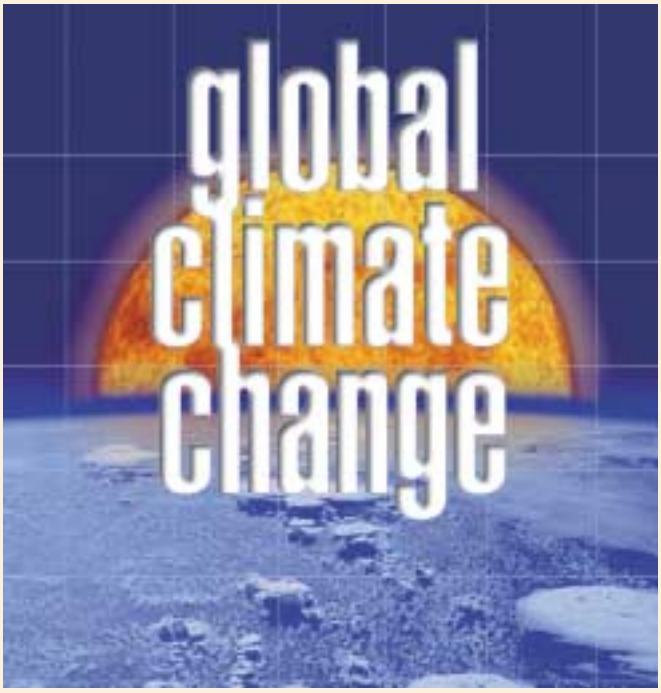
Global Climate Change: Electrochemical and Photochemical Perspectives

by Andrzej Wieckowski

"Global temperatures could rise by as much as 10.5 degrees over the next century, triggering droughts, floods, and other disasters from shifts in weather patterns. The projected rise in average worldwide temperatures is sharply higher than the 2.5–5.5 degrees previously thought." These are conclusions drawn from the recent United Nations meeting on climate change in Shanghai, China (January 2001), as reported, for example, by the Associated Press and CNN. Despite the fact that hundreds of scientists were involved in this study, including many from the U.S., many questions and doubts still remain about such assertions. However, general consensus has arisen that carbon dioxide and other greenhouse gases have built up in the upper atmosphere and the heat generated by human activity is trapped or reflected back to the surface of earth. In principle, the effect can be real and problematic. But is the climate warming trend caused primarily by the human factor? It is necessary to examine all data and correlations available. Indeed, as *Science* magazine recently reported (Vol. 288, p. 589, 2000), the temperatures recorded in the twentieth century were abnormally high in the overall pattern of the past millennium. Moreover, the beginning of the warming trend correlates well with the beginning of the industrial revolution that, as is also well known, has generated huge amounts of carbon dioxide. Because emissions of greenhouse gases into the atmosphere by the increasingly industrialized world continues, or even accelerates, escalation of quite diverse climate change effects may well be anticipated. This is a reasonable, first approximation hypothesis that our world needs to address. In fact, the climate change debate has already begun, despite an uncertainty as to the balance between the technological and natural factors contributing to the overall climate change trends.



Leaving the latter uncertainty unresolved, even a skeptical person may agree that release of massive amounts of toxic or greenhouse gases into the atmosphere could be considered potentially harmful. Some of the major preventive measures that are being considered or recommended are not electrochemical (or photochemical) in nature. For instance, curtailing deforestation or inducing technological changes in the chemical industry to generate less greenhouse gas have been discussed. However, electrochemistry and solid-state science and technology have a unique potential to be key players in atmosphere remediation efforts via clean energy technologies, *e.g.* fuel cells, solar energy, and batteries, and via development of new, viable technologies for carbon dioxide reduction. The Electrochemical Society has recognized the importance of the climate change problem, and began discussing some preventive measures in Phoenix, Arizona, during the 198th meeting of ECS last October. Specifically, a symposium was held, under the title "Electrochemistry *vs.* the Global Climate Change: A Coordinated Response," that involved all the Divisions and Groups within the Society. This symposium addressed some essential climate change issues from electrochemical and photochemical perspectives, and provided a forum to enhance connectivity between various investigators (whose research directly or indirectly relates to climate change issues), and identified new research opportunities in environmental electrochemical research.

Three feature articles in this issue of *Interface* describe specific R&D approaches that may help to restore the atmospheric equilibrium, and invert the climate change trends by a meaningful degree. David P. Wilkinson, from Ballard Power Systems, Canada, reports on progress made in the development of commercial fuel cells for motor vehicle transportation. Gillian M. Bond and co-authors review the status of various sequestration technologies being considered for carbon dioxide. Donald A. Tryk and Akira Fujishima, from the University of Tokyo write about "The Carbon Dioxide Reduction Battle," emphasizing electrochemical and photochemical approaches.

Interface readers and members who want to learn even more about the climate change issues in the electrochemical and photochemical perspectives are urged to examine the ECS proceedings volume (PV 2000-20), from the ECS Phoenix meeting, soon to be published. This volume contains a collection of about 20 chapters, and covers a range of climate change topics. Our Society is comprised of a unique blend of electrochemists and solid-state scientists and is thus an ideal platform for debate of climate change issues. It is our hope that this special issue of *Interface* and the proceedings volume mentioned above will be the catalysts for such dialogue and information transfer. ■

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