A Century of Science Publishing
E.H. Fredriksson (Ed.)
IOS Press, 2001

Chapter 15
Institute for Scientific Information

Tony Cawkell[a] *and Eugene Garfield*[b]
[a]CITECH Ltd., Iver Heath, UK
[b]Chairman Emeritus, ISI, Philadelphia, PA, USA

The history and development of ISI, is, to a large extent, mirrored in the history of Garfield.

International Encyclopedia of Information and Library Science.

The man

In his *Times* article about the characteristics of Americans, Linklater [11] asks: "What other country could carry out a survey in which a staggering 81% from richest to poorest concluded 'I am optimistic about my personal future' and in which three quarters of those polled went on to endorse that corny but still deeply held belief that 'in America if you work hard you can be anything you want to be'." The belief may be corny but Eugene Garfield's progress is a classical example of it.

The author byline indicates that this chapter has two authors — but that is not really correct. Introducing myself as the first author, an Englishman, I wrote this chapter from information gained from Eugene Garfield, from the impressions of others, and from experiences gained while working for ISI. It is not necessary to write a hagiographic biography about Dr. Garfield. It is perfectly obvious that it was he who propelled ISI to its unique position.

Garfield got a B.S. in chemistry at Columbia University in 1949 and worked with Professor Louis Hammett in 1950–1951. His first paper (as a joint author with Bernhard [2]) written when he was at Columbia, took three years to be published. In 1951 he joined the staff of the Johns Hopkins University Welch library's Medical Indexing Project under contract to what would become the National Library of Medicine but was then the army medical library. His reference from Professor Louis Hammett of Columbia was somewhat inaccurate. It said he is a "hard but not very original worker". It was here that Garfield realised the potential of machines for handling large files of information. He used an IBM 101 statistical punched-card sorting machine for searching punch cards which had been encoded with subject headings and standard IBM tabulating machines for the preparation of

printed indexes. More general inspiration was drawn from H.G. Wells' idea of a "World Brain" [12].

He met a number of people while at the Welch Library who were well known in the profession but he did not have a library degree and was advised to get one if he intended to stay in the library field. He attended the Columbia library school and was subsequently awarded a Grolier fellowship, partly because of the excellent references — rather better than those he received when joining the Welch library — he received from the eminent librarians he had met at Johns Hopkins. He could not have afforded the fees without it. He obtained his M.S. in Library Science in 1954.

In 1961 he was awarded a Ph.D. at the University of Pennsylvania [7]. Garfield has always been interested in chemistry and was concerned that the indexes produced by *Chemical Abstracts* were up to five years late. Later, he entered into competition with the entrenched state-supported *Chemical Abstracts* by introducing *Index Chemicus* in 1960, later re-named *Currrent Abstracts of Chemistry and Index Chemicus*. It included the Wiswesser Line Notation for encoding substructures.

This product tells us something about Gene's motivation. He had a small number of industrial charter subscribers for *CAC&IC* but it lost money for twenty years so why wasn't it killed off? Its continuation was one reason why several executives left in the sixties as described later. Garfield says that "the key point was that I had invested a lot of ego in it and there was a very loyal staff of chemists" [10]. He also explained why he pursued citation more intensively than chemical indexing: "I suspect the choice was motivated by the usual desire of a scientist for recognition. Maybe mine was stronger than my need for money or power… I came from a socio-cultural-economic family background that cultivated a deep sense of justice… A lot of people are passed over in the formal reward system of science… SCI and the citation analysis became for me a vehicle to transform an informal system of recognition into an explicit reward system for science".

Garfield ran his company in such a way that he rarely found it necessary to dismiss people. He didn't mind if his staff adopted flexible working hours. Consequently the company steadily acquired hundreds of members in its "10-year club". Dozens of them stayed much longer. I will never forget the African American man who had the job of bringing up journals from the basement in Chestnut St. as required. He wore a large badge proclaiming himself "keeper of the archives". Soon after I joined the company I was doing a search and needed some journals. "Yes Sir" said he "It will only take ten minutes". It did. He returned bearing the journals and a huge smile. He had changed a menial task into a challenge.

