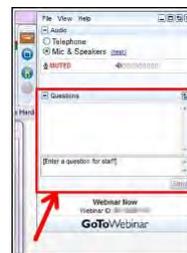




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<http://acsoncampus.acs.org>

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- GC&E Virtual will take place from June 15-19, 2020

<https://www.gacnde.org>

9

ACS GCI Pharma Roundtable Research Grant Opportunities



- Increasing the Utility of Surfactant-Based Chemistry in Water Methodologies (\$50,000)
- Oligonucleotide Processes (\$50,000)
- Development of New Membrane Technologies (\$50,000)
- Greener Peptide and Peptide Conjugate Synthesis (\$50,000)
- Ignition Grant Program for Green Chemistry and Engineering Research (2 grants of \$25,000)

Proposals due June 1, 2020 by 5 p.m. EDT

www.acsgcipr.org/advancing-research/

10

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View all events



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Find out how

78%+

participation by ACS local sections



86,000+

issues of Celebrating Chemistry



5,000+

unique visitors to the website



3.3M+

reach with #CCEW

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11



How Chemists and Engineers Will Make a Difference for a

Healthy Planet



#CCEW



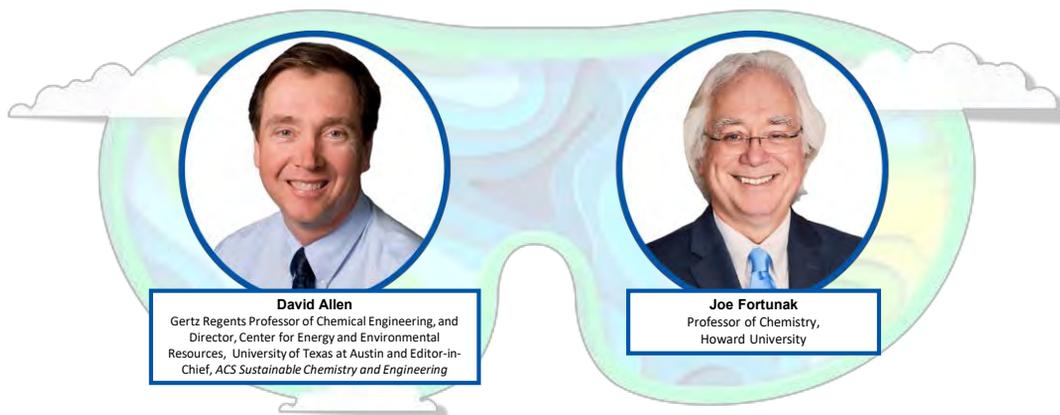
FREE | Thursday, April 23 at 2pm ET



THIS ACS WEBINAR WILL BEGIN SHORTLY...

12

How Chemists and Engineers Will Make a Difference for a Healthy Planet



Presentation slides are available now! Recordings are an exclusive ACS member benefit.

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This ACS Webinar is co-produced with the ACS Green Chemistry Institute, ACS Sustainable Chemistry and Engineering, Earth Day, and CCEW

13

State of the nation's waters at the time of the first Earth Day -1970

A nationwide grassroots demonstration and teach-in for the environment



On August 1, 1969, from *Time* magazine:
"Some River! Chocolate-brown, oily, bubbling with subsurface gases, it oozes rather than flows."

"Anyone who falls into the Cuyahoga does not drown," Cleveland's citizens joke grimly.
"He decays" . . .

The Federal Water Pollution Control Administration dryly notes: **"The lower Cuyahoga has no visible signs of life, not even low forms such as leeches and sludge worms that usually thrive on wastes."** It is also -- literally -- a fire hazard.



State of the nation's air at the time of the first Earth Day -1970



Donora at noon; Pittsburgh Past Gazette



In 1948, the nation's worst air pollution disaster occurred in a small Pennsylvania steel mill town as industrial emissions were trapped in the small valley where the town of Donora is located.



State of the nation's air at the time of the first Earth Day -1970



Los Angeles in the 1950's as described by the *LA Times*:

“The densest smog on record grayed Los Angeles for hours yesterday, threatening closure of industry and curtailment of traffic.”



