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Resurgence of malaria in Bombay (*Mumbai*) in the 1990s: a historical perspective*

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Bombay has achieved extraordinary success in controlling its malaria problem for nearly six decades by relying primarily on legislative measures and non-insecticidal methods of mosquito abatement. In 1992, however, malaria reemerged in Bombay with a vengeance. During 1992-1997, the city witnessed a manifold increase in the number of malaria cases diagnosed and treated by the public health system. The large number of malaria patients treated by private practitioners was not recorded by the municipal malaria surveillance system during this period. In 1995, at the peak of the resurgence, public health officials of the Municipal Corporation of Greater Bombay (MCGB) confirmed that 170 persons in the city had died due to malaria. The crisis was unprecedented in Bombay's modern public health history. In response to intense criticism from the media, the city's public health officials attributed the resurgence to the global phenomenon of mosquito-vector resistance to insecticides, and *Plasmodium* resistance to antimalarial chemoprophylaxis and treatment. Local scientists who investigated the problem offered no support to this explanation. So what might explain the resurgence? What factors led the problem to reach an epidemic level in a matter of two or three years? In addressing the above principal questions, this paper adopts a historical perspective and argues that in the resurgence of malaria in Bombay in the 1990s, there is an element of the 'presence of the past'. In many ways the present public health crisis in Bombay resembles the health scenario that characterized the city at the turn of the 19th century. It is possible to draw parallels between the early public health history of malaria control in Bombay, which was punctuated by events that followed the bubonic plague epidemic of 1896, and the present-day malaria epidemic punctuated by the threat of a plague epidemic in 1994. As such, the paper covers a long period, of almost 100 years. This time-depth is used to illustrate how malaria control programs in Bombay and in other parts of India have evolved through a combination of local historical forces and political expediencies in the context of technological developments. The boom in construction activities in Bombay following the liberalization of the Indian economy in 1991, and the local politics affecting administrative practices of the MCGB, are discussed as crucial factors in the crystallization of the present-day malaria resurgence in Bombay. The paper concludes by arguing that malaria in urban India is a serious problem that cannot be neglected. In the case of Bombay, the solution to the crisis can be found, in part, by reexamining the historical and political issues that have determined the nature and magnitude of the problem over the last century.

Key words: Bombay, Charles Bentley, Gordon Covell, DDT, malaria eradication campaign, colonial malaria prevention.

After 60 years of successful malaria control, Bombay (*Mumbai*)[1], is currently in the midst of a malaria situation gone awry. Starting from the monsoon season of 1992, the city witnessed a dramatic increase in the number of malaria cases diagnosed and treated by the public health system (see Table 1)[2]. In 1995, at the peak of the resurgence, the Municipal Corporation of Greater Bombay (MCGB) confirmed that

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[1] Bombay (*Mumbai*), was known as the Gateway of India, a major port, economic hub and commercial and financial center under colonial rule to the present. Bombay Island has an area of 68.71 square kms. It was originally built on a group of seven islets that were gradually connected by reclamation projects, construction of causeways, railroad embankments and breakwaters. The Metropolitan area (Greater Bombay) which includes suburban areas has an area of 603 square kms. It is one of the largest and most densely populated cities in the world (estimated pop=12,571,720 in 1997).

[2] It may be noted that the malaria surveillance figures of the MCGB represent only a small proportion of the actual or estimated number of cases that get diagnosed and treated in Bombay. Surveillance figures do not reveal the thousands of fever cases that go unreported or undiagnosed, or self-diagnosed and self-treated or treated by private medical practitioners and pharmacists. Private practitioners, numbering over 20,000 (Nandraj, 1994; Garg *et al.*, 1995) in Bombay, treat the majority of fever cases. Malaria being a non-notifiable disease, they rarely forward information about malaria patients they treat to municipal health officials who are constantly in need of accurate public health intelligence. For cultural reasons, malaria surveillance activities remain confined to low income localities. Middle and high income areas where malaria transmission is relatively more intense, get precluded from the surveillance because municipal surveillance workers are generally not welcome by residents who live in the well-to-do localities.

Table 1. Number of malaria cases detected by the Municipal Corporation of Greater Bombay (*Brihan Mumbai Mahanagarpalika*) during the period 1990-1997.

Year	Blood smears examined	Positive smears	*P. vivax*	*P. falciparum*	Mixed infection
1990	469084	3258	2817	421	20
1991	398831	5335	4532	754	49
1992	501994	11878	9672	2074	132
1993	508214	25171	18621	6135	415
1994	493127	21408	17550	3594	264
1995	535643	24074	18796	5124	207
1996	596054	24432	20996	3641	195
1997	582298	17702	13507	3932	263

Data source: Municipal Corporation of Greater Bombay, Malaria Surveillance Department

170 people had died in the city that year due to malaria. This predicament was unprecedented in the modern public health history of the city, which had prided itself for over six decades on being able to control malaria by relying almost exclusively on legislative measures and the use of non-insecticidal methods of mosquito abatement (Covell, 1955; Deobhankar, 1986). What then could have led malaria to reemerge in Bombay after such a long lull? What factors triggered malaria to assume the character of an epidemic in Bombay a matter of three years? The official line on the issue has been that of denial. In a public statement made on September 24, 1995, the Executive Health Officer of the MCGB explained that the resurgence had little to do with the MCGB's failure to deal with the problem in a timely and efficient manner and listed several measures that the Corporation had taken to control the problem. It was argued that the problem was tied to the global trend in malaria resurgence, and that the real problem was with the mosquito vector resistance to insecticides such as DDT, and *Plasmodium* resistance to antimalarial chemoprophylaxis and treatment. The problem was investigated by local researchers who, while confirming preliminary evidence of drug resistance in a small sample of patients who were infected with *P. falciparum* and *P. vivax* species, did not find any indication that the magnitude of malaria resurgence observed in the city could be because of the drug resistance factor[3].

This paper addresses the problem of malaria resurgence in Bombay from a historical perspective. It aims to show that Bombay's present-day malaria problem is in many ways similar to the scenario that characterized the city at the turn of the 19th century. Parallels are drawn between the public health history of malaria control in Bombay and present-day political contingencies that have precipitated the resurgence. In particular, the paper seeks to identify lessons that could be learned from the 'presence of the past' in a serious public health crisis of the 1990s. As such, the paper covers a long period – almost 100 years – to contextualize the problem in its proper historical perspective. This time-depth is also used to illustrate how malaria control programs in Bombay and in other parts of India have been contingent upon a combination of local historical forces and political expediencies in the context of technological developments.

