Eugene Garfield (1925–2017)

'To strive, to seek, to find, and not to yield'

–*Ulysses* by Alfred, Lord Tennyson

Eugene Garfield, the celebrated information scientist and inventor of the *Science Citation Index*, died on 26 February. He was 91 and lived in Brynmawr, a suburb of Philadelphia.

The impact of his work was felt in academia and policymaking bodies throughout the world and in science, technology, social sciences, and humanities.

Belver Griffith, his long time friend, attributed Garfield's success to 'early and deep insights regarding the structures of scientific literatures and the nature of scientific communication'.

He rose from humble beginnings to reach the pinnacle of fame, but his life was one of ups and downs. It was by sheer persistence and the force of his ideas he made it a success. He was a modern day Ulysses who had *enjoyed greatly, had suffered greatly, and become a name; for always roaming with a hungry mind much had he seen and known*. He was constantly *yearning to follow knowledge like a sinking star*.

Simple ideas

The databases he created were based on simple ideas, but had far reaching impact and tremendous utility. For example, *Current Contents* is basically a weekly collection of the contents pages of hundreds of journals along with author addresses and a subject index. The actual number of its users far exceeded the combined readership of *Nature* and *Science*. And it provided him a platform to air his views week after week on a range of topics to a worldwide audience.

Science Citation Index (*SCI*) was based on the simple idea that 'if two items are connected because one mentions the other, they are likely related'. Garfield made a big leap from there: by gathering and putting together all the references in all the papers in all the important journals he made it possible for us to perform *prospective* as well as *retrospective* searches of the literature. With *SCI* and other citation databases, one could move *back* in time to locate previously published papers as well as move *forward* in time to determine who has subsequently cited an earlier work. It became useful for retrieval, for research on the nature of science and for science policy. Today it is a powerful tool for the historical and sociological study of science. It is this idea which later led to the development of *Google*. Indeed, Larry Page and Sergey Brin, founders of *Google*, have cited Garfield in their academic work.

Another great idea that occurred to Garfield in the early 1960s was to have a daily newspaper for science that would deal with 'the business of science: those matters that are relevant to professionals working in the scientific arena – bench scientists, professors of science, science administrators, and laypersons who formulate or monitor science policy'. If businessmen have *Wall Street Journal* and *Financial Times*, why not scientists have a paper of their own? Eventually *The Scientist* came out as a monthly in October 1986 and a biweekly since 1987. Since 2002 it is a daily and is accessible free on the net. *Science* and *Nature* started devoting more space to non-original research items, after Garfield started *The Scientist*.

Early life

Born in 1925 in New York city's East Bronx borough into a family of European immigrants, Eugene Garfinkel was raised by his mother with the support of her eldest brother. His father had left his mother even before he was born. His uncle changed his name to Garfield, the name of the newspaper distribution company of his father.

As he was good in math and scored a 100 in the Regent's Exam, he was admitted to the prestigious Stuyvesant High School, known for excellence in math and science. But after a year or two, Garfield left this school for a combination of reasons: he wanted to learn many foreign languages but the school curriculum did not encourage it; he had no real mentors there; and he had to commute all the way from the Bronx to 14th Street in Manhattan every day. He joined the DeWitt Clinton High School, which was near his home in the Bronx and where he could learn Spanish and German. By this time the family had moved to West Bronx where there was a branch of the New York Public Library across the road. He used to go into the library not to read books in the children's section but to scan the titles of books in the library's adults section. By the time he finished school, he had scanned the titles of almost all the books. They were all in his head and he was wondering how to make sense of it all. Years later he knew the answer: classification.

Garfield had to work hard when not in school. When he was 9, he was delivering groceries, and working in a laundry for a meagre fee; later on he worked in his uncle's garment shop.

Early on Garfield imbibed his work ethic and doggedness from his mother whom he called a 'speed demon.' She was pretty fast in everything she did – reading, writing, crocheting, cooking, and housekeeping. He learnt from her that one should never stop till the job at hand was finished.

Garfield also came under the influence of his five maternal uncles, three of whom were Marxists and the other two were capitalists. There was constant turmoil in the family, but the young Garfield acquired business acumen, radicalism, atheism, and a love for classical music. One of the Marxist uncles gifted him a copy of J. D. Bernal's *Social Functions of Science* when he was just 14, and the book left a lasting impression on him. Bernal became his hero, whom he met years later at the International Conference on Scientific Information which was held in Washington, DC.

