

Fred T. Mackenzie

Melding of Life at the Kolleg with Global Environmental Change



Fred T. Mackenzie was born on March 17, 1934 in Garwood, N. J., USA. He studied at Upsala College where he received a B.S. degree in physics and geology in 1955 and at The Johns Hopkins University and Lehigh University where he received his M.S. and Ph.D. degrees in geology and geochemistry in 1959 and 1962, respectively. In between degrees, he served as an infantry foot-soldier and in Special Services in the U.S. Army. Fred has been: Teaching Assistant, The Johns Hopkins University, 1955-56. Teaching and Research Assistant, Lehigh University, 1958-62. Geologist, Shell Oil Company, 1962-63. Staff Geochemist and Assistant Director, Bermuda Biological Station for Research, 1963-67. Assistant, Associate, and Full Professor of Geological Sciences, Northwestern University, 1967-81. Professor of Oceanography and Geology and Geophysics and Head of Marine Geochemistry, The University of Hawaii, 1981-present. Fred has been a Visiting Scientist at the Bermuda Biological Station for Research, West Indies Laboratory of Fairleigh Dickinson University in St. Croix, Université Libre de Bruxelles, Bellairs Marine Laboratory in Barbados, Stareso Marine Laboratory in Corsica, and the Woods Hole Research Center in Woods Hole, Mass., USA. Fred is the author or co-author of more than 150 scholarly publications. — Address: Department of Oceanography, University of Hawaii, 1000 Pope Road, MSB 525, Honolulu, Hawaii, 96822, USA.

My introduction to the Wissenschaftskolleg came at the end of 27 hours of traveling and a 12-hour time differential between Hawaii and Berlin! I was almost exactly half-way around the world from my home. I was bushed but was immediately taken well in hand by Frau Monika Fogt and the Kolleg staff and delivered to my apartment, which also served as my office. What an apartment! I shall always remember the four-meter ceilings and the spaciousness of both the "Royal Suite" and the

Villa Jaffé. The night of my arrival I collapsed and did not awaken until late the morning of the next day. On that day, I met my fellow colleagues at the Villa Jaffé — Abe Lerman, my associate for more than 25 years who was to work with me while I stayed at the Kolleg, and Richard Law, Ulf Dieckmann, Tome Herben, and Norbert Frei. All of these individuals were to prove to be a pleasure to be with and intellectually stimulating during my stay. I also met Frau Grundlach and the other house staff who would maintain my apartment in immaculate condition and put up with my broken German.

I awakened to the gray, rain, and cold of Berlin; weather which continued far into the summer. Needless to say, coming from Hawaii—"Paradise"—I did not appreciate the Berlin weather during the spring/summer of 1996. There were a few spectacular sunny days and the smell of the Linden trees in summer and our location in Grunewald among glacial lakes and forests were heavenly. I regret that this particular year was generally gray and dreary.

I also awakened to my new computer which had been set up in fine working order by Dr. Hans-Georg Lindenbergr — without his help, I would still be writing on a yellow pad and doing calculations and manuscripts by hand. With the computer platform and network provided by Hans-Georg, it was remarkably easy to reach my associates at the University of Hawaii and to log into our calculating and modeling programs, obtain library materials, and complete my manuscripts.

On the following day, I met many of the Kolleg staff, all of whom were to be particularly helpful to me during my stay. I shall not forget any of them, in particular Frau Barbara Sanders and Frau Andrea Friedrich. I cannot imagine a more perfect receptionist than Barbara, who made immeasurable efforts to make the stay of all Fellows pleasant and who, in particular, induced me to speak the German I was learning from Frau Eva Hund. Andrea in her daily interactions made my journey as a Fellow at the Kolleg a sea without storms and provided my daughter and in turn my son with the night spots of Berlin.

During my first two months at the Kolleg, I was without my family. I worked every day and did very little traveling, except to Berlin Zentrum and Mitte and the museums in the area. I also had the opportunity to learn German from Eva. Although I had two years of the language in undergraduate school more than 30 years ago, I remembered little. Eva was a great help and by the end of my stay, I had no trouble handling myself in restaurants, stores, etc. and actually could understand some of what was being said at the colloquia, which were generally, but not always, held in German. Then, one by one, my wife, Judy, my daughter, Deborah, my son, Scott, and granddaughter, Ashlyn, arrived.

Apartment 4 in the Villa Jaffe became a really "happening" place with my working, my family (and I as much as possible) getting to know and enjoy Berlin and the Berliners, and our traveling to other German cities and European countries. As I look back on my stay at the Kolleg, I wonder in retrospect how I managed to get so much work done.