Credit: LA Times



State of the nation's air at the time of the first Earth Day -1970



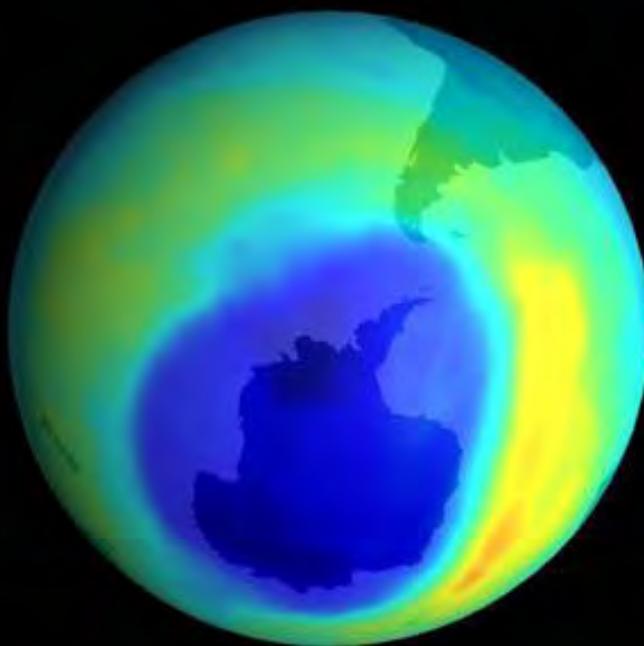
By 1966 large scale smog events were being experienced over large parts of the eastern US, including a Thanksgiving, 1966 event that stretched from New York City to Birmingham, Alabama.



Credit: NY Times



There were even problems we didn't know we had – such as depletion of stratospheric ozone



<http://www.earth.nasa.gov/>

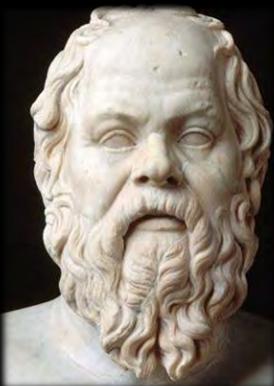
Yet, at the same
time we were
living in an era of
unprecedented
scientific and
technological
achievement

Earthrise as seen by Apollo 8,
December, 1968



**"A man must rise above the Earth to the top of
the atmosphere and beyond, for only thus will he
fully understand the world in which he lives."**

- Socrates, about 399 BCE



"Once a photograph of Earth, taken from outside, is available, once the sheer isolation of the Earth becomes plain, a new idea as powerful as any in history will be let loose."



Fred Hoyle, astronomer, 1948



Chemists and engineers went to work

They identified the scientific basis of the problems

(sometimes in ACS journals)



Chemistry and Physiology of Los Angeles Smog

A. J. HAAGEN-SMIT

*California Institute of Technology, Pasadena, Calif., and
Los Angeles County Air Pollution Control District, Los Angeles, Calif.*

Air pollution in the Los Angeles area is characterized by a decrease in visibility, crop damage, eye irritation, objectionable odor, and rubber deterioration. These effects are attributed to the release of large quantities of hydrocarbons and nitrogen oxides to the atmosphere. The photochemical action of nitrogen oxides oxidizes the hydrocarbons and thereby forms ozone, responsible for rubber cracking. Under experimental conditions, organic peroxides formed in the vapor phase oxidation of hydrocarbons have been shown to give eye irritation and crop damage resembling closely that observed on smog days.

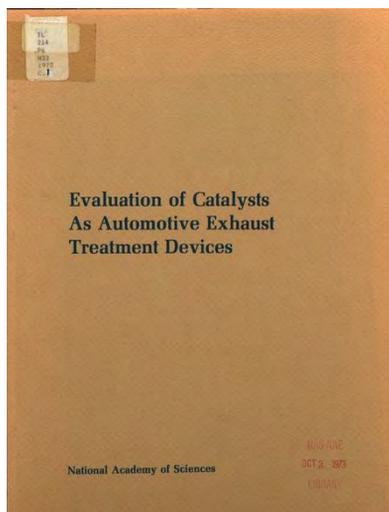
The aerosols formed in these oxidations are contributors to the decrease in visibility. The odors observed in oxidation of gasoline fractions are similar to those associated with smog. Hydrocarbons present in cracked petroleum products, harmless in themselves, are transformed in the atmosphere into compounds highly irritating to both plants and animals, and should therefore be considered as potentially toxic materials. A proper evaluation of the contribution of air pollutants to the smog nuisance must include not only the time and place of their emission, but also their fate in the air.

