Maintaining the local Empire: The Public Works Department in Dar es Salaam, 1920–60

Frank Edward
History Department, College of Humanities, University of Dar es Salaam, Tanzania

Mikael Hård
Department of History, Darmstadt University of Technology (TU Darmstadt), Germany

Abstract
Historical studies of infrastructures in colonial settings tend to focus on planning, design and construction. The article modifies this bias by highlighting the repair and maintenance of infrastructures. Investigating the Public Works Department in British Tanganyika, the authors illustrate its importance for keeping streets and roads clear, preventing sewage pipes from flooding and keeping electricity lines working. At the same time, the authors show that the Department struggled with a shortage of funds, and that it was often squeezed between other units of the British administration. Despite the obvious importance of repair and maintenance to keep the colonial economy and power apparatus running, such activities did not enjoy high esteem. The authors explain this state of affairs by referring to the generally low status of operation, maintenance and repair in Western culture and to the somewhat uneasy status of the engineering profession in British culture.

Corresponding author:
Mikael Hård, Department of History, Darmstadt University of Technology (TU Darmstadt), Dolivostrasse 15, DE-64293 Darmstadt, Germany.
Email: hard@ifs.tu-darmstadt.de
Introduction

In 1930, roughly 25 years after the first streetlights had been erected in Dar es Salaam by the German East-Africa Railroad Company, the electricity system was in decay. In a letter directed to the Director of Public Works, the Chief Electricity Engineer of the Tanganyika Railways, Mr E. Dennis, drew a dismal picture of the situation:

I would like to call your attention to the general question of Street Lighting in Dar-es-Salaam.

268 of the Existing Street Lamps have been in use since before 1907.
The bulk of the Standards are so far corroded as to be unsafe.
The cables are at the end of their useful life and it may be thus assumed that the whole of the original Street Lighting Scheme requires re-constructing.
It is becoming yearly more expensive to maintain by means of repairs and in the main, as the system has now become grossly in-efficient for its purpose.¹

This sad state of affairs did not please the local government. The Dar es Salaam Township Authority was “under pressure from members of the public” and the central government to make sure that the provision of “this essential public service” be secured. The system had deteriorated to such a degree that the only solution seemed to be “the renewal of the whole street lighting system”. Estimated costs: £10,000 to £15,000.²

This issue was not the only one to cause tension between the local administration and the – now British – railroad company. Archival material and newspaper clippings testify to the fact that electricity provision was an intensely debated issue in the interwar period. Complaints from frustrated customers found their way into the local press, and legal conflicts between users and providers were recurrent phenomena.³ By the early 1930s, the situation had accelerated to such a degree that the local and provincial authorities began to consider withdrawing the electricity concessions from Tanganyika Railways again – only two years after this company had taken over the “administration of the Electricity Department”.⁴

¹ Tanzania National Archives (hereafter TNA), File No. 18878, Letter from E. Dennis, Chief Electricity Engineer of the Tanganyika Railways, to the Director of Public Works, 14 March 1930.
² Ibid., Letter from the Executive Officer of the Dar es Salaam Township Authority to the Chief Secretary of the Provincial Commissioner of the Eastern Province, 21 November 1930.
³ Cf. further documents and newspaper clippings in TNA, AB356 and 18878.
⁴ Report by His Britannic Majesty’s Government to the Council of the League of Nations on the Administration of Tanganyika Territory for the Year 1928 (London: His Majesty’s Stationary Office, 1929), 80.
Electricity provision was not the only heavily criticized infrastructure in interwar Dar es Salaam. During the first two decades of British rule, the Medical and Sanitary Services Department (hereafter MSSD) of Tanganyika repeatedly targeted the disastrous state of the capital’s drainage and sewerage system. The Department suggested that the haphazard and unprofessional design of the system made repair and maintenance unnecessarily problematic and frequent. Stormwater drains in Dar es Salaam were “chiefly open ditches” whose “soils consist entirely of loose sand”, leading to a situation where “much time and labour are expended in their maintenance”⁵. The task of keeping the drains clear from debris apparently overwhelmed the responsible Public Works Department (hereafter PWD). The failure of the sewage system also had implications for the road network of the town. Flooded streets damaged motor vehicles and caused inconveniences for pedestrians and carriages. To alleviate the situation, the Executive Officer – who also functioned as Township Health Officer – called for a permanent and integrated stormwater and sewerage system to avert the high costs for repair and maintenance.⁶

**Beyond production and distribution**

Our introduction highlights the importance in colonial settings of repair and maintenance. What concerned the self-critical electricity providers, the uneasy township authorities and the dissatisfied Health Officer alike was the insufficient and inefficient way repair and maintenance were carried out. For more than two decades, the power utilities had been primarily concerned with expanding the electricity system to serve ever more areas and meet an increasing demand. The utilities had modernized their power generation plant and had been busy putting up new streetlamps, but the Electricity Department of the PWD does not seem to have prioritized the upkeeping of the lighting system. Not only cables had become unsafe and brittle; some of the wooden utility poles also had to be replaced. Similarly, the PWD had tried to patch the sewage system to the best of its efforts – albeit with limited success.

Our paper complements the existing literature on colonial infrastructures by bringing out the work done by PWDs, especially their repair and maintenance activities. Most studies on energy and street networks, water and sewage systems and railroads and telegraph lines in colonial settings tend to focus on design, planning, construction and expansion. This does not only go for Daniel R. Headrick’s classic works on colonial technologies, but also, for example, for Ian Kerr’s book about the expansion of the railroad system in India and Heather Hoag’s on the development of hydropower in Africa.⁷ If we are interested in the repair and maintenance of these large technological systems, we have to look

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⁵ Tanganyika Territory, *Annual Report of the Medical and Sanitary Services Department for 1929* (Dar es Salaam: The Government Printer, 1930), 47.
⁶ *See* the annual reports of the Tanganyika Medical and Sanitary Services Department from 1928 to 1932.
⁷ Daniel R. Headrick, *The Tools of Empire. Technology and European Imperialism in the Nineteenth Century* (New York NY & Oxford: Oxford University Press, 1981); Ian J. Kerr, *Engines of Change. The
elsewhere. One of the few exceptions to this rule is Joshua Ryan Grace’s dissertation on the history of the motorcar in Tanganyika and Tanzania, where the author in some detail discusses the daily activities at the PWD.8

This observation does not only go for studies of the Global South. More than 20 years ago, Carroll Pursell tried to explain why people in the Occident are particularly fascinated by new technologies: “Perhaps it is the old Platonic prejudice favouring ‘knowing’ over ‘doing’ that encourages our society to value the design of technology over its production, and its production over consumption, with maintenance hardly considered at all”.9 A number of historians of technology have in recent years answered Pursell’s call for more studies on repair and maintenance. In 2011, Joseph J. Corn published a book on users’ attempts to handle consumer products, and one year later the German journal *Technikgeschichte* devoted a special issue to the history of repair.10 In 2018, Andrew L. Russell and Lee Vinsel published a programmatic article on the “Turn to Maintenance”, and Stefan Krebs, Gabriele Schabacher and Heike Weber brought out an interdisciplinary oriented volume on the “cultures of repairing”.11 Many scholars tend to focus on the repair and maintenance of automobiles; not only Corn, but also Grace, Alexia Sofia Papazafeiropoulou, Kevin L. Borg and Stephen L. McIntyre are cases in point.12 In fact, it seems that most studies in this emerging field investigate the repair of certain products and machines rather than the maintenance of infrastructures. Russell and Vinsel claim that even historians of USA technology have hardly quarried the available “source material that would support maintenance-centered histories of railways, telephones, roads, and other large technological systems”.13 If this is true for the United States, it is even more so for the colonial world.

