Right Now

The expanding Harvard universe

EFFLUVIUM UNLEASHED

An Arctic Mercury Meltdown

When people think of mercury, says Daniel Jacob, they tend to think of the element in its silvery, fluid state—the stuff to avoid if a thermometer breaks. "It's a fascinating metal in that it is liquid at room temperature, but it is present in the atmosphere as an elemental gas," says the Vasco McCoy Family professor of atmospheric chemistry and environmental engineering. "It's really amazing."

Amazing, but potentially very dangerous. At high levels, mercury is a toxin that can impair neurological development in children and affect the adult nervous system. Jacob has been studying the movement of atmospheric mercury for the last decade or so, and has been particularly interested in how and why it shows up at elevated levels in the Arctic—in both the atmosphere and the food cycle. Conventional wisdom, he says, was that emissions from coal combustion and mining in North America, Europe, and—increasingly—Asia were drifting over the Arctic and depositing the mercury via precipitation.

A few years ago, he began testing that theory using a complex 3-D computer model called the Geos-CHEM, which measures atmospheric transportation. "What I was expecting was to find that atmospheric deposition was the dominant source of mercury to the Arctic," says Jacob. With that finding, he could then examine how that deposition was affected by changes in global emissions patterns—rising levels in Asia, falling levels in the United States and Europe—and by the melting of the Arctic sea ice, which receives and re-emits the mercury into the atmosphere, keeping it from further dissemination in the water. "But, as often occurs in science," Jacob says, "serendipity took over."

When he and research teams from the Harvard School of Engineering and Applied Sciences and Harvard School of Public Health started analyzing their data, they found something the emissions theory could not explain: mercury levels in the Arctic peaked in the summer, when the transportation of emissions pollution was low, but fell off during the winter, *despite* a concurrent annual emissions-pollution peak.

The hidden element? Their study, published in a recent issue of the journal *Nature Geoscience*, found that the major Arctic mercury source wasn't the atmosphere, but the Arctic Ocean itself.

That body of water, Jacob says, receives 10 percent of all global river discharge, thanks in large part to three massive Siberian rivers: the Lena, the Yenisei, and the Ob. Jacob's team theorizes that the rivers carry mercury to the Arctic Ocean from myriad sources, including Siberian mines and the erosion of other polluted land masses—and because the ocean is relatively shallow, the mercury-laden river waters

Illustration by Doug Bocksm

have a greater influence on its smaller volume of water.

Climate change is another culprit. An unfrozen Arctic Ocean lashing at the coast and eroding mercury-rich land masses means more of the element entering the water, especially in summer. The effect of rising temperatures in Siberia eventually affects the Arctic, as well: "As the permafrost thaws, mercury in the soil gets released into the river system," Jacob explains. "From a policy standpoint," he adds, "the message is that the mercury accumulation is not necessarily a recent phenomenon, and we can't really blame increasing pollution from China—which is what people wanted to do. It seems to be really old mercury, and it's coming from really old human activity"—such as mining—"that is a century old, maybe older."

When that mercury enters the marine ecosystem, it can accumulate in fish in concentrations as much as a million times higher than the element's oceanic or atmospheric levels—posing a serious risk to indigenous human populations in the Arctic who rely on the fish as a food source. What's next, Jacob says, is to chart Arctic mercury's course. He and his team will use their study results to plot how the accumulation has changed during the past 30 years and use that data to predict what challenges Arctic inhabitants might face in a warmer future. —DAN MORRELL

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SOFT-DRINK STIR?

Soda and Violence

MONKEY BUSINESS IMAGES/DREAMSTIME IMAGES

Already implicated in the obesity and diabetes epidemics, soda may be linked to violence in young people, new research suggests. In a study of 1,878 students at Boston public high schools, heavy soda drinkers were much more prone to violent behavior than other teens.

That finding came about by accident. While seeking to document the incidence of violent behavior among the high-school students, professor of health policy David Hemenway, who directs the Harvard Injury Control Research Center at Harvard School of Public Health, agreed to incorporate unrelated (or so he thought) questions about nutrition at a colleague's request.

Analyzing the survey, he found surprising correlations. Heavy consumers of non-diet soft drinks—students who had drunk five or more cans in the week preceding the survey—were more likely to have behaved violently toward peers (57 percent, versus 39 percent of respondents who drank less soda); to have behaved violently toward another child in their own families (42 percent, versus 27 percent); to have behaved violently in a dating relationship (26 percent, versus 16 percent); and to have carried a gun or a knife during the past year (40 percent, versus 27 percent). The strength of the effect was on par with the correlation (well known among researchers) between these behaviors and alcohol and tobacco use; in some cases, the correlation with soda was stronger.

Even within the scientific community, people found these results very surprising, Hemenway reports: "When you think about the causes of violence, soft drinks are not on the map of variables that you tend to look at."

His findings recall the 1979 "Twinkie defense" mounted in the trial that followed the murder of gay-rights activist Harvey Milk; the defense attorney persuaded the jury to render a verdict of voluntary manslaughter in part by arguing that his client's recent switch from a healthy diet to one high in junk food and soft drinks contributed to mental-health issues that led to the killing. The argument may have been prescient in its recognition that what people put into their mouths influences how they feel and, consequently, behave. But whether this is the case with soda is not yet clear.

The researchers have since tested the correlation, with similar results, in three other datasets: one surveying more than 5,000 adolescents in California, one of nearly 3,000 five-year-olds of low socioeconomic status born in major U.S. cities (the question about guns and knives was omitted in this case), and one of more than 16,000 students in public, private, and parochial high schools across the United States. (Hemenway has not investigated the relationship between soft drinks and violence in adults. Although violent crimes committed by adults tend to make headlines, he says, teenagers behave in physically aggressive ways far more often than adults do.)

