

Asia Research Institute

Working Paper Series

No. 62

*The Battle of the Microbes: Smallpox, Malaria and
Cholera in Southeast Asia*

Anthony Reid
ariar@nus.edu.sg

Jiang Na
arijn@nus.edu.sg

Asia Research Institute
National University of Singapore

April 2006



The **ARI Working Paper Series** is published electronically by the Asia Research Institute of the National University of Singapore.

© Copyright is held by the author or authors of each Working Paper.
ARI Working Papers cannot be republished, reprinted, or reproduced in any format without the permission of the paper's author or authors.

Note: The views expressed in each paper are those of the author or authors of the paper. They do not necessarily represent or reflect the views of the Asia Research Institute, its Editorial Committee or of the National University of Singapore.

Citations of this electronic publication should be made in the following manner: Author, "Title," ARI Working Paper, No. #, Date, www.nus.ari.edu.sg/pub/wps.htm. For instance, Smith, John, "Ethnic Relations in Singapore," ARI Working Paper, No. 1, June 2003, www.ari.nus.edu.sg/pub/wps.htm.

Asia Research Institute Editorial Committee

Geoffrey Wade
Tim Winter
Shen Hsiu-Hua
Manjit Kaur

Asia Research Institute

National University of Singapore
Shaw Foundation Building, Block AS7, Level 4
5 Arts Link, Singapore 117570
Tel: (65) 6874 3810
Fax: (65) 6779 1428
Website: www.ari.nus.edu.sg
Email: arisec@nus.edu.sg

The Asia Research Institute (ARI) was established as a university-level institute in July 2001 as one of the strategic initiatives of the National University of Singapore (NUS). The mission of the Institute is to provide a world-class focus and resource for research on the Asian region, located at one of its communications hubs. ARI engages the social sciences broadly defined, and especially interdisciplinary frontiers between and beyond disciplines. Through frequent provision of short-term research appointments it seeks to be a place of encounters between the region and the world. Within NUS it works particularly with the Faculty of Arts and Social Sciences, Business, Law and Design, to support conferences, lectures, and graduate study at the highest level.

The Battle of the Microbes: Smallpox, Malaria and Cholera in Southeast Asia

Anthony REID & JIANG Na

Southeast Asia in the Disease Pools of Eurasia

Data on long-term disease patterns in all parts of the humid tropics is sparse and serious research in its infancy. Until the nineteenth century there can be said to be little systematic knowledge of any diseases, and much of what we know is a matter of deduction from fragmentary reports of “plagues” and “miasmas”, and extrapolation both backwards in time from more satisfactory recent data, and laterally from better-documented patterns of the same period in Europe, China and India. Nevertheless in seeking to understand the long-term disease patterns of the world’s humid tropics, no region is better provided with potential data for the fifteenth to eighteenth centuries than that offered by the copious reporting of Chinese, Spanish, Dutch and English agents in Southeast Asia (and Taiwan).

The heavily-forested environment and year-round high temperatures and rainfall made these humid tropics distinctive in various ways. A wide variety of human and animal parasites, which would not have withstood the rigours of a northern winter, could flourish here. Human populations found it relatively difficult to establish settled agricultural communities in areas of dense forest where most of the biomass was far above in the forest canopy. Hunter-gathering and shifting swidden (or slash-and-burn) agriculture endured for many centuries after disappearing in the temperate areas of Europe, China and Japan. Only in the last half-century, in fact, have these life-styles been fatally endangered by the shrinking forests. With less than 25 million people in 1600, Southeast Asia then had a population density of only about 5.5 persons per sq. km, around a sixth that of India (32) and China Proper (37) at the time (Reid 1988-93, I: 13-15). McNeill (1976: 110) some time ago proposed that malaria and enteric diseases were a major cause of this lower population in the humid tropics. My own initial investigation of the low-population phenomenon placed more weight on the raiding and warfare of stateless societies and consequent insecurity for family units, and the

particular preference of animist shifting cultivators for spacing children (Reid, 1987; 1988: 15-18). I am now readier to allow malaria and other diseases as an additional factor that kept populations sparse in coastal and lowland areas in contrast with highland ones.