The paper begins with a brief discussion of the early history of urban malaria in colonial India, starting from 1896, the year of the famous bubonic plague epidemic. To contextualize the historical moment during which Bombay's malaria problem was 'solved', a brief review is presented of the well-documented activities of Charles Bentley (1909-1911) and Gordon Covell (1928). Significantly, the solution to Bombay's malaria problem was found before the modern era of residual insecticides. The paper then shifts its attention to the DDT era and briefly reviews the malaria scenario at the national level. The analytical framework is widened at this point to take stock of what was happening elsewhere in India at a time when Bombay had successfully controlled its malaria problem. Bombay's malaria control strategy, while hailed as an exemplar, was not emulated by the municipalities of other urban centers in India. The paper argues that the resurgence of malaria in urban areas was in part linked to a change in public health priorities after the failure of a malaria eradication campaign that focused on rural areas. The paper then returns to discuss the scenario in Bombay and sheds light on the recent resurgence by contextualizing the influence of several factors in precipitating the problem. Thus, using Bombay as a case study example, the paper highlights the complexity of the problem and argues that urban malaria in India is a serious problem that cannot be neglected. Furthermore, it is argued that the solution to Bombay's present day malaria problem can be found, in part, by taking a fresh look at the historical and political contingencies that have shaped and precipitated the problem.

[3] Only a small number of malaria cases, diagnosed, treated and studied in Bombay were found to be resistant to chloroquine or quinine treatment (cf. Garg *et al.*, 1995; Potkar *et al.*, 1995; Sorabjee, 1996). In all probability, those who succumbed to malaria in 1995 were the city's poor, migrant laborers who worked on construction sites and those who could not afford timely medical treatment. Also, it is most likely that those who died were infected with *P. falciparum* and did not receive timely and appropriate medical help.

Urban malaria in colonial India

India's struggle with malaria spans several centuries. Early accounts of 'malaria' in India appear mostly in the form of travelogues recorded by missionaries and explorers from the year 1673 onwards, right up to the end of the nineteenth century. As Harrison notes, these recorded impressions suggest that 'malaria' played a crucial role in the moral and medical topography of the Indian subcontinent. As both cause of disease, and as a disease in its own right, malaria came to symbolise the wild, unconquerable, and hence 'uncivilised spaces of British India: it became an index of the lethargy, 'unwholesomeness' and misrule (Harrison, 1998: 11; see also Bentley, 1911). Viewed from an historical epidemiology standpoint, malaria has indeed been the greatest single cause of mortality in the Indian sub-continent (Klein, 1972, 1973; Harrison, 1998).

In British India, during the late 19th and the early 20th century, the ramifications of malaria in terms of its impact on the political economy and demography were by all accounts sensational. It is believed that as many as 20 million people died from malaria during this period, one in every five deaths recorded[4]. The malaria-related morbidity figures were significantly higher, and scores of episodes went unreported (Klein, 1973; Arnold, 1993; Harrison, 1998). Significantly, although malaria was a major killer and a debilitating disease, it attracted less attention from the colonial government than other epidemics, and in particular, the plague epidemic that started in Bombay in 1896[5] (Bynum, 1998; Harrison, 1998). As Professor Arnold has explained:

> The significance of plague for the political epidemiology of colonial India was far greater than that of the concurrent epidemics of malaria or influenza, even though in any given year the mortality they caused might have been considerably greater. Plague, like smallpox and cholera, dramatically restated the centrality of epidemic disease to the colonial state medicine of the period; but it also emphasized the enormous difference in perception and response – indigenous and colonial alike – between one epidemic disease and another (Arnold 1993: 202).

For the colonial government then, malaria did not pose a serious threat to the colonial order. In contrast, diseases such as cholera and plague attracted the government's immediate attention because of their visible disruptive effects on the local socio-political dynamics, and international politics and commerce (Harrison, 1994; see also Manderson, 1996: 85-89).

Until the very end of the nineteenth century, the framework in which malaria transmission was understood in British India by the medical establishment remained by and large unchanged. The nature of the measures taken to control the disease remained more or less the same, although the energy with which these were pursued varied according to political and economic circumstances (Harrison, 1978; 1998; Bynum, 1998). Malaria prevention methods during this period focused on (a) the drainage or avoidance of swampy areas, clearing of vegetation, forests, land filling (in accordance with the miasma theory), and (b) the prophylaxis provided by various cinchona preparations, most commonly quinine. By 1900, the colonial government had taken measures to implement extensive drainage schemes in most of the larger Indian cities. These were not primarily aimed at controlling malaria, but constituted part of the general sanitary program. Quinine powder was manufactured in the Madras Presidency. It was not usually sold on the open market, but at a cost to medical departments for distribution among government employees, soldiers, and plantation workers; it was not readily available to the general populace (Harrison, 1994; 1998; see also Harrison, 1978; Muraleedharan, 1991; Muraleedharan and Veeraraghavan, 1992).

For several years, the colonial government relied on anti-malaria measures such as anti-larval measures and attempts at source reduction through drainage and oiling (Muraleedharan, 1991)[6]. Because of the financial implications of such measures, they were restricted to certain urban areas of economic and/or military importance, while the rural areas, where over 90% of the country's population lived in over 500,000 small villages, were neglected. The colonial

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[4] It is important to note that malaria researchers in India at the time (Vandyke Carter, for example) were acutely aware that different types of illnesses complicated by fever were often misconstrued as malarial fever. Deaths resulting from such illnesses were often erroneously included in the category of 'malaria death'. Thus, the accuracy of 'malaria' morbidity and mortality figures frequently remained in doubt.

[5] Bombay's early social and political history has been documented by several researchers (cf. Harris, 1978; Kooiman, 1985; Klein, 1986; Dossal, 1991; Chandavarkar, 1994; Patel and Thorner, 1995a,b; Ramasubban and Crook 1995). By 1900, Bombay had emerged as a major commercial and industrial metropolis, and its importance as an administrative and political capital was also growing (Chandavarkar, 1994). However, as Klein (1986) has pointed out, Bombay's commercial growth and prosperity during the late nineteenth and early twentieth century did not flow down to the masses, nor did it improve the quality of existence or material conditions of the ordinary populace. Rather, it caused a great quantitative expansion in the working class, incredible congestion and environmental contamination. Alongside the enormous growth of the city, toward the end of the nineteenth century, its inhabitants, who were mostly migrants, became victim to the bubonic plague in 1896 and the years that followed (Arnold, 1987; Catanach, 1988; Klein, 1988; Dyson, 1989; Harrison, 1994; Chandavarkar, 1992, 1994).

[6] In the meantime, exemplary work on malaria had been accomplished by Christophers in the Punjab (1905) and Liston (1908), Turner (1909) and Bentley (1911) in Bombay. A series of malaria surveys were also conducted in various parts of India (Hehir, 1927; Sinton, 1929). However, during the early decades of this century, there was no appreciable decrease in the country's overall malaria-related mortality and morbidity figures.

government believed that steps to prevent malaria in the rural areas would be at odds with schemes for agricultural improvement (such as irrigation schemes) and famine relief projects (Harrison, 1998). Even in urban areas, however, environmental measures had limited impact on the disease. While certain source reduction programs were successfully implemented, their benefits soon evaporated with the neglect and overconfidence of the health administrators. According to Harrison, who has argued that the government's malaria policy contributed to the situation at the time:

> Medical desirability and practical limitations were by no means the only determinants of malaria policy in [colonial] India. Much depended on the willingness of the government to finance malaria schemes, and on the financial and political circumstances affecting municipalities and local boards. After the apparent failure of experiments at Mian Mir[7] [a large British troop cantonment at Lahore, in the Punjab] and several uncoordinated attempts at mosquito eradication in other parts of India, there was something of a lull in anti-malarial activity. Where preventive measures continued, they had been integrated, and were barely distinct from ordinary sanitary activity. Provincial governments and local and municipal boards were generally reluctant to allot funds for 'special malaria work' or 'experimental demonstrations' (Harrison, 1994: 163).

