2023 Citation for Chemical Breakthrough Award Program Update (Up To and Including the 2022 Award Year)

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Award Committee Secretary

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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).

Executive Annual Summary

- Seventeen years of awards (2006 –2022) have been completed, including five awards for the 2022 award year. See Table 1.
- As of January 1, 2023, 84 CCB Awards have been made to date with plaques on display at 97 sites (due to multiple collaborations and multiple locations for certain awards) in 15 countries. The countries are: Austria, Belgium, Canada, France, Germany, Italy, Japan, Latvia, The Netherlands, Poland, Russia, Scotland, Switzerland, the United Kingdom (England and Scotland), and the United States. See Table 1.
- Status for the 2023 award year: Three awardees have been announced including locations in two new countries (Denmark and Sweden). Nominations for 2024 award years have been announced (due March 1, 2024.
- CCB Awards are plaques presented to the institutions from which the research was published.
- We assist with and generally participate in the award ceremonies.

- Because of COVID, very few award presentations have occurred in the past three years.
- Photographs and associated text dealing with the 16-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
- 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 has been added to the CCB award's web-based home page.

Table 1. 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		
9	2014	4		
10	2015	5		
11	2016	4		
12	2017	4		
13	2018	6		
14	2019	4		
15	2020	4	1	2
16	2021	3	2	1
17	2022	5*		
	Total	84 in 15 countries*	4	11

* Plaques have not been provided to the University of California at Berkeley for the invention of the cyclotron (E. O. Lawrence, 2006 award year) and for the Le Bel/tetrahedral carbon configuration (2022 award year). Thus, 82 primary plaques hang in 14 countries as of January 1, 2023.

** 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.

Elaboration of award 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 2022, five awards were made to four sites

- Ghent University. for August Kekulé's 1865 determination of the structure of benzene.

- Award for Joseph-Achille Le Bel's 1874 determination of the tetrahedral carbon atom; no recipient for the award plaque was found.

- The University of California at Berkeley. for Wendell M. Latimer and Worth H. Rodebush's 1920 analysis and description of hydrogen bonding.

- Northwestern University. for Robert L. Letsinger and V. Mahadevan's 1966 discovery of solid phase peptide synthesis.

- University of Pennsylvania. for Hideki Shirakawa, Edwin J. Louis, Alan G. MacDiarmid, Chwan K. Chiang, and Alan J. Heeger 1977 discovery of electrically conducting organic polymers.

The members of the 2022 Award Selection Committee are listed below (see Table 2). This information is also placed 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 institutions in 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 19th 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.

Table 2. Award Committee Members
2021 – 2022

Anthony G. M. Barrett, F.R.S. (Imperial College of Science, Technology and Medicine, retired)
Michael Bowers (University of California, Santa Barbara)
Carmen Giunta (Le Moyne College, retired)
Harry Gray (Caltech)
Catherine M. Jackson (University of Oxford, England)
Peter Morris (Science Museum London, retired)
Mary Virginia Orna (College of New Rochelle, retired)
Amos Smith (University of Pennsylvania)
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 or Asia is another $75 - $100. We have just been advised that the cost of these plaques will increase to ca. $500 each in 2023 due to environmental costs for the metal etching process.
- Funding
    - $10K from ACS Division Activities Committee (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 provides 50% matching to current donations. In 2020, a donation in the amount of $16,500 was given to HIST for the CCB award program. With this donation and with HIST's 50% matching of this gift, HIST has guaranteed funding for the CCB award program up to and including its 25th year.

- Annual costs ca. $1700 - $2200/year. To compensate for the increased cost of the plaques, the number of awards will decrease from three-five/year to three/years in the future.
- As of August 8, 2023 (prior to the expenditure of funds for the 2023 award year), $12,780.76 is available for the plaque program (Vera Mainz, Treasurer).
- 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 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

The CCB award program's website is exceptional and expanding, thanks to the continuing excellent participation and ingenuity of Vera Mainz, HIST's webmaster. 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.

On the CCB Award's website, the following appears for the 2022 CCB awards. Please go to the website to see these in larger font.

Citations for Chemical Breakthrough Awards

2022 Awardees

NOTE: Text in **COLOR** indicates a "live" link.

