THE CONTROL OF NATURE.

In order to proceed further in trying to solve the puzzle of the escape from the Malthusian trap we need to know more about the wider context. In particular we need to have some idea of the similarities and the differences in the ways in which the English and Japanese adapted to and shaped their natural environment.

At first sight, the fact that both Japan and Britain are islands lying off a larger continent makes them seem similar. The great German historian of Japan, Kaempfer, drew attention to this and other similarities. Japan, he wrote in the 1690s 'may in different respects be compar'd to the Kingdoms of great Britain and Ireland, being much after the same manner, tho' in a more eminent degree, divided and broke through by corners and forelands, arms of the Sea, great bays and inlets running deep into the Country, and forming several Islands, Peninsula's, Gulphs and Harbours. Besides, as the King of Great Britain is Sovereign of three Kingdoms, England, Scotland and Ireland, so likewise the Japanese Emperor hath the supreme Jurisdiction of three separate large islands.'[1] Yet the similarity is once again deceptive.

To start with, Japan is far further from its Continent, with over an hundred miles of rough sea intervening as compared to the relatively calm twenty miles of the English channel. Furthermore Japan is not an 'island' but a group of islands lying in the Pacific ocean off the East Coast of the Asiatic mainland. Japan consists of the four main islands of Honshu, Ikikoku, Kyushu and Hokkaido. The total area of Japan is 142,766 square miles, about one-quarter larger than the whole of the British Isles. It currently holds more than 120 million inhabitants. It mainly consists of volcanic rocks, with 60 active volcanoes and 450 defunct ones. The frequent earthquakes to which it is prone are connected with the outward thrust of Asia towards the Pacific. Physically, practically the whole of Japan is rugged hill and mountain country, plains occupying less than one sixth of its surface. The flat lowlands are fragmented into tiny mountain-surrounded valleys and coastal patches. Volcanic eruptive materials cover more than a quarter of the country. Much of the lowland area is covered with coarse gravel fans laid down by the mountain streams.

Because of its situation in relation to the great land mass of Asia, Japan is strongly influenced by a cold air-stream, which comes from the continental anticyclone in winter, making it extremely cold. Parts of Hokkaido, for instance, experience four months with sub-zero temperatures. In the summer, however, warm, moist air from the Pacific moving into the continent is sucked in. At low altitudes, Japan therefore suffers very hot summers. The climate is very extreme for an island, both within the year, and in variety from the semi-frozen north to the tropical south. The huge variations in climate can be better understood when we consider the length of Japan. King explained to his American readers that 'The Island Empire of Japan stretches along the Asiatic coast through more than twenty-nine degrees of latitude from the southern extremity of Formosa northward to the middle of Saghalin, some 2300 statute miles; or from

[1] Kaempfer, History, 1, p.100

the latitude of middle Cuba to that of north Newfoundland and Winnipeg'. [2] It also has extremely heavy rainfall, nearly all the country receiving more than 40 inches of rain a year, most of it falling in the summer. It is also very humid in early summer, with typhoons in late summer and autumn. The mountains have severely limited the existence of cultivated land and five-sixths of the country is still covered by wild vegetation, mainly forest. It is basically an irrigated rice growing area.

All this is very different from England, given the similarity in size and in being islands off a continent. England is the largest of the three constituent parts of Great Britain. It lies off the coast of France, at roughly the same latitude as northern Japan. The total area of England is 50,332 miles. It currently holds about forty-five million inhabitants, again one third of Japan's population. The land is a mixture of many old and new rocks, none of them active volcanoes. There are only occasional minor earth tremors and no severe earthquakes. Physically most of England is relatively flat and cultivable, with rich soils and good drainage. Because it lies in the gulf stream, it enjoys a comparatively mild climate with few extremes of heat or cold. It receives a reasonable rainfall through the year, with up to sixty inches of rain on the high, westerly, hills. The land is broadly divided into two main zones, both of which have been cultivated for many centuries, namely the 'upland' area of the west and north, with pastoral farming, and the 'lowland' area of east and south with arable. The main crops are wheat, rye, barley and oats in the north.

The physical differences are immense, but even more pronounced are the cultural and historical contrasts. The people of Japan are of Mongoloid origin; those of Britain of Indo-European background. Thus their body weights, eye-folds, and many features of physique are different. The Japanese speak a unique language whose origins puzzle experts but but with some affinities to other Asiatic languages. The English speak a Germanic language of the Indo-European group. The written language of Japan is a mixture of several scripts, heavily influenced by the pictographic script of China. English is written in alphabetic form, based heavily on Greek and Roman roots. The Japanese political system is an amalgam of Chinese models, with later internal variations and western importations - it has historically been very different from the unusual form of constitutional monarchy that grew up in England. The philosophic and religious traditions in Japan are based on an ancient amalgam of Shinto, Buddhism, Confucianism and Daoism. That of England is a particular brand of western Christianity. The culture of Japan, based on Chinese ideas, is in almost every respect different from that of England based on classical and Germanic roots. The history of the two countries over the last thousand years has been very different. Japan was alternatively heavily influenced by outside pressures, first China, then the West, while England has always received a stream of influences from a basically Roman and Christian continent. England spread outwards to set up the largest Empire the world has ever known, Japan turned inwards except for a few short interludes and was without an Empire. England developed the first industrial society in the world from the eighteenth century, Japan only did so with outside inspiration over a hundred years later.

The effects of geography on climate.

[2] King, Farmers, 425.

It is well known that disease patterns are strongly affected by the physical background; climate, soil and general ecology. It is obvious, for instance, that a number of serious diseases are limited to countries with equatorial climates. Furthermore, it has been suggested that since we know that both Europe and Japan went through the 'Little Ice Age', with cooler weather, from the sixteenth century perhaps this lowered disease.[3] But as Schofield points out, while 'Perrenoud...feels that a colder climate helped mute the effect of disease...this point is very difficult to substantiate, and runs counter to the conclusions of other studies in which colder winter temperatures have been shown to worsen mortality.'[4] The association between hard winters and high mortality was noted in the early ninteenth century by Blane and has recently been re-analysed by Galloway. [5] The evidence is equivocal.

