

This PDF includes a chapter from the following book:

# **Sulphuric Utopias**

## **A History of Maritime Fumigation**

© 2020 Massachusetts Institute of Technology

### **License Terms:**

Made available under a Creative Commons  
Attribution-NonCommercial-NoDerivatives 4.0 International Public  
License

<https://creativecommons.org/licenses/by-nc-nd/4.0/>

### **OA Funding Provided By:**

The open access edition of this book was made possible by  
generous funding from Arcadia—a charitable fund of Lisbet  
Rausing and Peter Baldwin.

The title-level DOI for this work is:

[doi:10.7551/mitpress/12437.001.0001](https://doi.org/10.7551/mitpress/12437.001.0001)

## Conclusion

The history of sulphuric utopias does not present a tale of a radical hygienic vision transformed into reality by means of a new technology. Nor is this merely an account of a failed technology, which never achieved the full abolishment of involuntary ship and cargo detention. Instead, we have undertaken the history of the development, production, dissemination, and experimental examination of a mechanical and chemical process, so as to think about sulphuric utopias as a focal point in which many histories of modernization and hygienic innovation coalesce.

First of all, the mobilization of sulphur-based fumigation relied on a long history of sulphurous alchemy both for therapeutic and hygienic purposes. Confronted with the requirements of quarantine and catalyzed by the conceptual foundations of disinfection, the vapor was reinvented. Sulphur was known for centuries to be therapeutic in supporting bodily balance and in providing a fortified atmosphere against pathogenic ailments. In the late nineteenth century, it was slowly transformed into a chemical gas with dedicated effects on organic forms of life. This is then a story of a chemical compound, supported by the budding science of bacteriology, in which the detrimental effect of  $\text{SO}_2$  to microbes was observed and experimentally confirmed. Moreover, through the material requirements of maritime sanitation, sulphur-based fumigation became a practice attached to more than just the practicability of enabling hygienic cleanliness in hospitals or laboratories. At the end of the nineteenth century, a traditional compound was renewed as a chemical substance with antibacteriological capacities and applied through machines to fortify and encourage the belief in a continuous flow of trade without the risk of disease transmission.

Second, the technological advancement of disinfection intersects with the history of maritime trade and the late nineteenth-century push for economic globalization. We have shown that the concern about global shipping routes as pathways of epidemic disease provided a privileged site for the experimental implementation of chemically intrusive routines and practices. The development of maritime fumigation followed on from a drastic price reduction in global sea transport. The transport of basic goods, such as grains, tobacco, and cotton, from new territories in the colonies began to appear as an economic alternative to their production in Europe and the United States. Mostly attributed to the revolutionary transformations in shipping, the surge in global trade relied fundamentally on seamless, uninterrupted, and safe circulation of vessels and their goods. From Holt's invention in New Orleans to Calmette's considerations in experiments conducted in France and its territories, fumigation was seen as essential to guaranteeing the free flow of goods. The apparatus and its sulphuric potential were supposed to remove the persisting risk of epidemics from this newly emerging global economic order under European and American direction.

But when brought into association with the global archipelago of quarantine stations and islands, the ship, with its moving and suspended space, also set a scene for a different kind of hygienic utopia—one in which the capitalist dream of uninterrupted commerce and the colonial imaginary of uninhibited expansion became tied to visions of control over infectious diseases. This was the same vision that the laboratories of French and German bacteriology had enabled at the time. The utopia that fumigating machines embodied and catalyzed was one of the abolition of maritime disease transmission from global colonial and capitalist maps. But perhaps more importantly, its purpose was the protection and indeed defense of Europe and the United States against the importation of diseases that were seen as essentially foreign and belonging to a premodern or "tropical" chronotope.

The fumigation apparatus was thus positioned at the heart of the well-studied late nineteenth-century political nexus of infectious diseases, trade, and migration. Clayton and its variants collapsed three different frontiers: First, the device served as a barrier to bacterial and animal agents of epidemic diseases, separating spaces of infection from hygienic spaces of imagined health and salubrity. Second, the machine's installation in ports

integrated this bacteriological barrier with the borderline between land and sea, and between the ship as carrier and the land behind the port as a vulnerable space. Thirdly, this biopolitical border regime was then folded into the colonial and imperial order as it doubled as a boundary regulation of the hygienic West, separating colonial space (the tropics) as one ontologically linked to disease and infection. We have shown that the securitization of this multiple borderline remained always fragile and inconsistent, for the mechanical contraption of the Clayton apparatus failed to secure these border regimes on microbiological, geographical, and political lines, as much as it failed to bring about a sulphuric utopia.