Scientists/Inventors	Breakthrough Publication (If text is in color, this is a live link to the plaque.)	Location of Award (If text is in color, this is a live link to photographs and other materials related to the presentation.)
August Kekulé	"Sur la constitution des substances aromatiques," *Bulletin de la Société Chimique de Paris* **1865**, *3*, 98 - 110.	Ghent University
Joseph-Achille Le Bel	"Sur les relations qui existent entre les formules atomiques des corps organiques et le pouvoir rotatoire de leurs dissolutions," *Bulletin de la Société Chimique* **1874**, *22*, 337 - 347.	Médecine de l'Université Paris-Cité*
Wendell M. Latimer and Worth H. Rodebush	"Polarity and Ionization from the Standpoint of the Lewis Theory of Valence," *J. Am. Chem. Soc.* **1920**, *42*, 1419 - 1433.	University of California, Berkeley
Robert L. Letsinger and V. Mahadevan	"Stepwise Synthesis of Oligodeoxyribonucleotides on an Insoluble Polymer Support," *J. Am. Chem. Soc.* **1966**, *88*, 5319 - 5324.	Northwestern University
Hideki Shirakawa, Edwin J. Louis, Alan G. MacDiarmid, Chwan K. Chiang, and Alan J. Heeger	"Synthesis of Electrically Conducting Organic Polymers: Halogen Derivatives of Polyacetylene $(CH)_x$," *J. Chem. Soc., Chemical Communications* **1977**, 578 - 580.	University of Pennsylvania

From: http://acshist.scs.illinois.edu/awards/CCB-2022_Awardees.php

The 2022 award plaques are shown on the next pages.

Division of the History of Chemistry
American Chemical Society

Citation for Chemical Breakthrough

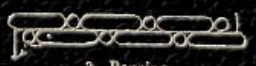
Bulletin de la Société de Paris 1865, *3*, 98-110.

Sur la constitution des substances aromatiques, par M. Aug. KEKULÉ.

La théorie de l'atomicité des éléments, et surtout la notion de la tétratomicité du carbone, ont permis d'expliquer d'une manière assez satisfaisante la constitution d'un grand nombre de substances organiques, de toutes celles que j'ai désignées sous le nom de « *substances grasses.* » On n'a pas encore tenté, que je sache, d'appliquer les mêmes vues théoriques aux substances aromatiques. J'avais bien fait entrevoir, lorsque j'ai publié, il y a sept ans, la théorie de la tétratomicité du carbone, que j'avais une idée toute formée à cet égard (1), mais je n'avais pas jugé à propos de la développer en détail. La plupart des chimistes, qui depuis lors ont écrit sur des questions de théorie, n'ont pas touché à ce sujet; quelques-uns se sont franchement déclarés incompétents, d'autres ont admis l'existence d'un groupe hexatomique, formé de 6 atomes de carbone, sans toutefois se préoccuper du mode de combinaison de ces atomes, et sans pouvoir expliquer pourquoi ce groupe se combine à 6 atomes mono-atomiques.

1. Chaîne ouverte.

2. Chaîne fermée.



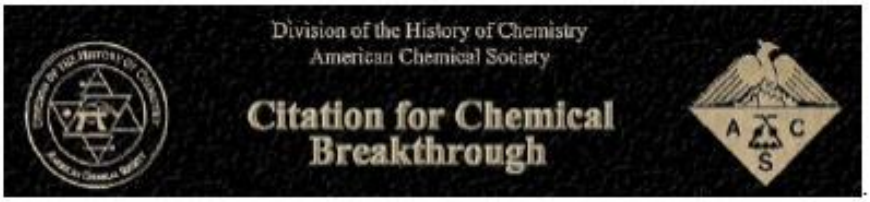
3. Benzine.

4. Benzine chlorée.

5. Benzine bi-chlorée.

Presented to Ghent University, 2022.

Note: The following draft plaque was designed by J. I Seeman in 2022 but, in that a recipient for this plaque was never located, the award plaque was never manufactured.



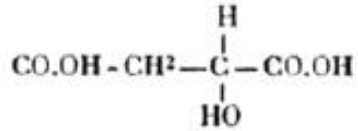
Bulletin de la Société Chimique **1874**, *22*, 337-347.

MÉMOIRES PRÉSENTÉS A LA SOCIÉTÉ CHIMIQUE.

Sur les relations qui existent entre les formules atomiques des corps organiques et le pouvoir rotatoire de leurs dissolutions; par **J.-A. LE BEL.**

Les travaux de M. Pasteur et de plusieurs autres savants ont établi d'une façon complète la corrélation qui existe entre la dyssymétrie (1) des molécules et le pouvoir rotatoire. Si la dissymétrie n'existe que dans la molécule cristalline, le cristal seul sera actif ; si au contraire elle appartient à la molécule chimique, elle se manifestera par le pouvoir rotatoire *de la solution*, et souvent même par celui du cristal, si la structure de celui-ci permet de l'apercevoir, comme cela a lieu pour le sulfate de strychnine et l'alun d'amylamine. Il y a, du reste, des démonstrations mathématiques de l'existence nécessaire de cette corrélation, que nous considérerons comme un fait entièrement acquis.

GROUPE MALIQUE. — L'acide malique présente une disposition tout à fait analogue ; sa formule met en évidence le caractère du pouvoir rotatoire :



GROUPE TARTRIQUE. — L'acide tartrique a pour formule :

Presented to the Médecine de l'Université Paris-Cité, 2022.

