THE MIDWAY REVIEW

A JOURNAL OF POLITICS AND CULTURE

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and

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WINTER 2007 • VOLUME 2, ISSUE 2 • WWW.MIDWAYREVIEW.ORG

THE MIDWAY REVIEW

FEBRUARY 2007 ❋ VOLUME 2 ISSUE 2

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THE SOCIOECONOMIC CONTEXT OF HEALTH AND HEALTHCARE

Robert Perlman

Medicine is a wonderful and satisfying profession, largely because it focuses on caring for individual patients. The physician-patient relationship can be healing to patients, and making a difference in the lives of patients is rewarding for physicians. Medicine's concern for individual patients is part of our cultural focus on individual autonomy and individual rights. We rightly value our individual freedoms. At times, however, our preoccupation with individuals may cause us to lose sight of the fact that we are not isolated human beings but are embedded in families and larger communities, and we live in an environment that is increasingly shaped by human cultural practices. Our relationships with others and our interactions with our environment are critical determinants of health and disease; indeed, from a population perspective, they have far greater influence than do the actions of individual physicians caring for individual patients. With this in mind, I want to discuss some of the socioeconomic and cultural influences on health.

Of course we know that environmental factors influence health, but I don't think we always appreciate the extent to which our environment is shaped by cultural practices and by the products of human activity. Think for a moment about your own lives. You live in man-made buildings, you wear man-made clothes, you eat food that has been grown, harvested, and brought to market by other people—even the air you breathe and the water you drink has been modified, for better or worse, by human actions. Many cultural practices are health-promoting; we live longer and healthier lives than our ancestors did. Indeed, many cultural practices probably spread and have been maintained because they improved health. But other cultural practices are pathogenic.

It is perhaps ironic that many of the most important health advances in the last two hundred years have consisted in undoing the deleterious effects of human activity, and many of our remaining challenges involve undoing the deleterious effects of other cultural practices. Because undoing the pathogenic effects of cultural practices entails confrontation with institutions that have political and economic power, this work takes personal courage as well as knowledge.

I want to illustrate these ideas by discussing three specific examples—fecal contamination of drinking water, a problem that was largely solved in the United States in the nineteenth century; childhood lead poisoning, a major health problem in the twentieth century that has been greatly ameliorated but that, unfortunately, is still with us; and health disparities, which I believe will be among our greatest challenges in the twenty-first century.

Sewage

Since the time of the agricultural revolution and the beginning of permanent human settlements, people ran the risk of contaminating their water supplies with their own feces. Fecal contamination of food and water was one of the reasons that infectious diseases became prominent at the time of the agricultural revolution. Even though many of us walk around with bottled spring water, we in the United States take the availability of pure water for granted. But it hasn't always been this way. In Chicago, our present sewage disposal and water supply systems date to the second half of the nineteenth century. Before about 1850, both sewage disposal and the water supply were hap-

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hazard and poorly organized. Most homes had outdoor privies, and many people got their water from backyard wells. This arrangement was conducive to the contamination of drinking water; Chicago, like other American cities, suffered from recurring epidemics of cholera and other diarrheal diseases. In the early 1850s, Chicago experienced several severe cholera epidemics. The worst occurred in 1854, when cholera killed more than 1,400 people in Chicago—and this was a time when the population of the city was about 100,000! Coincidentally, the same year John Snow demonstrated that cholera was caused by drinking contaminated water in London.

At that time, the two prominent theories of disease were the miasmatic and contagion theories. The miasmatic theory postulated that disease arose from the environment, from polluted air, water, and soil, while the contagion theory postulated that disease was transmitted from person to person by some unknown means. The miasmatic theory of disease led to efforts to purify urban water supplies, long before disease-causing bacteria were isolated and before the rise of the germ theory.