One cannot write a commentary like this without mentioning the wonderful meals that we had at the Kolleg. Frau Christine Klöhn and her staff did an absolutely superb job in preparation of the meals and went out of their way to provide me, a virtual vegetarian, with specially prepared dishes. I shall never forget my last evening meal — a delicious sushi dinner! Although the meal schedules at times were a little disrupting to my work schedule, I found that they afforded me the opportunity to meet the other Fellows and learn what their intellectual and personal interests were. In this respect, I also enjoyed the trips arranged by the Kolleg to the Oder and the Wannsee. It would have been nice to have had more such excursions with both staff and Fellows participating together. It is at times like these that people get to know and appreciate one another.

My personal remembrances would be incomplete without mentioning the colloquia, the perception of the humanists concerning science, and the lack of scientists as Fellows. The latter is obvious when one scans the *Wissenschaftskolleg Jahrbuch*; scientists have only constituted about 20% of the Fellows over the years. Because of my strong interests in the linkages between environmental change and the human dimensions issues of change, I would have liked to have seen a more even mix of natural scientists and humanists at the Kolleg. As Chief Scientist of the Center for a Sustainable Future at Hawaii, I also feel there is a strong need today for better interaction between scientists and humanists and a demand for more institutional structures to recognize such a need. The Kolleg is a perfect venue for such activity.

As to the colloquia, it was interesting for me to see reinforcement of my perception of the manner in which humanists and scientists present their lectures. Humanists tend to use very few visual aids and to read from prepared manuscripts; at times, this approach can make for a very boring and tedious lecture. On the contrary, scientists rarely read from a prepared manuscript and generally use a profusion of visual materials.

In listening to lectures and in direct conversations with the humanists and scientists at the Kolleg, I sensed a better appreciation for the fields of study of history, sociology, classics, and economics by scientists than for science by the human scholars. This may simply reflect my prejudice as a scientist, or the fact that generally, at least in the United States,

university students in the non-scientific fields are woefully inadequately trained in science whereas scientists take at least four years of liberal studies in most universities, or the fact that human science is so much part of everyday life that we are all knowledgeable to some degree and have opinions on various aspects of these studies, or some combination of these factors.

Now what did I accomplish scientifically during my nearly four months at the Wissenschaftskolleg? Perhaps the best way to demonstrate what I did is to look at what I proposed the week I arrived and the present status of these projects.

During the past 30 years, much of my research in geochemistry has been directed at gaining an understanding of the evolution of the surface environment of the Earth, past, present, and future. The approaches have involved theoretical, experimental, and field observational methodologies. Studies of the global biogeochemical cycles of the elements as perturbed by human activities and the now "popular" field of global environmental change constitute an important element of this work.

During my stay at the Wissenschaftskolleg, I intended to work on four major projects in concert. They included:

1. Draft and completion of a manuscript on the interactions among the biogeochemical cycles of carbon, nitrogen, phosphorus, and sulfur in the land-ocean-atmosphere system. This manuscript is divided into two parts: the first documents human interference in this interactive system on the global scale and with emphasis on Asia; and the second presents the application of an Earth system model developed by our group — the Carbon-Nitrogen-Phosphorus-Sulfur Earth System Model (CNPS-ESM) — to examine the behavior of the global sources (including human) and sinks of atmospheric CO₂ during the past 300 years. Model results are then applied to the region of Asia. Of special interest to the reader, perhaps, is the fact that our model calculations predict remarkably well the historic observed record of global atmospheric CO₂ concentrations during the past 300 years of Earth history (see Figure 1). What is even more exciting is the fact that, in order to reproduce the record, one must consider in the modeling calculations the human activities of fossil fuel combustion and land-use emissions of CO₂ to the atmosphere, the remobilization of the nutrients nitrogen and phosphorus from land-use activities, the application of fertilizer nitrogen and phosphorus to croplands, and the global temperature record of the planet during this time period. In other words, the