Current Contents

It was while he was at the Welch library that Gene started reproducing the contents pages of journals as *Contents in Advance*, this first version being targeted at librarians and library schools, assisted by some students from Columbia. Four photographically reduced contents pages were reproduced on 9" x 11" sheets. The price was $6 per annum. When Gene went to library school it was continued by Anne McCann of Prometheus Press, but folded a few years later suffering the fate of all underfunded businesses. In the article cited above, Garfield quotes an estimate from the Small Business Administration that two thirds of all new businesses in the United States cease trading within the first five years.

He has described his early progress [9]. This article includes a photograph of him standing in front of the chicken coop near the house into which he moved in 1955.

Garfield called his firm Documation Inc., later changing the name to Eugene Garfield Associates. Nothing daunted by the failure of *Contents in Advance* Gene decided to start up a similar but more ambitious booklet called *Management's Documation Preview* later changed to *Current Contents of Management and Social Science*, using a Xerox platemaker and a small offset press. He kept a dehumidifier running so that the dampness from the floor of the coop would not impede the workings of the machinery.

The Bell Telephone Company heard about *Current Contents of Management and Social Sciences* when it was starting up. They ordered 500 copies of a customised edition named *Survey of Current Management Literature* which had a different cover. The financing of this relatively large order reveals the spirit of a true entrepreneur. Garfield went to the banks for a loan but they were not interested. He then heard about the Household Finance Corporation. Having grown up during the depression Garfield thought that "going to a finance company was like being in the hands of the devil". However, they lent him $500 — the State limit — and suggested that he tried a branch in another city for more. He did just that when he learned painfully that large companies are often slow to pay, and borrowed from several branches.

The size of the Bell Labs order meant that the new publication had to be commercially printed. A Washington-based printer and their public relations man offered to put up $5,000 to partner Garfield with the new publication. If it was a success they would put in more. They also provided him with an office in Washington. His new partners spent the $5,000 on a mailing shot to a list of the highest paid people in the United States. It was a disaster, generating a total of about 20 subscriptions — but they did provide a better name for the publication

— *Current Contents* (CC). Meanwhile a *Current Contents* service for one pharmaceutical company had been started and then expanded to others.

Universities and medical people later heard about CC and it gradually became successful. Current Comments — an editorial piece which appeared in the front of *Current Contents* issues — were eventually reproduced in the *Essays of an Information Scientist*. In volume 1 Garfield said: "It would be difficult to acknowledge everyone who has contributed to these essays in one way or another… though I take full responsibility for everything I publish I owe a great deal to the knowledge and help of my colleagues and friends".

Joshua Lederberg wrote the foreword to this same volume. Of Current Comments he said: "Gene has displayed his enthusiasm, his deep insight into the scientific process and sometimes a candor and artlessness in the expression of his feelings that may even offend some who have not also experienced his own scrupulous integrity at first hand".

The Science Citation Index

In March 1953 Garfield found himself single-handedly conducting a symposium at the Welch library after two of his colleagues became ill. He presented a paper later published in *American Documentation* [5]. The title of the symposium was "The first symposium on machine methods on scientific documentation". Among the three hundred people who attended it was a reporter who gave it national coverage. It was noticed by Dr. Gordon Allen, a geneticist at the National Institute of Health.

Gene is remembered "vigorously marketing his ideas" about CC at the Dorking conference — a landmark meeting described later in this chapter. He has been no less vigorous in talking about his ideas for an even better known publication — the *Science Citation Index* (SCI). His output in print discussing aspects of the SCI has been enormous. As it was a completely new indexing concept the library and science communities took a long time to be convinced.