It is an important fact that the climate of England is on the whole bland - mild and temperate, without extremes of heat or cold. De Saussure wrote in the early eighteenth century 'Here it is healthy, light, and agreeable on account of its temperature. Generally speaking, there is in England no excessive cold in winter, nor heat in summer; meadows remain green, so the frost cannot be very hard, and as grapes do not ripen, the heat cannot be very severe.'[6] The temperate climate may well have been an important background factor in the mortality patterns, discouraging certain forms of illness. Yet it is difficult to see how, alone, climate could have been the major cause of the surprisingly low mortality in England. There are plenty of documented examples of people who live in equally pleasant climates and yet, because of social and other factors, have very high rates of morbidity and mortality. Nor is it easy to see how climatic changes can explain the steady or falling rate of mortality from the middle of the eighteenth century, well after the 'Little Ice Age' had started.

The climate of Japan was also considered to be both pleasant and healthful. Kaempfer at the end of the seventeenth century wrote that 'Japan boasts of a happy and healthful Climate.'[7] As with England, its advantage lay in the absence of extremes. It was 'not inconsiderable an advantage' that 'the Climate is exceedingly temperate, not exposed to the burning heat of the more Southern Sun, nor froze by the extreme cold of the more Northern Countries.'[8] Alcock thought 'the climate is superior to that of any

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[3]Flinn, European, 100

[4]Schofield, Decline (xerox), 5

[5]Blane, Dissertations,131; Galloway, Seasonal Variations(xerox),pp.496,500.

[6]De Saussure, Foreign, 313

[7]Kaempfer, i, 160

[8]Kaempfer, History, ?, 313

other country east of the Cape.' For instance, it 'does not make mere existence a burden and all life an effort, as it often becomes both in India and China.'[9] Isabella Bird decided to visit Japan 'attracted less by the reputed excellence of its climate...'[10] than other factors. Morse noted that 'The climate of Japan is considered remarkably healthful.'[11] Others believed that one should be more discriminating, since the climate was good for some, less good for others: 'the climate of Japan is stated on the highest medical authority to be excellent for children, less for adults, the large amount of moisture rendering it depressing, especially to persons of a nervous temperament and to consumptive patients.'[12]

The island climates of England and Japan may well have been one of the necessary ingredients for their rather unusual mortality patterns. Furthermore, the weather may be important if there is anything in the view of Lane-Claypon that 'Rain has a very cleansing effect on air, it carries down the dust and draws down the higher and purer strata of air. A rain and wind-swept area is usually healthy, although it may not have a pleasant climate.'[13] Both England and Japan, because of their position, were unusually rainy and windswept. Furthermore, we have seen that in the case of malaria,and possibly some other diseases (for instance the common cold), the fact that there are sharp winters with below freezing temperatures may be beneficial. Thus we certainly cannot ignore climate. However, all of the major diseases which we have been considering - plague, smallpox, typhus, leprosy and so on - could flourish perfectly well in the climate of both England and Japan. The only case where the climate may well have played a significant part was in lessening the impact of malaria in northern Britain and, possibly, the northern half of Japan. Climate and climate change is a background feature, but it is does not solve our problems.

The effects of islandhood on disease.

It is obvious that the patterns of disease are often affected by very large changes in patterns of trade, exploration and conquest.[14] The arrival of Columbus in America had enormous effects on the disease

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[9]Alcock, Tycoon, i, 128, 189

[10]Bird, Tracks, 1

[11]Morse, i, 39

[12]Chamberlain, Things, 100

[13]Lane-Claypon, Hygiene, 64

[14]cf Crosby XXX

patterns of both America and Europe. To a lesser extent, the European pressure on Japan in the later nineteenth century, as we have seen, introduced a number of diseases into that country. It is difficult to allow for these 'macro' changes for they are often so large that they escape our notice. This pattern of the migration of diseases is becoming more apparent to historians. The general tendency from the sixteenth century was for disease levels to rise as mobility both between different parts of the globe and within specific countries increased. For instance, Dobson suggests that one reason for the rise of mortality in seventeenth century England was 'the increased global and regional population movements of the time.'[15]

The situation of England and Japan may have been important in this respect. As Burnett pointed out some time ago 'it is self-evident that if the microorganism responsible is not present in a community then no cases of that disease will occur. It is one of the great advantages of Australia that as an island nation remote from the continental sources of most infectious disease it is relatively easy to prevent entry of disease.'[16] It was relatively easier in the case of Japan, with its large sea-barrier, than in the case of England. This may account for a difference of strategies.

There can be no doubt that this exclusion of disease was very important in Japan. As we have seen, the absence of a number of epidemic diseases before the later nineteenth century may well have been the result of a combination of a wide sea, deliberate policy to keep out foreigners and to confine the few who were allowed in to very small, quarantined, port enclaves. Though much less pronounced, the English channel may have helped to diminish disease.

In the English context, there was little that could be done at the island level, given the many ports and short sea-passages, though there were times when it appears that effective action was taken, for instance in relation to plague, 'In the face of a new epidemic in North Sea and Baltic ports in 1711, the English Parliament enacted, and effectively endorsed, a severe quarantine for all vessels arriving from infected areas.'[17]

Work in England.

In assessing the impact of economic developments in these two countries, it is necessary to return again to some wider impressions of those who lived in and visited the two countries over the centuries. If we start with the case of England, we find that, along with Holland, it appears to have been about the

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[15]Dobson, Hiccup (xerox), 419; cf also 420-1

[16]Burnett, Infections, 118

[17]Flinn, European (xerox), 60

most leisurely, yet wealthy, society which one could achieve before industrialization. The ease of English production was noted from very early on. Fortescue in the fifteenth century commented that England 'surmounteth all other lands in fruitfulness' and that 'it bringeth forth fruit of it self scant provoked by man's industry and labour.'[18] In the sixteenth century, van Meteren from Antwerp, who lived in England for many years, noted the high standards of living in England. He believed that English wealth came from sheep, rather than from hard labour. He noted that people did not have to work as hard as people in other nations: 'the people are not so laborious and industrious as the Netherlands or French, as they lead for the most part an indolent life like the Spaniards; the most toilsome, difficult, and skillful works are chiefly performed by foreigners, as among the idle Spaniards...They keep many lazy servants, and also many wild animals for their pleasure, rather than trouble themselves to cultivate the land.'[19] Lupold von Wedel on his visit in 1584-5 commented that 'the peasants and citizens (of England) are on the average rich people', adding that 'I have seen peasants presenting themselves statelier in manner, and keeping a more sumptous table than some noblemen do in Germany. That is a poor peasant who has no silver-gilt salt-cellars, silver cups, and spoons.'[20] Hume notes that 'Lord Bacon, accounting for the great advantages obtained by the English in their wars with France, ascribes them chiefly to the superior ease and plenty of the common people amongst the former.'[21]