The rise and fall of malaria in Bombay

The state of affairs in Bombay in the years following the 1896 plague vividly illustrates Harrison's central point. Bombay became the first major city in British India where early experiments in controlling malaria using 'modern' methods were carried out. Its status as one of the most prosperous and cosmopolitan cities in India, and as the principal western port, made it the obvious focal point. Moreover, its island situation gave it a circumscribed area for operational purposes, and it possessed definite administrative and sanitary structures (Bynum, 1998: 24). Plague had commanded the colonial government's attention to the city's predicament. For example, one of the striking effects of the plague in Bombay was the mass exodus of hundreds of thousands of the city's residents. Out of a population of nearly 850,000, an estimated 380,000 people deserted the city between early October 1896 and the end of February 1897, bringing the commercial and industrial life of India's second largest city almost to a standstill (Arnold, 1993: 207). Even so, the heavy ongoing toll of mortality from other diseases could not be forgotten (Ramasubban and Crook, 1995). By 1901, the Bombay Municipal Corporation (BMC) had acknowledged that malarial fever accounted for a very large percentage of the

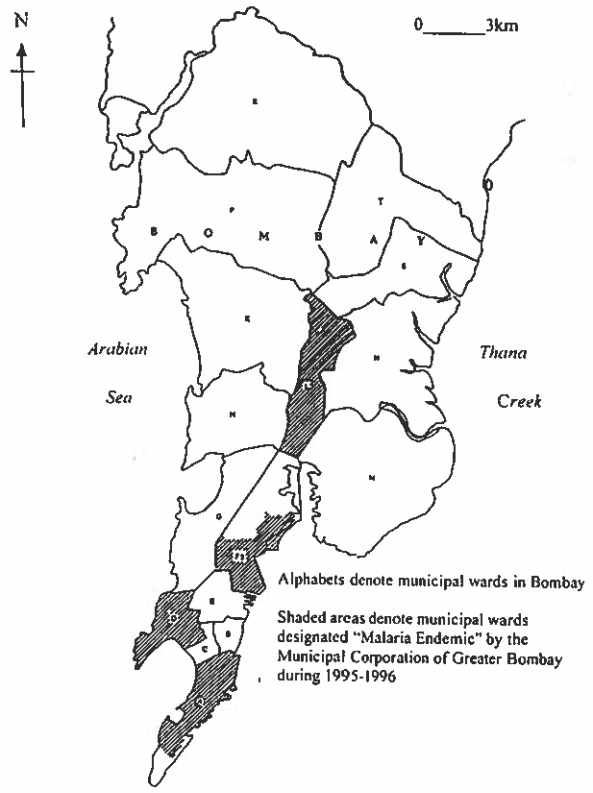

Fig. 1. Map of Bombay.

sickness in the city[8]. In that year a committee consisting of 11 members of the BMC was appointed to look into the problem and to decide what could be done to deal with Anopheline mosquitoes in Bombay. The committee recommended that steps be taken to destroy all kinds of mosquitoes (Covell, 1928: 8). In September 1905, the BMC passed the following resolution:

> That in the view of the steadily increasing prevalence of malarial and various other fevers in the City, and the very high rate of mortality resulting therefrom for several years past, it is very necessary in the opinion of this Corporation, that a comprehensive and searching enquiry should be instituted with regard to their causation and spread and the measures necessary for their prevention and removal so far as is possible (Bentley, 1911: 24).

[7] For a critical analysis of the events that surrounded the Mian Mir experiment – an experiment in the application of Ross's mosquito-eradication methods – which 'singularly and spectacularly failed' see Harrison (1978: 131-134), Bynum (1994), Bynum (1998), and Bradley (1998).

[8] The actual incidence of malaria in the city was truly left to speculation. According to Bentley (1911), prior to 1903, the only information available regarding the incidence of malaria among the city's population was in the form of mortality returns and statistics of admissions to hospitals and dispensaries. However, in 1903, Dr S.A. Powell, who was then the Police Surgeon, read a paper before the Bombay Medical and Physical Society, in which he gave some idea of the acutal incidence of malaria in a select population in the city between 1901 and 1903. Dr Powell reported the results of his microscopic examinations of the blood of 3,413 cases of fever, mainly among the Police of the City, wherein he had found malaria parasites in the blood of 2,542 cases.

As a follow-up measure, the BMC established a committee of representatives of the Government Medical Service, Sanitary Service and 'mosquito experts', members of the Corporation and medical men, to inquire into the cause and spread of malaria and other fevers in the city. The Committee deliberated upon the problem from 1906 to 1908, although without an actual investigation of the disease. Further, its 1908 published report emphasized the importance of controlling the (on-going) plague, while little mention was made of malaria (Bentley, 1911: 24; Covell, 1928: 8)[9].

In 1909, however, following the end of the Mian Mir experiment, which coincided with a serious epidemic (see Harrison, 1978), the government decided to convene an Imperial Malaria Conference. The conference, held at Simla in October 1909, led to the creation of the Central Malaria Committee which was charged with investigating the epidemiology and supervising control measures (Harrison, 1994: 163). The Malaria Survey of India also emerged from this conference – the first malaria research institute in the world (Harrison, 1978).

Circumstances surrounding the work of Charles Bentley

In the meantime in 1908, Bombay experienced yet another severe epidemic of malaria, causing considerable anger among the public. The BMC was anxious to bring the situation under control, and in 1909, authorized another inquiry into the problem. Captain AG McKendrick was appointed as a special officer to investigate the cause of the 1908 outbreak of malaria in the city. A committee consisting of representatives from the Municipal Corporation, the Bombay Port Trust, the City of Bombay Improvement Trust, the G.I.P. Railway and the B.B. and C.I. Railway (each owning large tracts of land on Bombay Island) was formed for the purpose of carrying out any measures which might appear necessary for the immediate mitigation of malaria. Captain McKendrick commenced his investigation, and examined more than 8,000 children in various parts of the city for spleen enlargement. However, he was recalled to duty at Coonoor in May 1909 and the investigation was taken over by Dr C.A. Bentley, who two years later submitted his classic 'Report of an investigation into the causes of malaria in Bombay, and the measures necessary for its control' (see Covell, 1928: 9).

Although Ross had provided the 'proof' necessary for the mosquito transmission theory (Bynum and Overy, 1998: xiii), prior to Bentley's investigation, the 'exact' causes for the spread of malaria in Bombay were not clearly understood. Excessive flooding during the monsoon season and lack of proper drainage were believed to be the chief factors influencing the incidence of the disease. Bentley stated in his report that prior to 1908, there was reason to believe that the disease in fact 'increased', as a result of vector behavior, rather than decreased during the period when the supposed anti-malarial work was in progress (Covell, 1928: 15). Bentley conclusively proved that the epidemic of 1908 was neither the result of importation of the disease from elsewhere into the city, nor was it a wave of malaria that was passing over India. Instead, the outbreak was the result of the existence of hundreds of *Neocellia stephensi* breeding places, especially housewells and wells in places of worship, each of which formed a locus of infection (Bentley, 1911: 152).