In the 1850s, the state created the Chicago Board of Sewerage Commissioners, and Chicago developed the first comprehensive sewer system in the country. At the same time, the Board of Water Commissioners began to build a public water supply system. Developing a sewer system was challenging, because Chicago is so flat. In many parts of the city, streets had to be raised so that sewers could be built under them. If you go to neighborhoods on the near North side, you can still see evidence of this—you can see nineteenth-century homes whose original entrances are now below street level. The sewer system emptied into the Chicago River, which at that time emptied into Lake Michigan. This was a start, but it was not an ideal solution, because the main intake of the water system was near what is now Navy Pier, very close to the mouth of the river. Around 1870, people dug a tunnel two miles out into the lake and built a water crib to bring in water that was uncontaminated by sewage. Off the Point, you can see a second crib, built in the twentieth century to serve the South side; the original one is on the North side, East of the Water Tower.

As the population grew and sewage production increased, the flow of the Chicago River was reversed, so that, instead of flowing into Lake Michigan, it drained into the Des Plaines River, and then on to the Illinois River and the Mississippi. As you might image, communities downriver of us were not happy. In 1900, Missouri petitioned the Supreme Court to pass an injunction forbidding the State of Illinois and the Chicago Sanitary District from sending its sewage into the Mississippi River. The Court ruled in Chicago's favor; it argued that, since Missouri towns dumped their sewage into the Mississippi, they couldn't prevent Illinois towns from doing the same. Today, we have treatment plants to detoxify the sewage before we dump it into the Illinois River. The important point of this history is that by the mid- to late nineteenth century, Chicago had sewage and water supply systems that were conducive to good health and could support population growth, and were models for the rest of the country. Our last cholera epidemic occurred in 1866.

The next time you walk on Michigan Avenue and see the Water Tower and the Pumping Station, don't think of them simply as relics that survived the Chicago Fire. They symbolize what enabled Chicago to become a world-class city in the nineteenth century. It's hard to imagine that Chicago would have been a thriving metropolis in the 1890s, or that Rockefeller would have chosen to found his University here, if we didn't have this infrastructure. Separating feces from drinking water may not sound sexy, but it was probably the most important advance in health in the nineteenth century. Remember that there are still large portions of the world where people don't have access to reliably clean water, and where diarrheal diseases are still endemic. The burden of disease in underdeveloped countries is at least part of the reason why they remain underdeveloped.

Lead

Construction of sewage systems and a public water supply required persistence and determination to convince the city and state governments to spend the necessary money, but it was comparatively easy because the health benefits were clear and affected everyone, and there were no commercial interests opposed to it. Improving health in the twentieth century became more difficult, because many of the major health problems were the result of corporate activities; companies that created the problems denied that problems existed and then opposed solutions that might decrease their profits or increase their liability. Cigarettes and lead are two commercial products that have been major causes of disease; reductions in smoking and in the use of lead have been two of the most important health improvements in the second half of the twentieth century. Because you are probably more familiar with the problems of smoking than with lead, I will focus on lead poisoning, and especially childhood lead poisoning.

Lead is part of the earth's crust but until relatively recently, all of the lead in the world was sequestered in mineral deposits; for most of our evolutionary history, our ancestors were probably not exposed to lead. The earliest evidence for the use of lead is the finding of lead jewelry, dated to be about six or seven thousand years old, in Turkey. Lead mining probably began around the time that our ancestors began living in fixed settlements. Lead deposits are commonly contaminated with silver; when silver became desirable, people may have begun mining and smelting lead to obtain the silver. Once people began mining lead, however, they discovered that it was soft and malleable, and easy to work with, and they found a number of uses for it. The Romans used lead pipes for their water supply and for sewage; you probably know that our word *plumbing* is derived from *plumbum*, the Latin word for lead. I'm sure that the original water and sewage pipes in Chicago were made of lead. Lead was also used in paint and in ceramic glazes. Lead-based paints are quick drying and durable, and they resist cracking. Lead carbonate itself is white, and is a good base for other pigments. Lead also tastes sweet, and it was added to wine and other foods as a sweetener. Lead turns out to be a very useful mineral. In the context of this discussion, though, it's perhaps symbolic that lead has been used since the middle ages as a lining for coffins.

Lead has been recognized as a toxin for thousands of years. The symptoms of lead poisoning include severe gastrointestinal cramping and pain, and a variety of neurological symptoms, ranging from headache and confusion to convulsions, coma, and death. By the time of the industrial revolution, lead was no longer being added to food or wine, and lead poisoning was considered an occupational disease, one that affected lead miners and workers in lead industries. Surprisingly, given that it must have been prevalent for centuries, childhood lead poisoning wasn't described until the end of the nineteenth century, and the first cases of lead poisoning in children in the United States weren't described until 1914. I think there are a couple of reasons for this delay in the recognition of childhood lead poisoning, and they're all worth thinking about.