From this high level, we know that **per capita** income increased year by year so that a century later, England was even wealthier. Thus we are told that 'The estimates of British national income made in 1688 by the statistician Gregory King set per capita income at a level far above that of modern Asian and African economies (two or three times as high, as nearly as can be determined).'[22] Defoe described the wealth of the English working classes: '...for the rest, we see their Houses and Lodgings tolerably furnished, at least stuff'd well with useful and necessary household Goods; even those we call poor People, Journey-men, working and Pains-taking People do thus; they lye warm, live in Plenty, work hard, and (need) know no Want.'[23] These were the people whose affluence was behind the 'consumer

[18] Commendation, 66ff

[19] Rye, Foreigners, p.70

[20] quoted in Appleby, Diet (xerox) p.102

[21] Hume, Essays, p.157

[22] De Vries, Economy, p.211

[23] quoted in Chambers, Economy, p.144

revolution' of which Peter Earle has written.[24] As Defoe explained, 'These are the People that carry off the Gross of your Consumption; Their Numbers are not Hundreds or Thousands, or Hundreds of Thousands, but Millions; 'tis by their Multitude, I say, that all the Wheels of Trade are set on Foot, the Manufacture and Produce of the Land and Sea, finished, cur'd, and fitted for the Markets Abroad; 'tis by the Largeness of their Gettings, that they are supported, by their Wages they are able to live plentifully, and it is by their expensive, generous, free way of living, that the Home Consumption is rais'd to such a Bulk, as well of our own, as of foreign Production...'[25] Defoe concluded that '...in a word the working manufacturing people of England eat the fat, drink the sweet, live better and fare better, than the working poor of any other nation.'[26]

Visitors to England in the eighteenth century were impressed. Benjamin Constant wrote of 'The beauty of the countryside, especially at that time of year, the magnificence of the roads, the cleanliness of the inns, the impression of happiness, good sense and orderliness which the natives convey - all these are a source of continuous enjoyment for any observant traveller.'(Benjamin Constant)[27] The young Frenchman La Rochefoucauld noted the comparative wealth. 'In the eyes of a foreigner Flanders is the province in France which gives the greatest impression of wealth. But, compared with England, is nothing.'[28] As compared to his own country, '...I am inclined to think that the English must be richer than we are; certainly I have myself observed not only that everything costs twice as much here as in France, but that the English seize every opportunity to use things which are expensive in themselves.'[29] He thought the relative affluence of ordinary English workers to be the result of the political system. 'The simple peasant, who lives in greater comfort than ours, is well clad and has meat for dinner every day. Is not this the result of good government?'[30]

[24] Earle xxx

[25] quoted in Chambers, Economy, p.145

[26]Defoe, Complete English Tradesman, quoted in Drummond, Food, 218

[27]Wilson (ed), Strange Island, 127

[28]Rochefoucauld, Frenchman, 116

[29]Rochefoucauld, Frenchman, 30

[30]4 hefoucauld, Frenchman, 116

Later in the century Henri Meister wrote that though the English labourer was better clothed, fed and lodged than the French 'he does not work so hard. You will wonder at this the less, when you consider that the wages of the former are higher, and his diet more substantial; consequently that he has greater strength and activity in the performance of his tasks.'[31] He was suggesting that the English had moved from the vicious spiral of poverty and were in a virtuous circle whereby they could do the tasks quickly because they had more energy, they could then rest more, and hence have more energy and so on. Another visitor in the eighteenth century, Kalm, was also surprised at the wealth and leisure of the poorer labourers. He observed of farm servants, for example that 'as soon as they entered the cottage in the evening, they did not apply themselves to the least work, than that they ate, sat and talked till eleven o'clock in the evening. They never troubled themselves to make waggons, or agricultural implements.' Drinking and gossiping was their common practice, so that he often 'wondered over this, that folk who could only provide food for themselves, their wives and children out of daily wages, could spend time and money in this way.'[32]

There is, of course, a considerable debate as to what happened after 1750. There is a vast amount of literary and historical material which shows that people were forced out of a relatively relaxed work pattern into working much longer hours in terrible conditions. Yet at the same time we should remember that most agreed that English conditions were better than French ones. For example both Malthus and Arthur Young agreed that conditions were far worse in France.[33] Before the revolution in England wages were seventeen pence a day, in France some ten pence per day. The fact that in England mortality rates did not rise, but actually fell somewhat in the period 1740-1840 is indicative. Between the fifteenth and mid-eighteenth century, England was able to produce very considerable surpluses with an amount of human labour which amazed outsiders. It was a relatively affluent country, second only to Holland, but with a much larger and more diverse population. This was the base from which it launched into rapid urbanization and industrialization, a process which paradoxically increased the need for human labour to service the new 'labour saving' machines. For two or three generations people worked long and gruelling hours in the conditions so well described by Chadwick and others. Stendhal in the middle of the eighteent century 'felt at once the absurdity of the eighteen-hour day of the workman.'[34] He added that 'My companions thought me quite mad when I added: the excessive and crushing toil of the English workman avenges us for Waterloo and four coalitions.'[35] At their most exhausting, these began to

[31] quoted in Marshall, English People, p.160

[32] Marshall, People. p.193

[33] Malthus, Population, i, 230-31

[34] Wilson (ed), Strange Island, 165

[35] Wilson (ed), Strange Island, 165

approach the conditions which were customary in most peasant societies through the centuries.

Work in Japan.

In order to examine the effects on work of the relative absence of domesticated animals (see APPENDIX), and their potential replacement by other forms of non-human energy from wind and water, let us examine the core activity in Japan, namely the production of rice. Rice, along with other grains, was by the eighteenth century supporting the densest population in the world, including huge cities and many artisans. How was this achieved? In order to see the enormous amount of labour involved we can examine one representative activity, the production of rice.

(This section on rice growing might go in an appendix...)