McNeill (1976: 70-77) has also pointed out that whereas civilizations, as dense urban populations with antibodies against endemic diseases, were able in the long run to defeat their rural enemies in temperate Eurasia, the scattered populations of the humid tropics such as Southeast Asia were able to hold their own against urban domination precisely because the abundant tropical diseases and parasites of the rain forest provided a biological “protection” against that urban advantage. This same factor must have played a role in Taiwan, notoriously dangerous to Chinese and Japanese soldiers and settlers before 1900 (Liu and Liu 2001: 248-55). This is undoubtedly a major factor why diversity survived so much more effectively in Southeast Asia than in East Asia, although the advantages of intense agriculture and the attendant civilizational gains in China ensured that peoples who learned some of these advantages within what is today China moved southward to dominate what is today Southeast Asia (Diamond 1997: 322-33).

Chinese sources certainly confirm this notion that the disease regimes of the south were the primary inhibition against more rapid expansion. Since Han times the standard Chinese description of these threats went by the name of *zhang* or *zhangqi* (瘴气 - miasma). The Chinese general Ma Yuan sent his troops back to the capital from the Red River Delta we know as northern Vietnam in the knowledge that ‘four or five out of ten of his soldiers had died of *zhangqi*’ (cited Zhang Wen 2005: 72; Xu 2005) As a result of several such well-publicized southern disasters, the reputation was sufficiently established for an eastern Han general to advise his emperor against defending a frontier county against southern barbarians with a similar image: “the soil and water in the southern states are hot, together with *zhangqi*, four or five out of every ten [soldiers] will die” (*Hou Hanshu*, cited Zhang Wen 2005: 72). The first major attempts under

Mongol (Yuan) rule to extend their power to Southeast Asia and Japan were defeated in large part by such diseases (Hopkins 1983: 110-11). The concept was as vague as the “tropical diseases” of western medicine, apparently covering a number of contradictory ailments, including those attributable to waterborne diseases, beriberi, and intestinal parasites, as well as malaria.

By Song and Ming times, when experience with the south was more intimate, northern tracts began to complain that ‘southerners call all diseases *zhang*’, and to seek themselves to subdivide and restrict the term in ways more compatible with what modern medicine would categorise as malaria and water-borne diseases such as cholera and typhoid (Zhang Wen 2005: 73; Zheng, Chen and He 2004). Nevertheless the conviction remained profound during the expansive early Ming times that *zhang* was the chief danger. Ming Dynasty sources describing military and political probes southward in Yunnan, Guangxi, Guizhou, Burma, Vietnam, the Tai-speaking areas and Taiwan, refer constantly to the dangers of ‘miasmatic vapours’ (*zhang qi*, *zhang bing*), causing severe losses to the Chinese sent to these barbarous southlands, especially in the warmer months (Wade 1995: *passim*). But as places such as Guangdong, Fujian (Hokkien), Hainan, and Jiangxi filled up with migrants from the Middle Kingdom in the Ming period, and Yunnan and Guangxi in the 18th century, the threat appeared to recede. One team of Chinese researchers beginning to take an interest in this issue concludes ‘In the past 2000 years, the border of China’s *zhang*-affected areas continued to push southwards, as a result of migration of northerners to the south’ (Mei, Yan and Gong 1997:41).

Despite this degree of ‘protection’ from outside intrusion, Southeast Asian populations were never wholly isolated from broader Eurasian disease pools as were the peoples of Australia, the Americas or the Pacific islands. From at least the dawn of the Christian (Common) era, there were entrepôts in the region serving the long-distance trade of the Indian Ocean and the South China Sea, and in turn interacting with hinterland forest populations. Two Eurasian diseases, malaria and smallpox, though not the most

dramatic in their mortality, are likely to have played the dominant role in keeping Southeast Asian populations low (in comparison with China and India). While malaria was long endemic in lowland areas and tended to discourage immigrants from more densely-settled temperate areas, smallpox was probably carried by Chinese and other visitors from places where smallpox was endemic, and may have given such visitors a vital competitive advantage at some times and places, as with Europeans in the Americas.

