Chapter 16

The Mosquito Taken at the Beerhall: Malaria Research and Control on Zambia's Copperbelt*

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Introduction

This article describes a historical case of medical research and its application – the study of mosquitoes that made malaria control possible on colonial Zambia's Copperbelt. Scholars have pointed to the ways that colonial doctors and sanitarians labelled Africans as 'wild' vectors or reservoirs of infection dangerous to 'civilised' European settlers. While not banishing racial divisions, the Copperbelt malaria control programme made an important step away from such medically justified segregationist visions, replacing them with new metaphors of health and risk, and new geographies of human/mosquito movement, consumption and reproduction. In addition to these European medical and industrial views, I will analyse African miners' and malaria control workers' responses, including their resistance to some aspects of malaria control, but also their frequent identification with its modernising, scientific mission.

Malaria control on the Copperbelt succeeded because its interventions to counter mosquito breeding shared many elements with new industrial and city planning ideas about worker health and housing. Research, experiment and intervention characterised these endeavours, too, as well as the larger interwar African context. In practical terms, however, the success of malaria control depended upon the ability of medical experts to translate their research on mosquito behaviour and habitats into routine practices of surveillance and environmental intervention – integrating research and application. Sharing of practices, if not always of interpretations,

enabled diverse actors to participate in malaria control – including mining engineers familiar with problems of drainage and African antimalaria teams who saw their work as hygienic, improving the environment where they lived. The research culture that emerged during antimalaria work also shared elements found in the emergent African urban industrial culture of the Copperbelt. This is revealed in the interactions, positive and negative, between African malaria control workers and Copperbelt residents.

I will use evidence gathered during archival work, participant observation and interviews on the Copperbelt, as well as during visits to rural sites with a high population of retired miners (the Lake Bangweulu area in Zambia's Luapula Province). Interviews done by a research assistant, Timothy Mgala, also took place in May and October 2006 in and around Luanshya. These interviews with antimalaria workers mainly focused on the late 1950s to 1990s, while a few remembered early mine history, 1928 to the 1940s.

The following sections describe the background to the Copperbelt programme, the malaria experts' approach and their research practices. I then consider the parallels and interactions of malaria control with the mines' organisation and control of workers. The final section will discuss Zambian miners' views and the antimalaria team members' perceptions of their work. Ultimately, the antimalaria programme played a role not only in the mine's approach to controlling workers and moulding them into a modern (and politically moderate) working class. It also appealed to African miners' views of themselves as a modern urban people, though they sustained continuing grievances about the ways that malaria control practices underlined their subordinate position in the Copperbelt's racial and class hierarchy.

The Ross Expedition to Roan Antelope Mine, 1929–1930

Interviewer: Some people think that when [the mining company] cut the reeds and used dynamite to straighten the river, the loud noises caused the snake to go away.

BaKacembele: Maybe the snake was just annoyed![1]

In 1929, the Roan Antelope Mine in Northern Rhodesia (colonial Zambia) embarked on a campaign against malaria based on advice from the Ross Institute for Tropical Diseases in London. The mine, founded in 1926 by A.

Chester Beatty's Selection Trust Company, had been rapidly developed after the discovery of deposits of copper sulphide ore the previous year. Beatty's personal history of ill-health caused by his early work as a miner in the American West may have predisposed him to consider worker health crucial to industrial success. It was not until a major labour recruitment crisis overtook the mine, however, that he called in the Ross Institute.

Roan Mine had suffered a high death rate among European and African workers due to malaria, dysentery, typhoid, pneumonia and blackwater fever (the latter caused by inadequate treatment of malaria infection with quinine). Both African and European miners, the former largely recruited from other parts of the region and the latter largely recruited from South Africa, began to avoid Roan Mine. Africans in particular deserted the mine after the death of a surveyor's assistant, Joseph Zgambo, in 1928 (Watson 1953: 14). Zgambo drowned in the Luanshya River, which flowed through the mining area, and African stories circulated about a snake spirit that caused people to die at the mine (ibid.: 14–15; Berger 1974: 13). The mine's African personnel manager C. F. Spearpoint and the Ross Institute's malaria expert Malcolm Watson believed the snake was an African metaphor for malaria. During the labour crisis Spearpoint visited an elderly African headman who said that people had always avoided the river because of the many illnesses that struck people down 'like a snake'. 'In spite of the many interesting stories I have heard from natives about the Snake', Spearpoint wrote in a chapter for Watson's later book on the malaria control programme, 'I feel that the one about sicknesses should be accepted as the true origin of the reptile' (Watson 1953: 15). Watson was respectful of Spearpoint's knowledge of 'the African' and echoed this metaphorical interpretation by comparing the snake to the 'Scylla' of Greek mythology. Watson also added another metaphor – the witches' cauldron from Macbeth – for the stew of diseases Africans supposedly brought to the mine from their villages (ibid.: 8–11).[2]

The Ross Institute's methods of malaria control focussed on the anopheles mosquito – the vector of malaria – using drainage, management of vegetation and channelling to increase the speed of flowing water to discourage breeding. The programme at Roan was the Ross Institute's first application of these methods in Africa, but it was carried out in the shadow of a failed attempt at Freetown in Sierra Leone (1899–1902) that had been implemented by Ronald Ross, discoverer of the role of mosquitoes in the transmission of malaria (Harrison 1978: 126–27).[3]

Roan Mine was ideal for mosquitoes, situated in a region crossed by sluggish, marshy rivers. Prior to the mine's construction the area had been

thinly settled and possibly not exceptionally malarious except at the missions and slave-trade centres that existed before colonial rule. Although Watson, going on information from mine managers, believed the area to have been depopulated by malaria and other diseases prior to the mine's arrival, Africans recall numerous villages along the Luanshya River that were displaced by the mine; they also believe malaria was brought to the region by Europeans.[4] Regardless, the mine's concentration of workers in a small area, its poor housing, its badly designed water system and its construction programme – that 'pockmarked' the landscape with holes that filled with water in the rainy season – all contributed to a series of devastating malaria epidemics in the late 1920s. Although the Ross Expedition later recognised the construction work as a contributing factor, they still laid the greatest blame on the African environment, as did the mine's owner, Chester Beatty (Watson 1953: 3, 26).