Rice was grown in irrigated fields in Japan. This meant that an immensely complex system of water control had to be developed. A good deal of the water could be taken to the appropriate terrace by using gradients and an elaborate system of dams and sluices which were copied from China. Thus Morse, for instance, described how 'These walls sustain level patches of land for cultivation, the irrigation coming from a mountain stream and the water running from terrace to terrace. The sides of these otherwise barren hills resembled a garden, a city park in fact.'[36] Yet, very often the water still needed to be raised from irrigation channel to individual fields. An obvious way to do this is to use the current of the stream for power, driving a wheel to raise buckets. This was a method early invented by the Chinese, and it was used in parts of Japan. Morse described 'A curious device for irrigating the rice-fields'. 'On the banks of a swift-running river a water wheel was adjusted and was slowly turned by the current. On the sides of the wheel were fastened square wooden buckets; as they dipped into the stream they became filled with water, and as the wheel rotated the water was spilled from the buckets into a trough which conveyed it into the fields beyond.'[37]

While this device was 'not uncommon in the southern provinces', Morse found that it was 'rare about Tokyo and farther north.'[38] In central and northern areas, instead of letting the water take the strain, a much more labour-intensive, if flexible, system was used. The principle of lifting buckets on a wheel was the same, but instead of power being provided by water, it was produced by human muscle. Morse drew a figure showing a man coming down the road with the wheel and box carried in the usual manner. In the same sketch is a man treading the wheel and raising water from the ditch in the rice-field. 'The box is first fitted into the embankment, the wheel drops into appropriate sockets, a long pole is driven

[36] Morse, Day ii, p.140

[37] Morse, Day ii, p.51

[38] Morse, Day ii, p.284

into the mud alongside the wheel, and holding onto this the man keeps his equilibrium and turns the wheel with his feet to lift the water from the channel to the field.'[39] Often more than one person provided power. 'It was interesting to see a tread wheel in which were two strong-looking samurai treading away patiently, supplying power for a certain portion of the machinery...'[40] Or again, 'The water-wheel device for irrigation purposes was on a large scale. There were three big wheel on the same shaft and six men treading them. Large tracks of rice-fields were being irrigated in this way.'[41] A device which could have saved this effort was known and used elsewhere in the country yet people opted for this method. The reasons for this and other peculiarities will be considered later.

Once the fields were irrigated, they needed to be broken up. In fact, often these processes occur together, with a first breaking up of the hard soil left from the previous crop, and cleaning of weeds, some irrigating, and a further breaking of the soil. The soil is usually baked hard and it is extremely difficult to turn over. This is one of the prime opportunities to apply non-human power, namely oxen or, even more powerfully, horses, as plough animals. It appears that in the sixteenth and seventeent century and perhaps before, animal power was used quite extensively for ploughing. In the early seventeenth century (XXX date?) it was noted of the Japanese that 'They plow both with Oxen and Horses as wee doe heere.'[42] Kaempfer had noted that 'On the road hither we saw great numbers of calves, which are nurs'd up for ploughing, the country hereabouts being reckon'd the best in Japan for wheat and barley.'[43] Thunberg described a mixture of hoeing and ploughing. 'In the beginning of April, the farmers began to turn over the ground that was intended for rice. The ground was turned up with a hoe, that was somewhat crooked, with a handle on it and was a foot in length, and of a hand's breadth. Such rice fields as lay low, and quite under the water, were ploughed with an ox or cow...'[44]

Alcock provided a picture of Japanese ploughing[45] Morse describes 'a farmer going to his owrk

[39] Morse, Day i, p.47

[40] Morse, Day ii, p.271

[41] Morse, Day i, p.116; for continued use into the 1950s, see Beardsley (ed), Japan, p.131

[42] Purchas, Pilgrims, 147

[43] Kaempfer, History, 3, p.202

[44] Thunberg, Travels, iii, 137

[45] Alcock, Tycoon, i, 295

carrying a plough on his shoulder. It is dragged by a single bull. The point is tipped with iron and the plough is typical of the region, for there are many types of ploughs in different parts of the country.[46] He adds that 'In mountain regions bulls are used to drag ploughs, and cows are used in softer ground so that boys can do the work.'[47] There are many varieties of plough. 'The varieties of ploughs in Japan are very interesting. The type is after the Chinese style, but the forms in different provinces are quite marked.'[48] It would appear, however, that humans also pulled special ploughs; 'peculiar shovel made of wood tipped with iron, The shovel part was over three feet in length and the handle seven feet long. It is used through the western part of this province (Musashi) and seems to take the place of the plough.'[49]

In fact, what seems to have happened, is that the Japanese moved from the plough to the hoe as the population built up in the seventeenth century. We can deduce this from the absence of plough animals by the end of the eighteenth century. Horses were not used for ploughing and were in any case very few in number, 'The small number of **horses** to be met with in this country, is chiefly for the use of their princes; some are employed as beasts of burden, and others serve travellers to ride on. Indeed I do not suppose that the sum total of all their horses amounts to the number of those made use of in one single town in Sweden.[60] As for oxen and cows, 'they seem to have a still smaller number...the sole use they make of them is sometimes for drawing carts, and for ploughing such fields as lie almost constantly under water.'[51]

Hayami has provided a useful overview of what happened. 'Instead of a plow drawn by livestock, a hoe or spade using human labor became the main plowing tool. This means that the labor that had been carried out earlier by horse-power now came to be done by man-power.'[52] Whereas there had been considerable numbers of draft animals to the end of the seventeenth century, 'after that, their number

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[46]Morse, day ii, 139

[47]Morse, Day ii, 332

[48]Morse, Day ii, 331

[49]Morse, Day ii, 326

[50]Thunberg, Travels, iv, 94/5

[51]Thunberg, Travels, iv, 95

[52]Hayami, Population Growth (xerox), 37

obviously declined.'[53]

Before the ploughing, the banks would have to be cleared of weeds, and after the ploughing the lumps broken up. For this and other stages, and perhaps in some areas where livestock were not available, a hoe was used. Morse was both impressed by the design of this hoe and aware of the strain it put on the human back. 'The cutting edges are slightly curved inward and this insures the cutting of roots in digging, whereas in our shovel and hoe, rounding the other way, the roots are liable to slip off sideways.'[54] On the other hand, he thought that 'The Japanese hoe is a very clumsy-looking object. It is much lighter than it seems. The iron part is thin and the wooden part fits into it like a dovetail joint. In using it the man has to stoop a good deal, but the habits of these people in bowing low, in carrying children on the back when young, and in planting their rice all tend to develop a back of great strength.'[55]

