducing any obvious direct measures to combat it. The decline in eighteenth century England may therefore hold one of the clues to the unexpected fall in general mortality during that century. A solution to these puzzles may provide us with insights that may be of value in combating the growing threat of resurgent malaria in many parts of the world today.

The case of Japan is even more interesting and important. Most of Japan is well within the temperature zone which would make it liable to various forms of malaria. Maps of malaria distribution show that China and Korea up to a latitude of north central Japan suffered seriously from the disease. It arrived in China before the birth of Christ and 'wise men assumed the new disease was three devils.'[92] Korea had a special strain of malaria.[93]

The system of wet irrigation agriculture practiced in Japan, the many ponds and lakes, the extensive drainage carried on along the coasts from the middle ages, all these would lead us to expect malaria to have been widespread. As one author has suggested, 'Japan is a land with many swamps; it is interesting

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[89]Burnett, Infections, 236

[90]Place, Illustrations, 251.

[91]Creighton, Epidemics, i, p.378.

[92]Nikiforuk, Fourth, 17

[93]Merck, Manual, 834

to speculate about the effects of malaria on a peasantry trying to convert these low-lying lands into productive rice paddies.'[94] We know, furthermore, that mosquitoes were present in large numbers. In the nineteenth century, for example Isabella Bird noted 'Evening does not bring coolness, but myriads of flying, creeping, jumping, running creatures, all with power to hurt, which replace the day mosquitoes, villains with spotted legs, which bite and poison one without the warning hum. The night mosquitoes are legion.'[95] Griffis wrote: 'At night, mosquitoes are numerous, hungry and of good size.'[96] We know that another mosquito-borne disease, significantly named 'Japanese B encephalitis' was to be found, carried by the genus **Culex**.[97] We are told that the **anopheles** mosquito 'seems to have been present in Japan at all times.'[98]

Unlike the New World, which probably never experienced malaria until it was brought over from Europe,[99] it seems clear that malaria was present in early Japan. We are told that in the tenth (check XXX) century, 'Diaries written by members of the gentry...refer to the occurrence of malaria.' 'Malaria was called either **okori** or **warawa-yami**, the latter meaning high fever and chills. Another name, also found in the scrolls, was **gyaku-shitsu**' According to this source, illness was characterized by fever and chills that recurred throughout an individual's life.'[100] We are told that even Prince Genji himself suffered from malaria, as did Muso Kokushi, the Zen priest.[101] Although the association with mosquitoes was not made, 'a court lady seemed to believe that butterflies were common where the disease broke out.'[102]

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[94]Kiple (ed), Disease, 380

[95]Bird, Tracks, 119

[96]Griffis, Mikado, 528

[97]Kiple, Disease, 811-812; Busvine, Insects (xerox), 156

[98]Kiple (ed), Diseases, 374

[99]Kiple (ed), Diseases, 860

[100]Kiple (ed), Diseases, 374

[101]Kiple (ed), Diseases, 380/84

[102]Kiple (ed), Diseases, 380

Thus from the tenth (XXX) to thirteenth centuries there is evidence of malaria. It seems likely that it persisted in certain places. In the nineteenth century Isabella Bird noted that 'Bange was malarious; there was so much malarious fever that the Government had sent medical assistance.'[103] Morse noted that '...some fevers due to malaria occur.'[104] Scidmore noted of the missionary settlement of Tsukiji that it was 'malarial'.[105]

Japan was a very densely populated island, with the right temperature, ecology and agriculture for malaria. The mosquitoes were present, the disease was present not only in neighbouring countries but early on in Japan itself. We would therefore expect malaria to have played a very significant role in Japanese history over the centuries.

When we turn to a more detailed analysis of the sources, we find that, to all intents and purposes, malaria has been of minimal importance in Japan for nearly a thousand years. Though there were words for it in the early records, these were forgotten and it is now called by the loan word, **mararia**, suggesting its foreign nature. The foreigners who visited Japan from the sixteenth to nineteenth centuries attest, either by their remarks or, more often by their silences, to its virtual absence. The doctors Kaempfer and Thunberg in their very detailed descriptions of the late seventeenth and eighteenth centuries do not refer to malaria. Nineteenth century doctors, von Siebold, Pompe and Willis do not mention malaria as a serious malady.