**The Public Works Department**

Our contribution to the literature on repair and maintenance concentrates on one type of organization that was responsible for attending the technical

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8 Joshua Ryan Grace, “Modernization *Bubu*. Car, Roads, and the Politics of Development in Tanzania, 1870s–1980s”, PhD dissertation, Michigan State University (USA), 2013.
9 Carroll Pursell, *White Heat. People and Technology* (Berkeley CA & Los Angeles CA: University of California Press, 1994), 33.
10 Joseph J. Corn, *User Unfriendly. Consumer Struggles with Personal Technologies, from Clocks and Sewing Machines to Cars and Computers* (Baltimore MD: Johns Hopkins University Press, 2011); *Technikgeschichte* 79: 3 (2012).
11 Andrew L. Russell and Lee Vinsel, “After Innovation, Turn to Maintenance”, *Technology and Culture* 59 (2018), 1–25; Stefan Krebs, Gabriele Schabacher and Heike Weber (eds), *Kulturen des Reparierens. Dinge – Wissen – Praktiken* (Bielefeld: transcript, 2018).
12 Kevin L. Borg, *Auto Mechanics. Technology and Expertise in Twentieth-Century America* (Baltimore MD: Johns Hopkins University Press, 2007); Alexia Sofia Papazafeiropoulou, “Technology Users as Empirically-Trained Mechanics. Assembly and Decoration of Improvised Vehicles in Greece During and After World War II”, *ICON* 18 (2012), 157–78; Stephen L. MacIntyre, “The Failure of Fordism. Reform of the Automobile Repair Industry, 1913–1940”, *Technology and Culture* 41 (2000), 269–99.
13 Russell and Vinsel, “After Innovation”, 11.
infrastructures that had become essential for upholding the British Empire: the PWD. Adopting Russell and Vinsel’s definition of maintenance as “the work that goes into preserving technical and physical orders”, we suggest that it was – among the official bodies of the colonial regime – the PWD that was supposed to carry out such work. Of course, the PWD planned, designed and constructed technical systems, but it also had the important task of keeping these infrastructures running. The main exception to this rule was the railroad system, which had its own organizational structure.

By focusing on the activities of the PWD in one colonial city, we bring out the everyday, mundane character of engineering. In the history of technology of the Global North, this is not necessarily a novel approach. Already 40 years ago, Edward W. Constant discussed the daily problem-solving that characterizes much technical work. Historical studies of technology in colonial settings, by contrast, tend to highlight political, administrative and ideological aspects rather than everyday engineering labour – maybe because the archival situation seldom allows detailed descriptions of “the practice of technology”. Maria Paula Diogo and Dirk van Laak’s synthetic book *Europeans Globalizing* is one of several studies that avoid place-based analyses on local levels.

In the interwar period, systems of electricity provision became a “critical infrastructure”. That is, electricity was now considered of critical importance for preserving the social and economic structures on which society was based. In the early decades of colonialism, railways, roads, telegraph lines and water pipes had been more decisive. Commercial interests had pushed for the expansion of railroad lines. Military and civil authorities needed a reliable network of roads and streets to control indigenous populations across vast areas of land. To combat disease and to be able to keep up a European lifestyle, the expatriate population expected the provision of clean water from centralized water-supply systems.

As Mr Dennis soon realized, it was never enough to simply design and build a certain infrastructure. Undermined railroad tracks and broken water mains had to be repaired. Dirt roads had to be stabilized to withstand the next rain season. Considering the size of the country, this task was especially demanding in the countryside. In British colonial settings, these tasks were usually carried out by

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14 Edward W. Constant II, *The Origins of the Turbojet Revolution* (Baltimore MD: Johns Hopkins University Press, 1980).
15 Mikael Hard, “Technology as Practice. Local and Global Closure Processes in Diesel-Engine Design”, *Social Studies of Science* 24 (1994), 549–85.
16 Maria Paula Diogo and Dirk van Laak, *Europeans Globalizing. Mapping, Exploiting, Exchanging* (Houndmills, Basingstoke: Palgrave Macmillan, 2016).
17 Concerning the application of the term “critical infrastructure” in the history of technology, see Per Hogström et al. (eds), *The Making of Europe’s Critical Infrastructure. Common Connections and Shared Vulnerabilities* (Houndmills, Basingstoke: Palgrave Macmillan, 2013).
18 This position was echoed two decades later in the special manual for civil engineers of Tanganyika: Frank Longland, *Field Engineering. A Handbook on Simple Construction* (Dar es Salaam: The Government Printer, 1952), 167.
so-called Public Works Departments – on local, regional or national levels. This was also the case in Tanganyika Territory.19

The Tanganyika PWD was founded in the early 1920s by the Territory’s first British Governor, Sir Horace Byatt. The PWD had its headquarters in Dar es Salaam, but we find traces of its activities across the country. Since Dar es Salaam was the biggest town and the seat of the colonial government, the PWD channelled most of its resources to projects in this town and the surrounding Eastern Province. These projects were not only supposed to enable the British to control movements in and guarantee access to various areas, but also to create living conditions that resembled those the expats knew from home. The task of the PWD was to construct and operate, repair and maintain basic infrastructures and public buildings in Tanganyika Territory. The Department had to deal with water supply and sewerage, stormwater management and drainage, roads and bridges, as well as electricity provision.