Once the land was prepared for transplanting of seedlings, there was really no way of mechanizing the process. Alcock describes people '...nearly up to their knees in a malodorous mud field, take each their basket of young plants, and separating them into small bundles, fix them at a space of about six inches apart, into the less fluid soil below, with no other implement than their hands.'[56] Numerous further stages then occur, the constant weeding, the harvesting, and so on. As yet I do not know whether animals were used in the threshing, as they can be, to help separate the grain by trampling it. This seems unlikely, for flails were widely used, though they were different in shape from western flails.[57] One invention which was said to have impoverished widows who used to do the work, is described by Smith. 'Nagatsune cited the case of one anonymous invention, the **senbakoki** (or **mugikoki**, as he called it), one of the most important farm tools developed in the Tokugawa period. It consisted of a waist-high frame fitted with bamboo or iron teeth through which stalks of rice or other cereal were pulled to strip away the heads of grain.'[58]

Once the grain had been brought back to the house, it has to be prepared for use. An immense amount

[53] idem

[54] Morse, Day i, p.307

[55] Morse, Day i, p.65

[56] Alcock, Tycoon, 2, p.71

[57] Morse, Day i, p.66

[58] Smith, Sources, p.180

of energy has to be used to de-husk grains and this was one of the areas where water mills became so useful in Europe and in many parts of the world. Given the numerous rushing streams and heavy rainfall of Japan, we would have expected water mills to be widely used at this stage. The principle of water-driven machinery was widely known. Mills could not only help with rice, but also with the equally tedious and time-consuming work of grinding beans and other crops. Such machines were used in parts of China, as King noted in the early twentieth century. 'At several places on the rapid streams crossed, prototypes of the modern turbine water-wheel were installed, doing duty grinding beans or grain. As with native machinery everywhere in China, these wheels were reduced to the lowest terms and the principle put to work almost unclothed.'[59]

Strangely enough, however, I have come across little evidence of the widespread use of water (or wind) mills for grinding grain in Japan. Instead, much more labour-intensive methods were used. One was the quern where, with immense effort of arms and shoulders, grain is ground between two heavy stones. Morse describes how 'The mill for grinding grain is turned by hand, and strong arms are required to turn it.'[60] This would turn grain into flour, but it is no use in taking off the outer, inedible, husk. To do this the Japanese used several methods, one of these is similar to that found all over the world, for instance in Nepal, where a heavy weight is dropped repeatedly on the rice until the husk is pounded off. 'The rice is hulled by a sort of trip-hammer made of wood and weighted with stone. This is worked by a man stepping on the end of the beam, thus raising it and letting it drop. This device has endured in China for two thousand years.'[61] Even in the heart of cities, people were employed for hour after hour to step on and off this kind of tread-mill. 'One may see this rice-pounding going on even in the city of Tokyo. The man is naked and is concealed by a curtain consisting of strands of straw rope, a convenient device, for one may pass through this curtain without delay.'[62] A picture of rice pounders is provided by Regamey.[63]

It is not a particularly difficult task to devise a mechanism to allow water to raise and drop this weight. Moeran's book on pottery describes just such a devise powered by water which is used to hammer clay. (Ref. XXX) Thunberg at the end of the eighteenth century saw some water-driven machines of this kind. Writing of rice husking, he observed 'Sometimes it was beaten with blocks which had a conical

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[59] King, Farmers, p.363

[60] Morse, Day i, p.55

[61] Morse, Day i, p.55

[62] Morse, Day i, p.56

[63] Regamey, Art and Industry, p.185

hole in them. These blocks were placed in two rows, generally four on each side, and raised by water, in the same manner as the wheel of a mill. In their fall they beat the rice so that the grain separated from the chaff.'[64] Alongside this was the foot-driven machine. 'Sometimes, when there was no opportunity for erecting similar water-works, a machine of this kind was worked by a man's foot; who at the same time also stirred the rice with a bamboo.'[65] Other grains were often beaten with flails. 'Barley, Wheat and Cabbage-feed are all of them threshed out at times quite in a plain and artless manner, upon straw mats, in the open air, in the villages, and not unfrequently before the doors of their houses, with flails which have three swingles.'[66] One key to the use of hand methods, as opposed to machines, may have been the desire to keep the rice stored in the husk, and only to prepare small amounts as it was needed for eating. This is implied by Thunberg's comment that 'In private families I sometimes saw rice pounded in small quantities, and for daily use, in the same manner as on board of the ships, and at other places in the East Indies; that is in a hollowed block with a wooden pestalle.'[67] He notes that having loosened the grains from the stalk, the threshing 'is seldom set about before the grain is wanted to be used...'[68]

If we now move beyond the rice cycle to consider some of the implications of what we have observed, the first point is that, with ample knowledge and ample water and wind, the Japanese were still extraordinarily eager to use human rather than natural power.

(APPENDIX on absence of wheel)

By the eighteenth century, Japan had a productive technology which was in many ways no more efficient in terms of its use of non-human labour than the remotest part of some of the poorest countries today, for instance in the mountains of central Nepal, where I have worked. My description of the technology of the Gurungs, written twenty-five years ago, would apply reasonably well to Japanese agriculture and industry. 'The Gurungs have a pre-wheel culture in which the human back lifts and moves everything, and the human arm and leg does most of the grinding and pounding. The only non-human power so far utilised is that of oxen in ploughing and residual threshing, and of water mills for a minor

[64]Thunberg, Travels, iii, 149; cf iv, 85

[65]Thunberg, Travels, iii, 149

[66]Thunberg, Travels, iv, 87/88; cf also iii, 216

[67]Thunberg, Travels, iii, 149

[68]Thunberg, Travels, iv, 85

part of the grinding...'[69] Likewise Japan had a basically pre-wheel technology dependent very largely on the human back and arms for all efforts to wrest a living from a rocky and rather sterile island. How then did the Japanese feed their immense populations? The answer is through incessant physical work and a high degree of co-operation.

The immense pressure put on the human body, possibly unparalleled even in China or India, is widely documented. This has been noted by historians of Japan.[70] For instance Thomas Smith writes about a unique farmer's work diary: 'The things that stand out in these detailed entries: the steadiness of the work flow, and the general infrequency of rest days.'[71] Smith quotes a passage from an (??) eighteenth century advice book for farmers which show the obsession with work and time. 'If the farm family would escape poverty, it must treat time as precious (**koin oshimubeshi**). By rising early and shortening the daily rest period, two additional hours a day can be worked. That is seven hundred and twenty hours a year; the equivalent of sixty days, or two months, when no food is consumed, no wage paid, no oil required for lighting...Thus can the farm family escape the pain of poverty...'[72] The gruelling work has been noted by anthropologists. Beardsley and his colleagues wrote that 'By far the largest amount of work is accomplished through human energy in Xliske.' In 1949, an average acre of rice required 870 man hours of labour. This was thirty times more than what it would have required in the United States and one hundred times as much as wheat production would have required in America.[73] The hard work had been noted by visiting agronomists. King's figures of work showed '...something of the tense strain and of the terrible burden which is being carried by these people, over and above that required for the maintenance of the household.' [74] He found that 'The Oriental farmer is a time economizer beyond any other. He utilizes the first and last minute and all that are between.'[75] He could do nothing but admire,