When they do mention it at all, it is clearly an illness which has been caught abroad and brought back to Japan. Willis in the middle of the century mentions it twice. In 1865 he noted that 'Both the Admiral and the Minister are suffering from it to no great extent, however, and I hope a few days will put them both on their legs completely, assisted with liberal doses of quinine.'[106] A few years later 'Willis was very busy attending large numbers of sick men who returned from Formosa suffering from malaria. They required large quantities of quinine, with which fortunately the hospital was well supplied...'. Willis noted that 'so far as he had been able to learn, nearly every Satsuma man who had returned was suffering from malarial fever or its effects. Many would never recover.'[107] It is worth noting the susceptibility of the Japanese to malaria once they went to a malarial area and the fact that the return of large numbers of

[103]Bird, Tracks, 106

[104]Morse, i, 23

[105]Jinrikisha, p.46.

[106]Cortaxxi, Willis, 62

[107]Cortazzi, Willis, 206-7

malaria infected people, which must have happened before in Japanese history, does not seem to have led to the establishment of malaria in the country.

Evidence from the many other visitors to Japan in the nineteenth century also suggests the absence of malaria. Chamberlain and Lafcadio Hearn in their detailed descriptions do not describe malaria. Griffis in all his extensive travels does not mention malaria on the Japanese mainland, though he does note the 'many thousands of lives' which were 'sacrificed to malaria and fever' on the nearby island of Formosa.[108] Even those we have cited as showing evidence of its persistence, Bird and Morse, give an impression of its absence in their wider work. Apart from the Bange case I have cited, Bird no-where else mentions malaria or the danger of malaria in her extensive travels. Morse notes that 'malarial diseases of severe nature are uncommon, even the milder forms in most regions not being common.'[109]

Medical historians have confirmed this picture of the unimportance of malaria. Fujikawa's **History of Disease** does not include a chapter on this disease; it was clearly of less importance than, for example, German measles or Chicken pox, both of which he devotes a chapter to. More recently, Jannetta's detailed account of epidemics in Japan has no entry for malaria in the index and does not discuss the disease. Neither of the major histories of Japan mention malaria in their index or text, namely Sansom and the four later volumes of the Cambridge History of Japan. More popular social histories paint the same, or an even more extreme picture. Thus Dunn writes of the Edo period that 'there does not seem to have been any malaria in Japan at the time.'[110] Modern maps showing the distribution of malaria show Japan as an area without the disease.[111]

Given the immense economic and demographic impact of malaria in most of Asia and even for a time in Europe, this virtual absence is of the very greatest importance. In terms of understanding the methods of eradicating malaria, the Japanese case, where the environment was suitable for malaria, where is was early known, and where there were mosquitoes, and yet where it seems to have been banished, is of particular interest.

The reasons for the decline in England and Europe, and the virtual absence in Japan, are likely to be a complicated set of conditions. We know that human feeding patterns are likely to affect immunity. For instance, 'There is some evidence, likewise, that children exposed to malaria remain free of this disease

[108]Griffis, Mikado, 654

[109]Morse, i, 39

[110]Dunn, Everyday Life, 161

[111]Hunter, Tropical, p.517.

as long as they are breast-fed because human milk is very low in paraaminobenzoic acid.'[112] Other eating habits may also be important. For example, it is likely that a well-fed population is less likely to succumb to malaria than a severely malnourished one.

Housing and particularly anything that prevents mosquitoes biting, such as netting, is important. Well before it was realized how malaria was spread, it had been noticed that 'In districts where malaria exists it is found by experience that those who go out of their houses only during the day...often escape the bad effects of the poison.' It was thought that there was something in the 'morning fogs' and 'evening mists' which was dangerous.[113] It was only in the early part of the twentieth century that Grassi discovered the true cause. 'Since mosquitoes bite mainly at dusk, he persuaded the families to stay inside their screened houses after dusk. Around these protected houses were the unscreened neighbouring station houses.' The occupants of the screened houses did not get malaria, those in the unprotected houses did.[114] Obviously as important as not going out is the nature of the housing, the 'protection'. It is well known that 'a large proportion of serious vectors bite humans indoors.'[115] 'Recent studies in Sri Lanka, for example, showed that people living in houses with incomplete mud or palm walls and thatched roofs had both malaria and indoor mosquitoes twice as frequently as people living in houses with complete brick and plaster walls and tile roofs.'[116]