Lederberg and Allen

Garfield's first article specifically about the SCI was published in *Science* [6] in the same year as his *American Documentation* article. It was this article which prompted a letter in 1958 from Joshua Lederberg — the year that he won the Nobel prize for discoveries about "Generic recombination and the organisation of the genetic material of bacteria". Lederberg explained why his letter took so long to compose: "for lack of a citation index I cannot tell what happened to your article in *Science*". Lederburg later coined the name *Science Citation Index*.

It was the recommendations of the two geneticists — Lederberg and Allen — which were so influential at the end of the fifties when Garfield was attempting to get grant support for SCI development.

Much later (June 1960) Allen sent a diagram showing citation connections between a collection of articles to Garfield. Allen explained that: "The arrows indicate the direction in which one would be led in a conventional literature search, starting at any point in the network. A citation index would permit one to trace the arrows in the opposite direction and hence to find all the articles no matter where on the network he started" [13]. Allen's diagram shows citation interconnections between articles arranged in chronological order with the most recent at the bottom. When many articles are included it is confusing to try and follow the routes taken by numerous lines crossing each other — a problem encountered in the early days of the *Science Citation Index* when its applications were often explained with the aid of diagrams of this kind.

Allen's diagram showed the citation connections between a set of biochemistry articles.

Garfield's reply was enthusiastic: "The material you sent was fabulous. Why didn't we think to do this before? I didn't have this in mind when I said I had some examples of the power of the Citation Index. I merely meant specific articles which could be traced through a CI. I once had the idea that some type of network could be used with Citation Indexes. I am now convinced more than ever, from your example, that his will be true" [13].

The Institute for Scientific Information and launching the SCI

The name Eugene Garfield Associates Inc., was changed to The Institute for Scientific Information in 1960. The reason for the adoption of this name was to create a more equal ground in competing with non-profit organisations. The perception of the scientific and library community was that of a government agency such as the Russian Institute for Scientific and Technical Information. The name needed to be right. Shakespeare elegantly makes the point. Juliet knew very well that as a Capulet her family was at odds with Romeo's — the Montagus. In the famous conversation from her balcony with Romeo in the street below she said "What's in a name? That which we call a rose by any other name would smell as sweet". The rose which was Eugene Garfield Associates altered its name, but not the nature of it's activities, to The Institute for Scientific Information.

The 1955 *Science* article shows that Garfield already had in mind applications which are widely used today. The idea for the SCI was inspired by *Shepard's Citations* which contains a listing of American court cases, each followed by a

record of publications which have referred to it. In regard to scientific articles, Garfield wrote in his *Science* article: "This would be particularly useful in historical research when one is trying to evaluate the significance of a particular work and its impact on the literature and thinking of the period. Such an 'impact factor' may be much more indicative than an absolute count of the number of a scientist's publications." Later Garfield wrote [10] "Using citations for evaluating people is a very tricky business. But if you use the data carefully you can facilitate an intelligence gathering process that can allow for reasoned and thoughtful decisions".

After initially giving ISI a grant the National Institute of Health was forced by Congress to change its rules. Because of these tortuous politics money had to be transferred from the NIH, which could no longer provide grants for companies, to the National Science Foundation. NSF negotiated a contract with ISI for one thousand copies of a *Genetics Citation Index* (GCI) for which a multidisciplinary database was required and for which ISI received $150,000 over a three year period. The idea was supported by Lederberg and Allen. From that database containing data from 600 journals the 1961 SCI was also created. Having produced the necessary machine readable data Garfield had hoped for a grant to proceed with it but that was not provided.

The GCI was published in 1963. It was extracted from a database of 100,000 articles and 1.5 million cited references In spite of the absence of a grant to proceed with the complete 1961 SCI Garfield took the risk of publishing it. His principle assistant was Irving Sher, a biochemist and mathematician. He was backed by Phil Sopinsky who was in charge of data processing. Regular quarterly editions of the SCI were launched in 1964.

Although *Current Contents* was bringing in cash, expenditure was exceeding revenue at this time and Garfield had to borrow some money as described in the later section "The Company". He also cut out the patent citation index section from the SCI.