[69] Population, ch.3 pt.1

[70] See Saito, e.g. XXX; this is what Hayami has termed the 'industrious revolution', the Japanese alternative to the 'industrial revolution' (see Hayami, Population Growth (xerox), 37)

[71] Sources, p.210

[72] Smith, Sources, p.199

[73] Beardsley, Village, p.177

[74] King, Farmers, p.430

[75] King, Farmers, p.261

'This marvellous heritage of economy, industry and thrift, bred of the stress of centuries...'[76]

It was also alluded to by native Japanese. In the seventeenth century, the author of the 'Millionaire's Gospel' warned that 'In earning his living a man should no more take a moment's respite than does a water-wheel harnessed to a swiftly flowing stream.'[77] In the early twentieth century another Japanese author explained that 'The servants are, moreover, expected to work without intermission from morning till night. In some families a fixed time is given them daily for rest; but in most houses no such hour is set apart and they snatch what rest they can in the intervals of their work. They get up early in the morning, about five or half past.'[78]

Visitors were amazed at how hard the Japanese worked. Kaempfer realized that it was partly the poor terrain which forced the people to work so hard and thought this a benefit. 'But even in this particular nature hath been exceeding kind to this Country: this seeming defect in the soil, this want of culture, is what keeps up in the inhabitants that so much commendable spirit of labour and industry.'[79] Thunberg noted in general that 'The diligence with which the husbandman cultivates the soil, and the pains they bestow on it, are so great as to seem incredible.'[80] Every tiny scrap of land was used with the utmost care. 'The pains which a farmer takes to cultivate the sides of even the steepest hills, is almost incredible. If the place be even no more than two feet square, he nevertheless raises a wall of stones at the bottom of the declivity, fills the part above this with earth and manure, and sows this little plot of ground with rice or esculent rooted vegetables.'[81] Alcock noted that 'Men, women, and children may be seen in the fields early and late, and the labour is chiefly manual.'[82] Morse described the work in the grain fields. 'The infinite industry of the people is shown everywhere. In speaking of the planting of their crops I have mentioned the thousands of acres of rice-fields where little bunches of rice-plants are transplanted by hand, but I was not prepared to see the barley, wheat, and buckwheat actually transplanted in rows,

[76] King, Farmers, p.165

[77] Sargent, Storehouse, p.140

[78] Inouye, Home, p.151

[79] Kaempfer, History, p.313

[80] Thunberg, Travels, iii, 257

[81] Thunberg, Travels, iv, 83

[82] Alcock, Tycoon, 1, p.319

and thorough weeding also done by hand."[83] He noted that 'The extensive rice-fields everywhere indicate the enormous amount of labour involved, not only in making them, but in the yearly amount of labour expended in planting-time.[84] Almost everyone worked almost all the time. 'A few infirm old men and women and little children were seen, but everybody else was at work in the rice-fields or on the farms or busy with duties in the house."[85]

The 'duties in the house' were not just household work, but bi-occupations which, as Thomas Smith has shown, were often as important and labour-consuming as agriculture (xxx). Morse described some of these. Having noted the deserted villages, he wrote that 'It illustrates the universal industry of the people. Everybody works; all seem poor, but there are no paupers. The many industries, which with us are carried on in large factories, here are done in the home. What we do by the wholesale in the factories they do in the dwellings, and as you ride through the village you see the spinning, weaving, the making of vegetable wax, and many other industries. In these operations the entire family is utilized from a child above babyhood to blind old men and women."[86]

The immense pressure of work is evident wherever we look. There is a moving passage in **Silk and Straw** (qv xxx) in which the fact that women did not even have time to comb their hair in the mornings because of the rush of work is noted. Oral histories of the nineteenth century give other examples. 'One peasant recalled, "We were taught that peasants must work from morning to night in order to stay alive. Whether bad weather caused crop failures or not, we lived believing that it was our predetermined lot to work".[87] A young wife described the attitude of the family she had married into. 'They would complain, "Our young wife takes a lot of time in the toilet", or "She sure takes a long time feeding the baby".[88] Her mother-in-law (check xxx) reputedly said 'I sure hate to see a young wife wasting her time feeding the baby. She should be working the loom and making some money.' Saito has figures on the hours worked by the Japanese, particularly women, in the later nineteenth century. They appear to work something like twice as long as equivalent groups in western Europe. (xxx)

[83] Morse, Day i, p.68

[84] Morse, Day i, p.10

[85] Morse,Day ii, p.51

[86] Morse, Day ii, p.51-2

[87] Hane ??

[88] Hane, p.90

The effects of this huge amount of physical labour, carried out on a largely vegetable and grain diet, must have been immense. One group who were particularly vulnerable were farm women. They not only had to labour in the fields with men, but had to bear and then suckle children, run the house, and spin and weave. A particularly sensitive account of the lives of working women at the end of the nineteenth century is provided by Alice Bacon. In general 'Journeying through rural Japan, one is impressed by the important part played by women in the various bread-winning industries...'[89] They worked in the fields. 'In the rice-field the woman works side by side with the man, standing all day up to her knees in mud, her dress tucked up and her lower limbs encased in tight-fitting, blue cotton trousers, planting, transplanting, weeding, and turning over the evil-smelling mire.'[90] They worked in the forests. 'In mountain regions we meet the women climbing the steep mountain roads, pruning-hook in hand, after wood for winter fire; or descending, towards night, carrying a load that a donkey need not be ashamed of, packed on a frame attached to the shoulders, or poised lightly upon a straw mat upon the head.'[91] They worked on the tea plantations. 'Then, again, in the tea districts, the tea plantations are filled with young girls and old women, their long sleeves held back by a band over the shoulder, and a blue towel gracefully fastened over their heads...'[92] They looked after the animals. 'In other parts of the country, in the neighborhood of Nikko, for instance, the care of the horses, mild little pack-mares that do much of the burden-bearing in those mountains is mainly in the hands of the women.'[93] They worked at the bi-occupations, particularly textiles. 'In the districts where the silkworm is raised, and the silk spun and woven, the women play a most important part in this productive industry. The care of the worms and of the cocoons falls entirely upon the women, as well as the spinning of the silk and the weaving of the cloth.'[94] They ran the hotels and tea-houses and worked in them. 'In the hotels, both in the country and in the city, women play an important part. The attendants are usually sweet-faced, prettily-dressed girls, and frequently the proprietor of the hotel is a woman.'[95] All this on top of child-bearing and keeping the

[89] Bacon, Japanese Girls, 206

[90] Bacon, Japanese Girls, 206

[91] Bacon, Japanese Girls, 206

[92] Bacon, Japanese Girls, 208

[93] Bacon, Japanese Girls, 207

[94] Bacon, Japanese girls, 208

[95] Bacon, Japanese Girls, 209

house.