First, the way we conceptualize dangers affects our response to them—physicians knew that lead was toxic, but because they thought of lead as an occupational toxin, they were blind to the possibility that it was also a hazard to the general population. In hindsight, this may seem shocking—but before we criticize physicians of a hundred years ago, we should acknowledge that we have blind spots, too. Just to give one example: AIDS was initially conceptualized as a disease of the gay population. It took us a long time—not centuries, but maybe a decade—before we recognized that it could also be acquired by heterosexual sex. We undoubtedly have other blind spots that will appear equally egregious to our children and grandchildren.

Another problem is that, before around the middle of the nineteenth century, physicians didn't focus their attention on children. I'm not sure why; perhaps it was because infant and childhood mortality was high, and there wasn't much that physicians could do about it. In any event, pediatrics didn't develop as a medical specialty in the United

States until the end of the nineteenth century.

A third reason for the delay in recognizing pediatric lead poisoning is that pediatrics developed as a specialty just at the heyday of the germ theory. Within a few decades at the end of the nineteenth century, Robert Koch and Louis Pasteur and their students had isolated the bacteria responsible for tuberculosis, cholera, plague, anthrax, and a number of other diseases. Perhaps not surprisingly, bacteria were thought to be the cause of all disease. People undoubtedly spent a lot of time trying to culture bacteria from children who displayed the symptoms of lead poisoning; when they weren't successful, they assumed that their failure was a technical failure rather than a conceptual problem. Again, our blind spots are not so different from theirs. The status of genes in the medical world today is reminiscent of the status of bacteria a century ago. We are so convinced of the importance of genes in causing disease that people are spending a lot of time trying to isolate genes for diseases that may well turn out not to have a genetic basis. And, as with unsuccessful searches for bacteria a century ago, people who fail to find genes that cause schizophrenia or autism, say, are likely to assume that the problem is a technical problem—perhaps they're studying the wrong populations, or they're not clearly defining the diseases—rather than accept that they are looking for the wrong causes.

In any event, by 1920 or so, lead poisoning was recognized to be a pediatric as well as an occupational disease. At that time, by far the largest use of lead was in paint. In the 1920s, most European countries banned the use of lead paint, or at least lead house paint; for whatever reason, the US didn't, and lead continued to be widely used in house paint in the United States. I said "for whatever reason," but the reason is clear—it was due to the political power and advertising acumen of the lead industry.

You may have seen pictures of "The Little Dutch Boy," which was the logo of the National Lead Company. Using children to advertise lead paint was not an accident; it was a strategy designed to make lead paint seem safe for children. Advertising in hospital journals was another paint industry strategy to associate lead paint with health. We've been brought up to believe that a fresh coat of white paint makes homes sanitary as well as attractive, but this belief comes from the self-serving and hypocritical advertising of the paint industry rather than from science.

The use of lead house paint in the United States declined gradually after about 1925, first because of the Depression, and then, after World War II, because of rising public concern about the hazard of lead, but it wasn't finally banned until some time in the 1970s. But the 1920s saw the rise of another use of lead, as a gasoline additive. The story of leaded gasoline is a stunning story of corporate greed and abuse of power. Around 1920, Model T Fords were the best-selling cars in the United States. They ran fine on the gasoline that was then available. In an effort to increase their market share, General Motors began making cars with more powerful engines, cars that were larger, had better acceleration, and could go faster. But these more powerful engines wouldn't run properly on regular gasoline because of a problem called "knocking," and so G.M. began searching for a way to overcome the knocking problem. A scientist in the General Motors research laboratory found that tetraethyl lead prevented knocking. Tetraethyl lead had been synthesized in the nineteenth century but it wasn't used for anything because it was known to be a potent toxin. Nonetheless, General Motors formed a partnership with Standard Oil to create the Ethyl Corporation, which manufactured tetraethyl lead and sold it to oil companies as a gasoline additive. Right from the beginning, it was clear that tetraethyl lead was a problem. At least a dozen workers in lead plants died from lead poisoning, and many workers suffered neurological damage. For reasons that aren't well understood, these symptoms frequently included hallucinations and other manifestations of psychosis. So many workers became psychotic that workers dubbed one ethyl plant the "loony gas building"; and because their hallucinations commonly involved hallucinations of insects, workers called another ethyl plant the "house of butterflies."

