

# 2021 Citation for Chemical Breakthrough Award Program Update (Up To and Including the 2020 Award Year)

Jeffrey I. Seeman  
Award Committee Secretary

August 25, 2021

## Summary

- Fifteen years of awards (2006 –2020) have been completed, including four awards for the 2020 award year. Because of COVID, there were no award ceremonies in 2020 or up to August 2021.
- As of January 1, 2021, 76 CCB Awards have been presented to date at 86 sites (due to multiple collaborations and locations) in 12 countries. The countries are: Canada, England, France, Germany, Italy, Latvia, The Netherlands, Poland, Russia, Scotland, Switzerland, and the United States.
- Status for the 2021 award year: Nominations are due October 1, 2021.
- CCB Awards are plaques given to institution from which the research was published.
- We provide assistance with and generally participation in award ceremonies.
- Because of COVID restrictions, no award presentations occurred in the past year.
- Photographs and associated text dealing with the 15-years of award ceremonies are found on the CCB Award's web pages.
- [http://www.scs.illinois.edu/~mainzv/HIST/awards/citations\\_chem-breakthroughs.php](http://www.scs.illinois.edu/~mainzv/HIST/awards/citations_chem-breakthroughs.php)
- The CCB Award program now has many and an increasing number of links on Wikipedia.
- The CCB Award program also has a link and a large description of the program on the ACS National Historic Chemical Landmarks Program (see below).
- Carmen Giunta has developed an interactive geographical-based application for the CCB awards. This will shortly be added to the CCB award's web-based home page.

[https://www.google.com/maps/d/edit?mid=16VU11\\_aYFk0s9nWfJDfP3P2xtfigyGzL&usp=sharing](https://www.google.com/maps/d/edit?mid=16VU11_aYFk0s9nWfJDfP3P2xtfigyGzL&usp=sharing)

## Objectives, Strategies and Criteria of the Citations for the Chemical Breakthrough Award Program

The Citations for Chemical Breakthrough Award program is intended to honor and celebrate the achievements in chemistry and the molecular sciences in a publicly visible fashion. Through the involvement of the recipient institutions in the design of the plaques and in the organization and hosting of award celebrations, the program will “expand people’s minds through the enlightening power of the history of chemistry. It will bring history of chemistry to scientists and bring scientists to the history of chemistry.”

The Citations for Chemical Breakthrough award recognizes breakthrough publications, books and patents worldwide in the field of chemistry. The term “breakthrough” refers to advances in chemistry that have been revolutionary in concept, broad in scope, and long term in impact. The award consists of a very high quality plaque, to be placed at a site selected by the recipient near the office or laboratory where the breakthrough was achieved. Each award will be made to the department or institution where the breakthrough occurred, not to the individual scientist(s).

### **Elaboration of criteria**

- “Revolutionary” implies some sort of change in practice or theory after the appearance of the patent or publication.
- “Broad in scope” implies an advance that permeates a sub-discipline of chemistry, or that has applications in more than one sub-discipline, or that has a significant benefit to society.
- “Long-term” implies a minimum of twenty five years since the date of publication.

In 2020, four awards to five sites were made:

- Imperial College London, for William Henry Perkin’s patent on the “lilac or purple color dye” (1856) that began the worldwide chemistry industry.
- The Royal Institution (London) and University College, London, for Lord Rayleigh and William Ramsay’s discovery of argon (1895).
- The University of Manchester, for H. G. J. Moseley’s establishment of the concept of atomic number (1913).
- New York University, for Robert S. Mulliken’s discovery of molecular orbital theory (1928).

The 2021 awards will be presented in the next CCB award annual report.

A tabulation of number of awards per year follows on the next page.

## Number of Citation for Chemical Breakthrough Award by Year

	Award Year	Number of Awards*	Duplicate plaques due to multiple collaborative sites*	Duplicates due to researcher associated with other locations*
1	2006	10		
2	2007	6	1	2
3	2008	6		2
4	2009	5		1
5	2010	5		
6	2011	5		
7	2012	4		3
8	2013	4		0
9	2014	4		
10	2015	5		
11	2016	4		
12	2017	4		
13	2018	6		
14	2019	4		
15	2020	4	1	2
	<b>Total</b>	<b>76 in 12 countries</b>	<b>2</b>	<b>10</b>

\* For instances in which the award publication resulted from a collaboration at two or more institutions, the “Number of Awards” represents one award for the collaborative publication.

