

ALLEVATING NJ'S CHRONIC BLOOD STORAGE
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PERSPECTIVES ON HEALTHCARE FROM THE 2009 EDWARD J. ILL. EXCELLENCE IN MEDICINE HONOREES

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WITH GLOBAL WARMING,
IT'S CREATING A BUZZ

MOSQUITO-BORNE DISEASE



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CLIMATE CHANGE AND MOSQUITO-BORNE DISEASE: A Historical Perspective

By Margaret Humphreys, MD, PhD

"We're going back – back to where there were no interlocking systems, no semaphores, no electricity – back to the time when train signals were not steel and wire, but men holding lanterns." In Ayn Rand's apocalyptic novel *Atlas Shrugged*, a woman determined to keep her railroad functional in spite of local electrical failure and the general breakdown of technological society. Fifty years ago, Rand imagined a world destroyed by incompetence and greed; today, we worry about global warming, the price of oil and the threat of terrorism. As the climate grows warmer, some have raised the possibility that tropical diseases such as yellow fever, dengue or malaria could move back into temperate zones and that these diseases could once again become major health problems.² Is there, indeed, a major risk of "going back" to the time when mosquito-borne diseases were important causes of morbidity and mortality in northeastern states like New Jersey? In answering this question, it is worthwhile to consider the history of the major mosquito-borne diseases in the United

States and the reasons for their disappearance.³

YELLOW FEVER

Yellow fever has been rare in the United States since the early 20th century, although it was once a frequent visitor to port cities such as Boston, New York, Philadelphia and especially New Orleans. Spread by the various members of the *Aedes* genus, these diseases probably never became established in the United States (except perhaps in its most tropical reaches, such as the Florida Keys), but rather were imported from tropical ports in the Caribbean, Mexico and Latin America. Yellow fever struck New York City several times in the 18th century, with the last outbreak occurring in 1822. Philadelphia was likewise afflicted, with major outbreaks in the 1790s. Historian James Goodyear has tied these epidemics to the growth of the sugar trade, for raw sugar was shipped to new refineries in New York, Philadelphia and Baltimore in the early republic. Transported sugar

Malaria remains a major world disease, causing a million or more deaths a year. In recent years, there have been hundreds of cases of imported malaria in the United States,

MALARIA

Researcher Reiter and colleagues noted that in Texas "most shops, restaurants and other public places are air-conditioned and have closed windows and self-closing doors, as do houses in residential areas, even in low-income areas." However, in Mexico most public areas are left open to the air, and many households are likewise not air-conditioned and are unscreened. Dengue could not thrive in Laredo because too few people offered their skin to infected mosquitoes.

Evidence from Texas helps explain this unfulfilled expectation. Research on the city of Laredo (pop. 289,000) and its Mexican counterpart, Nuevo Laredo (pop. 200,000) study in 1999 showed that while dengue was common in Nuevo Laredo, it was rare in Laredo, in spite of the fact that the appropriate vector, *Aedes aegypti*, was more common on the American side than the Mexican side. The researchers attributed the differences in dengue rates not to climate or the density of mosquito breeding, but to lifestyle factors that mediated human exposure to mosquito bites.

Unlike yellow fever, which now causes only rare outbreaks, dengue has become the world's most common arboviral infection and remains a major threat worldwide including in neighborhoods in close proximity to the continental United States. The Centers for Disease Control (CDC) maintains a dengue branch office in San Juan, Puerto Rico; there have been several indigenous cases in Texas in the past few years, and there was a small local outbreak in Hawaii recently.⁸ Given the many travelers who move through the New York and Newark airports from Puerto Rico and other tropical sites, it is perhaps surprising that there has not been an outbreak of dengue in the northeastern corridor from Philadelphia to New York.