Bentley's (1911) spleen census (discussed at length in his report) brought to light two significant facts not acknowledged earlier. First, the entire northern section of the island (now suburban Bombay) was virtually free of malaria, contrary to what had been believed to be true for hundreds of years – that the ill-drained, low lying areas in the center and north of Bombay were more malarious than the older portions of the city (A, and parts of B, C, D, and E Wards) on the higher land to the south. Second, Bentley refuted the common assumption that much of the malaria in the city was imported. He also questioned the value of the measures hitherto taken by the BMC to prevent the breeding of malaria-carrying *Anopheles*.

Significantly, Bentley did not underplay the useful role that quinine prophylaxis had to play in malaria control. For Bombay, however, he argued that there was no 'natural' malaria; rather its existence was 'man-made'. This meant that mosquito control was possible, largely by preventing *A. stephensi*, the principal malaria vector in Bombay, from breeding in the hundreds of uncovered wells and cisterns throughout the city[10]. He advocated stern legislative/legal measures as part of his anti-malaria scheme for the city. The BMC took Bentley's recommendations seriously and established a Special Malaria Department in April 1912. It introduced appropriate bye-laws resulting in swift control of the malaria problem despite active opposition to the staff by a section of the public over preventive measures. In particular, open wells, which were perfect breeding sites for *A. stephensi*, maintained by places

[9] In November 1908, W.G. Liston published his study in which he recorded that 25% of the specimens of *A. stephensi* that he dissected harbored malaria parasites. This was the first occasion on which this species had been found infected in nature. This discovery later provided the most significant clue to the causation and distribution of malaria in Bombay (Covell, 1928: 8-9).

[10] Bentley meticulously documented the favorite breeding sites of *A. stephensi*. Permanent breeding sites included water storage tanks (cisterns) on the terraces of buildings, suction tanks, overhead water storage tanks in textile mills, railways, dock yards, wells, garden tanks, fountains, and water reservoir seepages. Temporary sites included leakages from cisterns and pipelines water storages and accumulations at building construction sites, roof gutters, scrap yards, and rain water collection on terraces (Bentley, 1911; Covell, 1928; see also Hyma *et al.*, 1983; Deobhankar, 1986).

of worship (Parsee and Hindu temples) became points of confrontation.

Confident that the problem was no longer serious, the BMC disbanded the Special Malaria Department in 1918, and its staff was distributed to other departments. This proved to be 'a short-sighted piece of false economy' (Covell, 1928). During the following years, the city witnessed a marked increase in the incidence of malaria. In June 1922 the heads of about 40 commercial houses in the Fort area sent in a petition to the BMC, drawing its attention to the serious increase of the disease in their neighborhood. The Special Malaria Department was reconstituted in 1923, with the same number of staff as had been originally appointed in 1912. Much of the initiative had been lost by then, and whatever anti-malaria work had been accomplished, had to be done all over again. In January 1925 the Executive Health Officer issued a Note on the subject of malaria in the city, in which it was made clear that the scheme advocated by Bentley had never been given a fair trial, and urged that the malaria staff should be largely increased. Stress was now to be laid on the inadequacy of the existing laws, and of the fines inflicted for their contravention, the need for a satisfactory scheme of drainage, and the importance of 'unity of control and co-operation' in carrying out anti-malaria measures (Covell, 1928: 13). A Central Anti-Malaria Committee was appointed comprising representatives from the Port Trust Authority, Military Authorities and Railways, and the staff was also increased.

The early work of Gordon Covell

In 1928, a new spleen survey of the island was commissioned. This time it was executed by Covell. He examined 27,647 children in 286 municipal schools, and like Bentley, Covell too noted that the incidence and prevalence of malaria varied across different parts of Bombay. While some localities were almost entirely free from the disease, in other areas more than half of the children examined showed evidence of infection. Moreover, the disease was so remarkably localized that, while there was a serious amount of malaria among the occupants of a particular set of tenements, a few streets away there was very little evidence of the disease (Covell, 1928: 27-29). The recommendations put forward by Covell were directed solely towards the prevention of *A. stephensi* breeding. The results in terms of malaria control were very encouraging. The incidence of malaria in the city had come down significantly (Covell, 1955).

Earlier, besides documenting the legislative measures required to control the spread of malaria in Bombay, Bentley had made important observations that had long lasting implications for malaria control in Bombay. Describing the peculiar nature of Bombay's malaria problem, Covell reiterated Bentley's original observation in the following words:

> There is no natural malaria in Bombay, the chief reason being the absence of natural streams. *Anopheles stephensi* is the only species of mosquito which plays any appreciable part in the transmission of the disease in the island, and its breeding places are exclusively man-made... This mosquito is the one malaria carrying Anopheline in India which is able to adapt itself to life in a large city. In the case of other carriers facilities for breeding suitable to their needs are not produced in urban areas. But *A. stephensi* is the great well and cistern-breeder of India, and unless these breeding places and others of a similar nature are rendered permanently mosquito proof it will continue to flourish even in the heart of the City (Covell, 1928: 34-35).

One of Covell's most significant recommendations for the successful control of malaria in Bombay was the need for 'unity of control' of anti-malaria operations throughout the Island. Large tracts of land on the Island were controlled by bodies other than the Municipality - Military Authorities, the Bombay City Improvement Trust, the Development Directorate, the Port Trust, and the B.B. & C.I. and G.I.P. Railways, each of these institutions were carrying out anti-malarial work independent of the Municipality. Their efforts were nullified because of lack of coordination in implementing mosquito abatement measures. Hence, Covell recommended that the whole of Bombay be placed directly under the Special Malaria Officer of the Municipality, whose sole responsibility should be that of malaria control (Covell, 1928: 37).

The scheme that Covell drew up for the BMC served the city well for over 60 years. Except for an occasional flare-up, for all practical purposes, the disease was kept under control up until the beginning of the 1990s[11]. With Covell at the helm of the Malaria Department, anti-malaria measures, especially the implementation of bye-laws[12], were implemented with a missionary zeal[13]. Anti-malaria work was consolidated over the years[14], and Bombay ben-

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[11] Data in support of this statement can be found in the Bombay Municipal Corporation's Executive Health Officer's Annual Reports over the years and other data maintained in the Pest Control Officer's Office at the Crawford Market Branch, Bombay.

[12] Details of the bye-laws and antimalarial legislation extracted from the City of Bombay Municipal Act are provided in Covell (1928: 72-81). A more recent summary of the legislative measures as provided under the Bombay Municipal Corporation Act, Bombay Act No. III of 1888 (modified up to 1982) is given in Deobhankar (1986: 103-104).