The members of the 2020 and 2021 Award Committees are listed below (next page) and also on the HIST website (with the Award Committee members from the earlier award years).

- The program has received excellent responses in the USA and Europe. To date, no awards have been presented to Asia, the Middle East or South America.
- Nominations are open to all and are advertised on HIST’s website and in an announcement in *C&EN*.
- The plaque-design process is much more difficult than anticipated. It is often hard to obtain the required high-quality scans of original publications from the 19<sup>th</sup> Century. There have been design issues with the recipient organizations.
- We have received extraordinary cooperation from the plaque manufacturer, Stellar Kent (<http://www.stellarkent.com/index.php>). In fact, in 2014, HIST Certificate of Appreciation Awards were given to Carol Hall, Linda Mason, and the Stellar Kent Corporation for their work on the CCB award program.

- As of past years, the Linda Hall Library of Science, Engineering and Technology (Kansas City, MO) has donated several high quality images of journal articles, if available, at no charge for the award program

**Award Committee Members  
2019 – 2020**

Anthony G. M. Barrett, F.R.S. (Imperial College of Science, Technology and Medicine)  
 Michael Bowers (University of California, Santa Barbara)  
 Carmen Giunta (Le Moyne College)  
 Harry Gray (Caltech)  
 Dudley Herschbach (Harvard)  
 Peter Morris (Science Museum London, retired)  
 Amos Smith (Penn)  
 Jeffrey I. Seeman, Committee Secretary (Non-voting) (University of Richmond)

**Finances and Donations**

- The plaques cost ca. \$400 each including artistic design costs and shipping to the USA. Shipping to Europe is another \$75 - \$100.
- Initial funding
  - \$10K from ACS DAC Innovative Grant
  - \$10K from ACS Corporate Associates
  - \$6K from ACS DAC Innovative Grant for Local Section travel
  - Funds from individual donors (donations continue to this day)
- HIST currently provides 50% matching to an annual donation (individual donor, \$1500/year; HIST, \$750/year).
- Annual costs ca. \$1700 - \$2200/year.
- In 2020, HIST accepted a donation from Jeffrey I. Seeman in the amount of \$16,500 which will be 50% matched by HIST over a 16-year period beginning in 2020. With this donation, HIST has guaranteed funding for the CCB award program up to and including its 25<sup>th</sup> year.
- As of August 5, 2021, \$16,595.56 is available for the plaque program (excluding travel, see bullet statement immediately below). A \$60 reimbursement is due from the University of Manchester.
- Based on the latest update available for HIST Treasurer Vera Mainz, there is \$4103.16 available for travel support for local section and related representations (ACS Innovative Grant Program).

## Website

The HIST website contains high quality images of all the plaques and much supplementary information, including photographs of many awards ceremonies, ceremony agenda, and related materials.

[http://www.scs.illinois.edu/~mainzv/HIST/awards/citations\\_chem-breakthroughs.php](http://www.scs.illinois.edu/~mainzv/HIST/awards/citations_chem-breakthroughs.php)

The CCB award program's website is exceptional and expanding, thanks to the continuing excellent work of Vera Mainz. The website is organized by award year. Originally, there was only a table of all award winners for each year (from 2006 when the first awards were presented). From that page, one could and can see the award plaques for each winner as well as the supplementary material associated with that award. In 2014, several new pages were added that provide the visitor with rapid access to the awardees, organized by name OR location OR date of the awardee's publication.

We are fortunate that most of the recipients have provided photographs and other information about their presentation ceremonies, etc. for use on our website.

Continued . . .

## CCB Award on the ACS Historic National Historic Chemical Landmarks Program Website

On the “About the ACS Historic National Historic Chemical Landmarks Program” web page, <https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/about.html> the following text and link appears (screen shot):

### Citation for Chemical Breakthrough Awards

Since 2006, the Citation for Chemical Breakthrough Award program, administered by the ACS Division of the History of Chemistry, has honored scientific publications, books and patents that have been revolutionary in concept and broad in scope, and that forever changed the face of chemistry. As of 2020, 78 awards have been presented.