Unfortunately for the historian, archival records on repair and maintenance are often scant and seldom allow her or him to create a coherent narrative. This observation is not only valid for Dar es Salaam’s PWD but for most of the former colonies in the Global South. Still, within the framework of this paper we proffer a glance into the activities of the PWD, and we highlight maintenance as an important phenomenon for the history and social studies of technology – in contrast to the majority of works which, rather, focus on the establishment and expansion of infrastructures.20

Rehabilitating the German Technological Legacy

When the British assumed power over German East Africa toward the end of the First World War (hereafter WWI), they copied some elements of the German administrative system. For example, the Bezirksamtmann, who had been the highest official in German Dar es Salaam, was simply replaced by a District Commissioner. Of course, the British also took over the German infrastructures. The “railways, roads, barracks, post, and telegraph stations” which the Germans had built impressed contemporary British commentators. Albert Calvert, for instance, testified to the high quality of these structures: they had been designed in a “substantial and typically Teutonic” way.21 Prior to 1914, the Dar es Salaam

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19 Concerning the early history of public works departments in some British colonies, see David Sunderland, Managing the British Empire. The Crown Agents, 1833–1914 (Woodbridge: Boydell Press, 2014), 142–5.
20 See, e.g., Barbara Ntombi Ngwenya, “The Development of Transport Infrastructure in the Bechuanaland Protectorate 1885–1966”, Botswana Notes and Records 16 (1984), 73–84; Allen F. Isaacman and David Morton, “Harnessing the Zambezi. How Mozambique’s Planned Mphanda Nkuwa Dam Perpetuates the Colonial Past”, The International Journal of African Historical Studies 45 (2012), 157–90; Javier Márquez Quevedo, “Telecommunications and Colonial Rivalry. European Telegraph Cables to the Canary Islands and Northwest Africa, 1883–1914”, Historical Social Research 31 (2010), 108–24.
21 Both quotes are taken from Albert F. Calvert, German East Africa (London: Laurie, 1917), xviii.
infrastructure concerns were directly overseen by the German Governor. He chaired the Stadtgemeinde, the Municipal Council, composed of five Germans from key government departments.\textsuperscript{22} Under the supervision of the German state, it was mostly private companies which had built railroad and telegraph lines, urban streets and rural roads, as well as a rudimentary water and sewerage network in some towns. In the case of railroads, even the operation of the system remained in private hands.\textsuperscript{23} As mentioned, the Railway Company had also designed the first electricity system in the capital. After the war ended, the immediate challenge facing the new rulers was to repair these infrastructures and develop plans for their future expansion. It was in this situation that the Governor assigned the important tasks of operation, maintenance and repair to the PWD.

Street outlays define the framework for urban life and economic activities. In the case of Dar es Salaam, the British found a grid system based on the principles of military control and racial separation – “a lovely monotony”, as one British commentator somewhat ambivalently described it.\textsuperscript{24} Almost immediately after the Germans had settled in Dar es Salaam they designed the first arterial roads leading radially outward from the harbour. Still forming the basic axes in today’s megacity, these wide avenues enabled visual overview and allowed troops to move quickly.\textsuperscript{25} Other main roads marked the borders between various ethnic groups in a very physical manner. These borders divided the town into three zones: one for Europeans, one for Asians, and one for Africans (applying the contemporary categories).\textsuperscript{26}

In the first decade of German rule, streets were monofunctional, that is, they were only designed to serve physical mobility and were not connected to sewage or drainage systems. The situation changed after the turn of the century. Recurrent floods had shown the vulnerability of the road system in times of heavy rains, and an increasing awareness of the relationship between stagnant water and malaria made drainage a pressing concern. Shortly before WWI, the Governor of German East Africa appointed an American consulting engineer, Dr A. J. Orenstein, to come up with a strategy to combat malaria. Orenstein recommended to drain ponds and swamps and to make sure that the water in small creeks was led as quickly as possible into rivers or the Indian Ocean.\textsuperscript{27} To prevent malaria mosquitoes from hatching, ponds ought to be filled with soil, creeks needed to be cleared

\textsuperscript{22} Deutsches Kolonialblatt (1909), quoted from H. William Rodemann, “Tanganyika, 1890–1914: Selected Aspects of German Administration”, PhD dissertation, University of Chicago (USA), 1961, 85–6.

\textsuperscript{23} Franz Baltzer, Die Kolonialbahnen mit besonderer Berücksichtigung Afrikas (Berlin & Leipzig: G. J. Göschens’sche Verlagshandlung, 1916), 411.

\textsuperscript{24} George L. Steer, Judgement on German Africa (London: Hodder & Stoughton, 1939), 7.

\textsuperscript{25} James R. Brennan and Andrew Burton, “The Emerging Metropolis. A History of Dar es Salaam, circa 1862–2000”, in James R. Brennan, Andrew Burton and Yusuf Lawi (eds), Dar es Salaam. Histories from an Emerging African Metropolis (Dar es Salaam: Mkuki na Nyota, 2007), 13–75, here 24.

\textsuperscript{26} Karl Vorlaufer, Koloniale und nachkoloniale Stadtplanung in Dar es Salaam. Gesellschaftspolitische Zielvorstellungen und städtebauliche Ideen in ihrem Einfluß auf die Raumstruktur einer tropischen Großstadt (Frankfurt am Main: Frankfurt University, 1970).

\textsuperscript{27} TNA, 450/39/10, Report by Dr A.J. Orenstein to the Imperial Governor of German East Africa, 1913.
from vegetation, drains had to be dug and culverts constructed. Orenstein listed several streets where the installation of drainage networks was paramount. Most of these streets were in Asian and African areas, particularly the fairly centrally located Chafukoga area today’s Mchafugoke.

The outbreak of WWI meant that Orenstein’s report was never followed up. When the British moved in toward the end of the war, they encountered infrastructures badly in need of reconstruction. In fact, the first British repair and maintenance engineers were military personnel. It was they who in 1917 laid the foundation for what would later become the civilian PWD. It is thus fair to argue that WWI triggered the institutionalization of a repair and maintenance culture in Dar es Salaam.28

A “Report on New Works required in Daressalaam” from September 1919 listed necessary actions: wells situated close to cesspits ought to be closed, road drains were in need of repair, culverts had to be cleared, gutters needed an overhaul, public buildings had to be repaired, dust bins ought to be erected, “Mango and Acacia trees” (!) had to be repaired, and so on.29 The report even mentioned the “Repair or replacement of W.C. flushing cisterns”. The repair of underground networks was particularly problematic for those who were commissioned to carry out these projects: “No German plans of the drainage of the town seem to have been left, if indeed such existed.” The task ahead seemed formidable:

Many of the street drains are blocked up solidly with a type of sand which sets almost like a cement, and which can only be removed by taking up the drain. Again, many of the street drains fall into manholes, whose inlet is larger than the outlet; I am informed that in German times gangs of convicts were continually employed in baling [sic] out these traps by hand. This would hardly seem consistent with British ideas of road construction [sic].

Along other streets, the Germans had apparently made no attempts to design drainage culverts. In the rainy season, for example, Mosque Street and Bulow Street turned into “river beds”.