Haagen-Smit AJ. Chemistry and physiology of Los Angeles Smog. *Ind. Eng. Chem.*, 1952; 44: 1342.



23

Chemistry has also been central to providing solutions



24

New chemical insights have continued for decades



“Highly reactive VOCs” identified as a primary contributor to Houston’s smog problem in the early 2000s.

Combining Innovative Science and Policy to Improve Air Quality in Cities with Refining and Chemicals Manufacturing: The case study of Houston, Texas USA, *Frontiers of Chemical Science and Engineering*, 3, 293-304, doi: 10.1007/s11705-017-1660-0 (2017).



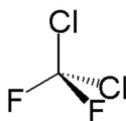
Some advances have proven to be Nobel-worthy



- 1930s: CFCs invented



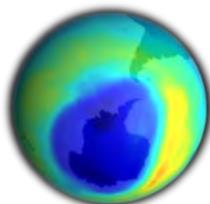
CFCs and the ozone hole



- Chloro-fluorocarbons (CFCs) are a class of industrial compounds used in refrigeration, as aerosol propellants and as solvents
- First made in the 1930s, they are not flammable and do not have direct health effects
- They do not react in the troposphere
- When they migrate to the stratosphere (over a period of decades) reactions driven by intense ultraviolet light produce atomic chlorine, which then consumes ozone. A single chlorine atom can catalyze the destruction of many ozone molecules



Some advances have proven to be Nobel-worthy



- **1930s:** CFCs invented
- **1974:** Molina and Rowland propose that chloro-fluorocarbons (CFCs) migrate to the stratosphere and deplete the ozone layer (Nature, 249, 810–812, 1974)
- **1978:** CFC use in aerosol cans banned in the US
- **1974-1985:** No significant ozone depletion measured at mid-latitudes
- **1985:** Antarctic ozone hole “discovered” (Nature 315, 207, 1985)



The ozone hole: More remarkable chemistry



Nature, 321, 755–758, 1986

- Why at the poles (especially Antarctica)?
- Why is the hole largest in the polar spring?



29

Some advances have proven to be Nobel-worthy



- **1930s**: CFCs invented
- **1974**: Molina and Rowland propose that chloro-fluorocarbons (CFCs) migrate to the stratosphere and deplete the ozone layer
- **1978**: CFC use in aerosol cans banned in the US
- **1974-1985**: No significant ozone depletion measured at mid-latitudes
- **1985**: Antarctic ozone hole “discovered”
- **1987**: Montreal protocol for substances that deplete stratospheric ozone
- **1995**: Molina, Rowland and Crutzen awarded Nobel Prize in chemistry
- **2006**: Most CFCs production and use eliminated
- **Decades from now**: recovery of stratospheric ozone



