

History of the “Light and Color in the Open Air” Meetings

by
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The “Meteorological Optics/ Light and Color in the Open Air” meetings are unique in the scientific community. Hard core physics meets art, history, perception and biology. The meetings would appeal to natural philosophers of previous centuries. Bob Greenler, said it best: “It is interesting to me to see a connection between these meetings and the very beginnings of the development of Science. The beginnings of our science lay in individuals' attempts to understand the things that they saw in the world surrounding them. The main motivation for wanting to understand these things was curiosity. Of course, as the understanding yielded benefits, various other motivations also entered. I think of these meetings as being closely related to the spirit of those beginnings of our scientific enterprise.”

ORGANIZING THE FIRST MEETING....

In 1977 I started wondering how to put together an international scientific meeting devoted to “Minnaert”-type things: rainbows, mirages, glories, halos, etc. My main concern was that such a gathering would be considered too “amateurish” and therefore inappropriate for a mainstream scientific conference. I was an NSF postdoc in the Caltech Physics Department and had never organized a meeting before. But at the same time I had published a few papers, read the literature and was teaching a course at the UCLA extension called “Color and Light in Nature” using Minnaert’s “The Nature of Light and Colour in the Open Air” as a text.

So I wrote to Jarus Quinn of the Optical Society of America and suggested the meeting. A couple of weeks later (this was before e-mail) he wrote back and enthusiastically endorsed the idea. “Round up your organizing committee, figure out a tentative program and tell me what you think it will cost. If we can do it, we will.”

The reason for organizing the meeting was a selfish one. I wanted to learn more about all these wonderful phenomena and I figured the best way would be to bring all the experts together and have them teach me. And it worked!

Deciding on the organizing committee was easy. I picked all my heros: Alistair Fraser (Penn State), Bob Greenler (U. Wisc. Milwaukee), Freeman Hall (NOAA) and Bill Livingston (Kitt Peak National Observatory). They all readily agreed, most with some

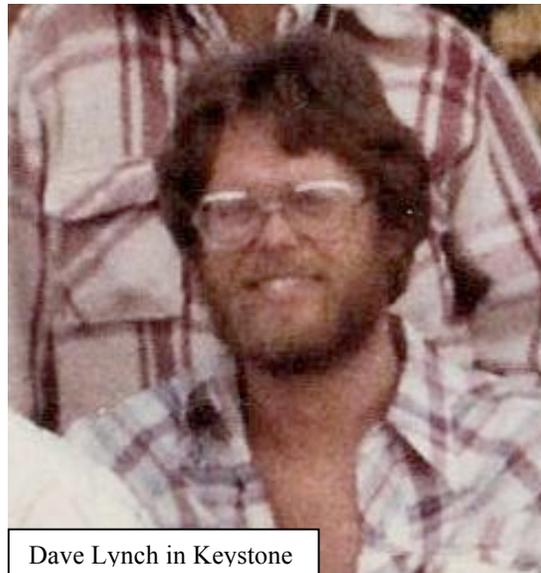
bewilderment because except for Bill, none of them had ever heard of me! I chose the name “Meteorological Optics” because of Ron Tricker’s book by the same name, the most up-to-date technical book in the field at the time. The name had been used earlier by Pernter and Exner in their “Meteorologische Optik”. The technical council agreed to sponsor the meeting with the American Meteorological Society cooperating. The OSA even allocated travel funds for several invited speakers including H.M. Nussenzveig from Brazil.

While selecting invited speakers, I realized what a diversity of professions shaped the field: meteorologists, astronomers, particle physicists, surface science and laser physicists, teachers, even an astronaut! No wonder the field was not recognized: there was no name, specialty or government funding. It was just a bunch of enthusiastic people from all fields who love naked eye optical phenomena in nature. And that became the meeting’s theme.

1. KEYSTONE, COLORADO August 28-29, 1978

Journal of Optical Society of America: August 1979

The meeting was held at Keystone, Colorado on August 28-29, 1978, and the location was perfectly suited to the theme: a ski resort, clear days, cool nights, no city lights. I don’t remember much about the meeting because I was so nervous. But there are three highlights that I hold very dear: Bill Livingston’s opening tribute to Marcel Minnaert, astronaut Owen Garriott’s presentation of the Earth from orbit, and the (now traditional) evening slide show where everyone showed their favorite pictures. Never before had I seen such happy, enthusiastic scientists. Everyone was delighted that the meeting actually happened. It was like we were a bunch of kids who just got away with something.



