

Recollections of Irving H. Sher 1924–1996: Polymath/Information Scientist *Extraordinaire*

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Over a 35-year period, Irving H. Sher played a critical role in the development and implementation of the *Science Citation Index*® and other ISI® products. Trained as a biochemist, statistician, and linguist, Sher brought a unique combination of talents to ISI as Director of Quality Control and Director of Research and Development. His talents as a teacher and mentor evoked loyalty. He was a particularly inventive but self-taught programmer. In addition to the *SCI*®, *Social Sciences Citation Index*®, and *Arts and Humanities Citation Index*®, Sher was involved with the development of the first commercial SDI system, the *Automatic Subject Citation Alert*, now called *Research Alert*®, and Request-A-Print Cards. Together we developed the journal impact factor and the *Journal Citation Reports*®. Sher was also the inventor of the SYSTABAR System of coding references and Sherhand. He was involved in key reports on citation-based historiography, forecasting Nobel prizes, and served as a referee for *JASIS* over a 20-year period.

Only through adventurous thinkers can the search for new knowledge succeed. Without this knowledge, the world would stagnate as a pool without an inlet; neither would there be an outlet for its progress. (David Sarnoff, Founder and President, RCA. Gutterman, L., 1967, *Wisdom of Sarnoff and the World of RCA*)

Irving H. Sher was the prototype adventurous thinker. He died on December 19, 1996, following a 6-month kidney disorder. In the 40 odd years I knew him, he had never taken any sick leave. I first met Irv at Smith Kline & French Labs in Philadelphia. He joined their Scientific Literature Department in 1956. He had received his D.Sc. in 1953 from Johns Hopkins University School of Public Hygiene with a major in biochemistry. From 1953 to 1959, his published work included papers in biochemistry, clinical and analytical chemistry as well as statistics (see Appendix).

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Having myself spent 2 years at Johns Hopkins Welch Medical Library from 1951–1953, just across the street, I knew that Sher had to be a fully qualified biostatistician. He had been trained by the likes of W. G. Cochran, Helen Abbey, and Clifford Bachrach, chief statistician of the Johns Hopkins Hospital. I had also attended their lectures. Cliff later became the MESH editor of the *Index Medicus* (Bachrach & Charen, 1978).

Just about a year after I left Welch, I began working for SK&F Laboratories in 1954. A few years later, he was hired by Ted Herdegen of their Science Information Department. He had a unique talent for spotting out-of-the-ordinary people. He had convinced me to come to SK&F as a “resident” consultant. At my suggestion, he also recruited Robert Hayne in 1956 (Garfield, 1977). Bob was an associate editor of *Index Medicus*. I first met Bob in 1951, in his capacity as assistant editor of the *Current List of Medical Literature*, the predecessor of the *Index Medicus*. He taught me, and later Dr. Sher, most of what we knew about medical indexing and, in particular, MESH (Medical Subject Headings).

Dr. Sher’s brilliance was apparent within minutes of meeting him. His doctorate of science, in contrast to the Ph.D., was indeed apt. He could discuss relativity, quantum mechanics, molecular biology, linguistics, statistical theory, biochemistry, and dianetics with amazing fluency. Indeed, he could easily teach all these subjects. Tutoring was part of his complex personality. He could not refrain from doing so in conversation with me, students, or experts alike. This quality often irritated visitors, who initially misinterpreted his pedagogical predilections as condescending. But they soon learned that he had an obsessive drive to communicate with precision.

Sher also had an innate inclination to contradict authority. The saying “the higher they come, the harder they fall” aptly describes that quality. I recall one such encounter between Sher and John Tukey, the renowned mathematical statistician from Princeton and Bell Labs. It was a unique experience to witness two leading experts on citation index-

ing debate some mathematical detail. Dr. Sher relished the exchange. I myself usually deferred to the likes of Tukey, and was somewhat embarrassed. But John later told me how impressed he was by Sher's knowledge and command of probability theory.

Tukey became a legend in citation indexing. To compile a "Citation Index to the Statistics Literature" he personally encoded all the cited and source references in every statistics journal. He did this even while participating actively in meetings of the PSAC (President's Scientific Advisory Committee) (Tukey, 1962). John recently died at the age of 85 (Leonhardt, 2000).

Sher correctly told Tukey that coding for a list of statistics and math journals was a manageable task in the hands of an expert but an impossible method for dealing with the variations in thousands of journal title and book abbreviations encountered in compiling the *Science Citation Index (SCI)*. Instead, Sher invented SYSTABBR, a system still in use at ISI to this day. In those days, we were constrained by the limits of the IBM punched card as well as the need to conserve space on the printed page.

