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Lawrence Berkeley Laboratory
Applied Science Division

NEWSLETTER

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AROUND THE WORLD, TWICE IN TWENTY MINUTES

BY TONY HANSEN

One program within the Atmospheric Aerosol Research Group is the study of Arctic haze, begun a few years ago by Hal Rosen. This haze appears to be a blanket of man-made pollution that has been detected at ground level during the winter and spring months at many locations in the Western sector of the Arctic. Wind currents tend to circle the pole during these months, and so the haze may very well be present in all parts of the Arctic. One component of the haze is carbon in the form of sub-micron sized particles of soot that can remain suspended for long periods of time, but can also be incorporated in precipitation or deposited on the snow and ice. If this soot is indeed geographically widespread and mixed throughout the lower layers of the atmosphere, the delicate balance of solar radiation and climate in the Arctic could be seriously disturbed.

In order to assess the extent and intensity of the haze, the National Oceanographic and Aeronautical Administration (NOAA) organized an aircraft-based sampling project with participation from about a dozen institutions, including LBL. Our installation on board the plane consisted of two conventional filter sampling lines in which the aerosol particles were collected on quartz fiber and Millipore (cellulose) filters and a new instrument recently developed by us that measures the concentration of black carbon particles in a continuous, real-time manner. From a Greek word meaning "to blacken with soot", we named this instrument the aethalometer.

Previously, the aethalometer had been operated only a few times at ground level to study daily cycles of combustion-derived particles in urban atmospheres. For use in an aircraft, it had to be strengthened somewhat to be able to withstand both a large pressure difference and anticipated vibration. The pressure difference arose between the aircraft cabin pressure and the interior of the analysis chamber connected to the outside atmosphere. At 30,000 feet altitude, the force developed would amount to maybe 2000 lbs. To counter this, Dick Schmidt neatly redid the interior of the instrument in quarter-inch steel plate, thereby making it the only armored aethalometer around. Using bolts, straps, clips, RTV glue, and lots of black tape, we made sure that nothing would shake loose - no matter what! Testing for vibration immunity

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was undertaken in a scientific and reproducible manner by dropping the aethalometer from height h onto a hard surface S under the influence of gravity g. This procedure caused a worse reaction in Hal than it did in the instrument, which retained its (digital) composure to better than one part in 2^{12} for a six-inch drop. These procedures paid off in that we suffered no down-time at all in almost 150 hours of flying, often under arduous conditions.

With my allotted "10 pounds of luggage" (everything had to be carried around the Arctic on the research plane and weight was at a premium), I headed off to Anchorage. There, the various members of the scientific team met up with the flight crew support team from NOAA. These people and the plane are normally based in Miami for hurricane studies and were not sure how well they would survive a 100-degree drop in temperature. A change of o-rings and hydraulic fluid took care of the plane, and the issuance of parkas, quilted overtrousers, insulated boots, etc. from the nearby Air Force base took care of all of us people. In Anchorage, where it was just below freezing, we laughed a little at these vast quantities of fiberfill; the laughter stopped when we had to work outside in Greenland. After a couple of days of preparation and testing, we took off at dawn for our first flight from Anchorage up to Barrow and then out over the Arctic Ocean.

The first flight was an eye-opener. We flew directly over Mt. McKinley, whose crags appeared to project almost straight up from the adjacent valley floor amidst glaciers and ice fields. We flew for ten hours over monochrome scenery - white, with any black being rocks and trees far below. To sample the full vertical profile of the atmosphere, we spiralled down from six miles altitude and flew for half an hour low over the jumbled pack ice of the Arctic Ocean. Strapped into a seat and flying at 300 mph only fifty feet above house-sized blocks of ice was indeed quite a change from Building 73 the week before, and not something that I would ever want to get used to. The biggest surprise, however, was the extent and intensity of the haze that our instruments detected as we descended from the clean air of high altitudes. I had set the aethalometer to its maximum sensitivity and was watching the output on a chart recorder, marking the altitude on the paper as we gradually flew lower and lower. Down to about two thousand feet, the concentration of soot increased slowly to a fraction of a microgram per cubic meter, a level that is surprisingly large for so remote a region but comparable with average ground-level measurements there. Suddenly, the pen went right off the edge of the paper and hit the end-stop. Almost simultaneously, shouts went up from people watching other real-time instruments. We had entered a different air mass, with different temperature and humidity, that contained a ten-fold increase of haze aerosols. The maximum soot concentration was found at an altitude of about 700 ft. and was similar to the yearly average measured here at LBL - and yet, over the Arctic Ocean, we were thousands of miles from major pollution sources. Flying level, we were still in this haze layer an hour later when our mission time expired and the pilot had to head home. Both the corridors of the Holiday Inn and the long-distance phone lines were buzzing that evening when we returned with this first-ever vertical and horizontal sounding of the Arctic haze.