[13] To this date, the Pest Control Officers (PCOs) of the Corporation use the term 'crusade' to refer to a co-ordinated endeavor between the PCOs and malaria surveillance investigators/ inspectors, when dealing with a reported focal outbreak of malaria within their jurisdiction.

[14] Localized focal out-breaks occurred in the city in 1963 and 1965, at a time when many of the closed wells were opened up as war emergency measure (Indo-China and Indo-Pak war respectively), leading to prolific breeding of *A. stephensi*. Transmission stopped soon after the wells were closed and sealed again (Pattanayak *et al.*, 1981). The BMC had otherwise meticulously enforced its bye-laws and ensured that potential *A. stephensi* breeding sites wells, cisterns and overhead tanks were rendered mosquito-proof (Deobhankar, 1986).

efited from the services of persons like Bentley, Turner and Covell whose enthusiasm, zeal and disciplinary measures enabled them to implement anti-malaria measures against several odds. Although Bombay's success had become legendary, other municipalities in the country did not follow the Bombay example by adopting legal provisions to control malaria. Malaria in other major cities such as Calcutta, Madras and Delhi continued unabated and with an increasing intensity over the years (see Sharma and Malhotra, 1986).

To appreciate what was happening at the national level at a time when Bombay had 'solved' its malaria problem, a brief review of the overall malaria scenario in the country is in order.

The national scenario: the DDT era and the subsequent neglect of urban malaria

The overall malaria situation in India remained unchanged until the 1940s, prior to the introduction of DDT. In the post-independence (1947) years, the political attention focused on rural India. The government was restructured, and political and administrative boundaries changed. With DDT and related technology (e.g., chloroquine) in hand, the Government of India felt that it was now possible to extend its malaria control activities into the rural hinterlands[15]. Nevertheless, the progress was immensely slow. In 1947 an estimated 75 million people were suffering from malaria and 800,000 people died from the disease annually (Akthar and Learmonth, 1977; Ray, 1977)[16]. The volume of malaria-related morbidity and mortality cases being reported from urban areas at the time were considered trivial in contrast to rural areas, and so did not attract the government's attention. It was only with the countrywide resurgence in the late 1960s that urban malaria was brought back into the limelight.

A fortuitous event?

DDT was first imported into India for military purposes. In 1945, following the first major large-scale trial in applications of DDT along the Tennessee River in the United States of America, it was made available to the Bombay Malaria Organization[17] in September 1945 for field trials in the rural areas of Dharwar and Kanara Districts (both now in Karnataka State). This had proved to be remarkably successful in the project areas (Vishwanathan, 1950; Covell, 1955; Harrison, 1978). The foundations for the creation of the Malaria Organization were laid in 1938. Kanara District was chosen as the venue of its activities when created, but the proposal was postponed because of World War II. Apparently, the former Governor of the Province of Bombay, the Earl of Scarborough, Sir Roger Lumley, experienced a serious attack of malaria. This event turned out to be a fortuitous one, in a sense, as it expedited the proposal's funding and the Organization was soon brought into being. The Bombay Malaria Organization (BMO) was created in the State of Bombay in 1942 with much political backing (Vishwanathan, 1950: 6). The experiments conducted by the BMO continued successfully for over a decade and thereafter 'became the basis for the first tests in India of transition from attack to surveillance' (Harrison, 1978: 242).

The Indian government launched its National Malaria Control Program (NMCP) in 1953 with the support of the WHO, USAID and Rockefeller Foundation. The main strategies for control of malaria included the use of pesticides to kill anopheline mosquitoes and treatment of infected individuals with quinine-related drugs, mainly chloroquine, which had been recently synthesized. Primarily targeted were rural areas. The initial spraying operations to control the malaria vector under NMCP produced results far beyond anyone's expectations. By 1957-58, under the NMCP, a population of 165.15 million was protected from malaria (Sharma, 1996b). In its enthusiasm over the successes achieved in malaria control, and in accordance with the WHO's newly designated 'eradication' program, in 1958 the government re-designated the national program as the National Malaria Eradication Program (NMEP), and the entire country was brought under the program. In the subsequent years, there was a rapid fall in morbidity and mortality resulting from malaria, and by 1960 eradication was almost considered to be a foregone conclusion. At this point, it was estimated that there were only 100,000 active cases with no deaths reported in that year (Dutt *et al.*, 1980). However, the euphoria surrounding spraying soon dwindled, as by the late 1960s there was a resurgence of malaria in India as in other parts of the world (Farid, 1980; Sharma and Mehrotra, 1986). The annual number of cases rose again to over half a million in 1970 (Cleaver, 1977; Chapin and Wasserstorm, 1983). The Government of India acknowledged the gravity of the situation and aban-

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[15] In this regard, Harrison (1978) notes that: 'India was big enough to comprehend nearly every possible difficulty, sophisticated enough to develop highly skilled leadership and organized armies... may fairly represent what was happening in so many places at once during the first decade of the war for eradication' (Harrison, 1978: 241).

[16] This excludes those who died from associated complications, such as pregnant women or those weakened by malaria, who more easily succumbed to something else (Jeffery, 1988).

[17] Under British rule, Bombay city was the headquarters of the Bombay Presidency which consisted of several other districts. Following Independence in 1947, Bombay city became part of the Bombay State. Again, following the reorganization of the Indian States in and after 1960, Bombay became the headquarters of the state of Maharashtra. Before integration and merger of States, Bombay State had a population of about 20 million in 20 districts and in the new set-up its population was 30 million in 27 districts. Even at a most conservative estimate the annual malaria death rate at the time was 1.5 per million. About 45,000 deaths were therefore attributed directly due to malaria (Vishwanathan, 1950: 241).

doned the eradication strategy in favor of a revised strategy known as the Modified Plan of Operation (MPO) implemented in 1977, in which the eradication program was replaced by a program of control and containment (Sharma and Mehrotra, 1986; Sharma, 1996a,b).

The dramatic resurgence of malaria witnessed in India and in other parts of the globe beginning in the late 1960s was believed to be the result of the world-wide spread of vector resistance to DDT and chloroquine by the malaria parasite (especially *P. falciparum*). The inappropriate and intensive agronomic use of insecticides, and the neglect of urban malaria (as emphasized by Sharma and Malhotra, 1986) were also recognized as critical factors determining the resurgence (see, however, Sharma *et al.*, 1994). Besides several other factors ranging from problems at the social and organizational level to epidemiological short-sightedness, the dwindling financial support from international organizations to the global malaria eradication program was also a crucial factor that hastened the problem of resurgence (Cleaver, 1977; Wessen, 1986; Desowitz, 1991; Packard, 1997, 1998; Packard and Brown, 1997).