The fact that the government allowed production and use of tetraethyl lead to continue seems almost inconceivable. Remember, though, that the Ethyl Corporation was owned by General Motors and Standard Oil, and at that time the DuPont Corporation was a major stockholder in G.M., so there were powerful corporate forces behind leaded gasoline. Tetraethyl lead was introduced and promoted in the 1920s, during the Harding and Coolidge administrations, which were as pro-business and against governmental regulation as is the current administration.

In what became a standard strategy, the Ethyl Corporation blamed the victims—workers didn't die because tetraethyl lead was toxic; they died because they were careless and didn't follow the company's safety instructions—and the company argued that the lead released from leaded gasoline wasn't a health hazard. Whereas the National Lead Company advertised the use of lead in its paints, the Ethyl Corporation referred to their product simply as "Ethyl" and never mentioned that it contained lead. And they, too, created ads that portrayed driving with "Ethyl" as romantic and beneficial.

After about 1950, leaded gas was the major source of lead released into the environment. The use of leaded gasoline began to decline in the 1970s, not because of health concerns but for business reasons. When people began to be concerned about automobile emissions, automobile manufacturers were required to install catalytic converters, to convert carbon monoxide to carbon dioxide, and nitrogen oxides to nitrogen gas. It turned out that lead inactivated the catalytic converters, and so automobile manufacturers had to develop engines that didn't require leaded gasoline. The use of lead in gas declined and lost its political support, and around 1985 it was finally banned in the United States. It is astonishing, though, that the Ethyl Corporation still sells tetraethyl lead to third world countries that haven't yet abolished its use.

Between 1920, when childhood lead poisoning was recognized as a serious problem, and the 1980s, when the use of lead was finally banned, physicians and others repeatedly raised concerns about the health effects of lead paint and of leaded gasoline, but the lead industry was able to deflect these concerns. It claimed that since lead was a natural part of the environment, putting it back into the environment wasn't a problem. It argued that more research on the health effects of lead was needed before the government took any regulatory action. And since most of this research was supported by the lead industry, it isn't surprising that the industry could produce data showing that lead wasn't a hazard. Scientific understanding is always incomplete, and scientific data are always prone to refutation or reinterpretation. Our willingness to view scientific knowledge as tentative and subject to change is one of the virtues of science. But people can always take advantage of the tentative nature of scientific knowledge to sow confusion. The lead industry had the same strategy as the tobacco industry, which claimed, "Doubt is our product." As long as the industry could raise doubts about the health hazards of lead, it didn't really have to prove that lead was safe, and it could postpone government intervention. And it could always hire experts to voice these doubts. Again, as a tobacco industry spokesman said, "For every Ph.D. there is an equal and opposite Ph.D."

At that time, childhood lead poisoning was thought to result from eating lead paint. The Ethyl Corporation accepted that lead paint was dangerous but argued that lead from gasoline wasn't a problem; the paint companies blamed parents for letting their children eat paint; and since most cases of lead poisoning were in poor, black children who lived in old homes with flaking paint, few people cared very much. When all else failed, the lead industry attacked the scientists who reported harmful effects of lead, accused them of falsifying their research, and in some cases even threatened their academic appointments. Although charges of research fraud were never proven, this strategy had the chilling effect of discouraging young scientists from entering this field.

Initially, childhood lead poisoning was thought to

be an acute disease; children either died or they recovered, without, it was thought, any apparent sequelae. By the 1940s, physicians recognized that many children who recovered from acute episodes of lead poisoning had cognitive and behavioral problems; lead poisoning was then understood to be a chronic disease. In the 1970s, the conception of childhood lead poisoning changed again, because people found that children whose blood lead levels were not high enough to cause acute symptoms such as convulsions or coma suffered from more subtle but still serious problems. Low levels of lead cause a decrease in I.Q. and a decreased attention span, which leads to poor school performance. For reasons that are still not clear, lead seems specifically to affect social behavior; lead toxicity seems to predispose children to aggressive or anitsocial behavior. Parents' and teachers' ratings of children's behavioral problems correlate well with the children's lead exposure.

