In the early 20th century, the Rockefeller Foundation embarked upon a massive public-health campaign that radically changed the economic landscape of the Southeastern United States. A parasite, the hookworm Necator americanus, not only had been leeching Southerners of their blood and good health but also of their agricultural productivity and wealth.

There are two types of hookworm, Ancylostoma duodenale, known as the Old World hookworm, and Necator americanus, the New World hookworm. While both species may be found in Africa, Asia and the Americas, N. americanus is predominantly located in the Americas and Australia, while only A. duodenale is found in the Middle East, North Africa and southern Europe (a). The origin of the New World species in North America has been attributed to the Atlantic slave trade beginning in the 17th century, where infected African slaves brought the parasite to the Americas (b). The hookworm quickly adapted to the loamy soil, humid climate and rainfall patterns of the Southeast that mimicked that of the African continent (d). The socioeconomic conditions of the South and the treatment of slaves also facilitated the spread of the hookworm due to an absence of sanitary outhouses, widespread use of feces as fertilizer in fields (known as night-soil), and lack of footwear for children.

![Geographic distribution of Necator americanus](image)

Infection begins when the soil-residing larval form penetrates human skin, typically a bare foot. It then embarks upon a multi-organ journey through the body, traveling through the blood vessels, the heart and the lungs to reach the trachea. The larva are then swallowed and reach their journey’s end in the small intestine. Upon maturation, the adult hookworm latches onto the mucosa of the small intestine and begin to blood-suck. An individual may harbor up to several hundreds of adult hookworms, which typically live for 1 to 2 years but in rare cases can live up to a jaw-dropping 20 years (i). Highly fertile females may churn out as many as five to twenty-five thousand eggs a day (e). Eggs exit the body with the feces and, upon finding themselves in environmentally friendly circumstances such as warm, moist soil, will mature into larva. And so the cycle continues.
The hookworm exacts a heavy toll on those infected but especially on those that are “poorly nourished, badly housed and equipped, and barefoot” (e). Symptoms include anemia, weight loss, fatigue, and impaired mental function; the heavier the worm burden, the greater the severity of symptoms. In fact, the weight loss, lethargy and reduced mental capacity brought about by severe hookworm infection earned the New World hookworm the title “the germ of laziness” (h). The popular image during the American Civil War of the lazy Southern redneck with “sallow skin, bare feet, scrawny neck, protuberant abdomen, retarded intelligence, and shiftless habits” undoubtedly derived from endemic hookworm infection and its debilitating symptoms (h).

As you can imagine, endemic disease amongst rural Southerners had a profound effect upon agricultural productivity and economic development in the region. The loamy soil found in the Southern coastal regions was ideal for farming but was also exceptionally well-suited to rearing hookworm larvae; what should have been the most successful agricultural region in the South was hampered by the hookworm’s presence in the guts of farmers (c). Hookworms had their heyday during the Civil War, when levels of infection exploded due to substandard living conditions, poor health and lack of sanitary infrastructure (j). Several studies have found negative correlations between agricultural income per capita and hookworm infection amongst rural families involved in subsistence farming prior immediately following the end of the Civil War and prior to the onset of the Rockefeller Commission (g)(j).

In 1910, the Rockefeller Sanitation Commission for the Eradication of Hookworm Disease set about investigating the state of the disease in the South and discovered that a staggering 40% of schoolchildren were infected, with an estimated roughly 7.5 million Southerners harboring the parasite (g). They immediately set about initiating a multi-pronged approach to tackling the disease. One million dollars was invested in a five-year program in eleven states that focused on the education of physicians, school children and the public on hookworm symptoms and transmission, along with construction of sanitary infrastructure and the creation of traveling medical dispensaries for diagnosing and treating hookworm infection (d).

Studies have found strong negative correlations between agricultural income per capita and hookworm infection amongst rural families involved in subsistence farming prior to the initiation of the Rockefeller Commission (g)(j). Following the campaign, those regions with the highest infection rates, particularly in Louisiana, Florida, Mississippi and Alabama, saw significant income expansion. The graph below shows the change in log earnings for exposed and unexposed cohorts depending on year of birth. This analysis of state-of-birth and average income suggests that those individuals that were young enough to benefit from the Rockefeller Commission, and thus experienced lower rates of hookworm infection post-treatment, subsequently enjoyed higher average incomes in adulthood (f). Zero or less exposure to the campaign’s activities during childhood effectively correlates with lower income (f).
At the time, the Rockefeller Commission constituted a major investment in human capital in its improvement of school-age children health. Studies of the intervention indicate that the campaign resulted in a general increase in enrollment, attendance, and literacy (f). Those regions with infection rates greater than 40% showed especially swift increases in these levels compared to regions with average or lower infection rates (f).

From a purely bureaucratic and economic perspective, poor health and high rates of disease retard productivity and limit capacity for growth. In this case, hookworm infection deleteriously affected the agricultural output and economic development of the postbellum South. Similar
Trends may be seen with influenza, malaria, dengue, and a host of other infectious diseases that affect the global workforce and economic productivity; a Report of the Commission on Macroeconomics and Health chaired by Jeffrey Sachs in 2001 found that “poor health has particularly pernicious effects on economic development in sub-Saharan Africa, South Asia, and pockets of high disease and intense poverty elsewhere” (k).

Though hookworm has been eradicated from North America, it remains a serious burden in Africa and is responsible for significant morbidity, disability and premature mortality. It is one of the most common chronic infections on the continent, affecting a third of its population, mostly children aged 5 to 14 years (l). Looking at the history of the postbellum South and the economic implications of hookworm treatment from a selection of data gives an idea of the gravity of endemic infection. Providing shoes, treatment and sanitation options could revolutionize the quality of life for those infected. For those who live in the South, myself included, this research serves as a reminder to cover those feet while putzing around in the backyard. Keep ‘em covered!

References

(g) Brinkley, GL. The Economic Impact of Disease in the American South, 1860-1940 (PhD dissertation). University of California, Davis, 1994.