Dave Lynch in Keystone

Ken Sassen recalled “Despite my limited experience, it was obvious that the Keystone meeting was not a normal conference. It may have been conducted like one, but the words eccentric, eclectic, and iconoclastic came to mind. Funding earmarked for the specific science issues involved was uncommon, but tolerated through ‘basic science’ activities, as through the National Science Foundation. Absolute legends of the scattering community attended. The rare mixture of experimentalists and pure and applied theorists worked. I gave a talk on polar nepheliometer laser scattering studies of pendant water drops (that I did for fun) showing various features of rainbow phenomena. More accurately, I described laser-induced ‘monochrome’ bows, which later launched a flurry of activity from more proper neologists (One should not mix terms of Greek and Latin

roots!) in the Letters section of Physics Today (1981). I also participated in the optical phenomena slide show, now an informal evening tradition often lubricated with libations, which resulted in a second article on aircraft contrail iridescence in the popular OSA journal special features connected to our gatherings. I was a PostDoc then and had an immensely nice time.”

Bob Greenler summed up the spirit and feeling of the gatherings well. “My impression of the meetings was that they have been unlike any of the other scientific meetings I attend. I think they must have some of the flavor of meetings of a century ago, before the time of professional scientists, when all of the participants were amateurs. Most of us who attend these meeting are "amateurs" in a couple of senses of the word. First, we are all there because of our love of the subject. That is clear in the enthusiasm and attentiveness of those who come. Secondly, while many (but not all) of us are scientists, most do not make our livings by working in this particular field. For most of us it is a side interest that is not supported by research grants.

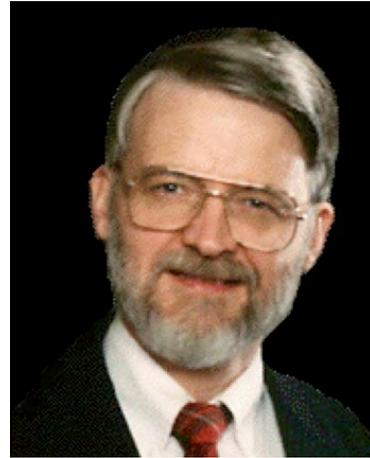


The last order of business was to ask the assembled participants (no one left early) if we wanted to hold such a meeting again. There was boisterous unanimity that we should. When I asked for volunteers to run the next meeting, Alistair Fraser leaped out of his chair.

2. INCLINE VILLAGE, NEVADA, January 3-5, 1983

Journal of Optical Society of America: December 1983

Alistair enlisted William H. Mach, a former student, to chair the meeting that was held at Incline Village, Nevada on January 3-5, 1983. With organizers Craig Bohren, Alistair, Jim Mallmann and Glenn Shaw, Bill did a wonderful job of attracting new faces to the now “recognized” field. Gunther Konnen’s invited paper discussed many aspects of polarization and Craig Bohren’s invited demonstrations of scattering were both excellent. Bob Greenler also presented beautiful demonstrations of refraction. We were all saddened a few months later to learn that one of the brightest new stars in the field, organizer Bill Mach himself, had passed away. After the Incline meeting, Dave Lynch agreed to put together the next gathering.



3. HONOLULU April 2-3, 1986

Journal of Optical Society of America A: March 1987

I don’t remember how I came to organize the 1986 meeting (“Meteorological Optics” Honolulu, April 2-3, 1986) but I was happy to do so. With able help from Bill Livingston, Walter Tape, Waldemar Lehn, Gunther Konnen, Ken Sassen and Freeman Hall, it was easy. The OSA was holding a bunch of meetings in Hawaii so we piggy-backed with them to save money. The location was wonderful: the Hilton Hawaiian Village at Waikiki right on the beach. But it was an expensive place for a meeting and many people were unable to attend, especially students. I recall hearing grumbling that we would gladly forego the hotel-supplied “Mink Oil Soap” for a larger turnout! Still, it was a terrific gathering, highlighted by Michael Berry’s (now Sir Michael Berry) paper on catastrophe optics and John Hallett’s paper on snow crystals.