Most people in the information industry believed that the SCI would fail. Garfield proved them wrong.

Other activities

In 1957 Garfield visited the UK for the first time. He was short of cash and paid for a ticket to the UK using TWA's installment plan. He had been invited to attend the 1957 Dorking classification and retrieval conference. He met such luminaries as Robert Fairthorne, Cyril Cleverdon, S.R. Ranganathan and many others. One delegate remembers him as "a young man vigorously marketing his ideas of

journal contents lists". Another "recalled the evening when Gene Garfield defended his proposals for a citation index against a group of very skeptical and outspoken critics including Cyril Cleverdon".

He took one day off, caught a train to London, and spent 15 hours seeing The Tower, The British Museum, House of Commons, etc. When he returned to Victoria station around midnight it was shut. He took a taxi back to Dorking as he had been asked to chair the next morning's session. "The audience gasped when I told them — I didn't mention that it used most of my remaining cash".

The extent of Garfield's enthusiasm, curiosity and depth of knowledge comes across very clearly in his Essays, published by ISI Press, and now available complete from his Web home page These essays are mainly reprints of his Current Comments articles which used to appear at the beginning of *Current Contents* issues. There were 15 volumes running from 1962 to 1993. After ISI had been sold to Thomson, in the foreword of the last volume I wrote: "The boring reality is that in today's business activities often require that entrepreneurs must give way to a formal business structure. Roald's fears will be realised — Gene will no longer entertain us with Current Comments or with the Essays in their present form. Few readers will be pleased with this news. (Roald Hoffman, Cornell University, wrote the foreword for volume 12)".

The Essays include such items as "Why medical research?", "More on cremation and other alternatives to traditional burial", "Noise R&D abatement could help employment problems of physicists", "What your air-conditioner may be giving you besides relief", "Of presidents, politics, and chicken pluckers" and "Jazz transcriptions will blow your mind". At one time, ISI Press did not publish books. Gene met V.V. Nalimov at a Moscow book fair and said he would like to publish one of his books. "But your Institute does not publish books" said Nalimov. "It does now" said Garfield.

Another of Dr. Garfield's ideas — *The Copywriter* — never took off. Perhaps it was ahead of its time — it required some of the miniaturisation and optoelectronic developments of the eighties associated with microcomputers to be successfully engineered. To some extent it was made unnecessary by the arrival of Xerox photocopiers. *The Copywriter* aroused the interest of Verner Clapp, President of the council for Library Resources (CLR) [8]. Gene met him when he was working at Johns Hopkins. It was hoped that it would be manufactured and sold by an appropriate company, its applications being an appropriate part of ISI's business but not its manufacture and service.

The idea was to use a small hand-held scanning head for sweeping across that part of a page required to be copied. It would resolve 4-point type. The copying

machine and printer, contained in a separate box, was connected to the scanning head by a flexible cable. The copied strip of data emerged from the box on Teledeltos electrosensitive paper. Several patents were taken out. The idea was put into practice and two prototypes were made, the second embodying a number of improvements. The construction was carried out by a local electronics company near Philadelphia. Some years later the Japanese made a device for a similar purpose called the Copyjack.

When the design started to become dated Dr. Garfield asked me to re-design the electronics which I did. I also took out a US and a European patent filed in 1984 on behalf of ISI. It embodied a CCD scanning unit with the means of scanning the whole page, and selecting the wanted part of the page by windowing and storing it. The circuitry was based on the microcomputer components available in 1983. The re-design and new patents were pursued in case a suitable company became interested in manufacturing. However, the idea was not taken up.

The company

ISI have developed a number of information products including the CC range, the SCI and related products, CAC&IC and many others. The SCI database represents the company's most valuable asset because of the many ways its data can be processed to form a new product.