Division of the History of Chemistry
American Chemical Society

Citation for Chemical Breakthrough

Journal of the American Chemical Society **1920**, *42*, 1419-1433.

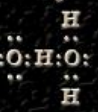
[Contribution from the Chemical Laboratory of the University of California.]

POLARITY AND IONIZATION FROM THE STANDPOINT OF THE LEWIS THEORY OF VALENCE.

By Wendell M. Latimer and Worth H. Rodebush.

Received April 26, 1920.

Let us compare again the compounds ammonia, water and hydrogen chloride. Ammonia adds a hydrogen readily but has little tendency to give one up. Hydrogen chloride, on the other hand, shows just the opposite tendencies. Water occupies an intermediate position and shows tendencies both to add and give up hydrogen, which are nearly balanced. Then, in terms of the Lewis theory, a free pair of electrons on one water molecule might be able to exert sufficient force on a hydrogen held by a pair of electrons on another water molecule to bind the two molecules together. Structurally this may be represented as



Such combination need not be limited to the formation of double or triple molecules. Indeed the liquid may be made up of large aggregates of molecules, continually breaking up and reforming under the influence of thermal agitation.

Such an explanation amounts to saying that the hydrogen nucleus held between 2 octets constitutes a weak "bond."[1] Ammonium hydroxide

Presented to the University of California, Berkeley, 2022.

Division of the History of Chemistry
American Chemical Society

Citation for Chemical Breakthrough

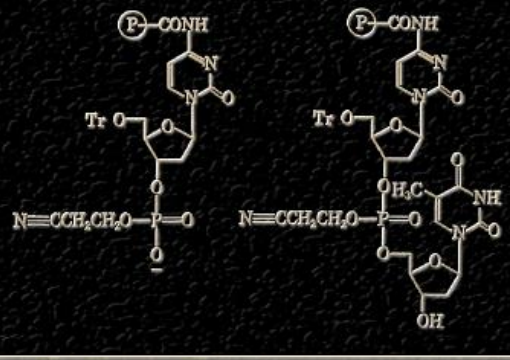
Journal of the American Chemical Society **1966**, *88*, 5319-5324.

Stepwise Synthesis of Oligodeoxyribonucleotides on an Insoluble Polymer Support[1,2]

Robert L. Letsinger and V. Mahadevan

Contribution from the Department of Chemistry, Northwestern University, Evanston, Illinois 60201. Received August 5, 1966

Some time ago it occurred to us that the labor involved in repetitive step syntheses of this type might be materially reduced if the syntheses were carried out on an insoluble polymer support. In the initial step a nucleoside would be joined covalently to the support. Nucleotide units would subsequently be added stepwise to this nucleoside, and in the final reaction the covalent bond joining the oligonucleotide chain to the support would be broken and the oligonucleotide eluted. This technique would enable one to separate the products in the building stages from the solvents, excess reagents, and soluble by-products simply by filtration, thus avoiding numerous time-consuming isolation steps.



Presented to the Department of Chemistry, Northwestern University, 2022.

Division of the History of Chemistry
American Chemical Society

Citation for Chemical Breakthrough

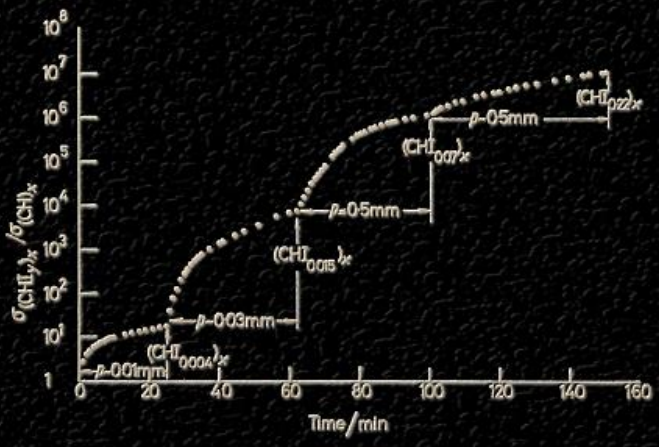
J. Chem. Soc. Chem. Commun. 1977, 578-580.

Synthesis of Electrically Conducting Organic Polymers: Halogen Derivatives of Polyacetylene, $(CH)_x$

By Hideki Shirakawa, Edwin J. Louis, Alan G. MacDiarmid,*
Chwan K. Chiang,† and Alan J. Heeger†

(*Department of Chemistry and †Department of Physics, Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia* 19104)

Summary When silvery films of the semiconducting polymer, *trans* 'polyacetylene', $(CH)_x$, are exposed to chlorine, bromine, or iodine vapour, uptake of halogen occurs, and the conductivity increases markedly (over seven orders of magnitude in the case of iodine) to give, depending on the extent of halogenation, silvery or silvery-black films, some of which have a remarkably high conductivity at room temperature.



Presented to the University of Pennsylvania, 2022