Collegiate education and becoming an entrepreneur

After finishing school, Garfield joined the University of Colorado in 1942 for a B S in chemical engineering. The war interrupted and he later joined the University of California, Berkeley as a premed student, but after two years decided to return to New York. Subsequently he earned a B S in chemistry from Columbia University in 1948.

Soon he got to work as a lab assistant to Louis Hammett at Columbia and he even had a paper with him in *Journal of the American Chemical Society*. He was not good at lab work and after a few explosions, he left Columbia. He got a consultant position with Smith, Kline and French, who needed a pharmaceutical documentalist. In order to give the impression that he was not just a lone self-employed person, he adopted the business name Eugene Garfield Associates. At a meeting of the American Chemical Society, he met James Perry, a pioneer in the field of chemical literature, and realized that one could get paid for searching the literature. Perry arranged for him to be hired by Sanford Larkey of the Welch Medical Library at Johns Hopkins University to work on the application of machine methods for indexing the medical literature, a project funded by the Army Medical Library, what would later become the National Library of Medicine. It was this project which eventually led to Medical Subject Headings or MESH. Garfield believed that practically everything he had ever done at ISI was in some way or another attributable to the thought processes that went on in this basic research.

It was while he was with the Welch Library project that Garfield started publishing *Current Advances*, a compilation of the contents pages of all the library and documentation journals. Later on, he produced one such service for management called *Current Contents of Management and Social Science*. Bell Labs was interested in this service and they were ready to buy 500 copies, but under the title *Survey of Current Management Literature*. These two subscription products were produced in a converted chicken coop with loans from Household Finance companies! These were the forerunners of *Current Contents* which was published much later by ISI in seven different editions.

In 1953 Garfield organized the 'First Symposium on Machine Methods in Scientific Documentation'. On learning about the symposium, a former vice president of *Shepard's Citations*, William Adaire, wrote to Garfield about the interest evinced by some engineering society in using their methods. Garfield looked up *Shepard's Citations* and he immediately realized how he could link bibliographic references to build the citation index for science, as he had been looking for that kind of structure.

The Welch Library project was coming to a close and Garfield was advised to take a degree in library science if he wanted to remain in the field. With the help of references from leading information scientists whom he had met while at the Welch Library, he got into Columbia University. He completed his M S in one year and topped the class. He had even submitted a paper on the preparation of printed indexes by automatic punched-card techniques to *American Documentation* even before the degree was awarded in 1954. He decided to pursue doctoral work in machine translation.

It was also around that time he wrote his seminal paper on citation indexing which appeared in *Science* in 1955.

Subsequently he went to the University of Pennsylvania to work with a professor of linguistics for his Ph D. He developed an algorithm which proved that a computer could convert chemical names directly into a molecular formula. Before then, chemists had always drawn structural diagrams from the names and then arrived at the molecular formula from the graphs. Meanwhile his advisor left for Europe on a long trip handing him over to another professor. He wrote his dissertation all in 10 pages! His interim supervisor said it would not do. He then wrote a 100-page document on a transformational analysis of Geneva nomenclature. Again, the degree was nowhere in sight. It was then he found out that they were waiting for his original supervisor to return from Europe! He wrote him a stern letter stating that he would not brook any further delay and soon he got his degree in 1961. He reported his work in *Nature* the same year.

ISI

In 1958 Garfield moved his office to Philadelphia and hired his first employee, Beverly Bartolomeo, as his secretary. She stayed on with the company, became a senior director, and retired in 2005. An exemplar of loyalty! In 1960, Garfield renamed his company Institute for Scientific Information or ISI, so it would sound like a non-profit organization. His idea was to do with a small staff all that VINITI, the Soviet Union's mega institute, was doing.

Garfield had always been interested in chemistry and was not happy with the indexes produced by *Chemical Abstracts* (*CA*) as they were several years late. With the algorithm he had developed he could index chemical compounds much faster, and thus was born *Current Abstracts of Chemistry & Index Chemicus*. This product could not win expected market response, as *CA* was an established product. It lost money for twenty years, but Garfield did not close it down as he had invested his ego; besides, there was a very loyal staff of chemists whom he would not like to lay off. He supported it with the money earned by *Current Contents*.

Garfield brought out many other great products such as *Citation Classics*, *Atlas of Science* and the software *HistCite*. In 1979, he wrote a book on citation indexing. He had also collected all his essays, originally published in *Current Contents*, into 15 volumes of *Essays of an Information Scientist*. All these essays are available at his home page. He not only strove and sought like Ulysses, but was also keen to share what he found with others! He was a quintessential people person.