When Sher first met Professor Joshua Lederberg, 1958 Nobelist and our close associate for 40 years, there were slight fireworks. Irv soon realized that Josh could never be intimidated or provoked. He never allowed Irv to elevate the noise level of a conversation. As the years went by, they developed a real mutual respect. During our private conversations, Irv would always conjecture as to what Josh might think of a new idea. Our conversations were often anything but calm. Irv knew how to get under my skin. The intellectual battles were often prolonged and furious. But no matter what he believed, once a decision was made as to which direction we should take, he executed the plan without the slightest hesitation.

It is sometimes said that success in business involves managing mediocrity well. It also takes a special talent and patience to manage genius. Because he had 10 ideas a minute, you just had to let him pursue some of his wildest ideas, even if they might fail.

Irv's talent as a programmer was incredible. Many of the main-frame computer programs he personally wrote are still in use at ISI or have been incorporated into newer systems. He served ISI at various times as director of research, director of development, director of production and training, and director of quality control. He used his statistical training in everything he touched. He also refereed many of my papers and commentaries, and served as referee for *JASIS* as well. The editor of *JASIS* in those days was Art Elias, and they became very close friends.

As you can imagine, he was a devastating referee. For any author, this was a real learning experience. Unfortunately, we do not have copies of comments he made on papers he was asked to referee. Irv was the atypical referee and returned manuscripts overnight—almost compulsively. He belied those who would question the value of refereeing.

Irv attended Overbrook High School in Philadelphia and attended the University of Pennsylvania, graduating in 1944 with a BA in Chemistry. He entered the U.S. Army about 1943. In his youth, Irv learned to speak Cantonese from a neighborhood friend. But he attended the Army language school at Yale University to learn Mandarin Chinese. He later served in the Burma-Chinese area as translator and interpreter until 1947. He remained a student of Mandarin and other Chinese dialects until he died. When we traveled to China in 1982, the National Librarian in Beijing was astonished when Irv asked if they had any books on Chinese shorthand systems. They produced a few volumes in about 10 minutes! He also invented Sherhand (Garfield, 1985), which he used to take notes that he recorded in a daily lab notebook. Alas, all of his notebooks were discarded. They would have made an incredible historical document.

While preparing for my recent nostalgic reflection on information science pioneers at ASIS (Garfield, 1998), I came across a photo taken by my former assistant, Dr. Calvin Lee, showing three Chinese airline hostesses conversing and giggling with Irv on an airplane. He and Calvin made quite a hit in China. Few believed Calvin was Chinese. Most thought he was an American Indian who had learned restaurant Chinese. On the other hand, Sher spoke Chinese so well they couldn't believe he was an American.

Irv's personality was complex to say the least. Here was a brilliant perfectionist scholar who refused to publish anything unless he was literally forced to do so. Almost without exception, the only way I could get him to publish was to start a draft and then ask him to edit it. After several drafts I would add his name to the byline without consulting him. The articles he coauthored are included in the bibliography of this article.

I mentioned earlier Dr. Sher's irresistible urge to teach. As a result, there is a stream of former proteges who have a loyalty to him that any university professor would envy. His mentoring skills were incredible. He would take people untrained in science, computers, and information science, or librarianship, and over time teach them so they eventually could make significant professional contributions. An early coworker was Catheryne Voytko, who later became the aide to Pennsylvania Congressman Daniel Flood. Others at ISI who worked for and with him were Beverley Bartolomeo, Carolyn Finn, Larry Hackett, Janice Abrams, Ellen Grenell, Helen Atkins, and Bonnie Lawlor.

One interesting example of Irv's ingenuity was reflected in our report on tracing the history of DNA through citation analysis (Garfield, Sher, & Torpie, 1964), coauthored with Richard Torpie. Dick was a former SK&F information scientist who returned to medical school and went on to a successful career as an oncologist. Irv not only designed the study details but also dealt with Dr. Issac Asimov—a our guinea pig. Issac was a professor of biochemistry in Boston at that time. In later years, Issac told me he enjoyed working with Irv even though they had never met in person. I'm not sure whether Irv was a science fiction fan, but we certainly

were impressed by Isaac as a biochemist and historian. He and Irv had incredible memories. Asimov was quite impressed when our study turned up several important papers he had overlooked in his brief history of DNA (Asimov, 1963).