Recognition of the toxic effects of low levels of lead exposure coincided with a period of urban gentrification, when middle-class families with young children began moving into older urban neighborhoods. Lead poisoning again became re-conceptualized; it was no longer a disease of ghetto children, but a disease of children. Political pressure from middle-class families led, finally, to a ban the use of lead in house paint and in gasoline, to increased efforts to remove lead from the environment, and to a great deal of progress in the prevention of lead poisoning.

Reductions in the use of leaded gasoline in the late 1970s were accompanied by a prompt reduction in blood lead levels. At present, 10 mg/dl (a deciliter is a tenth of a liter) is used as the criterion of "acceptable" lead levels in screening programs. Let's use this level as the upper limit of "normal" for the moment, although the best evidence is that even this level of lead can cause neurocognitive deficits. There appears to be no threshold for the toxic effects of lead. And that makes evolutionary sense; if our ancestors evolved in a lead-free environment, they would not have evolved mechanisms to protect themselves—or us—from lead. Average lead levels in children have greatly decreased, to perhaps only 20 percent of what they were just a few decades ago. The percentage of pre-school children with elevated lead levels—levels greater than 10mg/dl—has declined from almost 90 percent in the 1970s to around 5 percent in the 1990s, and perhaps even less today. But that still means that somewhere on the order of one to two hundred thousand children per year are born into environments where they will suffer from lead poisoning.

It is difficult to quantify the deleterious effects of lead on mental functions. Blood lead is measured once, or perhaps at intervals, while neural development is an ongoing process; also I.Q. is an imperfect measure of cognitive ability. Elevated lead early in life, while synapses are forming and becoming stabilized, is probably more detrimental than later. The best evidence, though, is that each increase of 10mg/dl in blood lead is associated with an I.Q. loss of perhaps 4–5 points.

As childhood lead poisoning has become less prevalent, it has returned to being a disease of poverty; lead poisoning is most prevalent in blacks and in the poor. What is true nationwide is also true in Chicago. Even with the continuing decline in blood lead levels, more than 10 percent of the children in some Chicago communities suffer from lead poisoning. These are poor, largely black communities on the South and West sides. Children in these communities will have lower I.Q.'s and shorter attention spans than children in other communities; they will be less successful in school, and will be disadvantaged in becoming productive members of the society. Blaming them, or their families, or their schools, is missing the point. Of course schools with a high percentage of lead-poisoned children will not perform well. President Bush's education program, which penalizes under-performing schools and does nothing about lead abatement, should more properly be called, "No Child Left Unpoisoned."

We now face difficult choices. Lead removal is expensive, and creates a health hazard for the workers who are engaged in clean-up ef-

forts. At some point, we may have to decide to live with a little lead, the residue of our infatuation with white paint and fast cars.

Health Disparities

The problem of lead poisoning leads naturally into the last topic I want to discuss, socioeconomic disparities in health. There are disparities in health both between countries and within countries. Let's take life expectancy as a reasonable measure of health in general. Today, there are huge disparities in life expectancies between countries; in many developed countries, life expectancy is close to eighty years, while in some countries in sub-Saharan Africa it is less than forty. It isn't surprising that, at low levels of per-capita income, life expectancy is dependent on wealth. People in these poor countries suffer from material deprivation; they don't have access to clean water, they can't afford food, and so on. But above some cutoff, life expectancy isn't strongly dependent on wealth. Although the United States is by any measure one of the richest countries in the world, we are not one of the healthiest. In terms of per capita gross domestic product, we rank fifth, behind a handful of small countries such as Bermuda and Luxembourg. In terms of life expectancy, however, we rank forty eighth.