Malaria

Malarial plasmodia, the parasites carried back and forth between the bloodstream of monkeys and humans by mosquitoes, may have been the principal reason why the lowlands of Southeast Asia were sparsely inhabited before the fourteenth century. Pierre Gourou (1960: 8) put it more strongly: “malaria is largely responsible for the poor health, small numbers, absence of enthusiasm for work, stationary demographic character, and backwardness of tropical peoples.” On the other hand, recent studies of haemoglobin variants in the Philippines have pointed to the possibility that “limited genetic resistance to malaria among Filipinos suggests a relatively recent origin” for malaria there (Newson, 1998: 20). The limited Chinese sources on the Philippines before 1500 also make no mention of ‘miasma’ there, in marked contrast to most other southern countries. If studies elsewhere confirm such findings, it may be necessary to consider whether the concentration of populations in lowland centres such as the Mataram plain in Java and the south Sumatran river deltas associated with Sriwijaya in the 7th-12th centuries predated the arrival of the anopheles vectors there.

In historic times the deltas of the Irrawaddy, Mekong and Chaophraya, the swampy eastern coast of Sumatra and most of coastal Borneo, were particularly forbidding for man because they were havens for the anopheles mosquito. Only when the forest was turned into continuous paddy fields where the mosquitoes were exposed to harsh sunlight did such areas become safe for humans. Viet cultivators appear to have

achieved this in the Red River delta in the first millennium of the Common Era, though Chinese invaders in the fifteenth century were still being ravaged by malaria (miasmatic vapours) on their land routes to the Vietnamese capital (Wade 1994, III: 425-6; 524-5; IV: 1086). Thais in the lower Chaophraya in the fourteenth century, and Javanese in the Surabaya-Gresik area in the fifteenth century, appear to have achieved similar victories over the anopheles. Only these local triumphs made possible the lowland civilizations of the Viet, the Thai of Ayutthaya (14th-18th Centuries), and the hybrid *pasisir* (coastal) culture of Java in the 15th-17th centuries.

The Ayutthaya chronicles record an intriguing myth about that city's foundation (conventionally dated 1350) and the conquest of a disease pattern that appears malarial. It explains (in the Van Vliet version) that an exiled Chinese prince was leading his fleet from place to place in search of an appropriate new settlement. When he came to the island of Ayutthaya in the Chao-Phraya River he was told by a hermit that a previous settlement had declined and no other could be built. The reason was that there was in the middle of the island,

A pool in which there was a voracious dragon, called Nagaraja by the Siamese, who on being disturbed blew poisonous saliva from his mouth. This brought about such an epidemic that everybody around there died of the stench (*Van Vliet's Siam*, 2005: 200).

The Chinese founder's solution of the problem is expressed in primarily metaphysical terms, but the fact that filling in the marsh was part of the formula suggests that malaria was the primary cause of the problem. A Thai term usually translated as smallpox was however used to explain the specific threat the colonisers faced from disease, which the hermit advised countering by smearing the body daily with cow dung. The founding ruler instead smeared himself with rice meal, "saying that the rice could not grow unless the land had been fertilized. By this he meant that the cow dung is also part of the rice" (*Ibid*: 200). The chronicle tradition appears here to have retained a memory that

establishing rice fields was also part of the solution to disease, as it would have been to malaria.

