

The Back Story

Jeffrey I. Seeman, University of Richmond,
Richmond, VA, jseeman@richmond.edu

Eugene Garfield (September 16, 1925-February 26, 2017), Information Scientist and Businessman

I enjoy celebrating the lives of those who made a real, lasting difference, a difference that expanded in value and importance over time, far beyond their own lifetimes. Eugene Garfield, born Eugene Eli Garfinkle, was one of those individuals.

Garfield's interest in chemistry, library science, and the collection, transformation, distribution and utilization of information was perfectly timed. Garfield's 1961 Ph.D. in linguistics at the University of Pennsylvania was entitled *An Algorithm for Translating Chemical Names to Molecular Formulas*. Computers were just becoming commercially viable. The game-changing IBM System/360 appeared in 1964, and the DEC PDP-8 hit the market in 1965 as the first commercially successful minicomputer. Garfield's ideas and inventions paralleled in time the rise in computer memory and power.

Garfield is credited for developing the weekly publication *Current Contents*, the *Science Citation Index (SCI)*, the *Journal Citation Reports* and *Index Chemicus*. Garfield was also the founding editor and publisher of *The Scientist*, a news magazine primarily for life scientists.

First published in 1958, three years before Garfield received his Ph.D., *Current Contents* reproduced the tables of contents from major journals. I remember poring over the chemistry edition of *Current Contents*. One could be promptly alerted to critical publications in one's field. Each issue included pertinent and insightful essays on the history, sociology and philosophy of science written by Garfield. Also included in *Current Contents* were one-page mini-essays entitled *This Week's Citation Classic*. These *Classics* included statements such as, "The *SCI*[®] indicates that this paper [the subject of that particular essay] has been cited in over [some number of] publications." In my reference collection are *Citation Classics* written by Carl Djerassi, Ernest Eliel, Paul Flory, Roald Hoffmann, David Taub and Howard Zimmerman. Indeed, hundreds of these from Garfield between 1977 and 1993 are available on the web at [http://](http://garfield.library.upenn.edu/allclassics.html)



Figure 1. Eugene Garfield holding what appears to be the May 28, 1959, issue of *Current Contents/Management and Social Science*. The cover credits "Eugene Garfield Associates."

garfield.library.upenn.edu/allclassics.html, searchable by year and name.

But it was the *Science Citation Index* that was the real lasting brainchild of Eugene Garfield. Today, bibliographic analysis using the Web of Science (WoS)—literally invented by Garfield—is not only a common mechanism for literature searching, it is also the basis for numerous research projects dealing with information science, often termed scientometrics. As Marie McVeigh of Clarivate Analytics, the provider of WoS, told me recently (1),

We used to joke that the *SCI* was a hypertext relational database that waited 40 years for the internet to be invented. *SCI*'s use is so obviously powerful, we so quickly take it for granted.

McVeigh ought to know; she joined ISI Holdings in 1994.

Meher Garfield, Eugene Garfield's widow, recalled recently (2),

It started as *Contents in Advance*, a contents page service in Library and Information Science which he had started in 1952 at the Welch Medical Library at Johns Hopkins University. Shortly thereafter, he started a contents page service called *Managements DocuMation Preview*, which was then changed to *Current Contents*[®]. At first, he was able to sell *Cur-*