The mine's expenditure on malaria control made sense given the scarcity of workers on the Copperbelt and the competition for labour with nearby Belgian Congo mines, known for their good housing and medical provision (Utzinger et al. 2001). Most important to the mine were the highly paid skilled white miners, increasingly reluctant to work in Northern Rhodesia because of its reputation for malaria. Thus even after suffering the worldwide economic depression of the early 1930s, Roan Mine sustained the malaria control programme because of its immediately obvious benefits.

The Ross Institute had been founded in 1926 to honour Ronald Ross. It aimed to promote his method of malaria control, as well as provide sanitation measures for other diseases in the tropics. Advising colonial commercial enterprises (and some mission and government health services) became the chief aim of the Institute, especially after Malcolm Watson arrived in 1928, fresh from his successful application of Ross's method to Klang District, Port Swettenham and the rubber plantations in the Malay States (Watson 1953: 5). He also developed his skills for dealing with colonial business interests through his work for rubber planters as an independent consultant from 1907 to 1928 (Litsios 1996: 47).

Already a noted philanthropist, Beatty had been invited to the opening of the Ross Institute's headquarters on Putney Heath in 1926.[5] Thus, he already knew of its work when the London-based managing director for his Copperbelt mines, Arthur Storke, sought advice in July 1929 (Watson 1953: 88; Storke 1933: 88, cited in Buchanan 2005: 65).[6] With funding from Beatty's company, the Ross Institute Expedition left for Northern Rhodesia in September 1929. The famous colonial sanitarian, W.J.R. Simpson, led

the expedition, accompanied by a doctor trained at King's College Hospital in London, A.C. Dalzell, who specialised in bacteriology and pathology, and by C.R. Harrison, a former rubber planter and expert on drainage who had met Watson in Malaya.[7] After Simpson returned to London, Harrison stayed on at Roan until late February 1930, putting into place the anti-malarial drainage scheme (Watson 1953: 26). Dalzell and a mining engineer from Roan continued the drainage and other anti-mosquito measures after Harrison left (ibid.: 35). Watson visited the mine periodically until 1950 to assess the malaria control measures and other sanitation efforts. During some of his visits in the 1930s, he carried out experiments with the new antimalarial drug, atebrin, using African miners' children as research subjects (ibid.: 29; see below; also see Manton in this volume).[8]

Drainage works to control the most important vector, Anopheles gambiae, began in late 1929 and had an immediate effect. Deaths due to malaria fell dramatically in the early months of 1930 and continued to be low throughout that year's rainy season. Subsequently Watson made much of the fact that the mine took his advice not to build a '300-bed native hospital' in 1930, because he believed it would not be needed once the malaria control programme was established (Watson 1953: 30–32). His triumphant observation that the smaller hospital they eventually built had only 39 patients during his 1932 visit, however, does not take into account the drop in the numbers of Africans employed at the mine due to the Depression. Nevertheless, the fall was real and proved the effectiveness of Watson's use of the Ross method: the incidence of malaria fell from an average of 61.1 per thousand per month during the 1929/30 rainy season to 31.6 in 1930/31 and 17.5 in 1931/32 (Rodgers 1962). Malaria incidence among European miners and their families fell from 105 per thousand in 1929 to 47 per thousand in 1932 (Fisher 1969: 5). The programme's success at Roan led to its adoption by other Copperbelt mines. Indeed, Roan and the contiguous government township of Luanshya (which had subsidised the work in its area and used the mine's malaria control team) began to promote the town as a 'garden city', to tempt skilled European miners into long-term employment.[9] The mining company (and Watson during his later visits) emphasised the high quality of housing for both African and European miners, and the well-watered gardens surrounding the white miners' family houses featured prominently in Watson's subsequent book on malaria control (Watson 1953: 68–69).

Although malaria control surely contributed to Roan's later reputation among African miners as a good place to work, those who worked there in

the 1930s recall stories of the mine's early days that blamed the numerous deaths on the Luanshya River snake, not malaria. Most interviewees today believe that the deaths came to a halt when the mine owners agreed to fund a ritual to appease this nature spirit and to show respect to the true African 'owners of the land' – the original Lamba-speaking inhabitants. As one interviewee put it, 'This is Lamba land. Now the chief of this land…got upset saying, "Why don't you give me something since this is my land where you dig the copper?" It's like the same chief caused these *amafya* – black magic'.[10] European observers, meanwhile, pointed out that the cutting of reeds that destroyed mosquito habitat may have also destroyed the snake's supposed habitat, thus calming African 'superstitions' (Watson 1953: 15; Berger 1974: 13; Kalusa 1993: 29). When Zgambo disappeared, white supervisors had also tried 'blasting in the river in case the body had become lodged beneath a rock or trees' (Watson 1953: 14). Some claimed that this convinced Africans that the snake had been frightened off. Nevertheless, as the opening quotation in this section illustrates, neither the snake nor the Africans were impressed.

Mosquito Control at Roan

The Ross method demanded meticulous research and surveillance into mosquito habitats to reduce mosquito numbers to the point where malaria transmission could no longer be sustained. The method was called 'species sanitation' by the Dutch malariologist, Nicholas Swellengrebel, who was influenced by Watson's focus on anophelines when they met in Sumatra in 1913 (Bradley 1994; Litsios 1996: 48). For species sanitation, Watson advised the use of a variety of methods underpinned by good drainage. This factor may have explained his success with planters and mining industrialists, for tropical agriculture relied on drainage for land reclamation while mine safety also required effective drainage, a mine being in many respects like a 'very large well' (Buchanan 2005: 67). Given the many different anophelines, each with different habits and habitat, species sanitation was complex. Depending on the species, drainage had to be directed to drying marshes, or filling depressions in the ground, or increasing the speed of a river's flow to stop larval development, or introducing either shade or sunlight to a river or marsh environment. Cutting reeds and removing vegetation, or 'scuffling' grass to ground level, were also required before ponds could be oiled to kill mosquito larvae (Watson 1953: plate 30 opposite p. 66).