But while the Clayton machine might have failed in its utopian project, it succeeded in the production of an extraordinary global sociotechnical ensemble among epidemiologists, bacteriologists, engineers, and sanitary officers. The Clayton enabled a technoscientific vision of the free flow of goods, and promised a future of maximized control over foreign pathogens. As such, the epidemiological-bacteriological-sanitary ensemble did not only invest in the development, testing, and distribution of a machine, but it also contributed substantially to the consolidation of the imagination of infectious diseases and to the installation of invisible adversaries to public health: first the pathogen and later the infectious insect or rodent. Installed in ports around the world, tweaked, improved, and repurposed for different pathogens and vectors, the system of maritime sanitation first advanced and materialized by the Clayton machine circled for about four decades around a constantly shifting target of infectious matter. Like any experimental system, it had to adapt, reformulate, and reshape to bring its object into focus. This system began with the fumigation of undefined infectious matter causing yellow fever, moved quickly to the destruction of pathogens and bacteria, before it shifted to the obsessive consideration and destruction of plague-carrying rats.

*Sulphuric Utopias* has focused on the experimental system that was erected around the Clayton apparatus so as to emphasize the conditions under which the machine was considered to enable a disease-free future. This setup did not only change in terms of the target of fumigation; throughout its development, the product of the apparatus—the Clayton gas—emerged in its own unique and changing composition. The gas became largely defined through its capacities: first of all, its disinfective qualities, which involved not only the ability to interrupt the growth of microbes in the moment of

application but to also render microbes innate. Not only did these microbes not show any further growth in agar, they were also incapable of causing infections in inoculated animals. Second, the sulphur-based gas was shown to have lethal effects on insects and rodents. A practice of disinfection could thus be carried out in parallel and in combination with disinfection, rendering the Clayton machine and its gaseous product a versatile apparatus able to counter some of the key pathways in which infectious diseases were believed to be spreading. In other words, the apparatus brought into focus an understanding of infection in strong causal relationship to spaces, objects, pathogens, and vectors, thus promising a regime of complete and combined disinfection, disinsectization, and deratization.

*Sulphuric Utopias* has proposed an understanding of the broad applicability of the Clayton machine against all imaginable and intelligible infection routes at the turn of the nineteenth century as its key utopian quality. Not only did the Clayton promise an active compound that (re)turned ships and their goods into an inconspicuous state, but it also articulated and demonstrated a human capacity of acting against a whole range of organisms, which had been identified as antagonistic and indeed detrimental to human life.

There is, however, a paradox at the end of the sulphuric utopia outlined in this book: parallel to the radicalization of fumigation into a weapon of mass destruction and a technology of genocide (as ultimately exemplified in the Shoah), we also see a weakened expectation toward the capacities of what fumigation was supposed to achieve in maritime sanitation. As the Clayton machine and its competitors (both sulphur and carbon based) became the focus of experimental systems across the globe, they also became entangled in international debates about the very goal of fumigation (this was especially pronounced in international sanitary conferences and conventions). Maritime fumigation technologies transformed cargo boats into containers where tests were conducted in situ with the aim of reaching a standardized chemical and engineering process. The common goals were disinfection and disinfection performed: a) across the maximum amount of space in the boat itself (rather than only near the floor of fumigated compartments, as was the case with heavy gases); b) at a maximum degree of penetration in the boat's structures, as well as the cargo itself; c) at a minimum risk for operators; d) at a minimum damage to both goods and the boat's structures; and e) at a minimum time of operation. As the hope of reaching such a

“sulphuric utopia” became time and again entangled in the webs of political, economic, scientific, and imperial competition and antagonism, the very conditions of achieving the goal of standardized “disinfection plus disinfestation” came to transform the standard in question itself: the goal of disinfection was eventually given up, to focus instead on disinfestation, the eradication of pests.