In our interpretation, it was this conglomerate of challenging “New Works” and the accidental supply of engineers between 1917 and 1920 that triggered the British authorities to establish the PWD. Although the Department would be responsible for the construction of new roads and bridges, the design of new water mains and sewage pipes and the erection of new buildings, its hour of birth was rather marked by the need to repair, reconstruct and rehabilitate the infrastructures the Germans left behind. It is true that the author of the “Report on New Works” (presumably an employee of the Health Office) flagged the need of

28 Concerning the concept of “repair culture”, see Wolfgang M. Heckl, Die Kultur der Reparatur (Munich: Carl Hanser, 2013).
29 All quotes in this paragraph are taken from TNA 450/39/10, “Summary of Report on New Works required in Daressalaam”, 30 September 1919.
novel “schemes” and massive investments.\textsuperscript{30} If we look closer at the suggested actions, however, repair and maintenance appear to have been of equal if not superior importance. Similarly, the PWD’s and the MSSD’s annual reports testify to the centrality of repair and maintenance activities in Dar es Salaam. Still in 1935, for instance, the MSSD emphasized the repair works it had undertaken in “the drain pipes which carry surface water and sewage to the harbour and Ocean road fronts”.\textsuperscript{31} It is thus not surprising that PWD Director C. Y. Stevenson later complained that his department had been reduced to merely a repair and maintenance unit that had few resources left to design and construct new infrastructures and buildings. His complaint featured in the 1937 proposal to reorganize the PWD:

The time of the Director of Public Works and his technical officers is unduly occupied by the number of petty undertakings and maintenance services which form so large a portion of the annual programme of public works. We consider that the majority of these minor works and services could [...] be adequately carried out by a less highly skilled organization and that the activities of the trained staff of the Public Works Department should be directed more towards design and execution of large works where their technical and professional knowledge can be employed to the best advantage.\textsuperscript{32}

The proposal called for the breaking up of the PWD into provincial and district organs. This move probably aimed at relieving the PWD leadership from their one-sided attention to Dar es Salaam to focus more on the emerging townships of Tanganyika and the vast rural areas. Although the proposal was approved by the Legislative Council of Tanganyika (LEGICO) in 1938, the Department continued to predominantly undertake repair and maintenance activities under the old organizational setup until the late 1940s. The key reasons were the long-term impact of the Great Depression and the onset of the Second World War (hereafter WWII), which complicated fund remittance from London and directed technical personnel to the battleground. Only after 1950 did the PWD receive substantial resources to focus on the development and construction of new infrastructures – predominantly in the areas of road building, public housing, electrification and sewerage. Historian John Iliffe credits the construction resurgence to the new Governor, Sir Edward Twining, whom he calls “a developer”. Sir Edward channelled as much as two-thirds of the newly set up Colonial Development and Welfare Funds “toward infrastructure”.\textsuperscript{33}

\textsuperscript{30} Ibid.
\textsuperscript{31} Tanganyika Territory, \textit{Annual Report of the Medical and Sanitary Services Department for 1935} (Dar es Salaam: The Government Printer, 1937), 10, 38.
\textsuperscript{32} Tanganyika Territory, \textit{Annual Report of the Public Works Department 1937} (Dar es Salaam: The Government Printer, 1938), 28.
\textsuperscript{33} John Iliffe, \textit{A Modern History of Tanganyika} (Cambridge: Cambridge University Press, 1979), 442–3.
Drainage and flood control

Although the “British ideas” on road design and drainage might have differed from German practice, the British after WWI nevertheless continued using and even expanding the German system. One typical characteristic of the German “dual” system was the application of underground pipes which combined the channelling of sewerage and stormwater. Parallel to this, the British began designing a surface drainage system which was unconnected to the combined, dual system. One advantage of the surface drainage system was that it better served the purpose of flood control, as it could handle larger amount of water in a particular time. The other advantage was the draining of possible locations for mosquito breeding, thus reducing the risk of malaria.

As far as the degree of coverage goes, the German system was extremely rudimentary. Only a few streets in the “European” parts of the downtown area had access to drainage systems: “African” areas were not at all connected. The British conceded that, when:

sewers constructed during the German occupation exist, these discharge into the sea and in some cases are in poor condition. At Dar es Salaam the outfalls have been repaired and function satisfactorily; it is however only a small section of the town, mainly along the water front, which is served by these sewers.34

As Orenstein had suggested, this critical state of affairs contributed to the spread of malaria and other diseases. Throughout the period of British rule then, one of the PWD’s main tasks was to design engineering solutions to health problems. Echoing Orenstein’s ideas, the PWD cleaned up creeks to prevent stagnant water and successively included ever more areas into the drainage and sewage network.

In addition to flood control, the most pressing task throughout most of the British period was malaria prevention. Controlling the breeding places of mosquitoes carrying malaria was a central concern for the central government and LEGICO alike. At one LEGICO meeting in 1930, Council member A. Khimji indirectly criticized the PWD’s drains by referring to the recurrent floods of the Chafukoga area. Mr Khimji’s concern was the need to contain the “mosquito menace” in this commercially lively part of town.35 The connection between floods and malaria in Dar es Salaam was well established in government circles, particularly in the MSSD. The Department’s annual reports reveal that whenever there were rains or floods, the MSSD was annoyed by the inefficiency of the drainage infrastructure. Between 1923 and 1945, the reports complained about the lack of money to construct a permanent, integrated stormwater drainage system to replace the existing earth drains. Since the surface drains were earthy and their soils were sandy, they had to be cleared each year after the pluvial period

34 Tanganyika Territory, Annual Report of the Medical and Sanitary Services Department for 1925. (Dar es Salaam: The Government Printer, 1926), 31.
35 Tanganyika Standard, 26 April 1930.
over and over again. The MSSD appreciated the allocation of funds to the PWD for “routine... maintenance of drains in Dar es Salaam”, but suggested that – in the long run – costs would be reduced if proper culverts were built.\textsuperscript{36}

To some extent, the continuous complaints by the MSSD also hit the department itself, since it held a fairly strong position in the British administrative structure. In accordance with the Government Notice No. 48 of 1923, the MSSD had the final say when it came to hiring executive administrators for Dar es Salaam, and it also had decisive influence on policy matters pertaining to drainage and flood control.\textsuperscript{37} The PWD could not veto decisions made by the MSSD. Its strong position enabled the MSSD to redefine engineering tasks in sanitary terms. For example, when the MSSD requested to appoint a Sanitary Engineer in 1923, it made abundantly clear that the design, construction and maintenance of drains and culverts had malaria reduction as their main goal. The Government followed suit, when it two years later appointed a Sanitary Engineer under the MSSD instead of the PWD.\textsuperscript{38} Despite objections on part of the PWD, the Government continued to favour the MSSD. When the sanitary engineer had to be replaced in 1927, the Government once more assigned this position to the MSSD.\textsuperscript{39} To emphasize the medical aspect of this job, it became known in the 1930s under the title “Malarial Engineer”. The PWD was not against recruiting a sanitary engineer for anti-malarial works but emphasized that the Department desperately needed a person who could be assigned other civil-engineering tasks as well. The MSSD, however, wanted the sanitary engineer to be integrated into its own organization, although he should also be allowed to cooperate with PWD. Anti-malaria campaigns reached a peak in “The Extermination of Mosquito Ordinance” of 1935, which justified the presence of a Malarial Engineer under the MSSD.\textsuperscript{40} After that, however, the MSSD’s position weakened, and the PWD became more powerful. The PWD was reorganized in 1938, and after WWII it received a kind of monopoly on all engineering positions.