A people person

When the Soviet Block was disintegrating, he helped a number of scientists visit the West. It was he who made the works of the philosopher mathematician Nalimov known to the English-speaking world. Indeed, ISI published English translations of some of Nalimov's books.

With a view to helping to preserve the memory of a vanishing way of life, he supported the Huichol tribe of southern Mexico by buying as well as commissioning a number of their yarn paintings. He always had a very high proportion of minority employees at ISI and there were many women holding senior positions. The company allowed the staff to adopt flexible working hours long before others did. ISI had an affordable child care

centre right from when the company moved to their own building in the University City Centre, Philadelphia. He found it extremely difficult to sack his employees. He was unhappy when in 1988 ISI's new management closed down several unprofitable products within four months of acquiring the business resulting in layoff of many employees.

He had met and corresponded with thousands of people from around the world. He often had house guests and guests he put up in hotels near ISI. He received and honoured requests for funds for travel or education, and for information. Here are two unusual requests for information from eminent chemists.

Joel Hildebrand, whose freshman classes Garfield had attended at UCal, called him after he saw *SCI* and asked him if he could use citation indexing to *prove* that the physical chemistry literature had become too mathematical. Garfield did not have an answer, but, in any case, he himself was a bit skeptical about the math that we see in a lot of fields these days. He thought that 'the world is, obsessed, or carried away with the mathematics that's behind all these things, that they lose the forest for the trees'.

The second is from Woodward of Harvard University, who in 1959 wanted to have an article by a German competitor, which he had seen listed in *Current Contents*. He told Garfield, 'We don't have this article in our library, *yet*.' In those days, it was not customary to receive journals by airmail as it was expensive. However, ISI received journals by airmail. Garfield offered to send him a copy, but Woodward answered, 'I have to know *now*!' Fortunately, the article was very short, just one or two pages. So Garfield read it to him on the phone because he knew German. The service could not have been faster than that!

He had a great sense of justice and fair play.

Immediately after he heard about *Shepard's Citations* from Adaire, he called him and requested him to write about it so he could give him credit in his own paper on citation indexing for science, and as an Associate Editor of *American Documentation* he invited him to write. And he quoted Adaire's paper in his 1955 *Science* paper. He always gave credit where it was due.

For a very long time *SCI* was in the red, but he would not close it down. One of the reasons, he told Tony Cawkell, was of course he was after recognition, which was much stronger than his need for money or power; another was his belief that *SCI* could be a vehicle to transform an informal system of recognition into an explicit reward system for science and help people who are passed over in the formal reward system of science.

Garfield's India connection

Garfield was in India for the first time in the last week of 1974 to take part in a classification conference held in Bombay. The Indian Academy of Sciences, Bangalore, where I was the Secretary-cum-editor of publications, invited him to spend a few days as their guest. He agreed to alter his travel plan. When he arrived in Bangalore, there was a general strike and disruption of services in the city. But, to our great relief, Gene took it in his stride. With a view to maximizing the benefits of his presence in Bangalore, I arranged talks at the Indian Institute of Science, National Aeronautical Laboratory and elsewhere. As a result, he was talking from morning till late in the evening, addressing large audiences. On top of it, he was reading and writing or playing on his saxophone whenever he was on his own.

Any description of Gene's India connection would be incomplete without a mention of his great admiration for Shiyali R. Ranganathan, whom he had met at the 1957 Dorking conference on classification and retrieval and whose portrait he had included in the mural 'Cathedral of Man' adorning the ISI building. Indeed, on one of his visits to India he delivered the sixth series of Ranganathan Memorial Lectures at Bangalore and unveiled a portrait of Ranganathan at the University of Madras. During that visit, he also spoke at the Centre for Cellular and Molecular Biology, Hyderabad. On another visit, he gave talks at the Indian Council of Medical Research and CSIR's Publications & Information Directorate.

He had paid tributes to Ranganathan and Sambhu Nath De, the great cholera researchers, in the form of essays detailing their accomplishments. Many years ago *Current Science* brought out a special issue on Sambhu Nath De who till then remained an unsung hero in India. It all started with a letter Joshua Lederberg had written to Garfield about his nominating De for the Nobel Prize more than once.

Despite his great accomplishments, Garfield remained simple. His friends included many distinguished scientists and scholars including Nobel laureates, writers and statesmen and also many others less known, but he treated them all alike. Garfield was a patron of art, music, theatre and museums. He liked to travel and he was a connoisseur of good food.

Garfield is survived by his wife, Meher, three sons, a daughter, a step-daughter, two granddaughters, and two great-grandchildren.

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