Overall, until the late 1960s, malaria was predominately regarded as a rural disease, and urban malaria was not included in the initial planning of the national malaria eradication program. Cities and towns with a population of 40,000 and above were considered hypoendemic or malaria-free zones, with malaria control devolved to local authorities. These were often ill-equipped, understaffed, inadequately financed and without the necessary expertise for vector control. Until the late 1960s, mosquito larvicidal oil (MLO) was often scarce. However, the NMEP noted that the incidence of malaria in urban areas was considerable. For instance, a malaria study in the state of Tamil Nadu in 1961, revealed that nearly 50% of cases detected were from the urban areas and the proportion increased to 95% in 1963. Between 1964-1967, urban malaria accounted for about 80% of the cases in the state. In 1970, 88.7% of the cases recorded were from urban areas. The majority of the cases were indigenous, and even the 25-30% that were imported were from other urban areas (Roy *et al.*, 1976; Dutt *et al.*, 1979; Hyma *et al.*, 1983; Sharma and Mehrotra, 1986). The country's major cities – Delhi, Madras, Calcutta, and Hyderabad – had also started reporting an increasing number of malaria cases each year.

The NMEP evaluation committee – referred to as the Madhok Committee (1969) – reviewed the malaria problem in urban areas in 1969 and found that 10 urban areas in Andhra Pradesh and Tamil Nadu contributed 11.2% of the total malaria cases in the two states. Recommendations of the committee led to the introduction of the Urban Malaria Control Scheme in the NMEP in 1971 (Pattanayak *et al.*, 1981). Yet, the number of cases reported from urban areas of India continued to increase from 3.4% in 1973, 3.9% in 1976, 9.8% in 1979 and 12% in 1982 (Bang and Shah, 1988).

Through the 1970s, major infrastructure development and large scale construction activities in Delhi and Calcutta, without synchronous larviciding operations, resulted in sudden increases in the incidence of malaria. Delhi, for example, recorded as many as 375,100 cases of malaria in 1978, when a large immigrant labor force came to participate in the extensive construction sites for the IX Asian Games that offered the most productive breeding sites for *A. stephensi*. In Calcutta, 26,000 cases of malaria were recorded in 1984 with a Slide Positive Rate (SPR) of 34.49% and Annual Parasitic Index (API) of 7.88%, again because of an influx of migrant laborers who participated in the construction of the underground Metro railway. However, during the same period, despite its enormous population density, Bombay recorded less than 5,000 cases per year with no deaths for over 10 years (Bang and Shah, 1988; see also Dhir, 1969; Pattanayak *et al.*, 1977).

The emergence of an urban conglomeration as a focal point for the dissemination of malaria to peripheral rural areas proved to be a major setback to the progress of NMEP. Efforts made toward permanent vector control and elimination of the reservoir of infection failed. Although the neglect of urban malaria was acknowledged as a problem issue, even two decades after the introduction of the Modified Plan of Operations, signs suggesting that the incidence of malaria had been lowered in urban India were nowhere in sight. On the contrary, the situation in most of the major cities worsened. Bombay witnessed its worst resurgence during the 1990s. The following section sheds light on the historical antecedents and factors that led to the most recent epidemic in the city.

Resurgence of malaria in Bombay: the present-day scenario

Indian malariologists and health administrators of other major cities held the BMC's primary reliance on legislative and non-insecticidal measures to control the malaria problem in high esteem. By the late 1970s and early 1980s, however, the first signs of a possible malaria resurgence in the city were observed. In this connection, evidence of *A. stephensi* breeding in the suburban areas of Bombay was detected for the first time by the BMC's Pest Control Officers in 1981. *A. stephensi* breeding was found in a masonry tank at a railway-bridge construction site in H/E municipal ward. The personnel at BMC's Insecticides Office considered this a crucial finding. It signified that unless appropriate measures were taken immediately, the suburban areas of Bombay which were hitherto believed to be 'malaria free' would soon become malarious areas. In other words, the BMC concluded that the rapid pace of construction activities in the city had a direct bearing on the city's potential for an outbreak of malaria.

To elaborate, Bombay's topography was changing rapidly around this time and population pressure was increasing at an enormous rate (Harris 1978). Vast tracts of marshy land in the suburban areas were being cleared and reclaimed for private housing projects. Simultaneously, the real estate prices skyrocketed in Central and South Bombay. Construction companies and real estate speculators increased their volume of investment in new housing projects. New residential complexes were being built all over the city, especially in the suburbs, at a remarkable pace. Prime land in South Bombay was being reclaimed to build skyscrapers. The height of several newly constructed private residential complexes in some of the plush areas of South Bombay far exceeded the legally permitted Floor Space Index (FSI) ratio[18]. After public outcry and intense media criticism, the Municipal Commissioner took legal action against certain construction companies (real estate developers) and private investors. As a result, construction work on several skyscrapers in South Bombay which had violated the legally approved FSI ratio limits was halted. In some cases, the Bombay High Court had ordered that the buildings be demolished.

While the legal battles were being fought in the Courts, most of the unfinished, unoccupied and neglected buildings became perfect breeding sites for *A. stephensi* following the first monsoon showers. In 1985 and 1986, the number of malaria cases increased rapidly in some of the elite residential areas of South Bombay, especially Malabar Hill/Walkeshwar where the Governor of Maharashtra and the Chief Minister of Maharashtra and other prominent personalities had their living quarters. The incidence was particularly high in the vicinity of five skyscrapers on which construction work had been suspended. Following the intervention of a local politician, who was knowledgeable about vector behavior and breeding sites, the MCGB's pest control office investigated the situation and took steps to destroy the mosquito breeding sites, thwarting a potential local epidemic. The efficacy of the measures that were taken during this period was only short-lived. Malaria continued at low intensity in the city, and surfaced in a major way in 1992. As shown in Table 1, the trend worsened over the years[19].

In response to intense media criticism and questioning by municipal councilors, the MCGB's Executive Health Officer acknowledged in a newspaper interview that the 1995 situation was by far the worst in the recent years. What had alarmed the city's public health officials, politicians and residents alike was not just the enormous increase in the number of cases, but the number of reported deaths due to malaria – from isolated instances in the early 1990s to the 170 confirmed cases of death due to malaria in 1995 alone. The city's malaria problem received unprecedented media attention. Significantly, the Chief Minister of Maharashtra, the Additional Municipal Commissioner, the Executive Health Officer, the Vice-Chancellor of a local university, and a prominent industrialist were among the scores of public figures who fell victim to the disease during the year[20]. The media picked up their illness stories to underscore the point that Bombay's malaria no longer spared anyone – not even the rich, the powerful and the famous. The subject of HIV/AIDS took a back seat in media coverage of health matters. The attention malaria received during the period was also provoked by the events that surrounded the 'plague' outbreak in August-September of 1994 (Madan, 1994; Qadeer *et al.*, 1994; Shah, 1997)[21]. A malaria epidemic in Rajasthan in 1994 and other parts of North India, followed by a similar epidemic in Thana District (Bombay's neighboring district) in 1995, also received extensive media coverage[22].

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[18] Issues of corruption and the scandals that ensued received wide publicity in the national dailies and critical commentaries were published in the Economic and Political Weekly and India Today. For an excellent depiction of the power politics at the municipal level surrounding the issues of land and construction, see Thakkar (1995).

[19] To reiterate, municipal surveillance figures represented only the 'tip of the iceberg' of the incidence and prevalence of malaria in Bombay.