It is hard to judge if these internal power struggles delayed the expansion of the sewage and drainage system in the capital. After several years of continuing demands by the MSSD for the construction of a comprehensive and permanent drainage infrastructure for Dar es Salaam, the Government in 1930 commissioned Messr. Howard Humphrey & Sons to design such a system.\textsuperscript{41} Their designs were ready by 1931, but the Government could not amass enough funds for

\begin{footnotes}
\textsuperscript{36} Tanganyika Territory, \textit{Annual Report of the Medical and Sanitary Services Department for 1923} (London: The Crown Agents for Colonies, 1924), 47.
\textsuperscript{37} Tanganyika Territory, \textit{Annual Medical and Sanitary Report for 1923} (London: The Crown Agents for the Colonies), 46.
\textsuperscript{38} Tanganyika Territory, \textit{Annual Report of the Medical and Sanitary Services Department for 1925}, 32.
\textsuperscript{39} TNA, 450/46/8, Letter from the Director of the MSSD to the PWD and letter from Governor to Secretary of State, Tanganyika, 14 April 1927.
\textsuperscript{40} TNA, 21507, Letter from the Clerk of the Executive Council to the Attorney General, 8 January 1937.
\textsuperscript{41} Tanganyika Territory, \textit{Annual Report of Medical and Sanitary Services Department 1930} (Dar es Salaam: The Government Printer, 1931), 21.
\end{footnotes}
its execution.\textsuperscript{42} It would actually take another 20 years before the PWD could start implementing it. In 1951, the work on a revised drainage design for sewerage and stormwater commenced, and it was completed in 1955. By then, the town had grown substantially, both spatially and demographically, and the expansion of surface drains for malaria and drains for sewage had become an extremely pressing concern.\textsuperscript{43}

Of course, the drainage system was not only supposed to keep malaria at bay. Its task was also to control floods that affected buildings, roads and bridges. Describing the threat of floods in the \textit{Chafukoga} area during German times, Orenstein had noted that water could stay in people’s houses for as long as two weeks. This situation persisted in the early British era with little or no action besides reporting the disgrace in official documents. Only in the aftermath of a protracted residential re-organization in 1925, which moved Africans to \textit{Kariakoo} and Asians further to the former African area of \textit{Chafukoga}, did the British implement a more comprehensive scheme for the repair and maintenance of the surface drainage with the goal of protecting roads and property from damage. These efforts soon proved insufficient, however. In 1927, the Township Health Officer wrote a letter to the Eastern Province Commissioner saying that “in other parts of the Native Town, it was seen that water stood for longer periods owing to complete lack of any drains at all”.\textsuperscript{44} In the end, it turned out that the Commissioner only intervened after the Health Officer reported that flooded African houses threatened to collapse.\textsuperscript{45} It would actually take until the 1950s before the British finally installed a combined sewage and stormwater network that covered several ethnic areas of town.\textsuperscript{46}

The most powerful users of larger roads were invariably government officials, settlers and rich merchants. The majority consisted of Europeans, and a few were of Asian origin. They owned motor vehicles, albeit few up to the late 1940s. They used media, like the weekly newspaper \textit{Tanganyika Standard}, and their strong social, political and economic position help them enforce prompt repair and maintenance. In 1930, the \textit{Tanganyika Standard} at several occasions ran articles with titles such as “Flood Havoc in Dar es Salaam” and “Damage to Roads and Bridges”. The bottom-line of these reports were always strong calls for immediate road repairs. The Governor was, in many cases, willing to use the emergency fund for road repair without LEGICO approval. In a letter to LEGICO in 1930, the Governor regretted that, “I have myself felt compelled to respond to an appeal from the Director of Public Works for a sum of £5,000...required for this

\textsuperscript{42} Tanganyika Territory, \textit{Annual Report of the Medical and Sanitary Services Department 1931} (Dar es Salaam: The Government Printer, 1932), 18.

\textsuperscript{43} Tanganyika Territory, \textit{Annual Report of the Public Works Department 1955} (Dar es Salaam: The Government Printer, 1956), 13.

\textsuperscript{44} TNA, 61/247/1, “Sanitation – Dar es Salaam”.

\textsuperscript{45} \textit{Ibid.}

\textsuperscript{46} Hugh H. Dixon, “The Main Drainage of Dar-es-Salaam, Tanganyika Territory”, in Institution of Civil Engineers (ICE), \textit{Proceedings of Conference on Civil Engineering Problems in the Colonies} (London: ICE, 1954), 95–110.
unforeseen service”

The service he meant was the repair of flood-damaged roads. This action was a response to floods that left heavily trafficked roads in a miserable condition. In one instance, it was reported that “motor cars ploughed through mud and water, into pot-holes, and sprayed the dirty water over those who had to walk”. In other words, the repair and maintenance of roads and drainage infrastructures in Dar es Salaam were of a reactive nature. These activities were not part and parcel of a preconceived plan but reactions to suddenly emerging events: dangerous floods, hatching mosquitoes and clogged drains.

The organization of the PWD

When the Germans built the first technological infrastructures in Dar es Salaam, they to a large extent relied on forced labour. Private entrepreneurs profited from the power of the so-called Protection Forces (Schutztruppen) over the indigenous population. In comparison, the foundation of the PWD implied a stronger formalization of labour relations. The PWD relied on a permanent staff of skilled and unskilled white-collar personnel of European or Asian descent, along with a large body of unskilled “African” workers, often organized in so-called labour gangs. These gangs were of two kinds. Some of them consisted of free, wage-earning workers, usually hired on a day-to-day basis by a middleman (who usually summoned workers from his own ethnic group). Other labourers were unpaid, often prisoners or villagers mobilized by means of brute force. The District Report of 1933 stated that much work was done by labourers of the last category, most of them accused of tax defaulting. Many of these tax evaders came from the rural vicinity of Dar es Salaam. In 1931, the MSSD reported that “under-drainage and filling were carried out in many” township “localities, especially on golf course. Grateful acknowledgement to the Prison authorities for assistance with labour for this work is made”.