Eliminated much of the standing water where such mosquitoes once bred. In any event, yellow fever disappeared before any directed public health efforts could be guided by knowledge of the mosquito vector, which was demonstrated by Walter Reed and colleagues just after 1900. Armed with Reed's discovery, public health officials were able to wipe out yellow fever from its last U.S. hangouts on the Gulf Coast by 1905 and in much of the Caribbean in the same decade.⁵

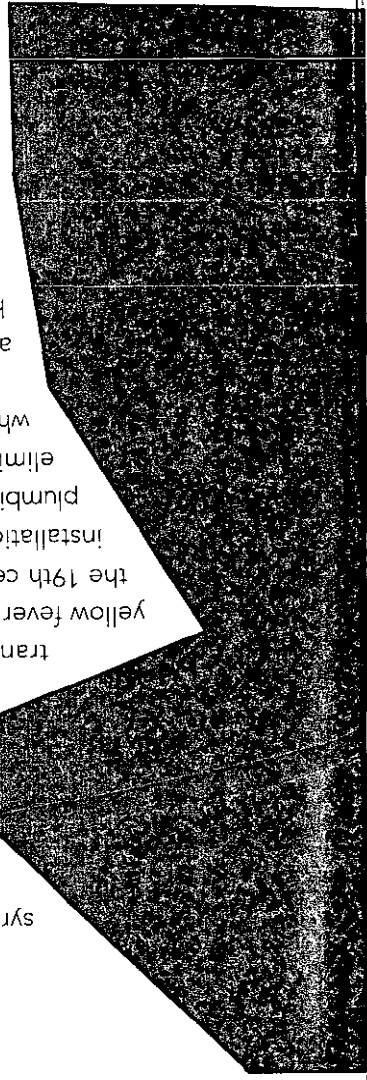
DENGUE

The story of dengue is similar to that of yellow fever, which is not surprising, given that they are spread by the same mosquito. The disease was often confused with yellow fever, and mixed epidemics of the two diseases appear to have been common. The Gulf Coast "yellow fever" epidemics of the late 1890s, for example, were probably mostly dengue, as contemporary physicians concluded after seeing the patterns of symptoms and the low mortality. In 1780, Benjamin Rush, Philadelphia's most prominent physician and signer of the Declaration of Independence, provided one of the first clinical descriptions of the fever we now know as dengue. After noting that "moschetoes were uncommonly numerous during the autumn" and that winds blowing over the docks and streets of Philadelphia filled the air with noxious odors, he described a disease characterized by high fever, intense body pain and at times profuse hemorrhage.⁶ Rush dubbed it breakbone fever; the

of the Caribbean in the same decade.⁵

may be that changes in sugar manufacturing and transport explain the diminution of yellow fever in the north after the first third of the 19th century.⁴ It is also possible that the installation of public water supply and plumbing and drainage systems may have eliminated much of the standing water where such mosquitoes once bred.

nutrion for yellow fever mosquitoes traveling from the Caribbean to the north-eastern United States. It may be that changes in sugar manufacturing and transport explain the diminution of yellow fever in the north after the first third of the 19th century.⁴ It is also possible that the installation of public water supply and plumbing and drainage systems may have eliminated much of the standing water where such mosquitoes once bred.



with 1,528 identified in 2005 alone.¹⁰ Every couple of years, cases of malaria occur in people who have not been outside of the U.S. or otherwise at risk for imported malaria. In 1991, for example, two cases of vivax malaria were reported to the New Jersey Department of Health and Senior Services: one child in Monmouth County and one young woman living in Camden County. New Jersey sees several dozen malaria cases each year in immigrants from parts of the world where malaria is prevalent, such as Central America, South and Southeast Asia and sub-Saharan Africa. The mosquitoes that spread the disease, especially *Anopheles quadrimaculatus*, remain common.¹¹

New Jersey, as it was in New York City and much of the nation. Most cases in the northeast were caused by the *Plasmodium vivax* parasite, an organism spread not only by Civil War soldiers returning from points farther south, but also by Italian immigrants who came to the area in large numbers in the 1880s and 1890s.¹² The New Jersey of that era provided abundant breeding areas for mosquitoes, as much of it remained low and marshy. The meadowlands of that day were just that, and the state was famous for its mosquitoes. By the early-20th century, one historian recorded, "New Jersey earned for itself the sobriquet of the 'Mosquito State,' and outsiders spoke of the 'Jersey Mosquito' as if it were an especially large and voracious species *sui generis*."¹³