[20] In an unprecedented move, on January 1, 1996, the Chief Minister of Maharashtra took a personal interest in this matter and convened a meeting of the Municipal Commissioner, the Executive Health Officer and other senior health officers and public health engineers of the MCGB. An executive order was promptly issued to eliminate and/or restrict the number of fountains within the Municipal limits – as a measure to prevent potential *A. stephensi* breeding sites.

[21] There were rumors that the "Surat plague" had already reached Bombay, and an epidemic in the city was inevitable. While the public panicked, the municipal officials took frenzied measures to prevent a possible plague epidemic in the city. No cases of plague were confirmed and the city was declared plague-free by the Corporation; a declaration that the visiting WHO's International Team of Experts corroborated without hesitation.

[22] Epidemics of malaria occurred in the States of Rajasthan (452 deaths), Nagaland (253 deaths), Andhra Pradesh (173 deaths), Manipur (48 deaths) and West Bengal (3 deaths) in 1994 and 1995. The states of Assam, West Bengal and Maharashtra experienced malaria epidemics with high morbidity and reports of deaths (Narayan, 1997; Mankodi, 1996; Kaul, 1995; Tyagi *et al.*, 1995; Bouma and Kaay, 1994, 1996). Focal epidemic outbreaks were recorded in many of the country's urban centers, especially in four metropolitan cities, Bombay (*Mumbai*), Calcutta, Delhi/New Delhi and Madras (*Chennai*) (Narayan, 1997; Pai *et al.*, 1997). The Government of India responded to the crisis by setting up an Expert Committee on Malaria in December 1994. This committee was entrusted with, among other things, the task of identifying towns and cities in the country which needed priority attention concerning malaria control, and to suggest short-term remedial measures. The Expert Committee identified 15 major cities including the 4 metropolitan cities and 14 other towns in the country where the malaria situation was serious and where the trend was worsening. The towns and cities designated as 'Cities Requiring Accelerated Urban Malaria Scheme' by the Experts Committee are: Delhi, Madras (Chennai), Calcutta, Bombay, Hyderabad, Bangalore, Amhedabad, Bhopal, Jaipur,

Under pressure from local politicians, the MCGB's health officials used rhetorical to explain the resurgence. The crisis was explained as being part of the global malaria resurgence. It was also argued that the city's population and housing units had multiplied enormously over the past two decades, whereas the number of personnel engaged in anti-malaria activities in the city had remained unchanged during that same period. Without substantive evidence, the problem of anti-malarial drug resistance was also cited as one of the reasons. Treatment failures and 'relapses' were blamed on a local pharmaceutical company which supplied the drugs to the Corporation (name withheld in MCGB's records). It was argued that the pharmaceutical company had apparently supplied 'spurious' primaquin tablets. The manufacturing contract with this pharmaceutical company was promptly terminated. The media also played up the malaria problem in South Bombay without considering the specifics of vector habitat. For example, a media report that appeared in *Bombay Times*, December 12, 1995, read as follows:

> Stagnant stretches of water are perfect breeding grounds for mosquitoes and the historic *Banganga* tank [a large water pond – place of worship] at Walkeshwar, say some doctors practicing in the area, could be the cause of the sudden upsurge of the disease [malaria] in south Bombay. The *Banganga* tank is among the most neglected patches of water in the city, thus inadvertently becoming the breeding ground for mosquitoes and a health hazard for all and sundry, say the doctors...[23].

While all of the above factors may have had some bearing on the resurgence, it is unlikely that even their combined influence could have been so overwhelming as to result in an epidemic. My central argument is that the resurgence had little to do with the global resurgence or the resistance phenomenon. It is true that Bombay's overall population had increased rapidly from eight million to ten million in a matter of a decade. The fact that the absolute increase in population occurred in the suburban areas, whereas the population in South and Central Bombay actually decreased or remained stable during this period, tends to be ignored. If the present anti-malaria workforce was considered grossly inadequate to provide enough coverage to the city's ever increasing population, how, was it that the same number of personnel were able to keep the malaria problem under control until 1991?

I argue that the steady increase in the number of malaria cases detected by the municipal surveillance system during 1992 and onwards could simply be attributed to the tightening of surveillance activities. Until the recent resurgence, each malaria investigator routinely collected at most 5-6 blood smears/slides per working day. However, following a barrage of press reports critical of the 'lackadaisical' attitude of the health authorities, the Corporation made it compulsory for all malaria investigators to collect at least 10-12 slides per day through 'active' surveillance. Thus, with the intensification of surveillance activities, there was a concomitant increase in the number of blood smear slides collected, and the number of positive cases of malaria detected in the city also proportionately increased. The municipal surveillance system was actually 'picking up' those fever and malaria cases that would have been left undiagnosed, untreated or most likely treated by a private practitioner. The malaria statistics compiled by the local authorities bore evidence of sudden spurts in the number of malaria cases in the city, followed by their gradual stabilization around 24,000 cases.

In 1995, the Executive Health Officer proposed a desperate measure to the Municipal Commissioner – that the city's malaria problem could be brought under control if the anti-malaria workforce could be expanded, and population coverage increased. With active persuasion from the Chief Minister, who had just recovered from a severe attack of malaria, the proposal received a sympathetic hearing from the Municipal Commissioner. However, the final decision on the matter was kept pending. In the meantime, malaria veterans who had been associated with the city's malaria control program for several decades remained skeptical about the decision to increase the anti-malaria workforce as a means to contain the malaria problem. They were not convinced that an expanded workforce would actually help resolve the problem. Instead, they advocated for more efficient coordination among the activities of existing workers. They feared that an increase in the number of surveillance staff would result in nothing but an increase in the number of fever/malaria cases being detected each month, while the crux of the problem in terms of controlling breeding sites, blocking the ongoing transmission, and consolidating treatment measures would remained unsolved[24]. They also expressed concern over the problem of 'union interference' and 'union politics' in matters pertaining to the hiring of new personnel to work in the existing infrastructure.

In the following section, I will outline factors that precipitated the problem of malaria resurgence in Bombay.

Lucknow, Chandigarh, Vadodara, Vishakpatnam, Vijayawada, Kanpur (Government of India, 1995). The capital city of the state of Goa – Panaji – while not included in this list of cities identified as 'high-risk', has recently been reporting an alarming number of malaria cases (Mukhopadhyay and D'Souza, 1997)

[23] The Pest Control Officer of the MCGB (D ward) ruled out the possibility that the pond in question could be a source of *A. stephensi* breeding, and thus responsible for rampant malaria in the vicinity. The pond held water that was polluted, and was therefore nonconducive for *Anopheles* mosquitoes to breed. Besides, the water body was too large for the larvae to survive their natural predators.

[24] As of May 1998, the proposal for an expanded workforce for anti-malaria operations remained shelved without approval.

Explaining the resurgence

Bombay's potential for an outbreak of malaria has never been low. Hundreds of potential and known *A. stephensi* breeding sites have been meticulously documented by the city's pest control officers since the time of Charles Bentley. Additionally, the city has always had an ever expanding corpus of migrants coming from malaria endemic areas arrive in the city in search of a livelihood. Yet, malaria had been kept under control using seemingly old-fashioned but time-tested methods in the tradition of Charles Bentley and Gordon Covell. Given the historical antecedents of the MCGB's Pest Control Department, a military-like sense of discipline and commitment had become part of the work culture. Larvidicing operations and punitive actions against offenders of the anti-malaria bye-laws were routinely carried out without fear of political interference (see Deobhankar, 1986). Between 1992 and 1994, however, a series of events occurred at the national and the local levels which played a crucial role in fostering the current epidemic.

