

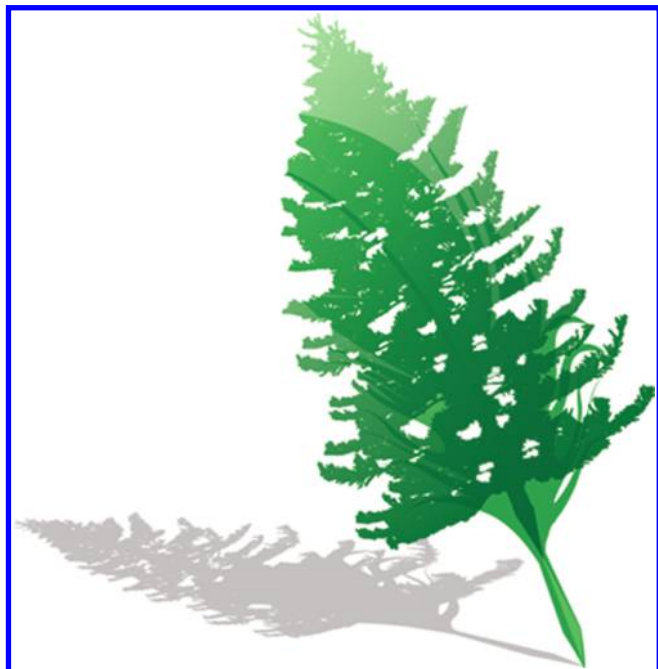
## Lester Lave, Visionary Economist

Jay Apt,<sup>†</sup> Chris T. Hendrickson,<sup>\*,‡</sup> and M. Granger Morgan<sup>§</sup>

<sup>†</sup>Tepper School of Business, Carnegie Mellon University, Pittsburgh, Pennsylvania, United States

<sup>‡</sup>Department of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania, United States

<sup>§</sup>Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, Pennsylvania, United States



Lester B. Lave, a leading applied economist on the faculty of Carnegie Mellon University, passed away at his home on May 9, 2011. This was a major loss to all of us who knew him and to the entire *Environmental Science & Technology* (ES&T) community. It may seem odd that an economist working primarily in a business school could be so important to the ES&T community, but Lave was both prolific and visionary with his interdisciplinary contributions. This perspective is intended not to provide a complete biography of Lave, but to appreciate the inception and role of his interdisciplinary contributions to ES&T.

Lave first came to international prominence with his work on the health effects of fine particulates. His 1970 regression results with his student Seskin<sup>1</sup> established a link between fine particles and mortality. This scientific link was at the junction of epidemiology and atmospheric science: an initial example of what would be Lave's life-long pattern of interdisciplinary contributions. Lave's work inspired others in atmospheric science, economics, and epidemiology to work on the link between air quality and health effects. Another continuing characteristic of much of Lave's work was also illustrated by this early study: the results were vigorously contested by parties with a stake in the existing situation and the existing state of conventional wisdom—in this case industrial polluters. Lave's findings have

been fully supported by subsequent research. Eventually, particulate air quality standards and emission regulations were introduced and they are saving lives. Lave was recognized for his air pollution and public health work with election to the Institute of Medicine of the National Academies in 1982.

At the same time Lave was working on the health effects of air pollution in the 1970s, he also continued work on transportation systems (notably automobile safety, congestion, and waterway operations) and medical care costs and efficiency. The latter work was often undertaken with his spouse, Dr. Judith Lave, who is a notable scholar in her own right on the faculty of the School of Public Health at the University of Pittsburgh.

In 1973, Lave published an initial paper on the health effects of power generation.<sup>2</sup> His interests in electricity generation organization, processes, and regulation continued for nearly forty years, with early work on alternative fuels and health effects. This interest developed into an ambitious concern for restructuring the entire energy use system in the United States. With technical colleagues Granger Morgan, Alex Farrell, and Jay Apt, he founded Carnegie Mellon's Electricity Industry Center in 2001, which today is the largest interdisciplinary group working on all aspects of the electric power industry.

During the 1980s, Lave became a seminal contributor in the developing risk analysis arena, with a particular interest in balancing environmental and other risks with economic and social objectives. Automobile safety, dam design, diabetic truck drivers, fuel additive risks, and global climate change were but a few of the topics addressed in research by Lave and his students. With Omenn, he did landmark work on testing of toxic chemicals showing that testing on rats and mice was a poor way to predict effects in humans.<sup>3</sup>

Interdisciplinary activity need not all be outreach. Welcoming outsiders into your own discipline is a contribution as long as the outsiders have something to contribute. Engineers Hendrickson and McMichael first interacted with Lave as a result of a comment on his published paper in the *American Economic Review*.<sup>4</sup> The comment read:

Lave noted that Congress typically pursues externalities with a 'one at a time' strategy. He suggested that both the legislature and regulatory agencies would be better served by considering the general cost effects of specific regulations... We suggest an extension to Lave's argument and analysis. In essence, we note that physical or technical constraints often exist on the production and control of

Published: May 23, 2011

particular unwanted by-products... Maximization of social welfare becomes a constrained problem, and regulatory policies should consider cross-media effects in such cases.