Even before the mosquito had been associated with disease, it was an obvious pest that made life unpleasant. After its association with yellow fever, dengue and malaria around 1900, public health officials could argue that it was a danger as well. Initial 19th century efforts to drain the New Jersey marshes had the intent of increasing land for building and decreasing a pest. In 1901, Dr. John B. Smith of the New Jersey Agricultural Experiment Station began a campaign to control mos-

"New Jersey earned for itself the sobriquet of the Mosquito State, and outsiders spoke of the Jersey Mosquito as if it were an especially large and voracious species sui generis."

quitoes for health reasons. He was able to convince the state legislature that mosquito abatement would not only limit disease, it would promote tourism. Those eager to build on the marshy lands around Newark were equally averse to have the state pay for major drainage initiatives. Combined, the reduction in mosquito populations, the disappearance of indigenous malaria and development of Newark as a port for shipping and airplanes. The New Jersey mosquito campaign was the first successful large-scale mosquito extermination in the country.¹⁴

Elsewhere in the country, malaria was likewise driven out by a combination of direct and indirect steps against

the mosquito population. On his trip to Cairo, Illinois and other points in the Midwest in the 1840s, Charles Dickens found the inhabitants sallow and weakened from their exposure to the malarious atmosphere and described his own face and arms as studded with mosquito bites.¹⁵ Malaria moved as far north as Ontario, Minnesota and Washington State. It persisted in the central valley of California well into the 20th century. It also plagued the American South until after World War II.

In most places, the disease receded as civilization advanced. Living with mosquitoes is annoying, and especially where the winters are cold (e.g., Ontario and Minnesota), pioneers were quick to build houses away from water sources and as airtight as possible. Commercially manufactured screens made summers more tolerable for affluent Midwesterners, while the money from prosperous farms bought quinine to quell malaria's chills and fevers. Growing herds of cattle, horses and pigs may have diverted mosquitoes from human hosts. In the 20th century, commercial insecticides added to mosquito-control efforts.¹⁶


Only in the states of the old Confederacy did malaria persist as a major disease hazard. Even there, the disease was brought under control in cities and towns when the

It seems unlikely that climate change will allow yellow fever, dengue or malaria to return to the United States. Even though states like New Jersey are repeatedly exposed to travelers from areas where these diseases prevail, our built environment has separated humans and mosquitoes so well that efficient transmission is unlikely to occur. Americans are not immune to mosquito-borne diseases. Every summer there are a few cases of encephalitis, and recently West Nile virus has added a new reason to fear mosquito bites. But we are unlikely to return to a time when 10 to 25 percent of the population of, say, Philadelphia, becomes infected with the virus of yellow fever via swarms of mosquitoes. Yellow fever disappeared through a combination of unknown factors (changes in the sugar industry? plumbing?) and direct action against its vector. Dengue initially traveled the same route but is now blocked more by air-conditioning and screens than overt anti-mosquito measures. Malaria in the United States did not decline through any changes in climate but rather due to humans' avoidance of mosquito pests, the drainage of land for farming and urban development and, finally, the application of insecticides. None of

CONCLUSION

the indigenous malaria threat for good.¹⁷ CDC and sprayed DDT in millions of southern homes, ending and industries. After the war, MCWA morphed into the agency, a branch of the United States Public Health Service, which fought malaria around important military encampments, erment created the Malaria Control in War Areas (MCWA) much of the South. During World War II, the federal government created the Malaria Control in War Areas (MCWA) southern countryside and thus broke the malaria chain in the end of sharecropping and the depopulation of the drainage and killing larvae. While malaria persisted in land use and prosperity drove urban areas to using connection between mosquito abatement, disease control,

¹ Rand, A. (1957). Atlas shrugged. New York: Random House, 952.
² See, for example: Stevens, W. K. (1998, August 10). Warmer, wetter, sicker: Linking climate to health. The New York Times, A1; Turone, F. (2007). Italian authorities deny that climate change has brought malaria back to its shores. British Medical Journal, 334, 65.
³ These diseases are all discussed in more detail with useful