With the exceptions of these conquests of the anopheles in particular lowland locales, most of the inhabitants of the forested ‘empty centre’ of Southeast Asia, the area of heavy year-round rainfall embracing Sumatra, the Peninsula, western Borneo and western Java, survived on higher ground. In this region one escaped the depredations of the anopheles only above 600 metres. A recent study has shown that whereas today 80% of Sumatra’s population inhabit the lowlands, only about 20% did so before the mid-19th Century when the lowlands began to be conquered from the anopheles (Reid 2004: 57). The pioneer Austronesian migrants from more northerly zones, where agriculture had been developed and smallpox perhaps become endemic would have suffered heavily from malaria until finding their way to healthier upland valleys.

In the contest between the southward advance of Chinese governance and civilization and Southeast Asian diversities, malaria would have been the main long-term advantage of the latter as smallpox was of the former. Although, as we have noted above, *zhang* (miasma) became a kind of trope expressing all that was dangerous, primitive and unhealthy in the southland, by Ming and early Qing times there was greater distinction between types of *zhang*. Chinese researchers differ in the extent to which they are willing to read specific *zhang* phenomena as malaria in this period of rapid expansion in Yunnan, Guangxi and Taiwan, and probes into Burma and Vietnam. Recent Western studies, on the other hand, have tended to simply translate *zhang* in the Ming record as malaria (Elvin 2004: 262-5; Bello 2005).

The disaster of the Chinese retreat from its Burmese adventure in 1765-9 is largely attributed by Chinese sources to the losses to *zhang* disease, which carried off more than half the 31,000 Chinese troops before the vital battle (Mei, Yan and Gong 1997: 34). Many historians see malaria as the most serious killer among the basket of unfamiliar diseases faced by Chinese troops. Similarly the Ming court sent “millions of

soldiers” to control and settle Guangxi province in the Hongzhi reign, but “most of them died of *zhangli*, and those fortunate enough to survive fled as soon as possible” (cited *ibid*: 37).

At the end of the first Ming reign, when officials were despairing of the difficulties the expansive policies of the Emperor were exposing them to, an official prayer to the protector deities declared in 1397:

The [Southeast frontier] mountains and rivers are far and dangerous; trees and grass are shadowy; breathing through smoke, haze, cloud and fog often causes diseases, and we could not succeed after a long confrontation with barbaric bandits (*man-zei*). (*Ming taizu shilu*, cited Yue 2005: 100).

The present borders between China and Southeast Asia, though drawn under the nineteenth century colonial regimes of Burma and Indo-China, owe much to the battle of the microbes in the previous centuries.

Further south in the Indonesian Archipelago visited by the Zheng He fleets, there were fewer references to ‘miasmatic vapours’, probably more due to the paucity of materials on these voyages than to the realities of malaria. It was particularly in Samudra-Pasai, the commercial city-state near which the Chinese fleets made one of their bases in the early 1400s, that miasma was noted as a problem (Ma Huan 1433: 117).

By the eighteenth century the mortality of coastal cities in the Archipelago was notorious. The most reliable data about urban crisis mortality comes from Dutch Batavia (Jakarta), which sustained an astonishing annual death rate equivalent to about half its roughly 100,000 population throughout the period 1730-52. Recent research has shown that Batavia’s notorious mortality at this time was a result of malaria, unleashed by the depredations of *Anopheles sundaicus* as soon as brackish fishponds were opened adjacent to the city in 1729. Malaria was endemic in the resident population, who built

a certain resistance, but caused havoc among new migrants to the city (Dutch soldiers, Chinese immigrants, slaves), about half of whom died within a year of arrival (van der Brug 1994: 82-3). Raffles (1817, II: App. A) may not have erred in identifying “An extent of mortality in Batavia, as compared with the number of inhabitants, that was perhaps never exempld, for the same space of time, in any other quarter of the world”.

David Henley has now assembled the data for another part of the Indonesian archipelago, northern Sulawesi. He documents the dramatic difference between the majority of coastal populations where the population was routinely affected by malaria and upland areas largely free of it. Minahasans of the highlands were fearful of travelling to the coast for trade, work, or the relocation often required by the incoming Dutch administration, because they knew from experience that a high proportion of such travellers succumbed to malaria. The more careful studies made in the early twentieth century identified malaria as the major cause of child mortality rates of around 40% in many of the coastal areas including the Sangir Talaud islands (Henley 2005: 261-74).