Garfield needed all his faith and perseverance over a period of several years to get the SCI off the ground. Until then he had been the independent publisher of the successful *Current Contents*. In the early days Gene's wife did the paste-up work in the chicken coop. Later an office in Spring Garden St., Philadelphia was rented across the street from Garfield's consulting client Smith Kline & French. More employees joined the firm. He had almost decided to undertake the preparation of the SCI without the support of either NSF or NIH. However after some arrangements were made between these organisations, a contract was signed in mid-1961 and ISI moved into a building on Chestnut St., Philadelphia near Independence Hall using rented office space.

In 1965 the company was almost forced to close down under the pressure of bringing the SCI to the market. Garfield sold 20% of the company as a convertible debenture for half a million dollars to a group of investors representing the ten top Wall Street firms, themselves represented by Walter Eberstadt — a decision which later had some serious consequences.

Shortly afterwards Garfield was faced with a kind of conspiracy. Four vice-presidents — The Director of Production, Director of R&D, The Treasurer and the Marketing Director believed that he was going to run the company into the

ground. They got together and presented him with an ultimatum. Unless he killed the loss-making *Index Chemicus* they would resign. Gene believed it had a future and told them to go. They resigned in a body. When Eberstadt heard about it he thought that Gene was totally dependent on them and became very worried. I had just joined the company and knew little about its operations. As far as I could make out these resignations did not make the slightest difference. I think that this was in part because Garfield was still an entrepreneur at heart and had always played a role in key company functions. Evidently the people who resigned were replaceable without too much difficulty with the exception of Dr. Sher who returned a few years later and remained with ISI until his death a few years ago.

By 1978 ISI employed 470 people and covered 5,200 journals published in 31 different languages. All its products are published in English. In that year construction of a purpose designed building started in the University City Science Center, Philadelphia, close to the Universities of Pennsylvania and Drexel. It cost $6.5 million. A child care centre was housed in a separate building. An IBM 370-148 computer was used for data processing. Peter Aborn was appointed chairman of the new building project [1]. The architects were Venturi & Rauch and Denise Scott Brown. The company moved into it in late 1979. "Every aspect of the building's design was carefully weighed to combine the benefits of rigorous systems analysis and energy efficiency tempered with a good measure of human whimsicality and warmth" writes Aborn.

In 1988 Ted Cross and JPT holdings acquired over 50% of ISI's shares. In 1992 they and Garfield sold their shares to Thomson Business Information, a subsidiary of the Thomson Corporation. The growth of ISI had forced Gene out of his role as a pioneer and entrepreneur into the politics associated with running quite a large Company — not his métier. The old incentive-driven success had been replaced with less satisfying activities. Although the manner of the change of ownership was not as he would have planned it he was left a rich man. Among his present activities he is President of the American Society for Information Science, where he is considering its problems — in particular its steadily declining membership.

Garfield continues to publish *The Scientist* — a biweekly news journal and the first full text journal available free on the Web.

Publications in print are gradually giving way to electronic publications — the Web of Science is a very large database designed by ISI for online network users. It is used in 14 countries by national higher education consortia. It contains details of over 23 million source articles containing 300 million cited references extracted

from the science, social science and arts & humanities journals covered in ISI's services.

By 1998 ISI employed 800 people and covered over 8,000 journals. It also owns offices in seven different countries.

Eugene Garfield sold ISI partly because of ill-health and partly because of management and executive staff problems in the early nineties. The pioneering child-care centre was shut down by JPT but was replaced by a non-profit centre operated by the same staff. Also closed were ISI Press and the Atlas of Science product. *The Scientist* was spun off to Garfield. JPT were not interest in the company — only its potential to make money. Short term considerations determined every decision to maximise value.

Garfield and ISI: reminiscences

I met Gene by accident in 1966 while waiting to meet a colleague in the foyer of a London hotel. I was scanning *Current Contents Engineering* when a camera flash went off and an American introduced himself as Dr. Eugene Garfield, its publisher. He said I was one of its few UK subscribers. Soon afterwards I found myself at the Philadelphia out-of-town airport, having been hired as ISI's man in Europe. My first visit to ISI was interesting. At the airport I was advised to take a limo to the Holiday Inn. Being unaware that there were Holiday Inns at all city centres I was delivered to the Holiday Inn at the city centre, Atlantic City. I changed to a seat beside the driver — an ex-US army black man who thought my mistake was very funny. He took me back to ISI's address in Philadelphia for nothing.