Still, paid labour gangs formed the core of construction, repair and maintenance manpower of the PWD. An important alternative to formal education and training, working experience from the PWD’s labour force and, especially, its workshops was an invaluable ticket for ambitious, young Africans wishing to climb the career ladder to the semi-skilled jobs in the Department. The Director was even reported to decline recruits from vocational secondary schools on the ground that they lacked work experience with the PWD or industrial companies. Some of the activities that were performed by Africans included digging road drains and ditches filled by sands, and repairing eroded roads and culverts using simple

47 Tanganyika Standard, 26 April 1930.
48 Tanganyika Standard, 4 March 1930.
49 Philip H.C. Clarke, A Short History of Tanganyika. The Mainland of Tanzania (Arusha: Longmans, 1966), 107.
50 TNA, Open Access, Annual Report of Dar es Salaam District 1933, 9.
51 Tanganyika Territory, Annual Report . . . 1931, 23.
52 Grace, “Modernization Bubu”, 211–2.
tools like hand hoes and trowels. Historians of technology recognize this emphasis on on-the-job experience as a typical British trait. Especially compared to countries on the Continental Europe and to some extent in comparison to the United States, British industry kept relying on in-house training well into the late twentieth century. 53 We find traces of this engineering culture also in the British colonies.

A survey of the PWD’s annual reports reveals that the Department was the government’s main arm for large scale technological structures and systems. In the 1920s, as already mentioned, its paramount task was the repair and maintenance of the German-built infrastructures in Dar es Salaam. It was only toward the end of the 1920s and in the early 1930s that the construction of new infrastructures and buildings began to receive more attention. This slow shift of focus had to do with the rapid expansion of the city, as the new European suburb of Oyster Bay was designed and the important Selander Bridge was built. 54 As shown above, when the PWD Director strived for institutional reform in the late 1930s, he did so in order to be able to focus more strongly on the building of new structures and systems. Construction was to replace reconstruction, if you like. Nevertheless, WWII put a spoke in the wheel, and larger reforms had to wait until late 1950s. Repair and maintenance remained the PWD’s main activities until the arrival of Sir Edward.

Until the implementation of the 1945 Colonial Development and Welfare Act, the PWD was forced to struggle with limited resources. These limitations go a long way toward explaining the haphazard and reactive character of the Department. They also to some extent account for the recruitment problems its directors repeatedly faced. Its senior staff was appointed in London by the Secretary for Colonies—a cumbersome arrangement that did not necessarily increase the efficiency of the PWD. Reports show that the PWD experienced a constant shortage of staff—from the beginnings and well into the 1940s. Funds for salaries, maintenance and repair remained largely constant between the early 1920s and the mid-1940s, and construction funds were highly limited throughout this period. As a result of the British shift toward a more concerted “development” policy toward its colonies after WWII, the situation only improved in the 1950s. 55

The PWD was initially manned by a small staff of civil engineers, along with a few architects and draughtsmen. Senior and highly technical positions remained a monopoly of Europeans, whereas Asians were found in semi-skilled jobs. Africans would occupy the less skilled jobs, like supervision, metal work and driving. From the 1920s to the mid-1940s, Africans, except the drivers, were not recorded

53 Austen Albu, “British Attitudes to Engineering Education. A Historical Perspective”, in Keith Pavitt (ed.), Technical Innovation and British Economic Performance (London & Basingstoke: Macmillan, 1984), 67–87, here 72–3.
54 Tanganyika Territory, Annual Report of the Public Works Department, 1929 (Dar es Salaam: The Government Printer, 1930), 6.
55 These changes in British policy had its parallels among other European colonial powers, see Joseph M. Hodge, Gerald Hödl and Martina Kopf (eds), Developing Africa. Concepts and Practices in Twentieth-Century Colonialism (Manchester: Manchester University Press, 2013).
as official PWD employees, despite the fact that the labour-intensive public works remained highly dependent on African labour gangs.

In the 1930s, the PWD began to expand gradually, and its organization and tasks became more elaborate. First, it established a number of provincial units. In areas where such a solution was not possible, it continued to rely on provincial and district authorities or consulting engineers for fulfilling the necessary works.\(^{56}\) The headquarters remained in Dar es Salaam. Second, reflecting its growing areas of responsibility after the mid-1930s, the PWD made its work structure more professional, on the basis of functional specialization. It formed, gradually, such units as the “Roads Branch”, the “Building Branch”, the “Electrical and Mechanical Branch”, the “Water Branch”, and the “Government Store Branch”. PWD reports from the early 1930s to 1960 show that, basically, this structure remained intact until Independence.\(^{57}\)

**Caught in the middle**

Despite its importance for the maintenance and continued expansion of Dar es Salaam’s critical infrastructures, the PWD – at least until the mid-1930s – often found itself caught in the middle. The Health Officer demanded better drainage and the removal of potential mosquito hatching areas. The press criticized the Department’s lack of efficiency. The municipal administration expected projects to be carried out within the prescribed budget. At times, the District and Provincial Commissioner made important decisions without even consulting the PWD’s technical experts. At the same time, the PWD had to cope with very limited resources and a difficult business environment. Spare parts took months to arrive from overseas, and the leading engineering positions were hard to fill.

Documents from the Tanzania National Archives illustrate the difficulties with which the PWD had to struggle. Already in 1919, the Dar es Salaam Health Officer, in a “Report on New Works”, had pointed to the Chafukoga area as a potential health hazard. In the rainy season, this “dirty washing place” turned into “a large stagnant pool about 7494 yards square, covered with green algae, and in its shadier parts affording amply opportunities for the breeding of myriads of mosquitoes”.\(^{58}\) Fourteen years later, the situation had not changed much. In 1933, the Directors of the PWD and the MSSD exchanged several letters discussing the unsatisfying situation in Chafukoga.\(^{59}\) Because of insufficient drainage and unsuccessful attempts to control floods, several buildings in the area were threatened by collapse. And, six years earlier, the Dar es Salaam Health Officer had complained to the Provincial Commissioner for Eastern Province that several

\(^{56}\) Tanganyika, *Annual Report ... 1937*, 4.

\(^{57}\) See, for instance, Tanganyika Territory, *Annual Report of the Public Works Department 1936* (Dar es Salaam: The Government Printer, 1938) and Tanganyika Territory, *Annual Report of the Public Works Department 1950* (Dar es Salaam: The Government Printer, 1952).

\(^{58}\) TNA, 450/39/10, “Summary of Report on New Works required in Daressalaam”, 30 September 1919.

\(^{59}\) TNA, 450/39/15, “Sewerage Scheme for Dar es Salaam”.
areas in the “Native Town” were almost unliveable. In a very direct manner, the Health Officer made it abundantly clear that he considered it “incumbent upon the Government to make these houses habitable. Permanent and semi-permanent drains are required in those places”.60 Interestingly, the PWD initially had not been included in this correspondence. Only later did it dawn to the Township Executive Officer that the PWD also ought to be “consulted in the matter of drainage”.61

The matter was complicated by the fact that the PWD itself seldom initiated new projects. Most of them were initially conceived by, alternatively, the Governor, the Provincial Officer, the District Officer or the Health Officer, who simply asked the PWD to execute them. Put bluntly, the PWD and its engineers were constantly receiving orders, while, on the other hand, its own advice was often being ignored. The case of not appointing a Sanitary Engineer in the late 1920s and early 1930s serves as a good example.