Smallpox

Smallpox has been in India and China for almost two millennia, and must therefore also have reached Southeast Asia. The earliest records suggest that it or related diseases such as measles were the most feared. In interactive populations in excess of 100,000 people, such as developed in some irrigated rice-growing areas and the largest trading ports, it became endemic. Here it would affect chiefly children every 7-10 years, as each new generation arose without the immunity conveyed by the previous disease cycle. When population data became reliable in Java in the nineteenth century, they revealed the epitome of a densely-settled region of endemic smallpox. Boomgaard found there “a rather elegant seven-year cycle” of smallpox, with mortality peaks in 1820, probably 1827-8 (though data were lacking in the Java War), 1835, 1842, 1849, 1857, 1862 and 1869-70 (Boomgaard 1987: 64). European observers mentioned the same 7-year cycle

in Maluku (eastern Indonesia) in the 16th and 17th Centuries (Boomgaard 2001:199; Reid 1988-93, I: 59).

Endemic smallpox was much less feared because it affected only children, and could not destroy the essential working and child-bearing population. The question is when this transition from epidemic to endemic occurred in different parts of Southeast Asia? To what extent did such transitions enable denser concentrations of population in cities and wet-rice agricultural complexes to dominate their less immune hinterlands and build important polities? The urban-agricultural complex of the upper Irrawaddy had reached this stage by about 1350, giving it a distinct population advantage against its neighbours and making possible some of the success of the Pagan empire and its later successor at Ava after 1600 (Lieberman 2003: 97-8). The irrigation basins cultivated by Tai settlers in upland tributaries of the Chao Phraya and Mekong, notably around Chiang Mai, Nan, and Vientiane, must also have reached this stage by the sixteenth century (Ibid: 251). But the flood-prone lower Chaophraya valley (site of the eventual Thai capitals of Ayutthaya and Bangkok) was seemingly almost unpopulated because of the ravages of diseases until the fourteenth century.

In more isolated populations the microbes died out with their carriers, immunity was lost in a new generation, and the devastation was severe among the most productive adult population whenever smallpox was reintroduced from outside. Various sources suggest that it was the most feared disease throughout the region, wiping out large sections of the population when it periodically visited non-endemic regions in Borneo, Sulawesi and the Philippines. Just before vaccination ended such periodic scourges in Minahasa, the upland area of northern Sulawesi, an epidemic killed one sixth of its total population or about 10,000 people (Henley 2005: 264).

Smallpox was endemic in the major Chinese population centres probably as early as the Tang Dynasty, and Chinese physicians had even pioneered the practice of inoculation

against it by the late Ming period (Hopkins 1983: 109-10; Glynn 2004: 48-50). That smallpox played a role in the expansion of densely-settled China as against the more scattered populations around its periphery is certain. One of the few such 'barbarian' populations to leave us a record of their fear of 'Chinese' smallpox were the Manchus, who of course intruded heavily into Chinese history in the seventeenth century. As Manchu forces were advancing against the Ming in 1642, a Manchu general reported to his leader Huang Taiji (later Taizong of the Qing dynasty), "[the Ming people] all know that we are afraid of smallpox; I am afraid that they will use this to play tricks and find more children with smallpox to put on the roads" (cited in Gao Yong and Wuyunbilige 2003: 61). The vulnerability of Manchu troops to smallpox was a major concern for the early Qing government (Xu Kun 1994: 91).