In 2020, four awards to five sites were made:

- Imperial College London, for William Henry Perkin’s patent on the “lilac or purple color dye” (1856) that began the worldwide chemistry industry
- The Royal Institution (London) and University College, London, for Lord Rayleigh and William Ramsay’s discovery of argon (1895)
- The University of Manchester, for H. G. J. Moseley’s establishment of the concept of atomic number (1913)
- New York University, for Robert S. Mulliken’s discovery of molecular orbital theory (1928)

More information is available on the [HIST Citation Awards](#) webpage.

On the CCB Award's website, the following appears (there were no NHCL awards in 2020):

The **National Historical Chemical Landmarks (NHCL) program**, administered by the American Chemical Society, honors "seminal achievements . . . to chemistry and society in the U.S."

In 2017, two Landmarks were awarded:

- [Infrared Spectrometer and the Exploration of Mars](#)
- [Chlorofluorocarbons and Ozone Depletion](#)

In 2018, one Landmark was awarded:

- [Plutonium-238 Production for Space Exploration](#)

In 2019, three Landmarks were awarded:

- [St. Elmo Brady, the First African-American Ph.D. in Chemistry](#)
- [Innovation in Steroid Medicines at Upjohn](#)
- [The Combination of Gas Chromatography and Mass Spectrometry at Dow Chemical](#)

The first NHCL Landmark was awarded in 1993 for Bakelite: [The World's First Synthetic Plastic](#).

The 2020 award plaques are shown at the very end of this report. Photographs of all plaques are also found on the HIST website under HIST Awards, Citation for Chemical Breakthrough Award. The blue link in the second column of each year's award listing leads the web visitor to that award's plaque.

For the 2020 awards: [http://acshist.scs.illinois.edu/awards/CCB-2020\\_Awardees.php](http://acshist.scs.illinois.edu/awards/CCB-2020_Awardees.php)

**The 2020 award plaques are shown on the next pages.**





Division of the History of Chemistry  
American Chemical Society



## Citation for Chemical Breakthrough

The Beginning of the Worldwide Chemical Industry



---

A.D. 1856, 26th August. N<sup>o</sup> 1984.

---

### Dyeing Fabrics.

---

LETTERS PATENT to William Henry Perkin, of King David Fort, in the Parish of Saint George in the East, in the County of Middlesex, Chemist, for the Invention of "PRODUCING A NEW COLORING MATTER FOR DYEING WITH A LILAC OR PURPLE COLOR STUFFS OF SILK, COTTON, WOOL, OR OTHER MATERIALS."

Sealed the 20th February 1857, and dated the 26th August 1856.

---

PROVISIONAL SPECIFICATION left by the said William Henry Perkin at the Office of the Commissioners of Patents, with his Petition, on the 26th August 1856.

I, WILLIAM HENRY PERKIN, do hereby declare the nature of the said Invention for "PRODUCING A NEW COLORING MATTER FOR DYEING WITH A LILAC OR PURPLE COLOR STUFFS OF SILK, COTTON, WOOL, OR OTHER MATERIALS," to be as follows:—

Equivalent proportions of sulphate of aniline and bichromate of potassa are

Presented to Imperial College London, 2020.



Two different plaques were designed for the Rayleigh-Ramsay publication, based on the chemistry that was performed by each collaborator. This plaque was presented to The Royal Institution (Lord Rayleigh's location). See next page for the plaque presented to University College, London (Ramsay's location).





Two different plaques were designed for the Rayleigh-Ramsay publication, based on the chemistry that was performed by each collaborator. This plaque was presented to University College, London (Ramsay's location). See the previous page for the plaque presented to The Royal Institution (Lord Rayleigh's location).