HONOLULU GROUP PHOTO

At the Hawaii meeting, Bob Greenler raised the question of whether we should widen the scope of the meeting from "Meteorological Optics" to include a wider range of naked-eye observable optical phenomena. “After all, people who were interested in sun dogs were invariably also interested in the retro-reflective properties of spiders' eyes or the iridescence of butterfly wings. There was general agreement that it would be a good thing to do, and we did some fumbling for a title to express this expanded view of our gatherings. As soon as someone suggested the name of Minnaert's book, Light and Color in the Open Air, we all knew that it was the perfect name to define our interests and the spirit of our meeting.”

4. WASHINGTON, DC July 11-13, 1990

Applied Optics: August 1991

The fourth meeting, now called “Light and Color in the Open Air” was organized by Bob Greenler and it was held in Washington, DC July 11-13, 1990. Bob reached out and touched some new talent, Raymond Lee, James Lock, Bill Mankin and Ken Sassen. At this meeting we heard the first of many talks on “biological optics” with invited papers by Greenler on “Beetles, Bubbles and Butterflies: Iridescence in Nature” and “Light and Color on the Wing: Structure and Development of Iridescent Butterfly Scales” by Helen Ghiradella. This was also the first appearance of the energetic Finnish halo observers in the form of Marko Pekkola who gave a talk on the work of his countrymen. Also presenting new results was Pekka Parviainen, also from Finland.



Scanned at the American
Institute of Physics

This meeting was also co-located with other OSA meetings and by now we had attained some recognition, if not quiet admiration by our peers. Bob Greenler noted “Several of us had the feeling that getting the Optical Society to sponsor those early meetings gave some kind of scientific legitimacy to something that we all would have done just for the fun of it. It was interesting to see people from some of the other co-located meetings slipping in the back door to listen to some of our presentations. We had the best meeting in the world!”

5. STATE COLLEGE, PA June 16-18, 1993

Applied Optics: July 1994

Somehow Bob convinced Craig Bohren to organize the next meeting, and on June 16-18, 1993, on the campus of Penn State, “Light and Color in the Open Air” took place, this time away from other OSA meetings. In addition to Ghiradella and Lock, John Robinson and John Kidder joined the organizing committee. This meeting was highlighted by two invited talks on visual perception (“Vision and Light Scattering in the Living Eye” by Claes Beckman and “Visual Perception in Challenging Environments: From Energy to Information” by D. Alfred Owens). And the event was



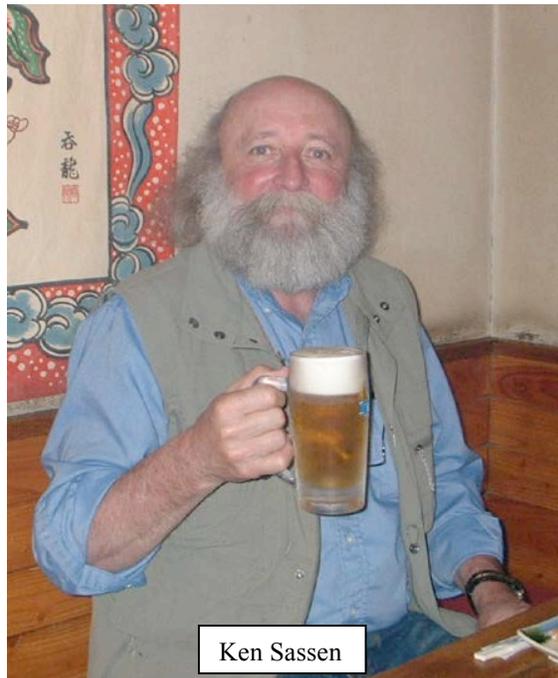
capped off with a wonderful party at Craig's mountain home. At some point during the soiree, I recall Craig Bohren saying something like "Yeah, let's get Sassen to run the next meeting. We'll strap a beer keg to his back and whip him like a mule."

6. SANTA FE, NM, February 10-12, 1997

Applied Optics: March 1998

Ken Sassen signed on to run the next meeting, and after enlisting the help of Qasim Zaidi, Helen Ghiradella, Bob Greenler, Gunther Konnen, Dave Lynch, Walt Tape and Ken Voss. The meeting was held in Santa Fe, NM on February 10-12, 1997.

