Bert Bolin
1925–2007

Bert Bolin, who died in Stockholm on 30 December 2007, was an exceptional research scientist and a masterful scientific statesman. He was also a scientific visionary who was among the first to realize that human activities, especially the production of carbon dioxide from burning oil and coal and natural gas, might quickly augment the natural greenhouse effect and lead to significant climatic change. His own research convinced him that large increases in atmospheric concentrations of carbon dioxide could come sooner than almost anyone else expected.

Today, when "global warming" is widely recognized worldwide as a major concern, it may be difficult to realize that, as recently as the 1950s, the prevailing view in the scientific community was that adding carbon dioxide to the atmosphere would have only a negligible effect on climate. Svante Arrhenius, who did the first detailed calculations in 1896, thought that doubling atmospheric carbon dioxide levels might take 3,000 years. He did not foresee the explosive twentieth-century growth in population and fossil fuel use. In fact, like others, Arrhenius studied the connection between carbon dioxide and climate, because he sought an explanation for the ice ages rather than a mechanism operating on shorter timescales.

Subsequently, with very few exceptions, most scientists who considered the issue came to incorrect conclusions. Some mistakenly thought that the carbon dioxide absorption bands for infrared radiation were already saturated, so that adding additional carbon dioxide would not increase absorption. Other scientists found other reasons to dismiss the effect of rising atmospheric carbon dioxide levels, believing, for example, that water vapor absorption of infrared radiation overwhelmed that of carbon dioxide, or that the ocean would speedily take up any additional carbon dioxide that puny humankind might add to the atmosphere.

Bert Bolin was among the pioneering researchers who shattered this complacency and alerted both scientists and the wider world to the prospect of manmade climate change. He then went on dedicate much of his career to a series of international efforts to promote and advance the science, culminating in his extraordinary role in founding and leading the Intergovernmental Panel on Climate Change (IPCC).

The New York Times for 28 April 1959, referring to the annual meeting of the National Academy of Sciences, held in Washington, D.C., reported that, "Members of the academy were told that within 40 years the amount of carbon dioxide in the air may have increased from 25% to 30% above the level at the time when man began using fuels. The effect on climate allegedly might be radical. The matter was discussed by Dr. Bert Bolin of the University of Stockholm."

Bolin was not quite 34 years old when he made this remarkable 40-year forecast. He had been invited to speak at the academy meeting at the suggestion of Francis W. Reichelderfer, chief of the U.S. Weather Bureau, who wrote to the academy about Bolin,

"He is carrying on as head of the institute in Stockholm since Rossby's death. He is a good speaker, young but very capable and he has been giving considerable attention to the chemistry of the atmosphere."

The scientific basis for Bolin's prediction was also published in 1959, in a remarkable paper by Bolin and Erik Eriksson appearing in the Rossby Memorial Volume, *The Atmosphere and the Sea in Motion*, edited by Bolin. This paper, building on earlier work, especially a celebrated 1957 result published by Roger Revelle and Hans Suess, clearly showed how the buffering mechanism of seawater would prevent the ocean from quickly taking up most of the carbon dioxide emitted into the atmosphere by humankind. Bolin's quantitative prediction was astoundingly good. In fact, thanks to the accurate measurements initiated by Charles David Keeling, we now know that the atmospheric concentration of carbon dioxide at the end of the twentieth century was about 32% higher than the preindustrial value of mid-nineteenth century. This concentration is still increasing today, as fossil fuel use, now the basis for some 80% of the global energy supply, continues to accelerate globally. The climatic consequences of this large manmade change in the chemical composition of the atmosphere underlie the dominant environmental issue of our time.

Bert Bolin was born in Nyköping, Sweden, on 15 May 1925. He studied physics and mathematics at the University of Uppsala, receiving his B.Sc. in 1946. He then undertook graduate work in meteorology at Stockholm, receiving his M.S. in 1950 and his Ph. D. in 1956. Stockholm during this period was an intellectually exciting venue for studying meteorology, because Carl-Gustav Rossby had returned to Sweden from the United States and showed his customary great energy in building up both the university department and an international institute in Stockholm. Rossby's iconic stature as a researcher and his proven ability as an organizer attracted many outstanding scientists to Stockholm, from Europe, the United States, and elsewhere.