In late 1929 Harrison dealt with the natural and artificial depressions in open sunlight that provided A. gambiae breeding sites, and by April 1930 Watson found none of this species within the control area (Watson 1953: 23). A. funestus took longer, for it bred in marshy areas in light shade – characteristic of much of the Copperbelt and especially of the vicinity of the sluggish Luanshya River (ibid.: 24). For the attack on A. funestus, Harrison focussed on *dambos* – low, treeless, marshy areas, with shallow pools and light shade provided by reeds and grass. As Watson observed, 'On the Roan Antelope Mine, the damboes mark the course of the Luanshya River and its several tributaries, sub-dividing the land so that hardly a house does not come within half a mile of a dambo', while blackwater fever cases were associated with houses built near their edges (ibid.: 24). Watson had selected a half mile as a rule-of-thumb for siting houses beyond the reach of mosquitoes flying out from their breeding grounds, though the reliability of this distance was subject to other conditions, providing opportunities for local research (see below).

Watson initially drew a half-mile perimeter around the mine and its housing areas, and around the small town of Luanshya contiguous with the mine, the area that would be subject to drainage and other control measures (ibid.: 38). Then Harrison attacked the *dambos* with a series of drains – with Watson commenting on the fertility of the soil revealed by drying (ibid.: 25). Harrison and his team also deepened the channels of the Luanshya River and its tributary streams, creating a faster current that prevented breeding of both A. funestus and A. gambiae. Other control measures dealt with vegetation and the depressions created by the mine's building programme. Some of the mine's other features, such as its tailings dam, a drinking water reservoir and a 'drift' or shallow crossing that obstructed the river's flow, were replaced by alternative arrangements that drained the stagnant water or created a more rapid flow (ibid.: 37–39). This campaign also included weekly spraying of oil on breeding sites that could not be drained.

Meanwhile Dalzell instituted a worker health regime that included effective treatment of malaria infection in white and black miners, first with quinine but in the later 1930s with atebrin and then mepacrine (Fisher 1969: 5–6). White miners' houses were also screened, though the houses of black miners were not, and the drop in malaria deaths among black miners was consequently less dramatic (Kalusa 1993: 30–31). New laboratory facilities also improved diagnosis of malaria, which was most significant for white miners' health, while improving black miners' health largely through combating pneumonia, the biggest killer of Africans on the mine.[11]

Mosquito control work became routinised during the 1930s under the supervision of the Ross Institute, with follow-up studies by Watson, including experiments with antimalarial oils for spraying bodies of water (Watson 1953: 74ff). Prior to the Second World War, routine work focussed on drainage and the development of larvicides, with teams of African mosquito control workers deployed to cut reeds, oil ponds and maintain and extend the drainage works. These medical auxiliaries also participated in the experiments to discover the flying range of the local mosquitoes, as well as locating *dambos* to be drained or stream beds to be deepened as the mine housing areas expanded (ibid.: 151). The experiments led to the zone of antimalarial measures being increased in the later 1930s to three miles from the nearest habitation (Anonymous 1960: 10). African workers routinely surveyed mosquito species, numbers and locations either using 'catching stations' for the capture of adult mosquitoes or dipping for larvae in ponds.[12] They also searched both African and European housing areas for unused tins, tyres and other containers that could fill with water and provide habitat for larvae.

After the Second World War, this work changed with the arrival of DDT and other insecticides. Although the mine continued with drainage, vegetation control and oiling (using mixtures with DDT from 1946), much of the malaria control workers' routine involved spraying inside African miners' houses with residual insecticides at regular intervals, as well as painting insecticides onto the screens of European miners' houses.[13] Under this new regime malaria dropped to the 'vanishing point' on the Copperbelt (Fisher 1969: 5).

Welfare and Control at Roan

Malaria control was part of a programme of welfare services developed by Roan Antelope Mine from 1930 onwards. Race remained a factor in the distribution of services because the mines saw segregation of housing as essential to attracting white miners and their families. Integration of housing and mine welfare services (including hospitals) only began during the African independence struggle of the late 1950s and early 1960s.

Although Roan developed welfare services and housing in order to attract and keep a sufficient number of workers, the urgency with which it pursued these improvements varied with its labour needs. During the1920s development phase until 1932, Roan experienced severe labour shortages which stimulated its investment in malaria control. From the outset the

mine encouraged African miners to bring their wives to live with them to increase stability and improve health through their domestic services (Parpart 1986: 36). After 1931, however, the Great Depression caused shedding of labour. Roan remained open but with a reduced labour force which suffered from the mine's cost reduction measures, as well as sharing their accommodation and food rations with any unemployed who did not want to return to the impoverished countryside (Kalusa 1993: 14, 45).

With economic recovery in 1935 the need for workers rapidly rose again. An African miners' strike on the Copperbelt in that year, which led to the killing of six miners at Roan, increased management's concern for worker control. Despite the ability of Africans to organise the strike across ethnic lines without a formal union, neither the mine nor government considered them ready for unionisation. Instead the mine strengthened an already existing 'tribal representative system' that employed so-called tribal elders to communicate the problems of their ethnic compatriots to the white compound manager. Government officials, too, felt that Africans could not (or should not) break their rural ties to become truly urban, industrial workers like Europeans, for whom union organisation was assumed to be appropriate (Cooper 1996: 43–50). The practical anthropology engaged in by colonial administrators who supported this migrant labour system saw Africans as vulnerable to social and individual breakdown under the stresses of a sudden permanent shift to urban life, a view that was bolstered by colonial psychologists and the culture contact school of professional anthropology in Britain (McCulloch 1995; Schumaker 2001; Tilley 2001). Most missionaries agreed about the dangers of the towns to African morals and family life, but in the interwar period some began to argue for the benefits of stabilisation in towns, particularly in a 1933 mission-funded study called Modern Industry and the African (Cooper 1996: 52–53). The anthropologists of the Rhodes-Livingstone Institute based in Northern Rhodesia also emphasised Africans' ability to adapt and take advantage of the opportunities available in urban industrial life, beginning with Godfrey Wilson's study of Northern Rhodesia's Broken Hill lead mine in 1938.