Sources will probably never be adequate to describe with clarity what the role of smallpox was in Chinese southward movement. It must have played a role in the great Zheng He fleets which brought tens of thousands of Chinese soldiers to Java, Melaka, Sumatra and other Southeast Asian locales seven times in the first decades of the fifteenth century. It is at least suggestive that Javanese and Balinese legends, which like Indian ones provide supernatural explanations for smallpox, associate this disease with the coming of Islam and the fall of the Javanese kingdom of Majapahit in the fifteenth century (Lovric 1987: 125-32). These phenomena were coterminous with the peak Chinese impact, and intimately related with them. The success, moreover, of mestizo Sino-Southeast Asian Muslim elites in creating new coastal and urban cultures in Siam, Java and Palembang in this period may have been facilitated by their immunity to this dread disease (Reid 1996; 2006).

If malaria or 'miasma' was the most effective weapon to protect the south from the advance of 'civilization', smallpox was very probably the major weapon of the north in its southward migrations.

Cholera

Cholera, transmitted through infected faeces in the water, was particularly savage as an epidemic disease in areas of dense population. Cholera Asiatica, not clearly identified in Southeast Asia until the great pandemic of 1817-21, spread with great rapidity and resulted in fatality in a high proportion of cases. The relationship of this virulent disease to the ever-present cholera of previous periods, subsequently distinguished as cholera Nostras, remains a matter of debate. It seems likely to the present writers that if cholera Asiatica had long been endemic in Bengal, as noted from its 1817 origins, that it must have spread to Southeast Asia on some previous occasions and been responsible for some of the crisis mortality of coastal areas in the 16th and 17th centuries. Boomgaard (1987: 55) noted of nineteenth century Java that, “Epidemic cholera (Asiatica) was always introduced from overseas, and the coastal, urban areas were hit first and hardest”. Unsanitary urban conditions, particularly in times of war and siege, were particularly conducive to savage cholera attacks. It seems probable that the devastating mortality which affected the coastal Java city of Banten in 1624-5, and spread to Central Java in 1625-6, was cholera. So probably was the epidemic that afflicted Batavia during its sieges by Mataram in 1628-9. Given the rapidity and scale of the mortality of the epidemic which devastated the coastal city of Makassar in 1636 (60,000 deaths in 40 days), and of Banten followed by Mataram in 1664-5, either cholera or plague (also doubted by earlier scholarship prior to the nineteenth century) are the likeliest explanations (Boomgaard 2001: 208-217; Reid 1988-93, I: 60-61).

The first securely documented pandemic of Asiatic cholera began in Bengal in 1817, and reached Bangkok via Penang in May, 1820. It may have caused upwards of 30,000 deaths there, and a similar number in the then much smaller city of Saigon, within only three weeks. It reached Java in 1821, and the Dutch recorded with precision that 1255 people died in Semarang and 778 in Batavia, each within a span of eleven days. Total additional mortality from the disease in Java in 1821 has been estimated at 125,000. Cholera remained a recurrent feature of nineteenth century Southeast Asia, but subsequently became devastating only during times of severe warfare.

Cholera returned to Southeast Asia frequently thereafter. Peter Boomgaard (1987: 55) estimated the deaths it caused in Java alone during peak years as 125,000 in 1821, 25,000 in 1834, 50,000 in 1851, 65,000 in 1864, and 70,000 in 1874. The last-mentioned epidemic played a major role in the Aceh War, which had begun a year earlier with the Dutch attack on the independent Sultanate of Aceh in northern Sumatra. After that initial force retreated in defeat, a larger force of 8,500 military and 4,300 labourers was dispatched in November 1873, from a Java already beginning to be affected by the cholera attack. About 80 men of the Dutch second expedition had died before the invasion began in December. By April 1874, when the Dutch prematurely declared victory, 1,200 of the Dutch forces had perished of cholera, ten times the deaths from war injuries. Over the ensuing year the Dutch continued to lose over 100 men a month from cholera. The disease spread to the Acehnese defenders, who lost far more men, including the sultan, in the pestilential, besieged fortress, and consequently had to abandon it on 24 January 1874 (Reid 1969: 110-12, 201). The story of this war cannot be understood without discussing cholera, and the same is likely for earlier wars for which the record is less clear.