The effects of all this immense physical effort on women's bodies was noted most sympathetically by Isabella Bird. She described the effect of work stress on the aging process of women. 'At Kayashima I asked the house-master's wife, who looked about fifty, how old she was...and she replied twenty-two - one of many similar surprises.'[96] 'The married women look as if they had never known youth, and their skin is apt to be like tanned leather.'[97] She describes the rapid process of ageing elsewhere. 'The girls marry at sixteen, and shortly these comely, rosey, wholesome-looking creatures pass into haggard, middle-aged women with vacant faces...'[98] She specifically links this to the hard work of women. 'Women with complexions and features hardened by severe work and much wood smoke into positive ugliness, and with figures anything but statuesque.' [99] At the end of the century another visitor noticed the same rapid ageing of women. 'A Japanese woman loses her beauty early. At thirty-five her fresh colour is usually entirely gone, her eyes have begun to sink a little in their sockets, her youthful roundness and symmetry of figure have given place to an absolute leanness, her abundant black hair has grown thin, and much care and anxiety have given her face a pathetic expression of quiet endurance.'[100] It is just worth noting that the work was not only long, but extremely heavy; beating, carrying incredible weights, and pumping water.

APPENDIX. Domesticated animals in Japan.

One fact that immediately strikes us is the curious absence of animals in Japan. It was Isabella Bird, coming from animal-rich Britain in the later nineteenth century who most graphically described the absence of domesticated animals. She was struck by the silence and emptiness of the countryside. 'As animals are not used for milk, draught, or food, and there are no pasture lands, both the country and the farm-yards have a singular silence and an inanimate look.'[101] She missed the sounds: '...a mean looking dog and a few fowls being the only representatives of domestic animal life. I long for the lowing of cattle

[96] Bird, Tracks, p.100

[97] ibid

[98] Bird, Tracks, p.79

[99] Bird, Tracks, p.87

[100] Bacon, Japanese Girls, 101

[101] Bird, Tracks, p.49

and the bleating of sheep.'[102] There were also very few horses: 'there is little traffic, and very few horses are kept, one, two, or three constituting the live stock of a large village.'[103] Horses were not used for ploughing, nor, even, were they used for carrying. 'Very few horses are kept here. Cows and coolies carry much of the merchandise, and women as well as men carry heavy loads.'[104] So rare were domestic animals even in the later nineteenth century, that they were exhibited like exotic species: '...monkey theatres and dog theatres, two mangy sheep and a lean pig attracting wondering crowds, for neither of these animals is known in this region of Japan.'[105]

Griffis also noted that 'In Japan, sheep and tame geese are unknown, except from reading of them.'[106] The mention of geese illustrates the relative absence of even domestic fowl. 'In riding through the country one soon notices the absence of flocks of hens. A single hen and cock roam together, though they are usually confined under an inverted wicker basket.'[107] Given all this, it is not surprising that there were no butcher's shops. 'A meat shop was a great novelty a few years ago, and even now only a few are seen in the larger cities.'[108] 'Vegetable and fish shops are plentiful, but there is neither butcher nor baker.'[109] The general situation by the later part of the nineteenth century was summarized by Chamberlain. 'Till recently the Japanese had neither manufactures nor foreign commerce, neither have they yet any flocks of sheep and goats, and droves of geese, turkeys of pigs. Even cattle are comparatively scarce, and neither their flesh nor their milk is in general use, beef being still regarded as a luxury, and milk rather as a medicine than a food. The pasture meadow and the farmyard are alike lacking.'[110]

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[102] Bird, Tracks, p.49

[103] ibid, p.128

[104] Bird, Tracks, p.131

[105] Griffis, Mikado, p.449

[106] Griffis, Mikado, p.449

[107] Morse, i, p.53

[108] Morse, i, p.128

[109] Griffis, Mikado, p.357

[110] Chamberlain, Things, p.19

The situation two centuries may have been smewhat different for there are also suggestions of a more extensive use of animals. In XXX, XXX had noted that pigs, goats and even cows could be purchased cheaply.[111] Kaempfer's account shows that knowledge of the animals was not lacking. Of pigs, he wrote 'They have but few Swine, which were brought over from China, and are bred by the Country people in Fisen, not indeed for their own Use, which would be contrary to their superstitious Notions, but to sell them to the Chinese, who come over for trade every year and are great admirers of Pork, tho' otherwise the doctrine of Pythagoras, about the transmigration of Souls, hath found place likewise in China.'[112] Or again 'Sheep and Goats were kept formerly by the Dutch and Portuguese at Firando, where the kind still subsists. They might be bred in the Country to Great advantage, if the natives were permitted to eat the flesh, or knew how to manage and manufacture the Wool.'[113] There were some horses, but not a great number. 'There are Horses in the Country; They are indeed little in the main, but some of them not inferior in shape, swiftness and dexterity to the Persian Breed. They serve for state, for riding, for carriage and ploughing.'[114] 'Oxen and Cows serve only for ploughing and carriage. Of milk and butter they know nothing.'[115] Thus in the most pastoral area of the mountains 'we saw no cattle grazing any where all day long, excepting a few cows and horses for carriage and plowing.'[116] 'They have a sort of large Buffles, of a monstrous size, with hunches on the back, like Camels, which serve for carriage and transport for goods only, in large Cities.'[117] Even chickens were of little use. 'Of tame Fowl they keep Chickens and sometimes Ducks, but being as I took notice above, imbued with the superstitious notions of Pythagoras, the generality will not eat them, and they are kill'd and sold to such as do venture to eat them, only by Persons of a mean extraction.'[118] Their main value was as a primitive