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AUTHOR CITATION INDEX					REFERANT				
47	WOODS G F	0069	J AM CHEM SOC	2246	60	PETERSEN R	0049	JAPHA SC ED	0750
58	WOODS J W	0037	J CLIN INVEST	1686	60	TALBOTT J H	0039	MEDICINE	0405
52	WOODS L A	0106	J PHARMACOL	0426	60	WAY E L	0012	PHARM REV	0383
54	WOODS L A	0111	J PHARMACOL	0064	60	WAY E L	0012	PHARM REV	0383
54	WOODS L A	0112	J PHARMACOL	0158	60	WAY E L	0012	PHARM REV	0383
56	WOODS L A	0117	J PHARMACOL	0117	60	WAY E L	0012	PHARM REV	0383
57	WOODS L A	0120	J PHARMACOL	0052	60	WAY E L	0012	PHARM REV	0383
57	WOODS L A	0120	J PHARMACOL	0058	60	WAY E L	0012	PHARM REV	0383
58	WOODS L A	0124	J PHARMACOL	0001	60	WAY E L	0012	PHARM REV	0383
59	WOODS L A	0001	PHARMACOLOGIST NO 2	0077	60	WAY E L	0012	PHARM REV	0383
59	WOODS P S	0183	NATURE	0303	60	KIT S	0020	CANCER RES	1121
21	WOODS R	0002	BR MED J	0065	61	NODA M	0011	A PATH JAP	0057
56	WOODS R S	0176	PRACTITIONER	0420	60	SMYTH C J	0053	ANN INT MED	0002
56	WOODS H G	0078	JACS	5653	60	BARTLETT P	0082	JACS	1240
56	WOODS H G	0078	JACS	5653	60	WINSTEIN S	0082	JACS	2084
41	WOODWARD	0063	JACS	1123	60	HAYNES L J	0014	Q REV	0292
41	WOODWARD	0063	JACS	1123	60	BOUNDS D G	1960	JCS	3676
42	WOODWARD	0064	JACS	0076	60	BOUNDS D G	1960	JCS	3676
42	WOODWARD	0064	JACS	0076	60	HAYNES L J	0014	Q REV	0292
45	WOODWARD	0067	JACS	1425	59	KITAGAWA T	1959	JCS	3741
48	WOODWARD	0070	JACS	1161	60	MCCRINDLE R	1960	JCS	1560
49	WOODWARD	0071	JACS	0379	60	JACKMAN L M	1960	JCS	1579
50	WOODWARD	0072	JACS	1297	59	BOYCE C B C	1959	JCS	2022
52	WOODWARD	0074	JACS	4223	60	BOYCE C B C	1960	JCS	4547
52	WOODWARD	0074	JACS	4223	59	AKHTAR M	1959	JCS	4058
52	WOODWARD	0074	JACS	4225	60	FISHMAN J	1960	JCS	3948
53	WOODWARD	0075	JACS	5455	59	BARLTROP J	1959	JCS	2183
54	WOODWARD	0076	CHEM IND	1391	59	COCKER W	1959	JCS	1998
54	WOODWARD	0076	JACS	2852	59	FAZAKERLEY	1959	JCS	1877
54	WOODWARD	0076	JACS	3567	59	BARLTROP J	1959	JCS	2183
55	WOODWARD	1955	JCS	1699	60	WOODWARD L	1960	JCS	4473
55	WOODWARD	1955	JCS	2655	60	WOODWARD L	1960	JCS	4473
56	WOODWARD	0052	TRANS FARADAY SOC	1458	60	LONG D A	0056	TRAN FA SOC	1570
56	WOODWARD	1956	JCS	3721	60	WOODWARD L	1960	JCS	4473
57	WOODWARD	1957	JCS	1284	60	WOODWARD L	1960	JCS	4473
58	WOODWARD	0002	TETRAHEDRON	0001	60	FISHMAN J	1960	JCS	3948
58	WOODWARD	0054	TRANS FARADAY SOC	1271	60	WOODWARD L	1960	JCS	4473
58	WOODWARD	1958	JCS	0716	60	WOODWARD L	1960	JCS	4473
59	WOODWARD	0005	TETRAHEDRON	0070	60	PETERS D	1960	JCS	1832
53	WOODWARD A E	0075	JACS	6189	60	BLANCHA. HS	0082	JACS	2014
41	WOODWARD R B	0063	JACS	1123	60	UHLE F C	0082	JACS	1190
41	WOODWARD R B	0063	JACS	1123	60	RAPOPORT M	0082	JACS	1171
42	WOODWARD R B	0064	JACS	0076	60	RAPOPORT M	0082	JACS	1171
42	WOODWARD R B	0064	JACS	0076	60	UHLE F C	0082	JACS	1190
45	WOODWARD R B	0067	JACS	1425	60	WARNHOFF E	0082	JACS	1472
46	WOODWARD R B	0068	JACS	2229	60	BAKER A W	0082	JACS	1923
48	WOODWARD R B	0162	NATURE LONDON	0155	60	FRANCK B	0047	NATURWISSEN	0169
49	WOODWARD R B	0071	JACS	0758	60	OLSEN S	0047	NATURWISSEN	0330
50	WOODWARD R B	0072	JACS	1428	60	OLSEN S	0047	NATURWISSEN	0330
52	WOODWARD R B	0074	J AM CHEM SOC	3458	59	WACKER W E	0234	JBC	3257
52	WOODWARD R B	0074	JACS	3458	60	RAUSCH N D	0082	JACS	0076

Figure 2. Samples of early science citation indices sent to Woodward on January 29, 1962 (see Figure 3) (3). The last five columns in Figure 2 refer to articles published in 1960 (6th column) whose first author (7th column) published a paper in the specified journal (volume, name of journal, page number; 8th, 9th and 10th columns, respectively). The articles cited in those journals (7th column) are specified by the first five columns in Figure 2, namely, the year of the cited article, the author, the volume of the journal and its page number (columns 1-5, respectively).

rent Contents/PharmacoMedical, Current Contents/Chemical, and Current Contents/Life Sciences to pharmaceutical companies on contract. Then in 1958 he converted it to a subscription service. *SCI*[®] [Science Citation Index] was launched in 1964 and almost bankrupted the company. He had to sell an interest in ISI[®] in order to survive through the years before *SCI* broke even. It was the success of *Current Contents* that made this possible.

Garfield presented R. B. Woodward with “the first experimental printouts [Figure 2] on our citation index project” accompanied by a letter (Figure 3) dated January 29, 1962 (3). Please take a short tour with me through Figure 2, as I did with McVeigh.

First: On lines 3-10 under AUTHOR CITATION INDEX, several references to “Woods L A” are found, all of which share a citing work by “Way E L” under REFERANT. If you search WoS for Author = WAY E L

and Source = Pharm* Rev*, and then go to the indexed cited references, you can then find the Woodward citations, just as if you were reading Way’s paper and looking specifically for those citations. This shows the citation index transporting Way’s paper backward in time, to its antecedent works.