For both sides, cholera was the most terrible curse of war. The same phenomenon occurred on an even bigger scale during the Philippine-American War of 1900-05. Cholera was probably the biggest killer among the hundreds of thousands who died of disease in southern Luzon in those years (May 1985).

* * *

In the twentieth century the battle against disease became a global one, and organisations such as WHO marshalled their forces on a global level. Recent experience with influenza and SARS has focussed minds as never before on the importance of seeing the planet as a whole in the way we monitor the transmission and mutation of viruses. Southeast Asia's place in this scheme is crucial, as a crossroads of people and diseases, a humid tropical environment with numerous island micro-regimes, and a

storehouse of biological diversity. Its proximity to southern China, where many viruses have begun their global careers, makes it a crucial front line in the battle. While evidence on the longer-term patterns is scattered and fragmentary, it is important to learn what we can of the ways populations have shaped diseases and been shaped by them.

Literature cited:

Bello, David A. 2005. 'To Go Where No Han Could Go for Long: Malaria and the Qing Construction of Ethnic Administrative Space in Frontier Yunnan,' *Modern China* 31, no.3 (July 2005), pp. 283-317.

Boomgaard, Peter 1987. 'Morbidity and Mortality in Java, 1820-1880: Changing Patterns of Disease and Death,' in Owen 1987: 48-69.
-- 2001. 'Crisis Mortality in Seventeenth Century Indonesia,' in Liu et al. 2001, pp.191-220.

Brug, P.H. van der 1995. *Malaria en malaise: De VOC in Batavia in de achttiende eeuw*. Amsterdam: De Bataafse Leeuw.

Diamond, Jared 1997. *Guns, Germs and Steel: The Fates of Human Societies*. London: Jonathan Cape.

Elvin, Mark 2004. *The Retreat of the Elephants: An Environmental History of China*. New Haven: Yale University Press.

Gao Yong and Wuyunbilige 2003. 'Tianhua yu huangtaiji dui ming zhanzheng' [Smallpox and Huang Taiji's war against the Ming dynasty], *Neimenggu shehui kexue* [Inner Mongolia Social Sciences] 24, no. 3 (May 2003), pp. 60-61.

- Glynn, Ian and Jenifer 2004. *The Life and Death of Smallpox*. London: Profile Books.
- Gourou, Pierre 1960. *The Tropical World: Its social and economic condition and its future status*, trans. E.D. Laborde. London: Longmans.
- Henley, David 2005. *Fertility, Food and Fever: Population, economy and environment in North and Central Sulawesi, 1600-1930*. Leiden: KITLV Press.
- Hopkins, Donald R. 1983. *Princes and Peasants: Smallpox in History*. Chicago: University of Chicago Press.
- Lieberman, Victor 2003. *Strange Parallels: Southeast Asia in Global Context, c.800-1830*. Vol. I: *Integration on the Mainland*. Cambridge: Cambridge University Press.
- Liu, Ts'ui-jung et al, eds. 2001. *Asian Population History*. Oxford: Oxford University Press.
- Liu, Ts'ui-jung and Shi-ying Liu 2001. 'Disease and Mortality in the History of Taiwan,' in Liu et al. 2001, pp. 248-69.
- Lovric, B. 1987. 'Bali: Myth, Magic and Morbidity', in N. Owen (ed.), *Death and Disease in Southeast Asia*. Singapore: Oxford University Press. pp. 117-141.
- McNeill, William H. 1976. *Plagues and Peoples*. Garden City, NY: Anchor Press.
- Ma Huan 1433. *Ying Yai Sheng Lan: 'The Overall Survey of the Ocean's Shores'*, trans J.V. Mills. Hakluyt, 1979; reprinted Bangkok: White Lotus, 1997.
- May, Glenn A. 1985. '150,000 missing Filipinos: a demographic crisis in Batangas, 1887-1903'. *Annales de Demographie Historique*, 1985. pp. 215-43.