Four missions were flown out of Anchorage with target areas in the vicinity of Barrow to link up with intensified activity at the NOAA ground sampling station there. After that, we flew across the Canadian arctic to what was intended to be a night's stopover at the Thule Air Base in northern Greenland. As it happened, our plane burst its two nosewheel tires, perhaps due to the intense cold, and we ended up spending a week in one of the most improbable places on earth. To the west, the ocean was frozen about fifteen feet thick. A couple of miles to the east, at the end of the valley, was the edge of the ice cap that covers Greenland with a thickness estimated to be close to ten thousand feet. The base houses a population of about a thousand men who primarily operate the gigantic radar installation that is the main station of the Ballistic Missile Early Warning System. It was built during the "Cold War" for a population of fifteen thousand and now has the external appearance of a Ghost Town Gulag. It was 45° below zero and the snow squeaked like brittle meringue under our boots as we walked the half-mile to the dining hall, a walk that invariably did wonders for our appetites. Inside the buildings was a <u>different world</u>. To make the eighteen-month assignment tolerable, through perpetually dark winters and perpetually light summers, the military flies up a large transport plane every other day from Philadelphia loaded with food, fresh vegetables, newspapers, videotapes of football games, and anything else that they are asked for. There are clubrooms with leather chairs, pool tables, and bars (one has a live Country & Western band shipped up fresh each week). There are two french restaurants with steak, lobster, waiters, and wine. The subsidized military prices look like a return to the fifties. Inside those squat metal buildings backed by snowdrifts, the personnel accommodations resembled a rather nice motel with plush carpeted hallways. Reality returned at the end of the evening when we put our parkas, boots, and overtrousers back on, went through the three sets of doors into the cold that froze your breath into icicles on your beard, and walked back through the gulag to our Transient Accommodation Quarters, vintage 1953.

Finally, our new tires arrived, the plane was thawed, and we were back in the saddle. Leaving Thule, we flew due north a thousand miles to the North Pole. The pack ice that covers the Arctic Ocean is in constant slow movement and so there is no way of marking the Pole itself. The ice went ever on, our instruments showed continuing moderate aerosol concentrations, and the navigational system display showed a latitude creeping ever higher. At last the display showed 90.0^{o}, and the pilot started to fly in a circle. Outside, the top of the world looked flat and cold. Inside, the longitude display raced from west to east to west again as we crossed all the meridians - twice in twenty minutes.

Weeks later, I am back in Berkeley. The scientific mission was an unqualified success - most instruments worked most of the time and showed surprisingly large concentrations of aerosol particles, with vertical and horizontal variations that seem to be linked to meteorological parameters. For my part, I have boxes of slides, new friends, ideas on "How to Do It Better Next Time", and about 70,000 pieces of data with which to exercise the electrons in my computer. The results are already indicating the possible magnitude of pollution-derived

climatic effects and new topics in atmospheric chemistry, and it is certainly the intention of Hal and myself to continue to pursue this interesting field of research.

Tony Hansen is somewhere inside this suit!

INVITED TALKS AND FOREIGN TRAVEL

July

- Robert Cheng presented a paper entitled "The Influence of Combustion on Reynolds Stress in a Strongly Heated Turbulent Boundary Layer" at the 22nd National Heat Transfer Conference held in Seattle, Washington.

- Emmanuel Altmayer was in Seattle, Washington, where he presented a paper entitled "Verification of a Numerical Simulation Technique for Natural Convection" at the American Institute of Chemical Engineers (AICE) conference.