We argue that the precarious situation of the PWD had to do with the professional status of civil engineers, not just in colonial Tanganyika but also in metropolitan Britain. In a presentation to the Institution of Civil Engineers (ICE) in 1948, civil engineer George Macdonald complained about the relatively weak position of so-called sanitary engineers in the British colonies.62 If we compare this statement with the position of civil engineering in the public imagination around the turn of the twentieth century, the difference is pronounced. Historian Casper Andersen, for one, has brought out the pioneering role of civil engineering for the colonial project had in the decades before WWI – not least “by establishing infrastructures”.63 Back then, engineers had been depicted as pioneers and harbingers of civilization. After the war, by contrast, their role was much more mundane and parochial – especially in war-torn Dar es Salaam. To clear gutters, dig drains and repair utility poles were, by far, not so heroic as constructing railroad lines, building bridges and designing harbour facilities.

The conflict between the PWD and the MSSD also concerned professional status. Reflecting the situation in Britain, engineers generally had a more difficult standing than medical doctors in the colonies.64 As Joan Lane and other historians have emphasized, British parents tended to encourage their children to study medicine rather than engineering, as medicine was considered a nobler profession.65 The decades around 1900 were the heydays of the so-called sanitation movement – in Britain and elsewhere in Europe and North America.66 Entrusted with the task

60 TNA, 61/247/1, “Sanitation—Dar es Salaam”.
61 Ibid.
62 George Macdonald, “Tropical Hygiene and the Engineer”, in Institution of Civil Engineers (ICE), ICE Conference Proceedings (London: ICE, 1948), 287–99, here 294.
63 Casper Andersen, British Engineers and Africa, 1875–1914 (London: Pickering & Chatto, 2011), 115.
64 Albu, “British Attitudes”.
65 Joan Lane, A Social History of Medicine. Health, Healing and Disease in England, 1750–1950 (London & New York NY: Routledge, 2001), 11–12; R.A. Buchanan, “Gentlemen Engineers. The Making of a Profession”, Victorian Studies 26 (1983), 407–29.
66 See Michael Worboys, Spreading Germs. Disease Theories and Medical Practice in Britain, 1865–1900 (Cambridge: Cambridge University Press, 2000).
of preventing the colonies from becoming the white man’s grave, medical doctors were regarded as indispensable.

The PWD was unwilling to accept a low social status. The outcome of its struggle for recognition and power brought some improvement but did not – in the eyes of the civil engineers – go far enough. The PWD’s reorganization did not, throughout the remaining British era, fundamentally change the structural pattern of being engulfed by other decision makers. The establishment of a parallel organization in 1949 did not bring the much hoped-for relief. Reflecting the British model of municipal governance, the newly established Municipal Council of Dar es Salaam founded its own Engineering Department in that year. Although it contributed to lessening the public condemnation of the PWD in the press, the most immediate repair and maintenance work remained the responsibility of the PWD. Since the Council did not have financial power, the newly appointed Municipal Engineer only undertook a very limited range of repair and maintenance work.

Conclusion: The critical infrastructures of the Empire

The British Empire was based on a firm material foundation. Harbour facilities, railroad tracks, military equipment, telegraph lines, bitumen roads, diesel generators, water pipes and sewage culverts were necessary to control the space where the sun never sat. In the interwar period, these technologies had become critical to the Empire. That is, in case of failure or breakdowns, affected areas of the Empire would find themselves in a critical condition, maybe even in a state of crisis. Our article can be read as a contribution by two historians of technology to the literature stressing the fragility of colonial power. In particular, the story we tell about the difficult position of the PWD squares well with William Cunningham Bissell’s analysis of the continuous and often futile struggle by British colonial officers in Zanzibar to keep chaos at bay. Paraphrasing Russell and Vinsel, we could say that our article investigates how British colonialists tried to maintain a certain degree “technical and physical orders”, and that Bissell studies how the British attempted to maintain a certain degree of social order.67

As our study has indicated, the responsibility for avoiding critical instances lay on the PWDs. Although our paper is restricted to Dar es Salaam and the Eastern Province of Tanganyika Territory, we expect that further investigations will show that similar institutions in other cities, towns and regions under British rule made sure that the Empire kept running. As our title suggests, it was these PWDs which maintained the Empire on the local level. By constantly repairing and attending, operating and expanding the technological infrastructures of the Empire, PWDs gave the colonial power a stable, material basis.

Despite its important functions, the PWD did not have an easy standing. It was often criticized by the public, looked down upon by other municipal units and

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67 William Cunningham Bissell, Urban Design, Chaos, and Colonial Power in Zanzibar (Bloomington IN: Indiana University Press, 2011).
pushed to its limits by governors and provincial commissioners. We argue that one reason for this exposed position was a social hierarchy, according to which engineering had a somewhat lower position than the medical profession. Just as important, however, was the traditionally low status of repair and maintenance in European culture.\(^{68}\) Since such tasks were often delegated to unskilled day labourers in the colonies, this problematic standing was even reinforced in colonial settings. In an ironic twist of affairs, one could say the local Empire relied on “African” labour gangs – without them, it would have ceased to function very quickly.

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**ORCID iDs**

Frank Edward [https://orcid.org/0000-0001-8510-7082](https://orcid.org/0000-0001-8510-7082)
Mikael Hård [https://orcid.org/0000-0003-2466-1092](https://orcid.org/0000-0003-2466-1092)

**Bibliography**

**Archival sources**

The National Archives, Kew, UK (NAK).
Tanzania National Archives (TNA), Dar es Salaam.

**Published sources**

Austen Albu, “British Attitudes to Engineering Education. A Historical Perspective”, in Keith Pavitt (ed.), *Technical Innovation and British Economic Performance* (London & Basingstoke: Macmillan, 1984), 67–87.
Casper Andersen, *British Engineers and Africa, 1875–1914* (London: Pickering & Chatto, 2011).
Franz Baltzer, *Die Kolonialbahnen mit besonderer Berücksichtigung Afrikas* (Berlin & Leipzig: G. J. Göschen’sche Verlagshandlung, 1916).
William Cunningham Bissell, *Urban Design, Chaos, and Colonial Power in Zanzibar* (Bloomington IN: Indiana University Press, 2011).