One of the factors that precipitated the resurgence of malaria in Bombay was the newly elected national government's economic policy, popularly known as Dr Manmohan Singh's (the then finance minister) fiscal policy, which was introduced in 1991. The Indian Rupee was involuntarily devalued by almost 100%, and the country's economy was opened up for foreign investment. Non-resident Indians (Indian nationals living in other parts of the world) and multinational firms (including investment firms) were given extraordinary concessions to invest in the country's economy. A substantial proportion of the investments that resulted from the new economic policy ended up in Bombay's real estate industry, popularly considered a safe haven for high-volume money laundering. The local commercial bourgeoisie also invested a larger proportion of its wealth in real estate ventures. Within a few months, the city witnessed an unprecedented boom in construction activities[25]. The real estate prices in South Bombay and its suburbs escalated. In a matter of two years, South Bombay had become one of the world's most expensive places to buy real estate. The cost of one square foot of land/accommodation in South Bombay was more than the cost for a piece of land/accommodation of a similar size in Tokyo, New York, Hong Kong and other cities where the real estate prices have been typically exorbitant. Apparently, with the imminent handing over of Hong Kong to the Republic of China, a significant proportion of the investments that would have otherwise been made in Hong Kong by Indian business persons and multinational companies was diverted into Bombay's real estate industry. This trend revealed the vested interest of the commercial bourgeoisie and international capital in helping to develop Bombay as a stable and lucrative base for market penetration (Ramasubban and Crook, 1995).

While the real estate industry in Bombay was booming, and the number of untreated mosquito breeding sites at the numerous construction sites was increasing by the day, Mr P B Deobhankar, a competent entomologist and a charismatic personality – the Insecticide Officer at the helm of anti-malaria operations in the city – retired. He was retained in a consultative capacity for two years, but could not wield any administrative authority. His position was filled by 'officiating' municipal officials appointed on the basis of seniority in the administrative cadre. Three persons took turns in officiating the Insecticides Officer's position, and none of them held the position for more than three months. None had the required background in entomology or possessed the personal characteristics of a leader that the pest-control workers had become accustomed to over the years. A lackadaisical attitude among the workforce soon set in, and routine mosquito control operations slackened. Pest Control Officers began to compromise their work schedules, and set an unfortunate example for those in the lower cadre to follow. The number of summons issued by the Pest Control Officers to known offenders of the bye-laws wavered significantly. The volume of revenue gained by the Corporation by way of penalties, imposed on those who had contravened the bye-laws, also wavered.

These events coincided with the retirement of the then Executive Health Officer who was replaced by an officer who was appointed to the coveted post after superseding four senior officers. The appointment of the new Executive Health Officer became a matter of controversy and attracted considerable media attention. That same year, one of the Corporation's seven Employees Unions, the Municipal Mazdoor Union, intensified its protested against the 'special' work schedule (timings) that had been made applicable to employees engaged in fogging and larviciding operations since the days of Gordon Covell. Traditionally, larviciding and fogging activities were carried out along a work-schedule termed 'break-duty' in municipal parlance. Given the resting and flying habits of anophelines, employees carried out larviciding operations between 7.00 a.m. and 10.30 a.m. took a recess and started fogging activities again between 2.30 p.m. and 5.30 p.m. The new work routine negotiated by the Union resulted in fogging operations being carried out later than the time-tested early morning schedule. With the intervention of the Municipal Mazdoor Union, 'break-duty' was converted into 'straight-duty'.

[25] The large scale construction activities attracted thousands of migrant laborers into the city. While many of them came from rural areas known to be malarious, others were infected while living on the construction sites. At one large residential complex under construction in suburban Bombay around the Powai lake, in 1995, there were as many as 15,000 laborers camped with their family members. While this area was completely free from malaria till 1992, within three years its name had become synonymous with malaria and human misery.

Employees began their larviciding and fogging operations at 7.00 a.m. and wound up their activities by 2.00 p.m. As a result, fogging became a worthless exercise.

The number of malaria cases recorded by the surveillance workers had already doubled over the previous year. To make matters worse, the threat of an impending plague epidemic in the city in August and September 1994 diverted the MCGB's attention and resources away from malaria control. These monsoon months were peak times for anti-mosquito operations and malaria surveillance work. The city had panicked during these critical two months. To avert the possibility of a plague epidemic, a large proportion of the health department staff was diverted from their routine activities and pressed into plague prevention measures[26]. The threat of a plague epidemic soon dissipated, and the corridors of the Corporation were filled with a self-congratulatory fever, for a possible disaster had been successfully thwarted. By then, much damage to anti-malaria work had already been done. The reservoir of infection in the city had significantly increased. This became all too evident in 1995 when malaria assumed a dangerous profile. The disease was now actually killing the people of Bombay.

Conclusion

This paper examined the resurgence of malaria in Bombay in the 1990s from a historical perspective. An attempt was made to draw parallels between the early public health history of malaria control in Bombay and the present-day malaria epidemic in the city to explore the 'presence of the past' as a means to highlight important lessons that could be learned in malaria control. Using the recent resurgence of malaria in Bombay as the case study material, the paper highlighted the limits of technology in controlling urban malaria. The Bombay example revealed that politico-economic and human dimensions are strategically important in urban malaria control. Examining Bombay's experience with malaria control from an historical perspective reveals that it was no coincidence that Bombay was able to keep its malaria problem under control for several decades. The methodology that the city had adopted until recently was successful because of the importance it gave to the everyday dynamics of malaria control. The lessons learned from the Bombay example are crucial, especially at a time when malaria researchers are busy testing impregnated bed-nets and others are waiting for the elusive malaria vaccine, while millions of people around the globe continue to suffer and die from the ravages of malaria. In India's case, despite the rhetoric of the volume of resources pledged by the government and international aid agencies for malaria control, the current scenario is grim (Brown, 1992; 1997; Butler *et al.*, 1997), and the prognosis poor. While transitory malaria epidemics in remote corners of the country attract nation-wide attention, endemic malaria in urban areas is neglected, presumably because fewer people die from the disease. The gravity of the urban malaria problem is often overlooked by other competing health problems. Urban malaria is the result of human activities. 'Its presence is an administrative crime' (Farid, 1980: 9). In the present case, the root causes of the resurgence lie not in the infamous wells and water storage tanks of Bombay or the numerous construction sites, or with the poor migrant laborers, but in the offices of elected officials and health administrators. One need not look too far to find a solution to the problem. Bombay's health administrators are not unaware of the 'truth' but they have conveniently swept it under the rug for reasons of political expediency.

[26] One of the activities that all the field staff were told to carry out was a house to house plague survey of the city's low income areas served by the Corporation's health infrastructure. Many of the workers were required to be on duty round-the-clock.

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