Next, Hemenway and his colleague, Sara Solnick '86, M.P.H. '90, now of the University of Vermont, plan to perform a similar analysis with objective sources such as police records and school-discipline records. Instead of relying on youths' self-reporting, such a study could examine whether youths who drink more soda are more likely to be suspended for fighting or arrested.

Other studies have linked soda consumption with depression and suicidal behavior, but Hemenway is not aware of anyone else studying the correlation with violent behavior. One further avenue for research is elucidating the underlying mechanism. It could be that a third variable, such as the quality of parenting, influences both soda consumption and

aggressive behavior. (The researchers attempted to control for socioeconomic status and the quality of parenting; when they did, the correlation remained strong.) If there is a cause-effect relationship, the researchers speculate that excess caffeine and sugar (along with the subsequent blood-sugar crash) may leave soda drinkers irritable and prone to aggression; or maybe those who drink soda in place of healthier food miss out on nutrients that promote a calmer demeanor.

One public-policy implication is apparent already: colleges may want to think twice about promoting soft drinks as a safe alternative to alcohol. Although soda doesn't share alcohol's acute, motor-skill-impairing effect, it may have emotional effects that build over time—meaning it may be safer just to stick with water.

—ELIZABETH GUDRAIS

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AMERICAN ATTITUDES

Mapping Cultural Change

THE U.S. CENSUS gathers a wealth of demographic data, providing a basic sketch of the American population. But since 1972, the General Social Survey (GSS) has been filling in the outlines of that sketch in living color.

The GSS asks about subjects the census cannot—such as religious affiliation (barred due to concern over separation of church and state)—or simply does not: sexual behavior, racial stereotypes, and *attitudes* about issues, including gay marriage, immigration, and much more. It even includes a vocabulary test to track trends in Americans' verbal knowledge. Among the findings: while the rate of "permissive disposition toward premarital sex" has remained steady among Americans since 1980, support for gay marriage rose from 12 percent in 1988 to 47 percent in 2010.

With funding from the National Science Foundation, a survey team fans out across the United States every two years, gathering data from 3,000 Americans during face-to-face interviews in their homes. (The project's home base is an opinion research center at the University of Chicago.) In its 40 years, the GSS has informed tens of thousands of research studies; its freely available data have been used by hundreds of thousands of students each year, and have become a crucial source of information on Americans' lifestyles and views. And it has Harvard roots—it is the brainchild of professor of sociology emeritus James Davis, who was the principal investigator until 2009—and continuing connections: Geisinger professor of sociology Peter V. Marsden has been co-principal investigator since 1997.

In each successive wave, the survey confirms some popular reports of social currents (there are more women in the workforce, but they still earn less than men do) and contradicts others. For example, the GSS finds that reports of Americans' increasing isolation (such as offered in Malkin professor of public policy Robert Putnam's *Bowling Alone*) don't get it quite right: Americans do spend less time with their neighbors than they did 40 years ago, but the frequency with which they see friends and relatives has grown, and the overall frequency of social interaction has remained relatively steady.

The survey sometimes highlights a turning point when a trend begins to change course. One example: Americans' open-mindedness—measured by gauging their level of tolerance for free speech when they don't agree with the viewpoint of the speaker—has risen steadily for most of the survey term, but that trend may be reversing. (The survey tests views from across the political spectrum: it includes questions about whether atheists and homosexuals, as well as racists and militarists, should be allowed to make speeches in public venues or college classrooms, or to express their views in books offered at the local library.) Americans' increasing educational attainment was responsible for a large part of the rise in tolerance, and now that educational gains are leveling off, tolerance may be following suit, Davis writes in *Social Trends in American Life*, a new volume (edited by

CLOCKWISE FROM TOP LEFT: SANDY HUFFAKER/CORBIS IMAGES; ARIEL SKELLEY/BLEND IMAGES/CORBIS IMAGES; C. LYTTLE/CORBIS IMAGES

Marsden) that anthologizes important GSS findings. Trust in institutions, on the other hand, may be rising. For almost every type—the media, the government, large corporations, and organized religion—the survey shows that Americans born in the 1960s or later are *more* trusting than their baby-boomer predecessors.

Another interesting change: cultural differences among Americans don't map along regional lines as closely as they once did. Instead, says Marsden, when seeking to predict sociodemographic factors, or opinions on issues such as immigration and gay marriage, "It matters a whole lot more whether you're in a city or a suburb than whether you're in the Midwest or the South."

The GSS chronicles change, but also produces sobering reminders of areas where change has come slowly. In the new book, Du Bois professor of the social sciences Lawrence Bobo and colleagues tally the progress made in Americans' attitudes about race: so few people felt that white people should have the "first chance" at a job opening, or that black children and white children should attend separate schools, that these questions were dropped from the survey (in 1973 and 1985, respectively). Even so, positive attitudes have been slower to develop, as measured by white respondents' perception of how intelligent or hardworking people of other races are, or by how commonly respondents report having friends of another race. "Very few whites embrace African Americans on an emotional level," the scholars conclude. This, they argue, is the new form of prejudice: subtle rather than institutional, but nevertheless holding the country back from becoming a truly "post-racial" society.

Despite its wide range, the GSS doesn't cover every facet of contemporary life. A panel of advisers suggests updates and new questions for each wave; Marsden sees attitudes about the environment as one possible area for expansion. But by and large, he says, the survey's greatest strength *is* its consistency: "We can look at attitude change over a 40-year period because we ask the exact same question about the same topic each time."

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