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\(^{68}\) Both pre-modern and modern European historians testify to this marginal position of such practices; see, e.g., Reinhold Reith and Georg Stöger, “Einleitung. Reparieren-oder die Lebensdauer der Gebrauchsgüter”, *Technikgeschichte* 79 (2012), 173–84; David Edgerton, *The Shock of the Old. Technology and Global History since 1900* (London: Profile Books, 2006), ch. 4.
Kevin L. Borg, *Auto Mechanics. Technology and Expertise in Twentieth-Century America* (Baltimore MD: Johns Hopkins University Press, 2007).

James R. Brennan and Andrew Burton, “The Emerging Metropolis. A History of Dar es Salaam, circa 1862–2000”, in James R. Brennan, Andrew Burton and Yusuf Lawi (eds), *Dar es Salaam. Histories from an Emerging African Metropolis* (Dar es Salaam: Mkuki na Nyota, 2007), 13–75.

R.A. Buchanan, “Gentlemen Engineers. The Making of a Profession”, *Victorian Studies* 26 (1983), 407–29.

Albert F. Calvert, *German East Africa* (London: Laurie, 1917).

Philip H.C. Clarke, *A Short History of Tanganyika. The Mainland of Tanzania* (Arusha: Longmans, 1966).

Edward W. Constant II, *The Origins of the Turbojet Revolution* (Baltimore MD: Johns Hopkins University Press, 1980).

Joseph J. Corn, *User Unfriendly. Consumer Struggles with Personal Technologies, from Clocks and Sewing Machines to Cars and Computers* (Baltimore MD: Johns Hopkins University Press, 2011).

Maria Paula Diogo and Dirk van Laak, *Europeans Globalizing. Mapping, Exploiting, Exchanging* (Houndmills, Basingstoke: Palgrave Macmillan, 2016).

Hugh H. Dixon, “The Main Drainage of Dar-es-Salaam, Tanganyika Territory”, in Institution of Civil Engineers (ICE), *Proceedings of Conference on Civil Engineering Problems in the Colonies* (London: ICE, 1954), 95–110.

David Edgerton, *The Shock of the Old. Technology and Global History Since 1900* (London: Profile Books, 2006).

Joshua Ryan Grace, “Modernization Bubu. Car, Roads, and the Politics of Development in Tanzania, 1870s–1980s”, PhD dissertation, Michigan State University (USA), 2013.

Mikael Hård, “Technology as Practice. Local and Global Closure Processes in Diesel-Engine Design”, *Social Studies of Science* 24 (1994), 549–85.

Daniel R. Headrick, *The Tools of Empire. Technology and European Imperialism in the Nineteenth Century* (New York NY & Oxford: Oxford University Press, 1981).

Wolfgang M. Heckl, *Die Kultur der Reparatur* (Munich: Carl Hanser, 2013).

Heather J. Hoag, *Developing the Rivers of East and West Africa. An Environmental History* (London: Bloomsbury, 2013).

Joseph M. Hodge, Gerald Hödl and Martina Kopf (eds), *Developing Africa. Concepts and Practices in Twentieth-Century Colonialism* (Manchester: Manchester University Press, 2013).

Per Högselius et al. (eds), *The Making of Europe’s Critical Infrastructure. Common Connections and Shared Vulnerabilities* (Houndmills, Basingstoke: Palgrave Macmillan, 2013).

John Iliffe, *A Modern History of Tanganyika* (Cambridge: Cambridge University Press, 1979).

Allen F. Isaacman and David Morton, “Harnessing the Zambezi. How Mozambique’s Planned Mphanda Nkuwa Dam Perpetuates the Colonial Past”, *The International Journal of African Historical Studies* 45 (2012), 157–90.

Ian J. Kerr, *Engines of Change. The Railroads that Made India* (Westpoint CT: Praeger, 2007).

Stefan Krebs, Gabriele Schabacher and Heike Weber (eds), *Kulturen des Reparierens. Dinge – Wissen – Praktiken* (Bielefeld: transcript, 2018).
Joan Lane, *A Social History of Medicine. Health, Healing and Disease in England, 1750–1950* (London & New York NY: Routledge, 2001).

Frank Longland, *Field Engineering. A Handbook on Simple Construction* (Dar es Salaam: The Government Printer, 1952).

George Macdonald, “Tropical Hygiene and the Engineer”, in Institution of Civil Engineers (ICE), *ICE Conference Proceedings* (London: ICE, 1948), 287–99.

Stephen L. MacIntyre, “The Failure of Fordism. Reform of the Automobile Repair Industry, 1913–1940”, *Technology and Culture* 41 (2000), 269–99.

Barbara Ntombi Ngwenya, “The Development of Transport Infrastructure in the Bechuanaland Protectorate 1885–1966”, *Botswana Notes and Records* 16 (1984), 73–84.

Alexia Sofia Papazafeiropoulou, “Technology Users as Empirically-Trained Mechanics. Assembly and Decoration of Improvised Vehicles in Greece During and After World War II”, *ICON* 18 (2012), 157–78.

Carroll Pursell, *White Heat. People and Technology* (Berkeley CA & Los Angeles CA: University of California Press, 1994).

Javier Marquez Quevedo, “Telecommunications and Colonial Rivalry. European Telegraph Cables to the Canary Islands and Northwest Africa, 1883–1914”, *Historical Social Research* 31 (2010), 108–24.

Reinhold Reith and Georg Stöger, “Einleitung. Reparieren—oder die Lebensdauer der Gebrauchsgüter”, *Technikgeschichte* 79 (2012), 173–84.

*Report by His Britannic Majesty’s Government to the Council of the League of Nations on the Administration of Tanganyika Territory for the Year 1928* (London: His Majesty’s Stationary Office, 1929).

H. William Rodemann, “Tanganyika, 1890–1914. Selected Aspects of German Administration”, PhD dissertation, University of Chicago (USA), 1961.

Andrew L. Russell and Lee Vinsel, “After Innovation, Turn to Maintenance”, *Technology and Culture* 59 (2018), 1–25.

George L. Steer, *Judgement on German Africa* (London: Hodder & Stoughton, 1939).

David Sunderland, *Managing the British Empire. The Crown Agents, 1833–1914* (Woodbridge: Boydell Press, 2014).

*Tanganyika Standard*, 26 April 1930; 4 March 1930.

Tanganyika Territory, *Annual Report of the Medical and Sanitary Services Department* (Dar es Salaam: The Government Printer) [series for the years 1923–35].

Tanganyika Territory, *Annual Report of the Public Works Department* (Dar es Salaam: The Government Printer) [series for the years 1929–55].

Karl Vorlauffer, *Koloniale und nachkoloniale Stadtplanung in Dar es Salaam. Gesellschaftspolitische Zielvorstellungen und städtebauliche Ideen in ihrem Einfluß auf die Raumstruktur einer tropischen Großstadt* (Frankfurt am Main: Frankfurt University, 1970).

Michael Worboys, *Spreading Germs. Disease Theories and Medical Practice in Britain, 1865–1900* (Cambridge: Cambridge University Press, 2000).