After the wave of strikes in the mid to late 1930s, concern for African welfare was bolstered by a shift in Colonial Office thinking towards viewing labour problems in terms of 'development and welfare' (see Cooper 1996: 62–67). Nevertheless, vast differences continued between African and European miners' housing and services, while for grievances the tribal representative system persisted until 1953 when a new African union demanded it be abolished (Harries-Jones 1975: 159). Even when stabilisation

of African labour became more widely accepted after the Second World War, white miners maintained their elite status using the threat of strikes. Segregation dragged on, with the dual wage structure lasting until 1969 (five years after independence) and segregation of housing continuing on a de facto basis well into the post-independence period.

Medical reasons for segregation had already lost their force in the 1930s, however. The Ross Institute method of malaria control did not require keeping African workers' wives and children at a distance from European settlements but brought them within the cordon of anti-malaria measures and provided them with curative treatment. Indeed, Watson's experiments with atebrin on African miners' children targeted them specifically to undermine the previous segregationist approach that had seen African women and children as a reservoir of malaria infection. Watson was also led by his belief that the mine was an ideal laboratory.[14] It provided him with a population of Africans on which to experiment, using as a control the population of nearby Luanshya where Africans were still exposed to conditions that Watson considered similar to those of African villages. This allowed him to compare spleen rates for Luanshya children with those of children born on the mine to demonstrate the effective reduction in malaria infection on the mine (Watson 1953: 107–8; enlargement of the spleen is an indicator of underlying malaria infection). Other features at Roan contributed to its status as an ideal research site – its fine pathology laboratory set up by Dalzell and its trained staff. African miners' wives soon disabused Watson of his belief that the mine provided willing subjects, however, for despite being bribed with food, 'they hid when the [mine] police went to collect them' instead of bringing their children back to complete their treatment with atebrin.[15] Historically their response was similar to Zambian responses to other biomedical technologies – to pills, injections and blood-taking in particular – when these targeted children or an adult's reproductive capacity.

Roan Mine developed its programme of worker welfare services with the aim to oversee most aspects of workers' production, reproduction and consumption. Its approach to company town paternalism derived from the same matrix of interwar environmental, social and medical concerns that stimulated the Ross Institute's approach to tropical sanitation. Just as changes in tropical medicine led to a greater emphasis on the health of colonial workers, industry began to move away from its previously mechanistic, Taylorist-driven view of workers. In addition, both Roan Mine managers and Malcolm Watson responded to the influence of a new wave of urban health thinking – the Garden City movement.

Beerhalls and Mosquitoes

The British-based Garden City movement idealised the psychological and physical healthfulness of the English village. In the late nineteenth century this movement stimulated the design of new British suburbs and cities, while some Garden City thinkers, such as Patrick Geddes and Charles Compton Reade, attempted to solve the urban problems of the colonies. These included rigid imperial designs that excluded the Africans or Asians on health grounds, designs preferred by older sanitarians such as W.J.R. Simpson (in his work in India before his arrival at the Ross Institute). In contrast, Geddes and Reade advised flexible responses to the colonial city's cultural, social and physical environment, showing a greater respect for indigenous design (King 1980; Home 1997).

Colonial businesses often selectively employed Garden City ideas and rhetoric while rejecting the Garden City planners' actual proposals, as was the experience of Reade in Northern Rhodesia and South Africa (Mutale 1999; Home 1997 161–65; Home 2000). Nevertheless, because of the later timing of urban development in Northern Rhodesia, Garden City ideas had a greater impact on mine housing at Roan and on the nearby town of Luanshya than they did in South Africa's already well-developed industrial centres. (For South Africa see Parnell 1993; Parnell and Mabin 1995 and Crush 1993.) Thus, after 1930 a new concept of the use of space and its relationship to health guided the construction of both African and European miners' separate living areas at Roan. Although the barriers between

Figure 16.1: Garden City – Roan Mine. (no date given) (Plate 31, in Malcolm Watson, *African Highway*; with permission from John R. Murray).

racially defined populations remained, managers paid increasing attention to the careful positioning of medical, leisure, marketing, gardening and administrative activities within African and European housing areas. This reflected an emerging vision of the worker as a consumer of (healthful) activities and services and the worker's body as a site for the demonstration of industry's social concern (Sturdy 2000).

This goal also demanded a focus on micro-environments within housing areas – and the movement of people between them. This resembled the attention to microenvironments and mosquito movements found in the method of selective anopheline control employed by the Ross Institute. The initial half-mile cordon between mosquito breeding habitats and human habitation was just one of the features of the mine's new environmental vision of health: the placing of beerhalls, football pitches, sanitation facilities and small neighbourhood maternity and child welfare centres all reflected this attention to micro-environments and issues of access.[16] The mine showed a similar concern for placement of facilities in the European area, employing a rigid class and status hierarchy of housing and amenities for whites, to control white miners' behaviour (Holleman and Biesheuvel 1973). And for both African and European miners, as for mosquitoes, their movements (or flight range) became the object of medical concern. In the 1930s, Watson invoked the idea of the Garden City as an achievable goal made possible by water management and species sanitation. By the 1950s, Copperbelt towns had indeed become relatively healthful places to live for both Africans and Europeans, with luxuriant vegetation, lavish use of water and greatly reduced levels of malaria and water-borne disease. Nevertheless, stark differences persisted in the health of Africans and Europeans at Roan. Most of these had to do with differences in wages and housing, with the majority of African miners and their families suffering greater levels of disease associated with overcrowding and their children prone to malnutrition into the 1960s (Kalusa 1993: 117–19). Roan's profits and its ability to pay high enough wages to attract skilled white workers depended on reducing outlay on the greater numbers of African miners. The mine's popular policy of encouraging African miners' families to live with them in mine housing also aided the mine to shift the costs of reproducing labour onto miners' wives, who provided domestic services, food from gardening and money from beer brewing (ibid.: 16–17; see also Chauncey, Jr. 1981, Parpart 1986 and Hansen 1984).