- 300-year atmospheric CO₂ record is a consequence of several interacting factors and feedbacks, but reflects mainly human interventions on the global Earth surface system. This research was done in cooperation with Abraham Lerman and May Ver, a senior Ph.D. graduate student working with me. The work entitled "Global Biogeochemical Cycles of Carbon, Nitrogen, Phosphorus, and Sulfur in the Land-Ocean-Atmosphere System" will be a chapter in the book *Asia in Global Environmental Change*, to be published by Oxford University Press in 1996 or 1997 (Accomplished).
2. Draft and completion of a monograph dealing with the connections between the biogeochemical cycles of the elements and the physical climate system. This work describes the biogeochemical processes and cycles that affect the exchange of radiatively active gases, like CO₂ and SO₂, between Earth's surface and the atmosphere. Emphasis is placed on the relative magnitudes of the transfers due to natural mechanisms and those due to industrial, agricultural, and household activities. The manuscript is entitled "Global Biogeochemical Cycles and the Physical Climate System" and will be published as a single volume by the University Corporation for Atmospheric Research Global Change Instruction Program in late 1996 or early 1997 (Accomplished).
 3. Commencement of work on the 2nd edition of one of my books, entitled *Our Changing Planet: An Introduction to Earth System Science and Global Environmental Change*, to be published by Prentice-Hall in late 1997. This work is an interdisciplinary textbook on global environmental change for students who are non-science majors and for the educated layperson. The first edition is co-authored with my wife, Judith Mackenzie, and was published in 1995. Much of this work is still in progress.
 4. Development of a computer model to test a series of hypotheses that attempt to explain the causes for the "Cambrian Explosion". This is the time about 545 million years ago when many groups of multicelled, shelled organisms first appear as fossils in the geologic record. The evolutionary record of life and the distribution with geologic age of the various isotopes of strontium, oxygen, carbon, and sulfur are being used as databases to constrain the model. This research is a collaborative effort between Ken Hsü, Abraham Lerman, and myself and is still in progress.
 5. A fifth and, when I arrived, unanticipated accomplishment was the writing of a paper with one of my graduate students, Rolf Arvidson, dealing with the thermodynamics and kinetics of an important mineral found in sedimentary rocks — dolomite. This manuscript entitled

"Dolomite Reaction Kinetics and Their Application to the History of Seawater" will be published in the journal *Aquatic Geochemistry* in 1996 or 1997 (Accomplished).

So in summary, I can only describe my few months at the Wissenschaftskolleg as highly productive in terms of scientific accomplishments. I wish I could do as well during my more normal days at the University of Hawaii!

Because of my heavy schedule of teaching, research, supervision of graduate students, and laboratory work, I was only able to spend 3 1/2 months at the Wissenschaftskolleg during 1996. This was regrettable because I found the experience absolutely marvelous and without precedent, despite all the time I have spent as a visitor at various institutions. I am especially grateful to Professor Wolf Lepenies and his staff for making my experience a memorable one in a positive sense and to my fellow colleagues who provided inspiration, conversation, amusement, and genuine companionship throughout my stay. I shall not forget my Kiwi deliverer, Bernd Herrmann, and his leadership of the Fellows, Kurt Spillmann and our conversations on environmental change as a cause of conflict, Bob Harms and his spirited lecture on the French involvement in the African slave trade, Michael Power and his enthusiasm for football, Holk Cruse and his models of insect movement, Andreas Wagner, Margaret Morrison, Klaus Günther, Ulrich Haarmann, and many others — I wish them all "Berg Heil". My experience was not all wine and roses but overall it was enjoyable and rewarding intellectually and personally.

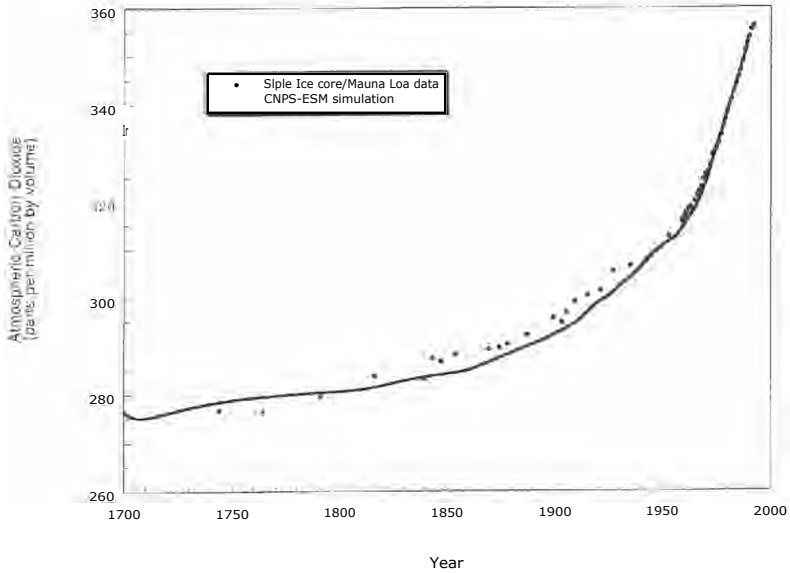


Fig. 1. The calculated atmospheric CO₂ model results (solid line) compared with the observational data (black dots) from the Siple ice cores and the Mauna Loa Observatory. Notice the very good correspondence between the model results and the proxy of direct atmospheric measurements for the past 300 years.