Second: Go a few lines down, under AUTHOR CITATION INDEX, to the “42” = 1942 paper with Woodward as the author in JACS, and trace to the Referent where you see Bounds and Haynes. Today, a cited reference search in WoS for Cited Author = Woodward, Cited year = 1942, and Cited work = J AM CHEM SOC will retrieve the Bounds publication in JCS and the Haynes publication in Q REV. Here, we are looking, from Woodward’s time in 1942 forward to 1960.

This was actualized by Garfield way back in January 1962! As McVeigh wrote (1),

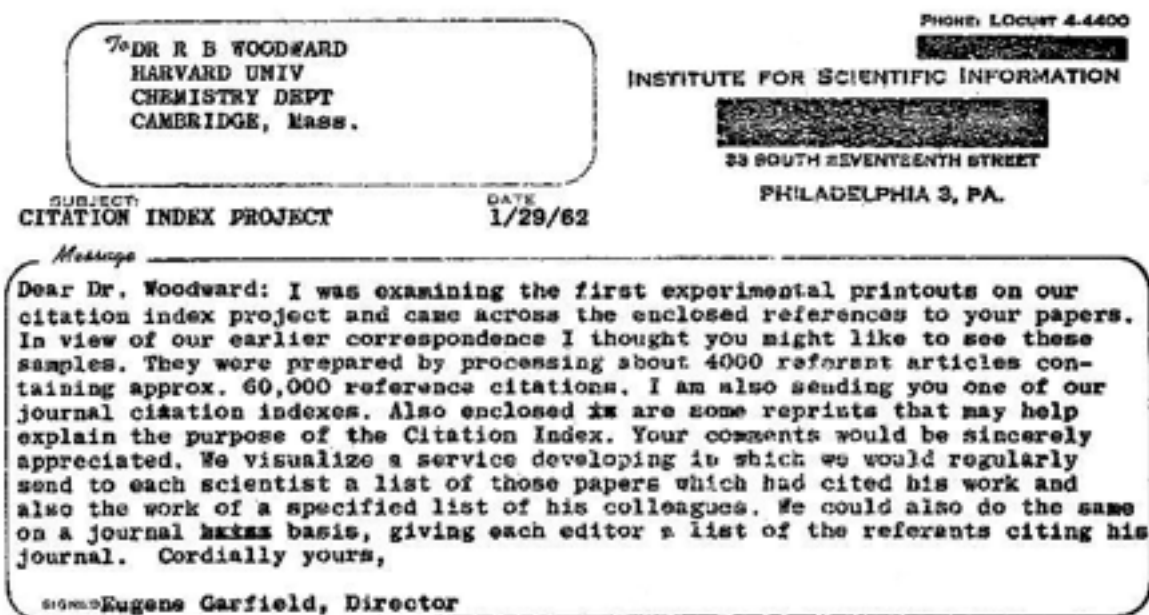


Figure 3. Message from Eugene Garfield to R. B. Woodward on January 29, 1962 (3).

You are seeing something Dr. Woodward in 1942 could not know when he wrote his paper—and that is: his work on *Spectra and Absorption Spectra of α,β -Unsaturated Ketones* was going to influence LJ Haynes's work on *Tetronic Acids*, and DG Bounds' work on *Miroestrol*—nearly 20 years in the future! This radical time-travel is what we take for granted now. Click here...and you are 20 years, 30, 40, 77 years into a future Dr. Woodward never could have imagined! There is even a 2019 article citing this same article from 1942.

McVeigh's own personal excitement speaks especially to historians of science when searching through the archives of eminent scientists or even when reviewing one's own old papers. McVeigh wrote (1),

Seeing this original form of the citation index, brought to life in Web of Science, is like finding a photograph of your great-great grandparents and realizing your son has those same eyes!

The 1962 letter from Garfield to Woodward (Figure 1) is a classic, given that the *SCI* was first published two years later in 1964. Garfield also sent Woodward "one of our journal citation indexes [and] some reprints that may help explain the purpose of the Citation Index" (3).

Unfortunately, Woodward's archives do not contain his response, if any. Garfield's note to Woodward suggests several immediate utilizations of this project, namely, providing individuals with lists of papers that cited their publications and providing editors lists of references citing their journal.

From his letter to Woodward, we can sense Garfield's anticipation that his creations would mightily serve many research communities in the future. We can also feel Garfield's personal love of knowledge and research. His website <http://www.garfield.library.upenn.edu>, now sadly dormant, provides links to hundreds if not thousands of his own intellectual and deeply thoughtful journeys.

The author thanks Meher Garfield and Marie McVeigh for delightful and helpful discussions.

1. M. McVeigh, emails to J. I. Seeman, Philadelphia, PA, Oct. 4 and 7, 2019.
2. M. Garfield, emails to J. I. Seeman, Philadelphia, PA, July 10 and 17, 2019.
3. E. Garfield, letter to R. B. Woodward, Philadelphia, PA, Jan. 29, 1962.