

This article was downloaded by: [72.193.103.238]

On: 15 September 2013, At: 09:19

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



## Archives of Environmental & Occupational Health

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/vaeh20>

### Environmental and Occupational Health: A "Critical Science"

Tee L. Guidotti MD, MPH <sup>a</sup>

<sup>a</sup> Archives of Environmental & Occupational Health

Published online: 07 Aug 2010.

To cite this article: Tee L. Guidotti MD, MPH (2005) Environmental and Occupational Health: A "Critical Science", Archives of Environmental & Occupational Health, 60:2, 59-60

To link to this article: <http://dx.doi.org/10.3200/AEOH.60.2.59-60>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

## Editorial

# Environmental and Occupational Health: A "Critical Science"

The latest issue of *The New Yorker*, one of my favorite magazines, contains an article on aids to navigation while driving an automobile.<sup>1</sup> In that article, Nick Paumgarten tells the reader that before there were reliable maps, mechanical devices and books of sequential photographs were developed to assist the driver in knowing where to turn in an era when there were no highways and few road signs. Over time, maps replaced these devices, and people got used to knowing more about the land around their routes, deciding for themselves which roads to take, and having a means to return to their preferred routes if they made mistakes. Now, Paumgarten impresses on the reader, people are entering the era of the global positioning system (GPS) and services such as MapQuest, which again provide single-purpose route information, the bare minimum required to get where one is going. The author worries about the imminent demise of the paper road map because most of the information on any map is useless on any particular trip, and, therefore, maps are inefficient.

Many years ago, I used the map analogy in a discussion of basic and applied research.<sup>2</sup> No sensible person would buy a map with just one road printed on it. Assuming that it led to the intended destination in the first place, it may not be the best way to go, it may bypass many places of interest, and there would be no way to correct oneself should one become lost. Applied research is like a map with one road on it—the destination and the point of origin are known, but the fundamental problem is how to get from here to there. Basic science is, by definition, investigation into areas with no immediately foreseeable application to become familiar with the landscape. It is ideally very much like a detailed map with all roads and features showing; however, if they were maps, fields of basic science would have huge blank spots.

The philosopher of science Jerry Ravetz, who has since gone on to other interests, invented a particularly useful concept in the 1960s.<sup>3</sup> He described *modes* of science, meaning the ways in which we practice and apply the scientific method.

*Basic science*, which is the exploration of knowledge unconstrained by intended use and led by what is found and the search for coherence, was one mode. Basic science is the mode of science that underlies all others. It fills in the

uncharted white spaces of our metaphorical map. It is the mode on which we fall back when confronted with the unexpected and from which come so many fortuitous observations, unanticipated applications, and understandings of mechanisms. In short, it is basic science that pieces together a world picture. Basic science obviously does not have a ready answer for every question as it arises, but, clearly, such answers are much closer when investigators extend their research into areas that appeared improbable of application before the question arose. Ecology, which is a basic science of environmental health, was like this in the early part of the 20th century, when natural history was still in vogue and before conservation science applied the knowledge.

*Applied science*, which is a goal-directed exploration of knowledge in new applications, was a second mode. Applied science provides the knowledge that technology applies to a product or particular use.

Ravetz discerned a third mode, which he called *critical science*. He described it as a new approach in which scientists critically evaluate and analyze the impact of technological developments within the context of the real world (not the engineer's world of simplifying assumptions), drawing primarily on basic science and collaborative critical research to predict, document, and correct physical and human problems of technological origin. Critical science provides a means of evaluating applied science and technology, assessing its impact, and identifying problems that need to be corrected if humankind is to reap the full benefit of technology. Without it, Ravetz said, humans are doomed to constant repetition of the past excesses of technology: air pollution, emerging infections as a result of microbial resistance, ecological degradation, toxic exposures, and other ills of civilization. Ravetz's point was not that critical science should argue for a halt to technological advances or that technology was inherently antihuman. Rather, it was that critical science provided the means to correct the unwanted consequences of technology and, therefore, to civilize it.

The single essential tool of critical science is knowledge, in the sense of both data and unifying concepts. To this end, critical science requires the highest quality of original research and

thoroughgoing comprehension of many scientific disciplines. Most of all, it involves a questioning and critical attitude that shapes the way people think. Bertrand Russell, in 1924, characterized well the impact of a scientific discipline: "A science may affect human life in two different ways. . . . Without altering men's passions or their general outlook, it may increase their power of gratifying their desires. On the other hand, it may operate through an effect upon the imaginative conception of the world, the theology or philosophy which is accepted in practice by energetic men."<sup>4(p7)</sup> Gender aside, this is a wonderfully concise description of how science influences our thought processes as well as about what we choose to think.

It should be obvious by now that the environmental health sciences fit quite well into Ravetz's description of a critical science. Environmental science work involves the assessment of human interventions into the natural world, the introduction of chemical and other hazards, the effects on humans of artificial structures of civil society and human communities, the means by which their risk may be defined and mitigated, and the values by which we make choices in our lives and as a society with respect to environmental management.

Environmental health sciences, as a critical science, may provide important evidence for use by the decision-making institutions of society. The ultimate goal, it should be clear, is to improve the quality of human life, to reduce the adverse impact of human activity on the environment, and to remove barriers to the achievement of a sustainable, healthful, and just society. (I will discuss environmental justice in a later editorial.) It is not to stop economic development in its tracks, to provide a political club for one partisan group to

beat another, to keep unwanted projects out of everyone's backyard, nor to lay the groundwork for lawsuits. But if things progress to that extreme, and critical science provides the evidence, it is not the fault of the scientists who push the boundaries of knowledge to document the effects of technology and change; it is a failure of the social mechanisms. Humans have to deal with uncertainty and to protect against the consequences of technology-driven change, leading to division, partisanship, and conflict.<sup>5</sup>

Critical science, in general, and the environmental health sciences, in particular, provide valuable corrective and stabilizing influences if people listen to the messages. If people shoot the messenger, as appears to be happening today particularly in climate-change science,<sup>6</sup> they destroy the valuable reflected image, the all-important feedback, that gives humans their best chance to build a better world.

Tee L. Guidotti, MD, MPH

Editor in Chief

*Archives of Environmental & Occupational Health*

### References

1. Paumgarten N. Getting there. *New Yorker*. 2006;82(10):86–101.
2. Guidotti TL. Medicine, critical science, and the real world. *West J Med*. 1975;123:69–70.
3. Ravetz J. Towards critical science. *New Scientist*. 1971;51:681–683.
4. Russell B. *Icarus, or the Future of Science*. New York, NY: E. P. Dutton; 1924.
5. Guidotti TL. Critical science and the critique of technology. *Pub Health Rev*. 1994;22:3–4.
6. Revkin AC. Climate expert says NASA tried to silence him. *New York Times*. January 29, 2006;1:1.

Copyright © 2006 Heldref Publications