According to Ken, "My choice as Chair, however, came by default: I was outvoted to host the previous meeting, and received a last-minute request from the former Chair to host the next, since no new volunteers came forward! This experience, which I (falsely) vowed never to repeat, was in retrospect gratifying. Despite the hundreds of e-mails and mailings required, the OSA conference staff was entirely helpful, and the outcome quite satisfactory in my view. Above all, since our little topical meeting had only myself as Chair, in contrast to the other collocated OSA topical meetings with multiple chairs, it appears that I and my wife were awarded by default, again! with a marvelous suite at the conference hotel in Santa Fe, New Mexico. I was successful at obtaining a travel support grant to assist foreign invited speakers and students from



the Department of Energy Atmospheric Radiation Measurement (ARM) program, which appreciated our remote sensing outlook even in the face of our apparent hostility toward things "technical". In one of my presentations, for example, I exploited a polarization lidar and aircraft study of a corona-producing cirrus cloud to consider the broader view of cold cirrus cloud radiative effects on climate: this is an example of using available resources to study atmospheric optics, while at the same time addressing basic scientific issues. It is well known that in the past, attempts to comprehend various optical phenomena have led to breakthroughs in the field of optical physics."

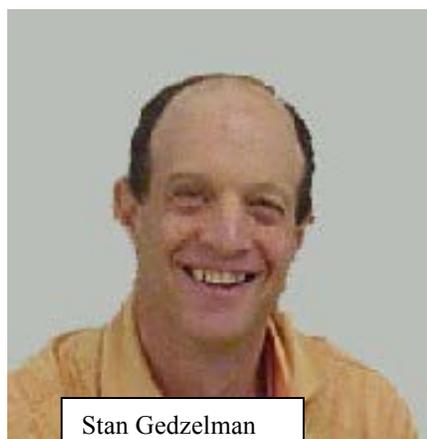


SANTA FE, NEW MEXICO February 10-12, 1997

7. BOULDER, CO June 6-8, 2001

Applied Optics: January 2003

Stan Gedzelman of CCNY volunteered to organize the seventh meeting in Boulder. Stan had been a regular contributor to the meetings and as often as not has discussed the phenomena in terms of fine art and historical significance, something previously noted by Ken Sassen. “The agendas of our meetings have not been limited to topics of classical physics. We have examined the cause for the beauty of the iridescent insect wing or carapace, the evolution of historical art versus proper scientific representation, and the depiction of rainbows and halos in prehistoric rock art. In my publications I have quoted both poets and blues singers. Where else could one get away with this?”



Stan Gedzelman

The Boulder meeting marked a turning point: it was the first meeting where some presentations were electronic. By the 9th meeting, virtually all were. The meeting was held from 05-08 June 2001 at the National Center for Atmospheric Research in Boulder, Colorado. The meeting was approved by Richard Anthes, President of the University Corporation of Atmospheric Research (UCAR) and hosted by UCAR's Advanced Study



Program under the direction of Dr. Al Cooper with assistance of Barb Hansford and others on the UCAR staff. NCAR provided the meeting room in the Mesa Lab along with audiovisual equipment and all logistics for free. Lunch was available in the NCAR cafeteria. NOAA provided additional facilities for free for the evening photo session on Thursday, 06 June and for the series of lectures and demonstrations open to the public on Friday, 07 June in the NIST auditorium. Very reasonable housing was made available in the dormitories at the University of Colorado, Boulder. The meeting was co-sponsored by the American Meteorological Society (this was for moral support). Papers resulting from the meeting were published under the direction of technical editors, Jim Lock and Chuck Adler in the special issue of Applied Optics, Vol. 42, Iss. 3 - January 20, 2003; pp: 307-596. Ray Lee authored a proposal to NSF under Roddy Rogers, who gave about \$9000 in support for travel and room and board. Although the funds were made available only to American citizens, some funds were transferred by individuals including Bob Greenler to European participants.