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these factors are tied to global warming. These conclusions do not apply to countries where mosquito-borne infections still persist as major health threats. There is ongoing controversy, for example, about whether the rising incidence of malaria in the East African highlands is due to warming trends or whether the effect of temperature is far outpaced by other changes in the social and built environment.¹⁸ Nor does this paper, pace Al Gore, take issue with the fact of global warming itself. Rather, I would argue that if yellow fever, dengue or malaria were to make major inroads in the continental U.S., it would more likely follow a major societal dislocation, such as that envisioned in Atlas Shrugged, than the rise in temperature. If our power grids began to routinely sputter, or if our water, sewage and drainage systems began to fail, or if the economy crashed, then it is possible to envision a return to the 19th century conditions that allowed the mosquito diseases to flourish.

Yellow fever disappeared through a combination of unknown factors (changes in the sugar industry, plumbing?) and direct action against its vector. Dengue initially traveled the same route but is now blocked more by air-conditioning and screens than overt anti-mosquito measures.

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⁴ Goodyear, J. D. (1978). The sugar connection: A new perspective on the history of yellow fever. *Bulletin of the History of Medicine*, 22, 5-21.

⁵ Humphreys, M. (1992). *Yellow fever and the south*. New Brunswick, NJ: Rutgers University Press.

⁶ Rush, B. (1815). An account of the bilious remitting fever as it appeared in Philadelphia, in the summer and autumn of the year 1780. In B. Rush, *Medical inquiries and observations*, Vol. 2. Philadelphia: Johnson and Warner, 232.

⁷ Humphreys, M. (1997). *Dengue fever: Breakbone fever*. In K. Kiple (Ed.), *Plague, pox, and pestilence*. New York: Barnes and Noble, 92-97.

⁸ Centers for Disease Control. (2008). *Prevention of specific infectious diseases: Dengue*. In CDC, *Yellow Book: Health information for international travel* www.cdc.gov/travel/yellowBookCh4-DengueFever.aspx.

⁹ Reiter, P., et al. (2003). Texas lifestyle limits transmission of dengue virus. *Emerging Infectious Diseases*, 9, 1-9.

¹⁰ Thwing, J., Skarbinski, J., Newman, R. D., Barber, A. M., Mali, S., Roberts, J. M., Slutsker, L., and Arguin P. M. (2007). *Malaria surveillance—United States, 2005*. *Morbidity and Mortality Weekly Reports*, 56, 23-40.

¹¹ Brook, J. H., Genese, C. A., Bioland, P. B., Zucker, J. R., and Spitalny, K. C. (1994). Malaria probably locally acquired in New Jersey. *New England Journal of Medicine*, 331, 22-23.

¹² Imperato, P. J., Shookhoff, H. B., and Harvey, R. P. (1973). Malaria in New York City: I. History of the disease from 1796 to 1903. *New York State Journal of Medicine*, 73, 2372-81.

¹³ Cowen, D. L. (1964). *Medicine and health in New Jersey: A history*. Princeton, NJ: D. Van Nostrand Co., 165.

¹⁴ Galischoff, S. (1975). *Safeguarding the public health*:

Newark, 1895-1915. Westport, CT: Greenwood Press, 68-80; Crams, W. J. (1992). *A history of malaria in New Jersey*. *Proceedings of the Seventy-Ninth Annual Meeting of the New Jersey Mosquito Control Association*, 115-122. Retrieved from www.rcl.rutgers.edu/~insects/mal1.htm.

¹⁵ Dickens, C. (1842/1972). *American notes for general circulation*. Hammondsworth, UK and NY: Penguin Books, 215-16.

¹⁶ Ackerknecht, E. H. (1945/1977). *Malaria in the upper Mississippi Valley, 1760-1900*. (Facs. rpt.) New York: Arno Press.

¹⁷ Humphreys, M. (2001). *Malaria: Poverty, race, and public health in the United States*. Baltimore: Johns Hopkins University Press.

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