P A R T I C U L A R S

The E-Newsletter of the American Association for Aerosol Research

WINTER 2019

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President's Message

Dear Colleagues,

The changing of seasons and start of a new year help us to reflect on where we have come from and where we are going. All around, this was a great year for AAAR and I hope is has been for you as well.

In September, AAAR hosted the **10th International Aerosol Conference in St. Louis, Missouri**. Congratulations to **Pratim Biswas**, **Brent Williams** and **C.-Y. Wu** for organizing an outstanding meeting that set ***NEW*** records for attendance (**1,436**) and technical presentations (**111**), and even inspired a proclamation from the Mayor of St. Louis making 2-7 September 2018 ***"Aerosol Science and Engineering Week"*** in the city. A hearty thanks also to the program committee, session chairs, poster judges, exhibitors, sponsors and administrative staff—all played crucial roles in the meeting's success.

A new initiative at the IAC was travel support for international students and professionals. We plan to continue this support in future annual meetings by focusing on students and professionals from the Americas. If you reside outside the United States and require support to attend the AAAR annual meeting, please be on the lookout for this new program. If you reside within the United States, please be sure to welcome our international colleagues at the meeting.

AAAR is a volunteer-driven organization whose strength is derived from its members. Future vitality of the Association depends on newer members taking up the mantle. If you have attended AAAR meetings in the past, but have not been involved in its operation, let me encourage you to become involved. AAAR functions through a robust set of committees and working groups that do everything from planning technical, educational and social activities at the annual meeting to managing finances, publications and our awards program. ***Will you make a resolution to become more involved in AAAR this year?***

I look forward to the year ahead and to seeing you at the **Fall 2019 meeting in Portland, Oregon October 14-18!** •

Murray Johnston
AAAR President

As always, we'd love any feedback or suggestions you may have for ***Particulars***

Simply email **info@aaar.org** with the subject line ***'Particulars'***

Jason Surratt, *Editor*

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10th International Aerosol Conference | Awards & Honors

New AAAR Fellows

— **Allen Robinson**
Carnegie Mellon University

— **Barbara Wyslouzil**
Ohio State University

David Sinclair Award

— **Allen Goldstein**
University of California at Berkeley

Sheldon K. Friedlander Award

— **Coty Jen**
Carnegie Mellon University

Kenneth T. Whitby Award

— **Chris Hogan**
University of Minnesota

Thomas T. Mercer Joint Prize

— **Chong Kim**
U.S. Environmental Protection Agency

Nikolai Albertovich Fuchs Memorial Award

— **Pratim Bitwas**
Washington University in St. Louis

— **Sotiris Pratsinis**
ETH Zurich

Fissan-Piu-TSI Award

— **Philip Hopke**
Clarkson University

— **Pentti Paatero**
University of Helsinki

AS&T Outstanding Paper Award

— **Peng Liu**
Synopsis

— **Paul J. Ziemann**
University of Colorado at Boulder

— **David B. Kittelson**
University of Minnesota

— **Peter H. McMurry**
University of Minnesota

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Article Highlight

By Gabriel Isaacman-VanWertz

"Chemistry of Hydroperoxycarbonyls in Secondary Organic Aerosol"

Demetrios Pagonis and Paul Ziemann

https://doi.org/10.1080/02786826.2018.1511046
(vol. 52, Iss. 10)

When terpenes in the atmosphere react with ozone, subsequent intramolecular rearrangements can lead the addition of multiple oxygenated functional groups, particularly peroxide and carbonyl groups. These highly oxidized multifunctional compounds (HOMs) are formed through gas-phase reactions but have very low volatilities, so may play a critical role in the formation and growth of particles, particularly in clean or natural environments. Once in the particle phase, these compounds are known to decompose once in the particle phase, but chemical fate is not well understood. Pagonis and Ziemann employ a variety of unique analytical approaches and a careful understanding of organic chemistry to explore the likely atmospheric fate of a HOM model compound in impressive chemical detail. They go on to use this understanding to explore a number of current pressing issues in aerosol chemistry, including the importance of liquid-liquid phase separation in particle-phase reactions, and the formation of oligomeric products by reactions between particle-phase compounds.

A compound containing both a hydroperoxide and a carbonyl (as is the case for many HOMs) can cyclize to form a peroxide-containing ring with a hydroxyl group on at least one side (a cyclic peroxyhemiacetal). Pagonis and Ziemann show that within only a few minutes, an equilibrium is reached in which the cyclic form is preferred by a factor of approximately 3. Using mass spectrometry and functional group analyses, they evaluate the full range of possible decomposition pathways and demonstrate that products are formed by decomposition of both cyclic and acyclic forms. They are also able to observe the addition of an alcohol to the molecule, demonstrating one possible pathway by which multiple compounds may bond together to form lower-volatility products. By identifying the specific chemical pathways through which HOMs may decompose or react, this work provides new chemical understanding of their fate, which is by itself a valuable advance to the field. However, they go beyond this detail to provide fundamental insight into atmospheric processes.