30

Chemistry again is central to identifying solutions

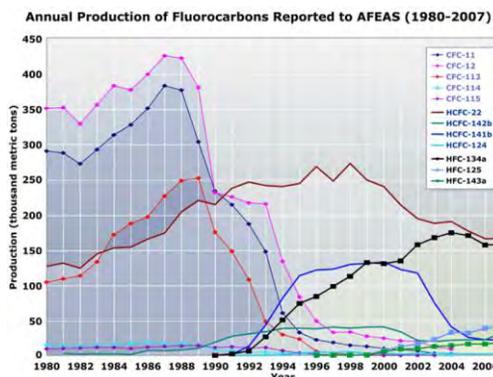


The CFC-Ozone Issue: Progress on the Development of Alternatives to CFCs

L. E. MANZER

Chlorofluorocarbons (CFCs) are now believed to be major contributors to the seasonal ozone depletion over the Antarctic continent. However, because they are so important to many aspects of modern society, it would be irresponsible to immediately cease their production. The identification of suitable substitutes is difficult when issues such as toxicity, flammability, cost, environmental impact, and physical properties are considered. Several candidates that meet these criteria have been selected by the industry and significant research and development programs are under way to commercialize them. Unlike the simple, fully halogenated CFCs, which can only be made in the single step, there are many potentially viable routes to the alternatives, but these will require significant improvements in catalysis. Many other important issues such as materials compatibility, energy efficiency, the needs of developing countries, and the product life cycle of the alternatives need to be resolved before a timely transition to substitutes can be accomplished.

Science, 1990: Vol. 249, Issue 4964, pp. 31-35



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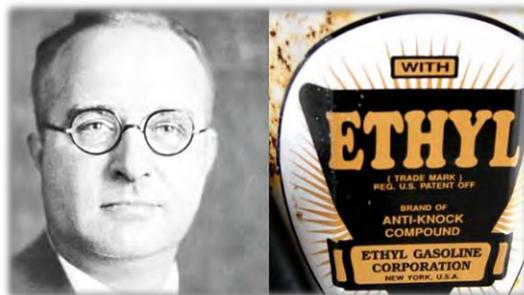
But this remarkable chemistry... also has embedded in it a cautionary tale



No. 684:
THOMAS MIDGLEY, JR.

by John H. Lienhard

[Click here for audio of Episode 684.](#)



The parable of Thomas Midgley, the inventor of CFCs
<http://www.uh.edu/engines/epi684.htm>



32

Chemists and engineers went to work, and 50 years later....



- Rivers in the United States no longer catch fire
- Air quality has improved dramatically
- The ozone hole is on its slow way to recovery
- And much more....



33

34

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



Chemists and engineers have gone to work discovering environmental issues, characterizing the science that drives their impact, and finding solutions to the problems.

Which best describes the work that you do:

(Select all that apply)

- Discovering environmental threats
- Characterizing their impact and mechanisms
- Finding solutions
- Other (Tell us more in the chat)
- None of the above

** If your answer differs greatly from the choices above tell us in the chat!*

Part of the challenge ahead:

Take the environmental improvements to the rest of the world



Beijing



Mumbai



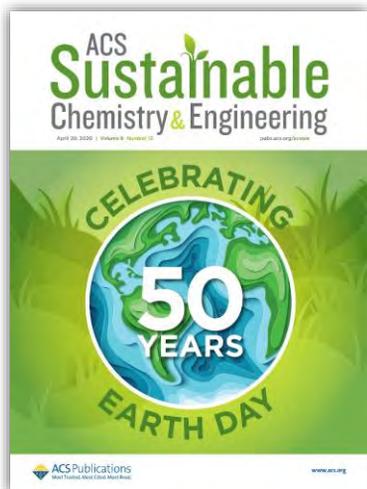
35

Another part of the challenge, energy and materials
in a resource and carbon constrained world



36

To see remarkable advances of chemists and engineers addressing these challenges



<https://pubs.acs.org/journal/ascecg>

ACS Sustainable Chemistry & Engineering invites Letters, Articles, Features, and Perspectives (Reviews) that address challenges of sustainability in the chemical enterprise and advance principles of Green Chemistry and Green Engineering.

Examples of topics in the journal's scope include:

- Green Chemistry
- Green Manufacturing and Engineering
- Biomass or Wastes as Resources
- Alternative Energy
- Life-Cycle Assessment



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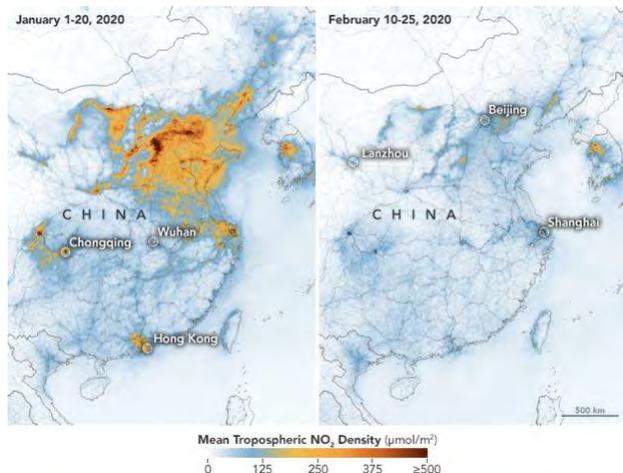


But for today, as you shelter in place and practice social distancing, consider how we will live and work in a post COVID-19 world.