On the Friday series of public lectures and demonstrations, invited speakers included Robert Eather, who spoke on the Aurora and Walt Lyons, who spoke on Thunderstorm Sprites and who videotaped the entire day's proceedings. (He might still have the tape – I don't know.) Joe Shaw and Dave Lynch gave separate talks on aspects of oceanographic

optics. Bob Greenler gave a talk that included his magnificent demonstrations of atmospheric optical phenomena. Walt Tape gave a lecture on atmospheric halos. Ray Lee spoke on the Rainbow Bridge – the rainbow in science, history, art, and literature. Ken Sassen spoke on coronas.

8. BAD HONNEF, GERMANY 13th to 17th of June 2004

Applied Optics: September 2005

Towards the end of the Boulder meeting, Michael Vollmer from Brandenburg University of Applied Sciences volunteered to host the next meeting in Germany. The 8th International Meeting on Meteorological Optics” and was held 13th to 17th of June 2004 in Bad Honnef close to the Rhine river and the old West German capitol Bonn. According to Michael “There were 43 participants from 10 countries. The scientific topics included refraction close to the horizon, quantitative analysis and interpretation of rare halo phenomena, simulations of glories and coronas, or light scattering from clear and cloudy skies analyzed using colorimetry. We also demonstrated that modern experimental and computational equipment can yield valuable new information in the field. For example,



microphysical properties within clouds are studied with modern LIDAR techniques or radiation transfer models combined with environmental spectroscopic techniques, thus allowing us to compute photon path length distributions within clouds. A special workshop dealt with resources for teaching using simulations, experiments as well as the multitude of possibilities of the internet, in particular, several extraordinary websites were presented. There was a good deal of satisfaction with the Bad Honnef meeting and we discussed the possibility of alternating future meetings between Europe and North America.”

9. BOZEMAN, YELLOWSTONE June 25-29, 2007

Applied Optics: December 2008

At the Bad Honnef meeting a proposal was approved to hold the next meeting in Bozeman, Montana, with Joe Shaw as the chair. According to Joe, “The 9th International Meeting on Light and Color in Nature was held 25-29 June 2007 on the Montana State University campus. The Montana State University Optical Technology Center sponsored the meeting and provided travel assistance to a number of international participants. Some travel support funds were also provided by the U.S. National Science Foundation. The meeting attracted 38 fully registered participants and 8 spouses or traveling

companions, for a total of 46 people from 7 different countries and 18 from outside the United States. An additional 20 people from the local community joined the group for the famous “pretty picture session” where photographs and videos are shown without technical discussion.”

Topics ranged throughout the spectrum of light and color, including demonstrations and explanations of ideas for teaching about natural optical phenomena. For example, Michael Vollmer delighted the room with his demonstration of quetelet fringes with a very simple setup. Walter Tape taught about halos with insightful discussion and a beach ball. Russell Sampson taught the participants techniques for viewing planets in the daytime sky, and then the group proceeded to achieve a record-setting pre-sunset visual observation of Jupiter. Ken Libbrecht gave a terrific invited presentation on his beautiful snow crystal work.