What is particularly interesting is that there may be other complex effects as well as merely stopping a particular person from being bitten and hence infected. This has been discussed by Ewald. He puts forward the suggestion that 'Widespread housing improvement may thus provide a benefit not just for the owners of the improved houses but potentially to all within reach of the malaria transmitted from the region. The most obvious benefit should be a stronger reduction in the frequency of **falciparum** malaria than in the frequencies of the milder **vivax, malariae** and **ovale** malarias, but indicators of virulence should show a reduction in the virulent strains within species as well, particularly within **P. falciparum**.'[117] In other words, effective screening by house construction and nets not only reduce

[112]Dubos, Adapting, 158

[113]Chambers,s Encyclopedia, s.r. malaria

[114]Clegg, Man Against, 204

[115]Busvine, Insects, 157

[116]Ewald, Infectious (xerox), 52/53

[117]Ewald, Infectious (xerox), 53

illness, but might 'cause an evolutionary suppression of virulence, if they were used comprehensively by all sick individuals.'

Unfortunately, as he continues, 'We shall not know whether making houses mosquito-proof will cause a strong evolutionary shift toward benignness until we try this intervention on a large scale - one that encompasses an entire interbreeding population of pathogens.'[118] The chances of this happening, he believes, are very small because of the nature of human beings. What is important is that **everyone**, including the sick as well as the well, use protection.' But the motivation to use nets and repellents is strongest for uninfected individuals who are trying to avoid infection. Infected individuals have relatively less to gain from the ruse, and, if they are ill, may be less able to use them fastidiously. Ill people do not have to remember to use their own mosquito-proof house, or be motivated to do so.'[119]

Lowering the virulence is one aspect of the problem. Another is breaking the cycle of infection altogether. We are told, for instance, that if buildings can be made free of biting mosquitoes for three years 'the cycle of transmission of man-mosquito-man can be broken. After this period the mosquitoes can be left to breed freely.'[120] The cycle may be even shorter in certain types of environment. Wilson reminds us that 'in temperate climates, adult **Anopheles** either die or go into hibernation each year with the onset of winter. The following spring, a new generation is hatched from eggs laid in water. **Anopheles** of the new generation will be free of malarial parasites until they bite people with malarial parasites in their peripheral blood.'[121] This would apply to both England and most of Japan. If the cycle could be broken by preventing the re-infection for one year, the chain could be broken. Thus the variations between summer and winter climate in England and Japan may be important clues to the eradication of malaria in these two cases. Such a factor would interact with other changes. As Cohen points out, malaria has been eliminated by improved drainage, 'but primarily only in temperate parts of the world where the life cycles of the appropriate mosquitoes are relatively fragile.'[122]

The prevalence of malaria and the possibilities of its eradication is very closely linked to the system of land use, agriculture and drainage. There are several different theories here. One concerns the fluctuating relationship between humans and domestic animals. Many species of mosquito will feed on the blood of

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[118]Ewald, Infectious (xerox), 54

[119]Ewald, Infectious (xerox), 54

[120]Clegg, Man Against, 211

[121]Wilson for ed. Bynum, Companion Encyclopedia, 386

[122]Cohen, Health, p.43.

cattle, even though human malaria itself is not transmitted through animals. The worst situation seems to be one where there are large numbers of large livestock and they live close to humans, sharing their dwellings or alongside. Where 'stabled domestic animals' are 'situated close to large anopheline breeding places', epidemics are likely to occur.[123] On the other hand Burnett suggests that the absence of malaria in certain parts of the world is sometimes 'because local farming conditions made it much easier for mosquitoes to feed on cattle than on human beings.'[124] If the number of domestic animals suddenly increases, this may draw away mosquitoes. This is one cause suggested for the decline of malaria in eighteenth century England.[125] Or again, if cattle barns are remote from houses, this may have the same effect.[126] It could also be argued that if large domestic animals are almost totally absent, and hence mosquitoes have to find human blood or die, and this is combined with protection against mosquitoes, one has the best of all situations. An interesting case of the disappearance of malaria from a country where it was once prevalent and the climate was suitable for its continuation was Queensland. It has been suggested that this was due to the relative scarcity of domesticated animals.[127] Again, it has been suggested that the kinds of domesticated animals may encourage less virulent species, such as vivax, and hence help to eliminate the most serious type, falciparium. 'Cattle herds grazing in northern Europe, in Asia, and later in the North American Midwest, for example, attracted the mosquito vectors of vivax malaria. Because that plasmodium does not live in cattle, the human-host-mosquito-human-host cycle was broken, especially in North America and Europe.'[128] All these possibilities will need to be borne in mind when we look at farming in England and Japan.