- Mei Li, Yan Changgui and Gong Shengsheng 1997. 'Mingqing shiqi zhongguo zhangbing fenbu yu bianqian' [The distribution and transition of *Zhang* disease during the Ming-Qing period], *Zhongguo lishi dili luncong*, 2, pp. 33-44.
- Newson, Linda A. 1998. 'Old World Diseases in the Early Colonial Philippines and Spanish America,' in *Population and History: The Demographic Origins of the Modern Philippines*, ed. Daniel Doepfers and Peter Xenos (Madison, University of Wisconsin Centre for Southeast Asian Studies, 1998), pp.17-36.
- Owen, Norman G. (ed.) 1987. *Death and Disease in Southeast Asia: Explorations in Social, Medical and Demographic History*. Singapore: OUP for ASAA.
- Raffles, T.S. 1817. *The History of Java*. London, repr. Kuala Lumpur, Oxford University Press: 1965.
- Reid, Anthony 1969. *The Contest for North Sumatra: Atjeh, the Netherlands and Britain, 1858-1898*. Kuala Lumpur: Oxford University Press.
- 1987. 'Low Population Growth and its Causes in Pre-Colonial Southeast Asia', in Owen 1987: 33-47.
- 1988-93. *Southeast Asia in the Age of Commerce, c.1450-1680*. 2 vols. New Haven: Yale University Press.
- 1996. 'Flows and Seepages in the Long-term Chinese Interaction with Southeast Asia,' in *Sojourners and Settlers: Histories of Southeast Asia and the Chinese in Honour of Jennifer Cushman*, Sydney, Allen & Unwin, 1996, pp.15-49.
- 2004. *An Indonesian Frontier: Acehnese and other Histories of Sumatra*. Singapore: Singapore University Press.
- 2006. 'Hybrid Identities in the Fifteenth Century Straits' in *Southeast Asia in the Fifteenth Century: The Ming Factor*, ed. Geoffrey Wade and Sun Laichen, forthcoming.

Van Vliet's Siam 2005., ed. Chris Baker, Dhiravat na Pombejra, Alfons van der Kraan, and David K. Wyatt. Chiang Mai: Silkworm Books.

Wade, Geoffrey 1994. 'The Ming Shi-lu (Veritable Records of the Ming Dynasty) as a source for Southeast Asian History – 14th to 17th Centuries', Unpublished Ph.D. Dissertation, University of Hong Kong. Translated references now available online as Geoff Wade, translator, *Southeast Asia in the Ming Shi-lu: an open access resource*, Singapore: Asia Research Institute and the Singapore E-Press, National University of Singapore, <http://epress.nus.edu.sg/msl>.

Xu Kun, 'Qingchu huangshi yu douzhen fangzhi' [The early Qing royal court, its prevention and treatment of smallpox], *Gugong bowuyuan yuankan* [Journal of the Forbidden City Museum], No. 3 (1994) pp. 91-96.

Xu Shiyi 2005. 'Shuo "zhangli"' [Discussions of *zhangli*], *Jiangxi zhongyiyao* 36, No. 266 (February 2005), p. 61.

Yue Jingzhu 2005. 'Mingdai yixue yu xinan bianjiang kaifa' [Medicine and the exploitation of the Southwest frontier in the Ming Dynasty], *Zhonghua yishi zazhi* [Chinese Journal of Medical History], 35, no.2 (April 2005), pp. 99-104.

Zhang Wen 2005. 'Regional and Ethnic Prejudice: A Cultural Interpretation of *Zhangqi* and *Zhangbing* in Traditional China', *Minzu Yanjiu* [Ethnic Studies], vol. 3, 2005, pp. 68-77.

Zheng Hong, Chen Zhaohui and He Lan 2004. “Zhangqi” bingyinxue tedian yuanliu kao’ [The origin and development of the etiology and characteristics of *zhangqi*], *Zhongyiyao xuekan* [Chinese Archives of Traditional Chinese Medicine], 22, no. 11 (Nov. 2004), pp. 2035-36.