38

Will we take what we have learned about working remotely to reduce our footprints?



The images show NO₂ densities across China from January 1-20, 2020 (prior to mitigation strategies) and February 10-25 (during mitigation strategies). The data were collected by the Tropospheric Monitoring Instrument on European Space Agency's Sentinel-5 satellite.

<https://earthobservatory.nasa.gov/images/146362/airborne-nitrogen-dioxide-plummets-over-china>



39

Or will the need for economic recovery lead us to reduce environmental protections?



40

Audience Survey Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT



What do you think?

- The current COVID crisis will transform human behavior in ways that will improve the environment
- The need for economic recovery will lead us to reduce environmental protections
- The path forward is uncertain and the environmental implications are not clear
- Other (Tell us more in the chat)

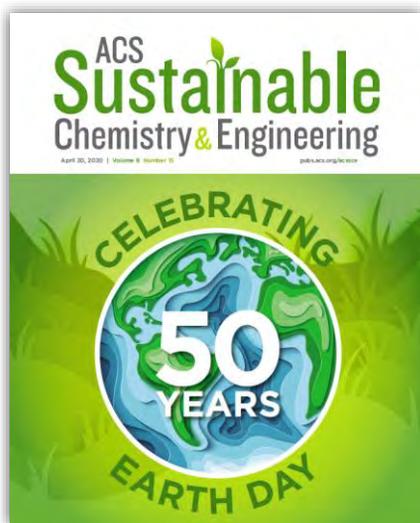
** If your answer differs greatly from the choices above tell us in the chat!*



How can we take the best of the innovations that have emerged from the COVID-19 outbreak, and use them to continue improving our environment?



If you have good ideas....



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participation by ACS local sections



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issues of Celebrating Chemistry



5,000+
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3.3M+
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Chemistry of wine flavor as it ages.

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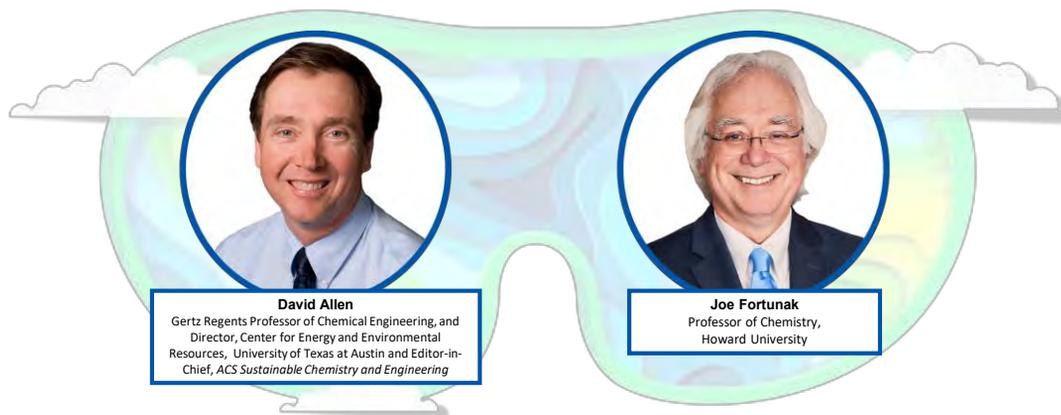
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How Chemists and Engineers Will Make a Difference for a Healthy Planet



David Allen
Gertz Regents Professor of Chemical Engineering, and
Director, Center for Energy and Environmental
Resources, University of Texas at Austin and Editor-in-
Chief, *ACS Sustainable Chemistry and Engineering*

Joe Fortunak
Professor of Chemistry,
Howard University

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A wine glass filled with red wine.

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