August

- Sam Berman was in Los Angeles where he presented four papers at the Illuminating Engineering Society (IES) Annual Conference. The papers were entitled "Fundamental Problems with Visual Performance Research Described in the Final Report of Committee TC-3", "Theory of the Effects of Magnetic Fields and Isotope Enrichment on the Radiant Emittance of the Hg-Ar Discharge", "Experimental Studies of Enhanced Emittance by Isotope Enrichment of a Low-Pressure Mercury/Argon Discharge", and "Experimental Studies Relating Environmental Lighting and Flicker to Visual Fatigue of CRT Operators".

- Rudy Verderber and Francis Rubenstein were co-authors of a paper presented at the IES Annual Conference in Los Angeles. The paper was entitled "Field Study on Occupancy Scheduling as a Lighting Management Strategy".

- Sam Berman will be in Amsterdam to attend a conference and present a paper to the International Commission on Illumination. He will then travel to Philips Laboratory in Eindhoven for research discussions.

- LBL was well represented at the 18th Intersociety Energy Conversion Engineering Conference (IECEC) held in Orlando, Florida. Elton Cairns was the Technical Program Chairman for the conference and Frank McLarnon was the Assistant Technical Program Chairman. Jeff Hirsch was the Topical Organizer for Energy Efficient Building Systems, Mike Wahlig was the Topical Organizer for Heating and Cooling, and Mark Levine was the Topical Organizer for Energy Policy and Analysis.

SEARCH FOR A NEW ASSISTANT DIVISION HEAD

After serving nearly five years as Assistant Division Head, Rollie Otto will be returning to full time research. Elton and the Program Leaders would like to take this opportunity to thank Rollie for a job well done, and to wish him well in the future.

We are starting a search for a new Assistant and will be advertising in journals such as Science, as well as via the regular Laboratory posting of Current Job Openings. The basic information that will be appearing in the posting and advertisements is as follows:

> The Applied Science Division seeks an Assistant Division Head to work with the Division Head and Deputy Head in coordinating the research activities of the Division. The Division has an interdisciplinary staff of some 330 scientists, engineers, and support personnel. Areas of research interest include: electrochemical energy storage; fossil and biomass conversion to liquid fuels; solar heating and cooling of buildings; solar thermal conversion; energy conservation in buildings with an emphasis on windows and lighting, computer simulation, indoor air quality, and building envelopes; atmospheric processes with an emphasis on atmospheric aerosols and acid rain; combustion of fossil fuels; advanced instrumentation; and energy policy.
>
> Duties
>
> A primary duty is working with the Division's scientists to develop new research areas. The Assistant also helps with resource allocation (e.g., equipment and laboratory space); long range planning; the development of information in response to requests from government officials; the development of material for presentations of the Division's research; personnel matters as they relate to the professional development and compensation of the Division's scientists; and the formulation of Division policy.
>
> The Assistant Division Head frequently represents the Division in interactions with personnel in other parts of the Laboratory, and by attending (usually in the absence of the Deputy or Division Head) Laboratory-wide meetings. The Assistant is also called upon to represent the Division during visits of distinguished visitors, outside reviewers, and government officials.
>
> Initially, the Assistant is expected to devote full time to the above duties. However, with time, it is expected that the person will develop his or her own research projects or become a participant in ongoing projects.

Requirements:

A Ph.D. in engineering or science, and several years of research experience beyond the Ph.D. are required. Experience in an area related to one or more of the Division's current activities is desirable. An interest in or demonstrated aptitude for scientific administration, good communication skills, and an ability to work under tight deadlines are essential. May be a term appointment with possibility of renewal or an indefinite appointment, and may be at the Staff Scientist II or III level, depending on the qualifications and experience of the chosen candidate.

Although the search will be a national one, we are particularly encouraging candidates from within the Division and the Laboratory. Anyone interested in the position, or wanting to recommend someone else, should see Elton, Don, or one of the Program Leaders.

RECENT REFEREED JOURNAL ARTICLES

"Pollutant Emissions from Portable Kerosene-Fired Space Heaters," Gregory W. Traynor, James R. Allen, Michael G. Apte, John R. Girman and Craig D. Hollowell, Environmental Science & Technology, Vol. 17, pp. 369-371 (June 1983).

"High-Temperature Oxidation of H_2 on a Platinum Catalyst," N.J. Brown, R.W. Schefer and F. Robben, Combustion and Flame, 51, pp. 263-277 (1983).