As a result, the 'garden city' at Roan looked very different when one moved from spaces occupied by Europeans to those occupied by Africans.

European areas contained screened houses on relatively large plots, surrounded by fruit trees, flowers and small vegetable gardens near the servants' quarters behind each house (Watson 1953: plates 31 and 32, opposite pp. 68–69). In the African areas much smaller unscreened houses shared communal water, toilet and bathing facilities, while the spaces behind houses and in nearby undeveloped areas were used for maize and vegetable gardens and grazing animals. Higher paid skilled African workers enjoyed larger houses (still unscreened) and better sanitation. Malaria control also took on a different aspect in each area, with the greatest difference in incidence of malaria no doubt due to the lack of screening in African houses. Differences in European versus African garden style would also attract different kinds of attention from both mosquitoes and malaria control workers (see below).

The mine used the provision of amenities to encourage miners to socialise within the mining community or nearby Luanshya, controlling their movements. The main beerhall was built by the government in Luanshya's African township, later joined by a sub-beerhall built by the mine in Roan township nearer African miners' houses (Epstein 1958: 66 and plate II opposite p.10). Movement was also controlled through work hierarchies and policing. At work, Africans fell under the scrutiny of African 'boss boys' and their white superiors, but in their housing areas, the white compound manager dealt with every aspect of African life, assisted by African mine police. Employed directly by the mine, they maintained discipline within the compounds, and in the early days provided the sole route of communication between miners and the compound manager, acting as translators and reporting (or failing to report) complaints or infractions (ibid.: 27). They could

Figuyre 16.2: European House, 1935, (Plate 32 in Malcolm Watson, *African Highway*, with permission from John R. Murray).

also abuse their power, by beating miners, harassing miners' wives, showing favouritism or taking bribes (ibid.: 27; also see van Onselen 1973 and Henderson 1975). Spearpoint recognised this problem when he instituted the tribal elders system in 1931 to provide a more direct channel of communication between himself and African miners (Epstein 1958: 17).

Although a worker's skills, class level and longevity determined his place in mine work gangs and the quality of housing he received, the tribal elders or tribal representative system ensured that, for purposes of organising around grievances, workers were isolated in controllable ethnic microenvironments, a system that discouraged cross-ethnic organisation such as unionisation. Although these ethnic microenvironments did not map spatially onto compound housing, they existed on the sociopolitical level as distinct cells of ethnic relations and activities. This system worked well for domestic concerns, but African miners did not feel their political and labour grievances were effectively handled and in the 1950s channelled these concerns into political parties and unions (Harries-Jones 1975).

In addition to mine police and tribal elders, the mine also used beerhalls as a means of controlling African workers. A beerhall had first been built in Luanshya township as part of a government scheme for funding urban social services for Africans (Epstein 1958: 18). Beerhalls kept African miners within the environs of Luanshya for their leisure activities, congregating under the eyes of tribal elders who might be treated with beer by their ethnic compatriots. They exemplified the mine's controlled and medicalized environment, serving beer of a standard strength in a setting regularly monitored for the presence of mosquitoes, and recirculating miners' wages into social services.

Various elements conspired to undermine this controlled environment, however. Marginal populations endangered the orderliness of mine life, contributing to ill health and violence. Mosquito habitats, and especially *dambos*, coincided with areas where dangerous populations could be found and where dangerous activities took place, both social and medical. The local Lamba people comprised one of these troublesome populations on the fringes of Roan. Notorious for refusing to work in the mine, Lambas near the mine had developed a thriving trade based on growing and selling food to the miners and providing beer and access to local women (Siegel 1989). Moreover, their lives on the fringes of the mining community demonstrated a viable alternative to the dangers of underground mining work and a means of survival when the mine laid off workers during economic slumps, allowing unemployed miners to avoid repatriation to their distant home villages.

This troublesome population of the unemployed was referred to as 'loafers' and 'squatters', while the Lamba themselves were called 'wild and lazy' by colonial administrators and the mining companies (Siegel 1989). Worse, the Lambas' successful agricultural activities were believed to contribute to the creation of mosquito habitat – due to the water that collected in the leaves of some crops, the small wells constructed to water gardens and the constant pockmarking of the land caused by grazing cattle, whose hoofprints filled with water in the rainy season.[xvii] *Dambos*, already pinpointed by Watson as ideal mosquito habitat, were also ideal for raising crops and grazing animals in an area subject to variability of rainfall, a purpose they had served in precolonial times in conjunction with local types of shifting cultivation on higher ground (Scoones 1997: 618; Wilson 1989: 371).

Even more disturbing, illicit beer-brewing by Lambas and by miners' wives (who used the sale of beer to supplement their husbands' meagre wages) also tempted African miners away from the legitimate beerhalls, to the margins of the compound outside the notice of mine police, in grassy areas on the fringes of the forest at night – thus in places and at times when the drinkers could be exposed to malaria.[18]

'I liked Science': Mosquito Control as Medical Mission

Malaria control on Zambia's Copperbelt was also a supremely scientific mission, with Roan Mine acting as its field laboratory. Because of its fine pathology laboratory – the first one north of the Zambezi – the mine attracted a high class pathologist from Southern Rhodesia for its staff (Rodgers 1962). During the 1930s, other mines learned from the Roan model and rapidly applied it to their own unique settings. This process involved much local research into mosquitoes and mosquito habitats, an experimental activity eagerly taken up by the medical officers at each mine.