Ken Libbrecht gave a terrific

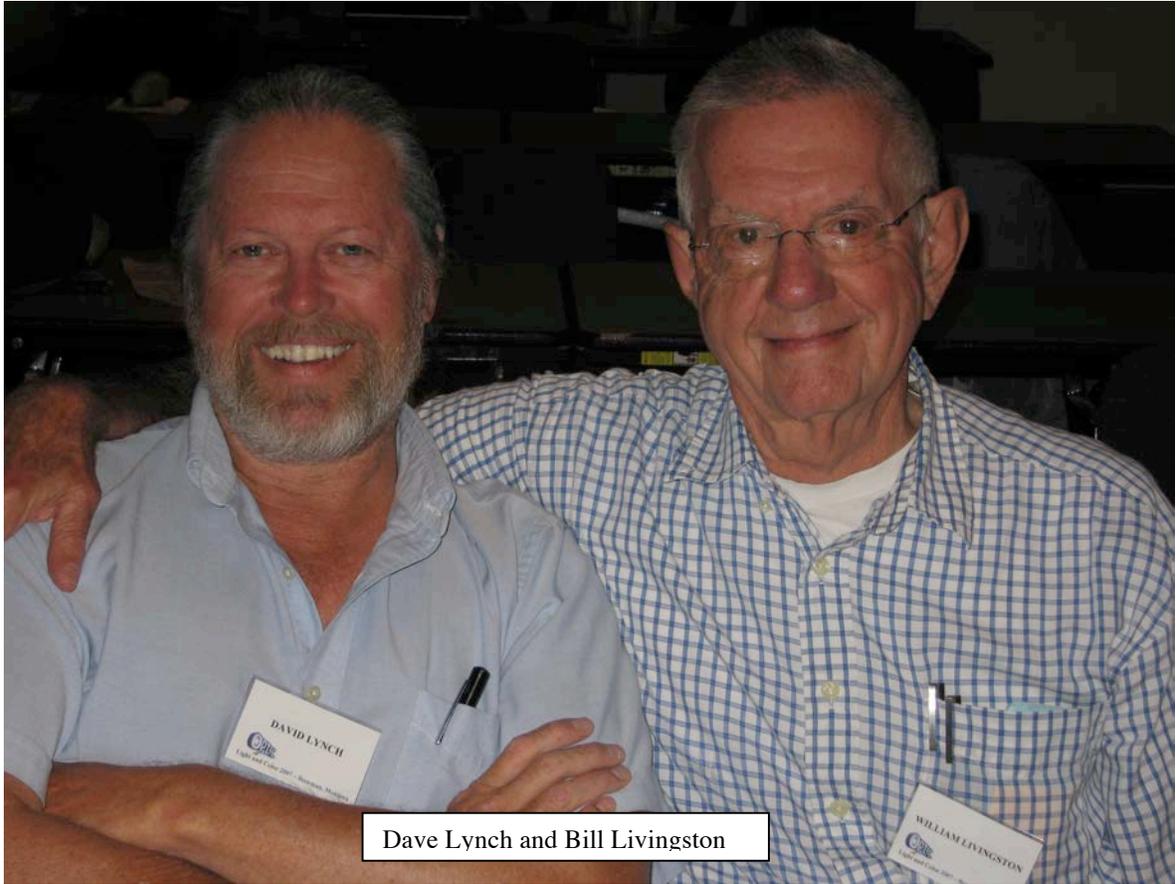
A highlight for everyone was a full day tour of nearby Yellowstone National Park, which provided wonderful opportunities for everyone to see lots of blue sky, iridescent clouds, colored hot pots, ponds, and rocks, geyser steam, forest fire smoke, and animals.





Bob Greenler and Dave Lynch accepting the Lord Rayleigh Prize

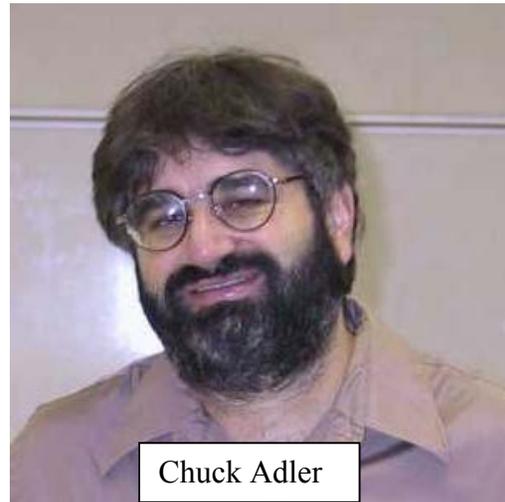
At the conclusion of the last session on Friday morning, Joe presented the inaugural “Lord Rayleigh Prize” to Robert Greenler and me for our “creative contributions and leadership to the field of light and color in the open air.” The tangible prize was a small toy milk truck emblazoned with the label “Fresh Milk from Lord Rayleigh's Farms”, referring to the Rayleigh dairy that provided financial support so that [John William Strutt, 3rd Baron Rayleigh](#), and his son, [Robert John Strutt, 4th Baron Rayleigh](#), could focus on their scientific studies. I was honored to be mentioned in the same breath as Greenler. After all, he was one of the people who inspired “COLOR AND LIGHT IN NATURE, by Bill Livingston and myself.