Division of the History of Chemistry  
American Chemical Society

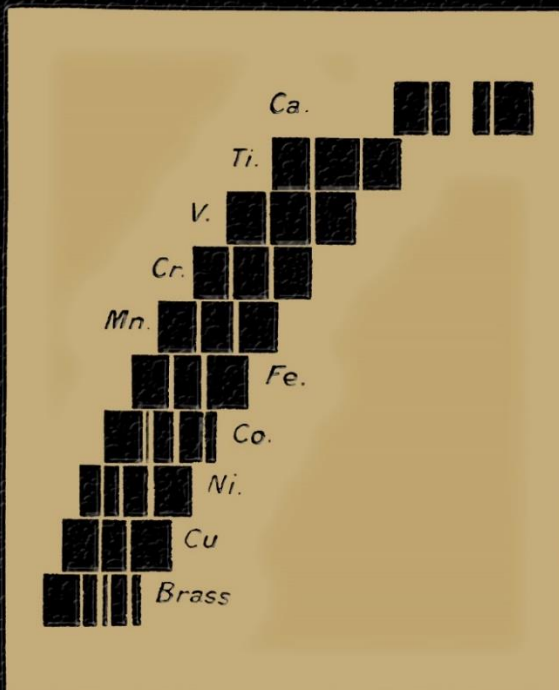
## Citation for Chemical Breakthrough



Established the concept of atomic number

*Philosophical Magazine Ser. 6, 1913, 26, 1024-1034 and Plate XXIII.*

*XCIII. The High-Frequency Spectra of the Elements.  
By H. G. J. MOSELEY, M.A.\**



Physical Laboratory,  
University of Manchester.

Presented to the University of Manchester, 2020.

See the next page for a photograph of the Moseley plaque in its display position at the University of Manchester.



The Moseley plaque is located in the foyer of the Schuster Building (54) at the entrance to the Moseley Lecture Theatre.

Schuster Building  
Brunswick Street  
The University of Manchester  
Oxford Road  
Manchester M13 9PL England

We thank Professor Sean John Freeman for these photographs.





Division of the History of Chemistry  
American Chemical Society

## Citation for Chemical Breakthrough

The Development of Molecular Orbital Theory



*Physical Review* 1928, 32, 186-222.

### THE ASSIGNMENT OF QUANTUM NUMBERS FOR ELECTRONS IN MOLECULES. I

BY ROBERT S. MULLIKEN

#### ABSTRACT

Quantum numbers, notation, closed shells, molecular states.—The problem of making a complete assignment of quantum numbers for the electrons in a (non-rotating) diatomic molecule is considered. . . . a suitable choice of quantum numbers for a diatomic molecule appears to be one corresponding to an atom in a strong electric field. . . . These quantum numbers may be thought of as those associated with the imagined "united atom" formed by bringing the nuclei of the molecule together. . . .

Configuration	States	Configuration	States	Configuration	States
(As)	$^2S$	(As) (Bp) <sup>2</sup>	$^2P_n, ^1P$	(Ap) (Bd)	$^2F_n, ^2P_n, ^1F, ^1P$
(As) (Bs)	$^2S, ^1S$	(Ap) (Bp)	$^2D_n, ^2S, ^1D, ^1S$	(Ap) <sup>2</sup> (Bd)	$^4D_n, ^2D_n, ^2G_n, ^2S, ^2D_n$
(Ap)	$^2P_n$	(Ap) <sup>2</sup> (Bp)	$^4P_n, ^2P_n, ^2F_n, ^2P_n, ^2S$	(Ap) <sup>2</sup> (Bd)	$^2F, ^2P_n, ^1F, ^1P$
(Ap) <sup>2</sup>	$^2S, ^1D, ^1S$	(Ap) <sup>2</sup> (Bp)	$^2D_n$ or $^2S, ^1D, ^1S$	(Ad)	$^2D_n$
(Ap) <sup>3</sup>	$^2P_n$	(Ap) <sup>2</sup> (Bp) <sup>2</sup>	$^2S, ^2S, ^1S, ^2D_n, ^2S, ^1G, ^1D, ^1S$	(Ad) <sup>2</sup>	$^2S, ^1G, ^1S$
(As) (Bp)	$^2P_n, ^1P$	(Ap) <sup>2</sup> (Bp) <sup>2</sup>	$^4P_n, ^2F_n, ^2P_n, ^2P_n, ^2P_n$	(Ad) <sup>3</sup>	$^2D_n$
(As) (Bp) <sup>2</sup>	$^4S, ^2S, ^2D_n, ^2S$	(Ap) <sup>3</sup> (Bp) <sup>2</sup>	$^2D_n, ^2S, ^1D, ^1S$	(As) (Bd)	$^2D_n, ^1D$

WASHINGTON SQUARE COLLEGE,  
NEW YORK UNIVERSITY,  
April 30, 1928.

Presented to the Department of Physics, New York University, 2020.