For example, A.J.P. Coetzee, chief medical officer at the Nkana Mine, reported to Watson on the 'flight tests' carried out in 1937 by Botha de Meillon, noting with concern that 'the mosquito (A. funestus) taken at the beer-hall must have flown at least 2.8 miles and that in one night' (Watson 1953: 151–52).

Coetzee used the results of this experiment to justify extending the controlled area by a considerable amount [to] include the swamps near the mine farm and those towards the Kafue river (ibid.: 152). As a perhaps not

unwelcome by-product, the mines' reclamation of land and extension of their farms also undermined the Lamba people's local marketing of produce to the mines (their unregulated sale of food to African miners would later come in for criticism as the source of dysentery outbreaks, compared to the controlled supply of fruit and vegetables from the mine farms).

The sense of a modernising scientific mission is also found in interviews with former African mosquito control workers. Asked about why he chose to do antimalarial work, Jackson Zgambo said '…at work it's where I liked science a lot. That's when I realised that science is a good job, it is a very good lesson even at my house. I said, 'how will I live?' The surroundings should always be clean. That's what made me to join the health department'.[19]

Although Zgambo worked during the post-independence period (1973–1995), his comments resonate with those of older malaria control workers and older residents at Roan, who look back with nostalgia on the 1930s through the 1950s (for a similar sense of scientific mission, but among government workers, see Geissler's chapter in this volume).[20] Indeed, in 2006 some used the mine's past malaria control regimen (which was maintained after the nationalisation of the mines in the 1970s) to critique the failures of the recently re-privatised mine. As former malaria control worker James Mulenga complained, 'even me here, my house has not been sprayed by the Luanshya Copper Mines. Now how do you eradicate mosquitoes if other houses have not been sprayed, because spraying for mosquitoes should be every house, but they only sprayed houses for those who worked for LCM'.[21]

Where gardens were concerned, however, Africans had reason to object to malaria control regulations. Despite Roan's policy of encouraging miners and their wives to supplement their rations through gardening, maize and cassava gardens came to be seen as dangerous malaria habitat in the late colonial and post-independence periods.[22] One malaria control worker recalled, 'Now when they gave us notices that they don't want us to grow maize around our houses because they bring mosquitoes, it was me who first slashed my maize to give example to my fellow miners'.[23]Despite giving a good example, malaria control workers experienced considerable resistance:

> Here in Mpatamato people used to grow food in dambos, so stagnant water was always there…they used to threaten us that they are going to beat us… The work was so sensitive that sometimes we worked in the presence of [mine] policemen.[34]

A kind of hygienic aesthetic also propelled this work – the mines insisted that maize and cassava gardens made the compound look 'dirty', according to one retired miner.[25] Although Luanshya might be a garden city, African gardens did not conform either medically or aesthetically to the garden-city.

With respect to house spraying, too, Africans experienced a more invasive style of malaria control. John Ntenje, an elderly Luanshya resident who worked as a gardener and servant in the 1950s, recalled that the interiors of white miners' houses were not sprayed – screening made that unnecessary.[26] Instead, the anti-malaria team would spray the screens from the outside of the house (Anonymous 1960: 4). Spraying the interiors of African miners' houses with DDT became routine, however, and for the most part miners and their families welcomed it. As Benard Mulenga recalled of the 1940s and 1950s, many saw their work as 'good because mosquitoes will reduce and diseases in townships will decrease'.[27] Other miners contacted the health department when they noticed mosquitoes, cockroaches or other insects in their homes, requesting a visit by the anti-malaria team.[28] The general reduction of pests and the ability to sleep without being disturbed by mosquitoes was mentioned by all interviewees as one of the greatest benefits of house spraying. Some, however, resisted spraying, even into the post-independence period, but, as one mosquito control worker remarked: 'we used to force them until that house is sprayed under what[ever] circumstance'.[29]

Resistance to house spraying stemmed from a number of concerns. People objected to spraying when a newborn baby or sick person was in the house . Some malaria control workers recalled that they would delay the spraying, though others said they would persuade the family to take the baby or patient outside. The latter, however, violated the indigenous medical practice of secluding newborns and patients to protect them from witchcraft. Others refused house spraying because it required them to take their meagre possessions outside, revealing their poverty to their neighbours.[30] Still others, especially miners' wives, would object because of the odour of the spray, complaining that it might cause spirit possession.[31] Malaria control workers also speculated that people kept one room in the house locked because they were hiding charms.[32] Retired miners said that during the independence struggle refusal to open a room for spraying could also mean someone was hiding stolen dynamite.[33]

The mine's health department viewed resistance as a product of ignorance, as did most malaria control workers. Miners who refused house spraying were threatened with eviction to the squatter settlements or gov-

ernment townships.[34] Few would have chosen this medical exile, agreeing with Benard Mulenga: 'No, even us, these things of spraying houses, we welcomed them. We did not stop them because we knew it was for our benefit'.[35] Most miners saw themselves as a modern urban labour elite deserving of the attention to their health and comfort that house spraying and other malaria control measures demonstrated, part of a larger communal project such as that of nation-building described in Geissler's paper in this volume. As one observed about the slashing of maize in the 1960s: 'At that time people were not starving [so] that they needed to grow maize – the mines cared for them a lot, and the mines were mapped in such way that people did not grow food in restricted areas'.[36]

African miners' general identification with the medically prescribed conditions of urban life and the goals of the malaria control programme ensured its success until the late 1970s, when economic stresses in Zambia, the failure of the global malaria eradication campaign and the advent of economic structural adjustment programmes began to erode the industrial, state and social commitment that had sustained it.