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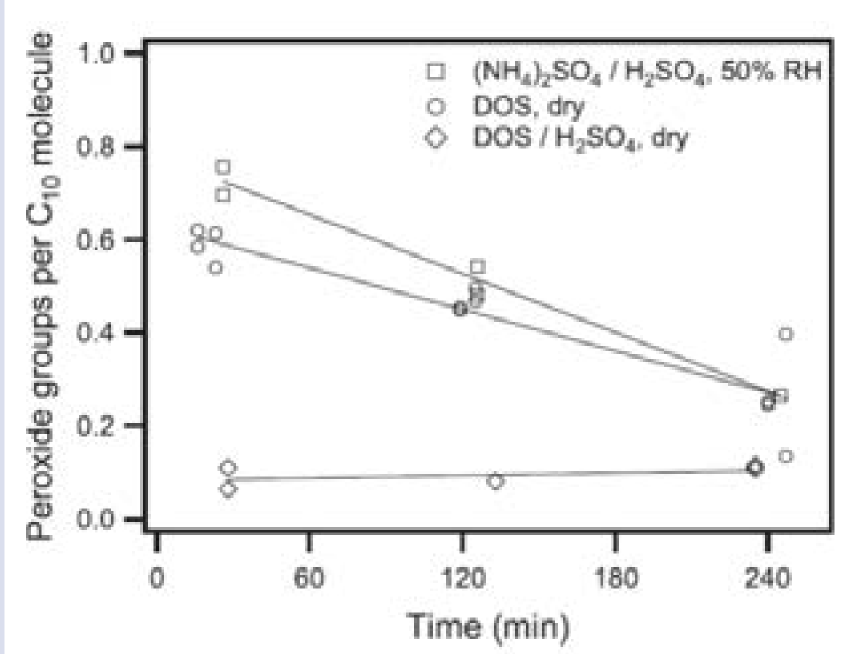

Figure 6 (from paper)

Decomposition over time of peroxide groups (specifically a αalkoxy hydroperoxyaldehyde) on particles with different compositions. On dry, neutral (circles) particles, decomposition occurs at a rate of 17% h-1, while complete decomposition occurs almost immediately under dry, acidic conditions (diamonds). Decomposition on wet, acidic particles (squares) is similar to on neutral particles, suggesting phase separation shields the organic peroxide from the presence of strong acid.

Decomposition under dry and neutral conditions is observed on timescales of minutes. This is substantially faster than timescales for other proposed decomposition pathways such as photolysis, suggesting the chemistry studied here may be a significant fate for HOMs. The researchers observe that the presence of a strong acid significantly enhances this decomposition, to the point where no peroxide remains by the time the first sample is analyzed. While this might suggest peroxides would be quickly decomposed in ambient particles, which can be highly acidic in certain environments, the researchers demonstrate that this may not always be so due to particle phase separation. While dry acidic particles quickly decompose peroxides, acidic particles under moderately humid conditions (such as those emulating the southeastern US, with pH = 1 and RH = 50%) decompose peroxides at rates similar to dry, neutral particles. Pagonis and Ziemann suggest that this is due to a lack of mixing between an acidic aqueous phase and a peroxide-rich organic phase. This result has significant implications for our understanding of aerosol chemistry, suggesting that even in humid and/or acidic environments, some organic molecules may be shielded from the presence of strong acids. This investigation of the conditions under which HOMs do (or don't!) react shines new light onto the importance of considering particle phase and mixing, and illustrates the broad implications that can come from detailed study of model systems. ●

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Aerosol Scientist in the Spotlight

By Arthur Chan

1. What first interested you in atmospheric aerosol research, and how has that initial experience shaped your career today?

I had no idea what aerosol was until I was looking for graduate school opportunities and came upon **John Seinfeld**'s group. After my summer research in process control, my undergraduate supervisor knew John (who worked on process control before air pollution) and recommended his group to me. I read the 2005 review paper on organic aerosol (Kanakidou et al., 2005 on ACP) and got very interested in how dynamic the problem is. The path was somewhat fortuitous and unplanned, but I am glad I am able to apply chemical engineering principles to environmental research.

2. Which people or programs in our field have been the most influential to you and your path?

My supervisors **John Seinfeld** and **Allen Goldstein** certainly have the biggest influence on my career. Their scientific acumen is unparalleled, and they always knew what was going to be next important topic. Both of them have also been very hands-off and gave me a lot of freedom, which really shaped how I work, and how I supervise my own mentees. I also appreciated John's approach to science: a simple, fundamental, elegant framework to explain an otherwise complex phenomenon. I also worked with a lot of great people, and among them Sally Ng has been the greatest mentor of all.

3. What currently excites you about working in Toronto in particular or Canada in general?

The greatest thing about returning to Toronto is to be with my family. I had lived in the US for 11 years for education, so it was nice to be back and see my little nephews grow up. University of Toronto has also been an excellent place to develop my career. There is a supportive and collegial community in aerosol research both within Toronto and across Canada. There have been many opportunities to collaborate and get advice within this community. In the last couple of years, Canada has also been proactive in evidence-based policy and recognizes the importance of generating scientific evidence and making use of it to guide policy. It has been quite rewarding to work in such an environment.