A second theory is linked to the system of agriculture. It is well known that mosquitoes will only breed in certain kinds of water. For example the 'malaria-carrying mosquito of Ceylon breeds in pools of clear water exposed to sunlight, not in overgrown swamps or rice fields nor in flowing streams.'[129] This explains the curious finding that 'Ceylon can be divided into a dry northern area, which is highly

[123]ikiforuk, Fourth, 20

[124]Bennett, Infections, 236

[125]Riley, Insects, 849; cf also Carmichael, Infection, 253

[126]Busvine, Insects, 7

[127]Crosby, Ecological, p.142.

[128]Kiple, Ecology (xerox), p.373.

[129]Burnett, Infectious, 236

malarious and relatively sparsely populated and a large well-watered south-western area, thickly populated and relatively free from malaria in normal years.'[130] If agriculture is disrupted by drought new areas may emerge, ideal for malarial breedings. This happened in 1934 in Ceylon, when rivers dried up in the south and the stagnant pools that remained were filled with mosquito larvi.[131] The converse of this is that if the agricultural system is very efficient and water control is good, and particularly if all waste land is well drained, malaria is likely to decline.

In nineteenth-century England, though they did not know why it was, people noticed that better drainage seemed to eliminate malaria - usually ascribing it to some invisible miasma. For example Greenhow notes that 'The covering of the surface of towns with roads and buildings, and the drainage of soil, tend to prevent the extrication of malaria, or to remove its cause.'[132] Chadwick cited a number of reports by local health officers which linked malaria to drainage. One wrote that 'two other localities, which must be considered as peculiarly fitted for the generation of malaria - I mean the waste land in front of Bradshaw Gate, and also that situated between Greenough's row and Kerfoot's row; the latter is one complete pool of stagnant water, mixed with various descriptions of putrefying animal vegetable matters.'[133] Thus a number of more recent authors have suggested that one of the main reasons for the decline of malaria was improved agriculture and particularly better drainage.[134] Indeed Riley sees drainage as the most important control technique. 'Although it is costly, drainage sharply curtails the breeding sites of insects, reduces the incidence of malaria, and brings into use land that is in most cases exceptionally fertile.'[135] We shall need to bear this in mind when we examine the nature of public space and agriculture in England and Japan, for instance when considering the suggestion that improvements in drainage in sixteenth and seventeenth-century Japan reduced malaria.[136]

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[130]Burnett, Infections, 235

[131]ibid, 236

[132]Greenhow, Papers, 105

[133]Chadwick, Report, 93

[134]Nikiforuk, Fourth, 20; Razzell, Essays, 160; Dubos, Adapting, 89; Bruce-Chwatt, Malaria (xerox), p.139; Creighton, Epidemics, ii, pp.370, 373; Cohen, Health, p.43.

[135]Riley, Insects (xerox), 840

[136]Yamamura, Technological, pp.86-8.

A few other possible factors may also be briefly mentioned. In 1632 a Spanish priest produced a sample of cinchona bark, taken from a tree in Peru, which was taken to Europe as a medicine for malaria.[137] From then on increasing quantities of 'Puruvian bark' or quinine were used in Europe. This undoubtedly mitigated the severity of the disease in England, as elsewhere, even though it did not strike at its root causes.[138] Or again, people may have developed some antibodies against malaria in areas of endemic malaria.[139] Mild strains of the disease 'may have the potential to act like a vaccine against more virulent strains.'[140] Finally, there are certain ways in which the larvae can be destroyed. 'The larvae can be suffocated by an oil film on the surface of the water, poisoned by Paris green or eaten by small fish.'[141]

In conclusion, it would appear that in Japan the three major insect-borne diseases, bubonic plague, epidemic typhus and malaria were either totally absent or of minor importance, as in the case of malaria in the early modern period. Given the amount of suffering they have caused in every other large agrarian civilization, the benefits of this absence for the people of Japan were clearly immense. In England the situation was different. Plague disappeared in the 1660s. Typhus was periodically important from the mid-seventeenth to the mid-nineteenth centuries. Malaria emerged in the early seventeenth century and declined in the first half of the eighteenth.

[137]Kiple (ed), Disease, 860

[138]For a general account fo 'peruvian bark' and the controversies over it, see Creighton, Epidemics, ii, pp.319-20.

[139]Burnett, Infections, 51

[140]Ewald, Infectious, 51

[141]Burnett, Infections, 239