I soon realised that I was going to have an interesting time working for a most unusual company run by a remarkable man. Gene said "find yourself a desk and familiarise yourself with the products". I worked out a search described as "Use of the Science Citation Index for checking the progress of television signal compression", based on Cherry's work [4]. I wanted to discover how well the system, designed for science users, worked in engineering. I knew a little about information retrieval systems [3].

The next evening Garfield invited me and another member of the staff to eat out. We eat one course and then moved on to a second restaurant for ice cream — according to Gene "the best in town" There were 20 varieties with a countless choice of "toppings". From then on I worked in Europe, returning to ISI two or three times a year for discussions. Garfield liked to become involved with the fine detail.

I had a free hand to promote ISI's products in Europe. Before a visit to a university I checked the authors listed under the address of the university in the SCI's

corporate index section, found out who was their most heavily cited author, and arranged a series of slides to describe the use of the SCI using his work as an example, having become a self-appointed, if superficial, expert on the subject area. The SCI seemed very expensive to potential UK customers so a special effort per customer was justified.

Eventually I established several people to act as representatives in different parts of Europe. I was appointed Vice President R&D of the company in 1974. Garfield naturally expected me to work in Philadelphia. When I said I wanted to work out of the UK, I was rather surprised that he agreed. My reason was that Gene's enthusiasm was too infectious. I did not believe that I would be able properly to divide my time between business and family.

References

[1] Aborn, P. (1979, August) How ISI designed its new workspace: an inside story. *Bulletin of the American Society of Information Science* **5**(6), 14–17.

[2] Bernhard, S.A., Garfield E. and Hammett. L.P. (1954) Specific effects in acid catalysis by ion exchange resins. 3. Some observations of the effects of polyvalent. Citations. *Journal of the American Chemical Society* **76**, 991–992.

[3] Cawkell, A.E. (1962) Classification and retrieval of technical information. *Wireless World* **68**(8–9) 352–356 and 432–434.

[4] Cherry C., Kubba, M.H., Pearson, D.E., Barton M.P. (1963) An experimental study of the possible bandwidth compression of visual image signals. *Proc. IEEE* **51**, 1507.

[5] Garfield, E. (1955) The preparation of printed indexes by automatic punched-card techniques. *American Documentation* **6**(2), 459–467.

[6] Garfield, E. (1955, July 15) Citation indexes for science. *Science* **122**(3159), 108–111.

[7] Garfield, E. (1962) *Thesis: An algorithm for translating chemical names to molecular formulas.* Ph.D in structural linguistics. University of Pennsyvlania.

[8] Garfield, E. (1973, May 2) Current Comments: Introducing the Copywriter and ISI's subsidiary Selective Information Devices Inc. (SID). *Current Contents.* Reprinted in *Essays of an Information Scientist* Volume 1, 1962–1973.

[9] Garfield, E. (1980, January 21) Current Comments: how it all began — with a loan from HFC. *Current Contents* **3**, 359–362. Reprinted in Essays of an Information Scientist Volume 4, 1979–1980.

[10] Garfield E. (1983, July 25) How sweet it is — The ACS Patterson-Crane award. Reflections on the reward system of science. *Current Contents* **30**, 229–236. Reprinted in Essays of an

Information Scientist Volume 6, 1983.

[11] Linklater, M. (1996, March 15) Socialism and the American way. *The Times.*

[12] Wells, H.G. (1938) *World Brain.* Doubleday Doran, New York.

[13] Wouters, P. (1999) *The citation culture.* Thesis, faculty of science, University of Amsterdam.

Note. Essays of an Information Scientist are available on www.garfield.library.upenn.edu