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4. How have you met the challenges of beginning and growing a research group in an era of diminishing funding opportunities?

I think what affects me the most is the shift from researcher-driven inquiry to more application-driven inquiry. As I think about growing my group, there is an increasing need to match the demands of applied research with basic science questions. I have tried to look for these connections so that broad fundamental questions can be answered along with more specific applied research, which generally provides the funding. That being said, I am not sure I have quite met these challenges as successfully as I wish.

5. What personality trait do you think is most important for a scientist in 2018?

Collaboration! The level of collaboration in our field is unheard of in other areas. We all know that to understand these increasingly complex topics on aerosols and atmospheric chemistry, we need many different perspectives and we cannot do it alone. I hope this collegiality and willingness to share and collaborate will sustain in our field. It also means that we mentor junior researchers and create an inclusive atmosphere, much like how I felt when I started as a graduate student in this area.

6. You now collaborate closely with Medical Faculty to study health effects of air pollutants. This kind of research (transdisciplinary if you will) has the potential to be much higher impact, but also carries a risk of not fitting with any individual research community.

What has been your experience securing funding and communicating the results of this work?

I knew from the beginning that I could not jump into a new area alone and needed to find the right partner. It was challenging at first, because the medical community has been so busy dealing with the complexities of human biology that they do not have the time/effort to work with chemical complexities. It took me a while to find a good collaborator who appreciates the value of understanding pollutant chemistry. We have been fortunate to get some seed funding to launch this collaboration and then use that to get larger grants funded. We now work on a variety of projects together, from laboratory experiments to field and cohort studies. We have both stepped outside of our own comfort zones and learned a lot more than if we had worked on our own. ●

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In Case You Missed It

By Ben Murphy

New Particle Formation Rates Observed and Quantified in Polluted Shanghai Airshed

Researchers in China have measured new particle formation events in a highly polluted atmosphere, where one would expect the large condensation sink to effectively scavenge small particles before they can grow. The smallest particles appear to be formed by neutralization of sulfuric acid dimers with dimethylamine. Organic compounds are thought to contribute substantially to particle growth beyond initial sizes.

Yao et al. (2018), Atmospheric new particle formation from sulfuric acid and amines in a Chinese megacity, *Science*.

https://doi.org/10.1126/science.aao4839

Volcanic Particle Pollution During the European "Dark" Ages had Dramatic Effects on Human Health and Economy

A recent article by Ann Gibbons, contributing correspondent for Science, highlights ultraprecise ice core measurements from the Swiss Alps that indicate eruptions in 536, 540 and 547 (A.D.) likely blanketed Europe in aerosols. The measurements were gathered by researchers at the Climate Change Institute of The University of Maine in Orono, who note these events coincide with the coldest decade on record in 2000 years as well as crop failures and starvation events. The team also found signals of lead pollution in 640 and 660 (A.D.), which may indicate increased silver production and thus economic recovery decades later.

Gibbons (2018), Eruption made 536 'the worst year to be alive', *Science*.

https://doi.org/10.1126/science.362.6416.733

Air Pollution Exposure after Hurricane Maria

A series of lower-cost air quality monitors [real-time affordable multipollutant (RAMP) monitors] were deployed in Puerto Rico to observe the magnitude of exposure to air pollution in the aftermath of and cleanup from Hurricane Maria. During the first month

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of deployment, the authors found most of the days exceeded U.S. EPA thresholds for SO_2 in San Juan, mainly attributable to increased reliance on generators for power needs.

Subramanian et al. (2018), Air quality in Puerto Rico in the aftermath of hurricane Maria: a case study on the use of lower cost air quality monitors, *ACS Earth Space Chem*.

https://doi.org/10.1021/acsearthspacechem.8b00079

Links between Well-Known Air Contaminants and Autism Spectrum Disorder

Many human epidemiological studies have demonstrated associations between dioxins and development of autism spectrum disorder (ASD) or ASD traits, but less is known about why these associations occur. This article reviews the current understanding of pathways by which humans are exposed at various stages of development and the effects that may be suffered as a result.

Guo et al. (2018), Dioxins as potential risk factors for autism spectrum disorder, *Environment International*.

https://doi.org/10.1016/j.envint.2018.10.028

Costs Incurred in Conforming to Paris Agreement Measures Likely would be Offset by Co-Benefits in Air Quality Improvements

European Commission scientists have calculated that emission reductions consistent with climate goals set in the Paris Agreement could avoid between 71 and 99 thousand premature deaths annually in 2030 compared to a reference case. The study considers both current goals as well as more ambition goals capable of meeting a 2 °C global atmosphere, while also accounting for complex uncertainties like agricultural output and the cost of decreasing exports of fossil fuels to other countries. The authors argue that a wholistic approach to analyzing costs and benefits in responding to climate change is needed.

Vandyck et al. (2018), Air quality co-benefits for human health and agriculture counterbalance costs to meet Paris Agreement pledges, *Nature Communications*.

https://doi.org/10.1038/s41467-018-06885-9 •

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