Bolin flourished in this environment, with Rossby as his mentor. His Ph.D. thesis research was in dynamic meteorology and numerical weather prediction. Bolin quickly undertook increasing responsibilities, including being editor of the journal *Tellus* that Rossby had founded. Like Rossby himself, Bolin evolved in his research focus from atmospheric dynamics to atmospheric chemistry. On the occasion of Rossby's sudden death in 1957, Bolin took over leadership of the International Meteorological Institute in Stockholm. He was also appointed to a professorship at Stockholm University in 1961, a position that he held until his formal retirement in 1990.

Beginning in the 1960s, in addition to his academic and administrative duties and his personal research on the carbon cycle and other topics, Bolin demonstrated an exceptional aptitude for promoting and leading international scientific programs and organizations. He played major roles in the Global Atmospheric Research Program, the International Geosphere Biosphere Program, the Scientific Committee on Problems of the Environment, the European Space Research Organization, and many others, on topics ranging from acid precipitation to weather prediction to biogeochemistry. To each of these tasks, Bolin brought great energy and diplomatic skills, in addition to his wide-

ranging scientific expertise. He also served in several high-level governmental advisory positions in Sweden.

All of this activity, however, may be regarded as a prelude for what was surely Bolin's crowning achievement, helping to establish and then leading the IPCC. Bolin was an obvious choice as the first chair of IPCC, serving from 1988 to 1997. IPCC has produced four major climate assessment reports, the first two under Bolin's chairmanship. The IPCC First Assessment Report (FAR) in 1990 was a key element in the establishment of the UN Framework Convention on Climate Change at the Earth Summit in Rio de Janeiro, Brazil, in 1992. This document, signed by virtually every nation in the world, has as its objective the prevention of "dangerous anthropogenic interference" with the climate.

The IPCC Second Assessment Report (SAR) in 1995 led directly to the Kyoto Protocol in 1997. The IPCC reports assess the peer-reviewed scientific research literature in a way that is policy relevant but not policy prescriptive. Both the FAR and the SAR attracted the participation of outstanding scientists from around the world, and it is certain that Bolin's own scientific eminence was a key reason for the willingness of other experts to contribute to the work of the IPCC. Today, the organization enjoys a reputation for fairness, transparency, and inclusiveness in its work, and this too continues a tradition established under Bolin. The Third (TAR) and Fourth (AR4) Assessment Reports appeared in 2001 and 2007, and reached increasingly strong conclusions about the seriousness and anthropogenic origins of climate change.

Bolin was thrilled when the announcement came in October 2007 that the Nobel Peace Prize was to be awarded in equal shares to Al Gore and to the IPCC. He was too ill to attend the Nobel ceremony in Oslo in December 2007, but Gore and many others clearly acknowledged the key role that Bolin had played in the success of the IPCC.

Bolin completed a major book, *A History of the Science and Politics of Climate Change: The Role of the Intergovernmental Panel on Climate Change*, published in late 2007. This book is both a scholarly work of history and a scientific and professional autobiography. The book, like Bert Bolin, is a model of clear communication, modesty, optimism, and vision. The IPCC itself is a lasting memorial to Bert Bolin. Wren's famous epitaph is apt: "Lector, si monumentum requiris, circumspice." "Reader, if you seek his monument, look around you."

Bolin's list of major honors is long and includes the AMS Rossby Medal, the Blue Planet Prize, the Tyler Prize for Environmental Achievement, and many other awards. He was a member of nine academies of science. His legacy of intellectual integrity and scientific leadership is embodied in the reports of the IPCC. The IPCC exemplifies the ideal of sound science in the service of society, a concept in which Bert Bolin believed deeply and which guided his life.—*Richard C. J. Somerville.*

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