"Geochemical Anomalies Near the Eocene/Oligocene and Permian/Triassic Boundaries," Frank Asaro, Luis W. Alvarez, Walter Alvarez and Helen V. Michel, Geological Society of America, Special Paper 190, pp. 517-528 (1982).

"Comment on 'An Evaluation of Working Level Measurements Using A Generalized Kusnetz Method' and 'Evaluation and Modification of Working Level Measurement Methods,'" William W. Nazaroff and Kenneth L. Revson, Letters to the Editors, Health Physics, Vol. 44, No. 6, pp. 703-704 (June 1983).

LBL AS A COMMUNITY RESOURCE

A group of six high school science teachers spent six weeks at LBL this summer from July 11 to August 19. The teachers represented five different school districts and they were nominated for the program by their respective district superintendents. The participants were Peggy Carlock (Albany Unified School District), Henry Nelson (Berkeley Unified School District), Greta Mayfield (Richmond Unified School District), Susan Cristancho and Bobera Lewis (Oakland Unified School District), and Terry Dearborn (Mt. Diablo Unified School District). The goal of the program was to assess the means by which LBL can further high school science and mathematics education by serving as a resource to local high school teachers. Rollie Otto and Susan Petersen served as coordinators for the project which was funded by DOE.

The teachers attended lectures by LBL scientific staff and participated in seminars planned for summer college students. They also met with representatives from UC Berkeley science departments, the UCB Learning Center, and the Lawrence Hall of Science. They visited various research facilities at the Lab to observe experiments that have potential for instructional purposes. Each teacher spent about fifty percent of his/her time with assigned research groups. The following is a list of some of the scientists who gave their time and energy to help make a rewarding experience for the teachers: Amos Newton and Skip Walker (GCMS Facility - Applied Science Division), Don Levy and John Rees (Lake Ecotoxicology - Applied Science Division), Patty Powers-Risius (Normal Tissue Radiobiology - Biology & Medicine Division), Robert Stokstad (Exotic Nuclei - Nuclear Science Division), John Girman and Kristin Geisling (Indoor Air Quality - Applied Science Division), and Arlon Hunt (Solar Advanced Materials R&D - Applied Science Division).

During the final week of the program, the teachers prepared a report for DOE containing recommendations as to how LBL and other national laboratories can serve as a resource for secondary science teachers. In their report, the teachers mentioned the tremendous morale boost they received from being exposed to the Lab's research environment, and they felt that the contacts with scientists at LBL would be of real value to them in their teaching. Anyone interested in a copy of the report should contact Susan Petersen in the Division Office.

AWARDS

A patent was issued on June 7, 1983 to Christian G. Daughton, a member of the Environmental Research Program's Oil Shale Research group: "Purifying Contaminated Water," U.S. Patent No. 4,387,025.

VISITORS

- Ray Sterling, Director of the Underground Space Center and Associate Professor of Civil & Mineral Engineering at the University of Minnesota, visited the Lab on July 29. He met with Robert Sonderegger, Ron Kammerud, Elton Cairns, Dave Grimsrud and Steve Selkowitz. He also toured the sky dome in Wurster Hall on the UCB campus.

- Bernard Manowitz, Chairman of the Department of Applied Science at Brookhaven National Lab, visited LBL on August 4-5. He met with Elton Cairns, Don Grether, Will Siri, Richard Crenshaw and Tica Novakov.

- Robert Wood, the Director for the Physical & Technological Research Division, OHER, U.S. Department of Energy, visited the Lab on August 8 to meet with Elton Cairns, Tony Nero and Tica Novakov.

- Earl Wagner and Jerry Mosley from Dow Chemical visited the Lab on August 10 to discuss possible interactions between Dow and NCAM in the area of electrochemistry.

- David Breuer, from Pacific Energy Design in Auckland, New Zealand, visited LBL on July 13 and met with members of the EEB and Solar programs working in the area of buildings research.

- On July 18-22, LBL hosted the ten student winners from the recent 34th International Science and Engineering Fair which was held in Albuquerque, New Mexico, May 9-13. A number of scientists in the Division met with the students and teachers to discuss ongoing research at LBL.

CONGRATULATIONS!

- To Wayne and Janie Place on the birth of their son, Thomas Jefferson. He weighed in at 11 lbs. 12 oz. at Alta Bates Hospital in Berkeley on August 11, 1983.

For Reference

Not to be taken from this room

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