Conclusion

The medical vision that informed the Ross Institute's malaria control programme interacted in a number of crucial ways with the Roan Antelope Mine's paternalistic vision of worker welfare. This interaction took place at the level of practices as well as visions, and African miners who experienced malaria control – sometimes enforced by mine police – saw similarities between malaria control and the mine's control of its workers' lives. Malaria control measures took a more invasive and coercive form when applied to African miners and their families than to European miners, particularly when dealing with the very different gardens that some Africans relied upon for subsistence even within the privileged environs of the 'garden city'. Mosquito habitat mapped onto the wetland areas in which these gardens thrived, and it also mapped onto the troublesome population of squatters and the unemployed living on the margins of the mine, a population from which the mines also tried to insulate its workers. Thus, the medical segregationist view, which had labelled African women and children as 'wild' vectors or reservoirs of disease infecting vulnerable, civilised and 'domesticated' Europeans, gave way to a more complex view in which marginal habitats – were populated by marginal people as well as

mosquitoes. These in turn endangered both African and European workers and their families by threatening the mining town's ever-expanding but permeable boundaries of sanitation and control.

Ostensibly, malaria control and tropical sanitation should have had similar benefits for both races and all classes of miner. In practice, the programme was more effective and less invasive for white miners because of their screened houses. Screens protected them prior to the introduction of DDT and later allowed them to avoid unpleasant house spraying. More importantly, both malaria control and the mine's control of workers' behaviour had negative consequences for the poorest and most vulnerable. The dangerous margins of the mining compound were essential to the well-being of the poorest mine families, who used them for maize and cassava gardens, for illicit beer selling and for leisure activities that were cheap and free from the surveillance associated with the mine compound. When unemployed, miners and their families also took refuge in the squatter settlements that grew around the mining town, to subsist on these illicit or disapproved activities. Malaria control measures that required destruction of maize and cassava gardens, thus, directly threatened their survival and inspired their resistance.

The study of malaria control also has significance for the ethnography of medical research in Africa. Malaria control at Roan started with the Ross Institute's initial research which later became routinised as part of the monitoring efforts behind mosquito control measures. When we study cases of medical research such as this, we are attempting to understand 'research cultures'. A research culture is a particular kind of work culture – one associated with laboratories, field research, research institutes or museum collecting (Griesemer 1990; Schumaker 2001). Colonial research cultures often existed as ephemeral moments of medical or scientific exploration, 'laboratories in the field', those established during scientific surveys or major colonial and postcolonial interventions such as public health surveys or disease campaigns, urgent one day and gone the next. The research culture at Roan, however, endured well into the post-independence period.

This research culture expressed itself in a number of ways, depending on the people engaged in its activities. C.R. Harrison, for example, did field research on mosquito habitats and the hydrological characteristics of the mine's environment. Malcolm Watson saw the mine as a natural laboratory, with a controlled population and trained staff suitable for conducting experiments with new anti-malarial drugs. Mine medical officers and outside researchers from the region did experiments on mosquito flight ranges.

And African mosquito control workers saw their work as a hygienic field science and called themselves 'searchers' when they captured mosquitoes or dipped for their larvae.[37] (See Geissler, this volume, for the perspective of African research workers on the 'research culture' of the Division of Vector Borne Diseases in Kenya.) These activities also fit the larger context of social, scientific and labour experimentation that characterised the interwar period and the 1950s in Africa. Thus, the mining companies viewed Northern Rhodesia as a laboratory for African labour stabilisation (Cooper 1996: 336, 346), while members of the British imperial scientific community carried out the African Survey, which characterised Africa itself as a 'living laboratory' (Tilley 2001).

My use of a 'research culture' approach for examining the work of the Ross Institute at Roan has focussed especially on the ways that different groups of people come to work together on a common project, despite their often radically different understandings of the project's meaning. The Ross Institute, for example, engaged in malaria control research with a sense of mission – to prove that Ross's method worked and could provide the springboard for tropical development. The mining industry, on the other hand, appreciated malaria control because of its implications for mining profits. In contrast, African mosquito control workers characterised their work as 'science', understanding it as a field activity akin to domestic hygiene (cleaning the surroundings of the home). When malaria control workers acted as 'searchers', the mining population also generally accepted this work as in their interest, reducing the nuisance of mosquitoes and other pests and protecting them from disease. Certain practices, such as the slashing of maize, might be resisted, but the mine's malaria control workers did not attract the 'vampire rumours' that government workers of various kinds attracted in this period (White 2000). All of the mine residents interviewed for this study saw the antimalaria team as miners like themselves, while malaria control workers said that their mining company uniforms and the regular notices of spraying ensured that they were known by the people and never accused of being *bamunyama*, the blood-suckers or thieves of body parts associated at that time with the government hospital.

Because of these links to the wider context, the Copperbelt malaria control programme helps us to understand the development of colonial society on the Copperbelt. Mining industrialists and malaria experts worked together towards a vision of African health that shaped the subsequent material, political and social life of the mining company towns. They were able to do this because malaria control and the mines' organisation of

labour derived from similar sources and mutually influenced each other during the crucial first phase of the establishment of Zambia's industrial towns in the 1930s. Malaria experts and mining industrialists possessed an overlapping vision of health and progress through the application of scientific research. Equally important, they shared a range of similar practices for surveillance, monitoring, mapping, experimenting and intervening in the environment, practices that impinged not only on the local mosquito population, but on African miners. Most importantly, however, African miners took up and adapted these practices, shaping Zambia's industrial urban identity.