Dave Lynch and Bill Livingston

10. ST. MARY'S CITY, MD Meeting (June 17-20, 2010)

The 10th meeting was hosted by Chuck Adler of St Mary's College of Maryland and at the college. In addition to the usual collection of fine papers, the meeting featured a crab luncheon, "The Atmosphere Exposed", a special exhibition of photographs of optical phenomena at the Boyden Gallery, an outdoor concert by the river and a banquet. Keynote speaker Henrik Wann Jensen of UCSD presented a talk on computer simulation of natural scenes, and surprise guest Craig Bohren received the Lord Rayleigh prize. Continuing Joe Shaw's introduction of a website for the meeting, Chuck – whose heroic management of the meeting made it a great success – also put together what may become our permanent website.



Craig at the crab luncheon.

11. Fairbanks, AK Meeting (Aug 5-8, 2013)

Ken Sassen scheduled the 11th meeting in Fairbanks to coincide with noctilucent cloud season. And boy, did he deliver. On Tuesday night the mesopause put on a spectacular show that stretched across the whole sky, with bright, thick waves to the north moving slowly westward. Ken said it was the best display he had seen in his twelve years at the Geophysical Institute. Rich Collins – world expert on NLCs - called it a “Hollywood” display.



Hosted by the Geophysical Institute at the University of Alaska/Fairbanks, the gathering featured 56 presentations on a wide variety of topics including the 3rd, 4th and 5th order rainbows, streetlight halos, glories, water colors, shadows, optical illusions, butterfly wings, and the Belts of Venus. Most gratifying were the numerous contributions from overseas (Germany, Japan, China, Italy, Belgium) by young researchers. Joe Shaw awarded the “Lord Rayleigh Prize” to Walt Tape for his immense contributions to our understanding of halos dating back to the first meeting in Keystone. Social events were a reception at the Museum of the North and a paddlewheel riverboat trip on the Chena River, all in full daylight of course due to the Alaska summer just south of the Arctic circle. Rich Collins also gave us a grand tour of Poker Flat Research Range.

Richard Collins gave the keynote talk (Noctilucent clouds – ice clouds at the edge of space in the polar summer), and invited talks were given by Glenn Shaw (Atmospheric optics at the early Geophysical Institute), Stan Gedzelman (Cloud Forms), Ray Lee (Twilight’s Belt of Venus), Michael Grossmann (The natural tertiary rainbow- A photographic first) and Bob Greenler (Lowitz Arcs Revisited) with Les Cowley and Robert Gorkin. Newcomer Michael Grossmann held a public demonstration of halo optics.





(Photo by Joe Shaw)

Committee: Ken Sassen, Joe Shaw, Dave Lynch, Phil Laven, Mike Vollmer, Javier Hernandez-Andres, Ray Lee. Papers from the meeting were published in a special issue of Applied Optics (editors: Joe Shaw & Phil Laven).

Meeting List

- 1) **Meteorological Optics**, August 28-29, 1978, Keystone, Colorado (David Lynch)
- 2) **Atmospheric Optics**, January 3-5, 1983, Incline Village, Nevada (William Mach/Alistair Fraser)
- 3) **Meteorological Optics**, April 2-3, 1986, Honolulu, Hawaii (David Lynch)
- 4) **Light & Color in the Open Air**, July 11-13, 1990, Washington, D.C. (Robert Greenler)
- 5) **Light & Color in the Open Air**, June 16-18, 1993, State College, Pennsylvania (Craig Bohren)
- 6) **Light & Color in the Open Air**, February 10-12, 1997, Santa Fe, New Mexico (Ken Sassen)
- 7) **Meteorological Optics**, June 6-8, 2001, Boulder, Colorado (Stanley Gedzelman)
- 8) **Atmospheric/Meteorological Optics**, June 13-17, 2004, Bad Honnef, Germany (Michael Vollmer)
- 9) **Light & Color in Nature**, June 25-29, 2007, Bozeman, Montana (Joseph Shaw)
- 10) **Light & Color in Nature**, June 17-20, 2010, St Mary's City, MD (Charles Adler)
- 11) **Light and Color in Nature**, Aug 5-8, 2013 Fairbanks, AK (Ken Sassen)

For papers and abstracts, please see Phil Laven's website at
<http://www.philiplaven.com/links2.html>

Lord Rayleigh Prize Winners (Joe Shaw)

Bob Greenler and Dave Lynch	2007
Craig Bohren	2010
Walt Tape	2013