One of the main reasons for our relatively low life expectancy is a disparity in the life expectancies of blacks and whites. Blacks have higher infant mortality than whites, they have higher overall mortality rates, and they suffer from chronic health problems, such as hypertension, at earlier ages than do whites. Why should this be? While it is difficult to ignore the historic effects of racism and segregation in health care in the United States, I believe that the racial disparities in health have relatively little to do with differences in health care and more to do with socioeconomic disparities between blacks and whites. We in the United States focus on race, and are often reluctant to talk about social class. Our national myth is that we are a nation of immigrants, and that the descendants of immigrants have participated in the American Dream and have enjoyed upward socioeconomic mobility. Talking about social class sounds unpatriotic and smacks of Marxism. The British, because of their very different history, are much more attuned to issues of social class, and so they have studied the relationship between class and health much more intensively than have we.

The British government classifies occupations on a five-point scale, from professionals in Class I to unskilled manual laborers in Class V. Data from Great Britain show a clear gradient in life expectancy as a function of occupational class. Remember that the United Kingdom has a national health service. While a few wealthy people may get their health care in the private sector, almost everyone has access to the same health care system. Also, it's not simply that those at the bottom of the socioeconomic scale do poorly. There is a gradient that runs through the whole society.

In the United States, we have fewer data about this, but the data we have support the idea of a socioeconomic gradient in health. Again, it's not simply that the poorest people in the population have the highest mortality rates; as in England, there is a gradient in mortality rates over a large economic range. While material deprivation might account for the high mortality rate in the lowest economic group, it can't explain the gradient in health.

Not only is there a socioeconomic gradient in health, but the steepness of the gradient appears to be related to the degree of economic inequality in a country. Among developed countries, life expectancy is highly correlated with income inequality. I think the evidence is strong that there is a real, causal relationship between socioeconomic inequality and health disparities. How should we understand this relationship? It's complicated. In comparison to rich people, people who are economically disadvantaged in general have poorer education, they may have poorer health habits, they live in unhealthy communities—lead-contaminated communities, for example—and their families and communities may provide less social support. All of these factors may contribute to health disparities but they're unlikely to explain them completely.

I think that the overriding explanation probably lies in the social stress that comes from living in a hierarchical and unequal society. Animals have evolved mechanisms to cope with stresses and threats. But these mechanisms evolved to help us cope with temporary emergencies and dangers. In the face of an acute emergency—the presence of a predator, for example—animals can devote their energy to a "fight or flight" reaction, even if this means diverting resources from the ongoing maintenance and repair of their bodies. Humans, like other primates, evolved as social animals, and we live in communities where other people make up a large part of our environment. The main challenges we face are not the presence of predators, but the stresses of living in hierarchical societies and coping with the competitive strivings of other people. Our physiological responses to these social stresses are similar to our responses to predators—but the social stresses are chronic, not acute. In the face of persistent stress, the continued diversion of resources away from bodily maintenance apparently leads to cellular damage, organ dysfunction, and disease.

The idea that social inequality itself is pathogenic, or disease inducing, is not a comfortable idea, but it seems to be true. I'm not suggesting that we should strive for some utopia—or dystopia—where everyone is exactly the same. I'm also not suggesting that we should hope to lead disease-free lives. What I am suggesting, though, is that there is something fundamentally wrong with a society that condemns some of its members to unnecessary disease and premature death. If it's true, as I believe the data show, that the steepness of the socioeconomic gradient itself contributes to health disparities, we ought to consider ways to reduce this gradient and improve the health of people at the bottom of the socioeconomic scale. When we analyze public policy questions—changes in the tax laws, for example—we ought to think not only about how these changes may fuel economic growth, or how they may benefit us as individuals. We need to consider how they will affect the distribution of wealth in the society, and how changes in the distribution of wealth will affect health. Today, few people are thinking in these terms. But if we care about health, and about people, we need to start.

So, where are we? We live in a society in which most people, at least in the United States, have access to clean water and sufficient food. We have identified environmental toxins such as lead and cigarettes, and have made significant progress in reducing our exposure to them. If history is a guide, however, many human practices that are currently deemed safe will be found to be pathogenic. It will be up to future generations of scientists and citizens to identify and correct these problems. Our society remains plagued by socioeconomic health disparities and has not yet been willing to face or ameliorate these disparities. There is a lot left to be done.