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Notes

1. James Sankwe Kacembele and other retired miners who worked on the Copperbelt in the 1930s, focus-group discussion, 4 August 2004, Chishi Island, Lake Bangweulu.
2. To be fair, Watson used this comparison to show that African superstitions were similar to European ones and based on reasonable fears. The focus of his discussion of myths, moreover, was on those of the malaria experts who attacked Ross's method.
3. The 'Freetown tragedy' was Malcolm Watson's phrase for this failure, because Ross's rivals, S.R. Christophers and John W.W. Stephens, used it (together with similar failures in Lagos, Nigeria, and Mian Mir in India, during the years 1902 to 1904) to discredit Ross's method (Watson 1953: 26; Bynum 1994; Litsios 1996: 40–41). They subsequently reaffirmed the standard practice of racial segregation of urban housing on the grounds that it alone could protect Europeans from African women and children, whom they saw as the chief vectors of malaria (Litsios 1996: 42). Controversy over segregation to protect Europeans from malaria continued throughout the interwar period, coupled with debates about African immunity versus use of treatment against malaria, and the question of whether combating malaria among Africans had to wait for a general improvement in standards of living brought about by development. For a summary of these debates see Litsios (1996).

4. Focus-group discussion with retired miners, 4 August 2004, Chishi Island; interview with Jackson Kabwe, 10 May 2006, Luanshya; for early prospectors' views of the area as healthy see Gelfand (1961: 178).
5. 'The Opening of the Ross Institute & Hospital for Tropical Diseases', 15 July 1926: 17, Ross Institute Annual Report and Accounts 1926–1932, London School of Hygiene and Tropical Medicine (LSHTM) Archives, London.
6. Also see a different account in which a Roan Mine doctor initiated the request for the Ross Institute's involvement (Rodgers 1962).
7. See Watson (1953: 6, 35), and the Ross Institute Annual Report for 1930, LSHTM.
8. Ross Institute Annual Report (1932: 38), LSHTM; Schulemann – Watson Correspondence, 1931–1932, BAL, 367–270, 'England-Korrespondenz', Bayer Archives, Leverkusen, Germany. Bayer supplied Watson with atebrin. He also visited the Bayer research laboratories and hosted visits by its researchers to the Ross Institute.
9. For government subsidies of malaria control work see Ross Institute Organising Secretary's Report for March 1933, LSHTM. The reference to garden cities comes from the Garden City movement, an architectural and city-planning movement in Great Britain in the later nineteenth century which lasted well into the twentieth century.
10. Jackson Zgambo, Buntungwa, Luanshya, 9 May 2006. *Amafya* means 'troubles' or 'problems' in iciBemba, the language most widely used on the Copperbelt.
11. Pneumonia was the cause of fifty per cent of African deaths in 1930, and Charles Fisher, Roan's chief medical officer from 1936, implied that for African workers pneumonia epidemics in the early days were more important to the bad reputation of the mine than malaria (1969: 5).
12. For the use of African houses and other sites as catching stations see the Second Annual Report of the Medical Department of Roan Antelope Mines for 1931, 'Mosquito Catches', ZCCM.
13. 'Notes on Malaria and its Control for Planters and Miners' by G. MacDonald, 'Ross Institute – Temp', Box 23–26, LSHTM; *Horizon*, February 1960: 10).
14. Ross Institute Annual Report (1931: 17), LSHTM.
15. Ross Institute Industrial Anti-Malarial Advisory Committee, 1 February 1933: 18, LSHTM.
16. Some of these facilities were subsidised by both the mine and government and shared between mine and government housing locations, including the welfare centres established in Luanshya in the 1930s (Gelfand 1960: 22). Subsidies for these welfare centres derived from beerhall profits to which African miners contributed (Kalusa 1993: 53).
17. Ronald Ngosa, 9 May 2006, Mpatamato, Luanshya; Jackson Zgambo, 9 May 2006, Buntungwa, Luanshya.
18. Illicit beer brewing and the *shebeens* (unregulated places for sale of beer), like the official beerhalls, also functioned as foci for the growth of new forms of sociality among urban Africans, as well as for the development of new types of African en-

trepreneurship and domestic relations (see Parpart 1986 and Chauncey, Jr. 1981 for women's use of beer brewing to increase their independence on the Copperbelt).

19. Interviewed at Buntungwa, Luanshya, 9 May 2006.
20. Interviews with John Ntenje (b. 1936), Jackson Kabwe (b. 1941) and Benard Mulenga (b. 1942), Luanshya, 9 May 2006; and interviews with Harrison Mwelwa Kosamu (b. 1922), Kosamu Chakumana Village, Mpongwe; Norice Samuel Maila (b. 1924), Katanga Village, Luanshya Rural; and Goodwell Steven Nondo (b. 1934), Mikomfwa, Luanshya, 14 October 2006.
21. Mpatamato, Luanshya, 9 May 2006.
22. John Ntenje, Roan, 9 May 2006; see also Parpart 1986: 50, on miners relying on food from their wives' gardens to maintain a lengthy strike.
23. James Mulenga, Mpatamato, Luanshya, 9 May 2006; see also Ronald Ngosa, Mpatamato, Luanshya, 9 May 2006.
24. James Mulenga, 9 May 2006, Mpatamato, Luanshya.
25. John Ntenje, Roan, Luanshya, 9 May 2006. This view is similar to the reaction of Zimbabwean agricultural officers, that trees left standing in farmers' fields look 'messy'; see Wilson (1989: 374).
26. Roan, Luanshya, 9 May 2006.
27. Ibid.
28. Jackson Zgambo, Buntungwa, Luanshya, 9 May 2006.
29. Ibid.
30. Ronald Ngosa, Mpatamato, Luanshya, 9 May 2006.
31. Jackson Zgambo, 9 May 2006, Buntungwa, Luanshya; Ronald Ngosa, Mpatamato, Luanshya, 9 May 2006.
32. James Mulenga, Mpatamato, Luanshya, 9 May 2006.
33. Anonymous comments made by other miners during John Ntenje's interview, Roan, Luanshya, 9 May 2006.
34. Jackson Zgambo, Buntungwa, Luanshya, 9 May 2006.
35. Roan, Luanshya, 9 May 2006.
36. Goodwell Steven Nondo, Mikomfwa, Luanshya, 14 October 2006.
37. Jackson Zgambo, Buntungwa, Luanshya, 9 May 2006.

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