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[111]Purchas, Pilgrims, 147

[112] Kaempfer, History, i, p.196

[113] Kaempfer, History, 1, p.195-6

[114] Kaempfer, History, 1, p.194

[115] Kaempfer, History, 1, p.194-5

[116] Kaempfer, History, 1, p.376

[117] Kaempfer, History, 1, p.195

[118] Kaempfer, History, 1, p.204

clock. 'The Cocks oftner find pardon than Hens, and are kept alive with great care, because they are held in great esteem, chiefly among the religious Orders, by reason of their measuring the time, and foretelling future changes of the weather.'[119] A century later, Thunberg noted that '**Sheep** and **Goats** are not to be found in the whole country; the latter do much mischief to a cultivated land; and wool may easily be dispensed with here, where cotton and silk abound.'[120]

There are a number of possible explanations for the marked absence of large numbers of domestic animals. The ecological arguments would stem from the nature of the volcanic soil of Japan. Japan lacked the possibility of pastoralism except in certain areas in the west and north. This argument is then supported by a second, namely that given the small area of cultivable land people could not afford to keep animals which would compete with grain production. The opportunity cost of giving up precious land to livestock was too high. It was necessary to use every piece of fertile ground to produce the basic grains on a very densely settled strip.

Many people have observed that raising animals is an expensive option - for instance, to feed grains to chickens may produce meat and eggs but many people in the world cannot afford the grain. The fairly desperate struggle to grow enough rice and other foodstuffs may have made animals a luxury the Japanese could not afford. Indeed, as population built up in the seventeenth century, the cereal rather than animal husbandry option may have become increasingly attractive. Thunberg at the end of the eighteenth century had noted the absence of pasturage and animals. 'Meadows are not to be met with in the whole country; on the contrary, every spot of ground is made use of either for corn-fields, or else for plantations of esculent rooted vegetables.'[121] He implied that it was the low number of grazing animals that led to the absence of pastorage. 'They have few Quadrupeds; for which reason there is no occasion to lay out the land in extensive meadows.'[122] The pressures against keeping livestock were again noted in the later nineteenth century by Alcock. 'Meadows are not to be met with in the whole country; on the contrary, every spot of ground is made use of either for corn-fields or else for plantations of esculent-rooted vegetables: so that the land is neither wasted upon extensive meadows for the support of cattle and saddle horse, nor upon large and unprofitable plantations of tobacco (they grow tobacco, nevertheless).'[123] As the agronomist King pointed out when he visited Japan in the early twentieth

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[119] Kaempfer, History, 1, p.204

[120] Thunberg, Travels, iv, 95

[121] Thunberg, Travels, iv, 81

[122] Thunberg, Travels, iv, 94

[123] Alcock, Tycoon, 1, p.69,201

century, 'By devoting the soil to growing vegetation which man can directly digest they have saved 60 pounds per 100 of absolute waste by the animal...'[124] He calculated that '1,000 bushels of grain has at least five times as much food value and will support five times as many people as will the meat or milk that can be made from it.'[125] The agricultural area of Japan, on this reckoning, could only have supported six million, if it had been based on pastoral agriculture rather than the thirty million actual inhabitants in 1800.

A similar theory was put forward by several anthropologists in the 1950s who described how 'Land shortage accounts particularly for the rarity of grazing animals. On arable land, crops grown for direct human consumption are much more efficient than natural vegetation or fodder crops for grazing animals.' There is not enough waste or spare grazing for larger animals.[126] This view is supported by the agricultural economist Boserup, who points out that 'Draft animals fed on produced fodder are not an efficient source of energy supply. The mechanical energy supplied by them is probably only some 3-5 per cent of the energy contained in the fodder they consume.'[127]

While all this is undoubtedly a powerful factor, there is clearly also a cultural or religious dimension; the dislike of animal products, whether meat, eggs or milk as food-stuffs which Kaempfer had alluded to as 'the notions of Pythagoras.' There is a mixture of ritual prohibition and a feeling of disgust which alone can explain why, even when chickens or cows were kept, they were not eaten by ordinary Japanese. This was an aversion that lasted into the middle of the twentieth century. For instance, an anthropologist describes how 'Horses and cows are kept, but they are used only as beasts of burden. The animals are backed into their stables, where they spend all their time when not working. Milk is considered dirty and is only drunk on doctor's prescription.'[128]

There is evidence that some Japanese interpreted the Buddhist scriptures as putting a ban on consuming the products of four-footed creatures. Hence meat and milk would be banned. That Buddhism in Thailand, China or much of south-east Asia has not lessened the consumption of sheep,

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[124] King, Farmers, p.135

[125] King, Farmers, p.135

[126] Beardsley, Village, p.177

[127] Boserup, Technology, 49

[128] Embree, Suya Mura, p.31

goats and other animals suggests that this can only be a partial explanation, but it does not make it an invalid one. There is obviously something more, however, which concerns the classification of what is 'good to eat'. Many were genuinely disgusted at the thought of eating meat or drinking milk, it was not merely a matter of religious prescription. This takes us into areas of animal classification and taboo which has been fruitfully explored by anthropologists (e.g. Douglas, Sahlins, Tambiah) but which cannot be elaborated here.

Of course, Japan is not quite the most extreme case of the avoidance of animals, and it may also have other roots, as Mokyr suggests. He notes that large domesticated animals 'were entirely lacking in pre-Columbian America and Africa, and scarce in most parts of Asia. This scarcity may have had deep historical roots: African and East Asian adults suffer from lactase deficiency and cannot digest large quantities of fresh milk (although they can digest milk in the form of cheese or butter).'[129] Crosby has likewise noted the contrast bettwen the Old World of Eur-Asia, with numerous anmals, and the New World with few. He commented that Old Europeans 'had as allies their livestock, which, somewhat like benign cousins in an extended family, provided the means for staying alive when the labour and luck of the nuclear family did not suffice...'[130] We shall consider this a little further under the question of nutrition. Whatever the reason, it is clear that, while knowing about most useful animals from at least the sixteenth century, the Japanese kept few domestic animals. This affected every branch of their life and is a central factor in trying to understand the patterns of disease on the island. If it is the case that the number of domestic animals declined quite significantly over time in Japan, particularly from the fifteenth century onwards, this may have had a significant effect. The association of such a likely decline were set out by Doubleday in 1847.He noted that 'as the food of a people degenerates from a preponderance of animal nutriment to a vegetable diet, in that ratio the population increases and thickens...'[131] Whether increasing population is the cause or effect is, of course, a moot point.

[129] Mokyr, Lever, p.161

[130] Crosby, Ecological, pp.19,24).

[131] Doubleday, Law of Population,123.