With the introduction of HCN, germs lost their status of being the principle target of fumigation. The rapid success of HCN and the pervasive global replacement of sulphur-based fumigation systems after WWI was accompanied by the acknowledgement of HCN’s relative inefficiency against bacteria. Cyanide-based fumigation gases seemed to leave most bacteria unharmed, while exhibiting an unparalleled efficiency in the destruction of living organisms. As the birth of the Clayton machine was conceived around the paradigm of disinfection (the destruction of bacteria), its end was marked by a systematic replacement of the goal of radical disinfection with that of the eradication of rats and the disinfestation of ships. This shift in the criteria of the efficiency and the very aim of fumigation aligns with a rising pragmatism in the fight against infectious diseases. This pragmatism was entangled with a simultaneously growing insight into the complexity of epidemics after WWI, when monocausal models began to be challenged by more ecological concepts of infectious diseases.

With the demise of sulphur came the end of sulphuric utopia as a vision of total disinfection, disinfestation, and deratization. As shown in this book, sulphuric acid had been lauded from its early systematic application in the 1880s as a chemical compound capable of eradicating germs and insects, as well as rodents. Persistent ambiguities about the role of insects in the transmission of yellow fever, and the ongoing controversy about the role of the rat in the case of plague reshaped the experimental system of the Clayton machine and its rivals up until the second decade of the twentieth century. While bacteriology was often charged with the introduction of a “biological reductionism” in epidemiological reasoning, the Clayton owed much of its success to the declared “war on germs.” Yet, at the same time, we have shown that it also sustained a conceptual dedication to infection as a nonspecific process, implicating the material conditions that foster bacteria as well as their hosts and vectors.

*Sulphuric Utopias* has demonstrated that after the conceptual emergence of the Clayton in New Orleans, the apparatus was increasingly integrated in

the global emergence of the rat as the central adversary to public health and maritime hygiene. While the paradigm of disinfection became quickly stabilized, and  $\text{SO}_2$  was shown to provide conclusive results in the destruction of bacteria, its capacity in relation to rats was not similarly trusted. In competition with carbon-based gases, and embedded in international conflicts with the Ottoman Empire, the rat appeared as a new frontier against which the Clayton had to prove itself. What followed was a series of ship-based experiments and international exchanges that eventually established the Clayton as a standardized and globally recognized procedure, but without a universal consensus about its deratization capacities ever being reached. Particularly illuminating is the Argentinean episode, where an electrified version of  $\text{SO}_2$ , produced by the Marot apparatus, was believed to have such overarching success against rats and other rodents, that the technology and ideology of the machine was transported from the seafront and was integrated into the fabric of the city itself, by means of fulfilling the unique Argentinean version of sulphuric utopia as “general prophylaxis.”

The displacement of the holy trinity of disinfection, disinfestation, and deratization by disinfestation as the goal of maritime sanitation was, however, what would eventually lead to the demise of the Clayton and other sulphur-based technologies. Port authorities’ increasing confidence with hitherto-considered too dangerous HCN-based fumigation, as well as HCN’s unambiguous capacity as regards rat and insect extermination, would set aside sulphur as a second-choice chemical. The ability to spray HCN directly into crevices inside ships’ holds also held another advantage over the Clayton, for it could reach spaces allegedly out of bounds for sulphuric gases. This aspect of HCN fumigation would lead the way, after the end of World War II, for the transformation of vector control via the employment of hand-held sprays, using a new highly effective substance: DDT.

Working in tandem with other methods of controlling vectors of infectious diseases, such as rat-proofing, these technological transformations in maritime sanitation formed part of a new era of hygienic modernity whose aim was less about total disinfection and more about creating and maintaining barriers and distances (physical as well as chemical) between humans and infectious disease vectors. At the same time, beyond the realm of infectious diseases, they led to applications already prefigured by the military use of gases in WWI and chloropicrin in the Rif War in the 1920s. These reached their nadir in the way in which the technoscientific frame

of fumigation played into the ideologies of Nazi Germany, as the methods, metaphors, and experimental setup were appropriated by the SS to utilize Zyklon B in the gas chambers of Auschwitz.

A defining mark of modernity has been the entanglement of machines and utopian visions in phantasmagorias of liberation and progress. The maritime fumigation technologies discussed in this book show that this connection goes beyond the locus of application preferred by most critical theorists, anthropologists, and historians: the city. As a floating but at the same time moorable space, ships formed a historically vital if analytically neglected ground for a global machinic travail toward a uniquely capitalist and imperialist utopia: the liberation of trade not only from infectious diseases, but also from the time restraints imposed on it by the latter in the form of quarantine.