Economists are generally noted for being argumentative. Hendrickson and McMichael wondered at the reception this technology constraint argument would receive, but Lave was remarkably open to this “outsider” insight.

With Hendrickson and McMichael, Lave founded the Green Design Institute at Carnegie Mellon in 1992. This interdisciplinary center provided new approaches to pollution prevention and waste minimization. With numerous students, the group developed an input–output approach to make environmental life cycle assessment both consistent and rapid.<sup>5</sup> They also had their share of controversy, such as their study of lead emissions from the life-cycle of lead-acid battery powered vehicles.<sup>6</sup> The American Metal Market review of the 1995 lead markets noted<sup>7</sup>

During 1995 there were a few major events that affected the lead market in one way or another. In May, three professors from Carnegie Mellon University [Lave, Hendrickson and McMichael] issued a report, which appeared in the *The New York Times* and eventually the journal *Science*, entitled ‘Environmental Implications of Electric Cars.’ This article disparaged the use of lead-acid batteries and production of primary and secondary lead due to what they said are harmful emissions...

While Lave published extensively in the peer reviewed literature, he has also been a regular contributor of opinion/editorial pieces and legislative testimony. His goal was to have widespread impact, yet he respected the restraints of the peer-review scientific process. He served on, and chaired, numerous study committees of the National Academies (NRC). Most recently he chaired the Academy report *Real Prospects for Energy Efficiency in the United States* that demonstrated large opportunities for saving energy by improving buildings.<sup>8</sup> At the time of his death he was chairing an Academy committee on whether and how to make motor fuels from biomass.

Lave was a dedicated educator. He supervised roughly 40 Ph. D. and postdoctoral students, many of whom have gone on to make important contributions of their own in environmental science and technology. Many of the MBA students he taught have played important roles in the greening of U.S. and international industry. CEOs of several of the nation’s best-managed companies are his former students. He offered one of the first university courses on the economics of the environment. A long-time accomplished practitioner of benefit–cost analysis, in 1996 he wrote a scathing critique of the method that argued that “the foundation of benefit–cost analysis is flawed: the tool cannot provide what some economists claim. Even if the technique might be valid when implemented by a master with unlimited time and resources for analysis, it is a problematic tool in practice when resources are extremely limited, time is short, and people with little training or experience do the analysis.”<sup>9</sup> This was at a critical time, when benefit–cost analysis was being used as a blunt weapon to cripple environmental regulations.

Lave was prescient in picking important problems and applying rigorous analysis. He was also exemplary in ignoring disciplinary boundaries. As a result, his legacy in a variety of important topics is enormous.

## AUTHOR INFORMATION

### Corresponding Author

\*E-mail: cth@cmu.edu.

## REFERENCES

- (1) Lave, L. B.; Seskin, E. P. Air Pollution and Human Health. *Science* **1970**, No. 21 August, 723–733.
- (2) Freeburg, L.; Lave, L. B. Health Effects of Electricity Generation from Coal, Oil and Nuclear Fuel. In *Toward an Energy Policy*; Roberts, K., Ed.; The Sierra Club: San Francisco, CA, 1973.
- (3) Lave, L. B.; Ennever, F. K.; Rosenkranz, H. S.; Omenn, G. S. Information value of the rodent bioassay. *Nature* **1988**, 336 (15 December), 631–633.
- (4) Hendrickson, C. T.; McMichael, F. C. Controlling Contradiction Among Regulations: Note. *Am. Econ. Rev.* **1985**, 75, 876–877.
- (5) Lave, L. B.; Cobas-Flores, E.; Hendrickson, C. T.; McMichael, F. C. Using input-output analysis to estimate economy-wide discharges. *Environ. Sci. Technol.* **1995**, 29 (9), 420A–426A.
- (6) Lave, L. B.; Hendrickson, C. T.; McMichael, F. C. Environmental Implications of Electric Vehicles. *Science* **1995**, 268, 993–995.
- (7) American Metal Market. *Metal Statistics 1996*; Chilton Publications: New York, 1996.
- (8) National Research Council. *Real Prospects for Energy Efficiency in the United States*; National Academies Press: Washington, DC, 2010.
- (9) Lave, L. B. Benefit-Cost Analysis: Do the Benefits Exceed the Costs? Chapter 6 in *Risk, Costs, and Lives Saved*; Hahn, R. W., Ed.; Oxford University Press, 1996.