Sher designed the unique overlapping color transparencies we used in the report. But we had to redesign them to publish in black and white (Garfield, 1967). Copies of the DNA report can be found in many leading libraries. It laid the cornerstone for our claim that there could be a new field of citation-based historiography. I regret that Irv did not complete the programming necessary to do this, but I hope to see that accomplished one day. I taught these methods to my students at the University of Pennsylvania's School of Electrical Engineering, and was always amazed at the term papers they produced, which included an historiograph.

Sher was responsible for the various standardization techniques ISI uses to unify and collate the millions of citations made by thousands of journals in disparate fields with different reference styles and typographies. Much has changed, but there still is limited standardization even within individual countries. Processing foreign citations often involves the need to transliterate names in dozens of languages including Russian and Chinese. Unless one has worked with the myriad details involved, it is difficult to realize the endless combinations of variants. Added to these complexities are the well-known errors made by authors, many of which defy comprehension, even by trained librarians.

Nevertheless, the cluster keys and other devices Sher designed have enabled us to produce a product that is of high quality though by no means perfect. The limitation of an 80-column IBM punched card in the original systems is evident.

To this day, authors are irritated to see their names "bumped" and/or truncated as, for example, in going from Alarcon-Segovia to "AlarconSego." But it was then the only way to "unify" the varied expressions of these source names. However, in the cited reference fields larger strings were possible. ISI now is facing and dealing with the daunting problem of unifying these source and cited truncated names in providing a Web interface.

The variance in journal abbreviations was also problematic. Irv not only compiled dictionaries of these abbreviations but also catalogued the syntax of their citation styles, of which there are hundreds.

In dealing with the citation of books, Irv invented the "SYSTABBR" system. Space limitations prevented the use of full book titles in the printed indexes. The size of the enterprise prevented the use of manual standardization as in traditional cataloging. So Irv taught high school-educated keypunchers how to key and simultaneously encode book and journal titles using Systabbr—a variant on soundex systems of shorthand and speedwriting.

Long ago, Irv Sher designed expert systems for dealing with reference citations in an algorithmic fashion. It is sad

that he did not live to see the possibility of its implementation with newer technology and mass storage as is done with autonomous citation indexing (Lawrence, Giles, & Bollacker, 1999).

Shortly after the SCI was introduced we realized that although scientists could identify primordial references to begin a search, librarians and others needed a traditional subject approach. We had studied the various permuted indexes and decided they were inadequate to the task. As briefly described in *Current Contents*[®] (Garfield, 1969), the *Permuterm Subject Index*[®] (*PSI*[®]) was added to *SCI* in 1966. When the 1965–1969 cumulation was produced we added the missing 1965 *Permuterm* data, but first had to translate all foreign titles. This was done with a marathon effort by Boris Anzlowar.

More than 6 years later I published a full account of *PSI*'s development (Garfield, 1976). It is important to point out that so-called natural language indexes were not at all fashionable then. Sher's research determined that most searches involved two or three terms. The system generated about 30 word-pairs per article, which provided highly specific access. ISI user studies confirmed this approach. The first versions of *SCI* on CD-ROM included *PSI* but it was abandoned in later CD-ROM editions. It is significant that no existing system has the *PSI* ability to tell the reader what other terms have cooccurred with the starting search term.

Sher was primarily responsible for the first commercially implemented system of selective dissemination of information (SDI). He is an unsung hero in this regard since SDI, as originally conceived, never became immensely popular among research scientists. Profiling became widely used by industrial librarians in systems like Dialog which adopted "Save SDI" profiles as a routine part of their command language. This meant the system would store your profile and run it whenever the file was updated. Most on-line services now use the word ALERT instead. But to this day no system fully matches the capabilities of the original *ASCA* system, now called *Personal Alert*[®] (Garfield & Sher, 1967). I myself have used the *Automatic Subject Citation Alert System* for over 30 years and cannot imagine life without it. Contrary to widespread belief, it is not limited to cited reference profiling for which it is certainly unique. But Sher also developed what he called the Chinese menu system of Boolean searching for categories of terms.

There is an important and amusing story concerning *ASCA*'s early development. About 1966, ISI ran an ad in *Science* magazine. It showed a Rorschach-like graphic of a human face with closed eyes. The ad said: Close your eyes: Imagine an information system designed just for you! Open your eyes—*ASCA*. (Garfield, 1983). This ad was reprinted in *Current Contents* in 1983. That ad pulled more responses than any ad in the history of *Science* magazine at that time.

When the orders arrived, we immediately sent subscribers profile forms. About 80% were returned eventually but 20% were not. Irv and I called some of these people. We

found that they literally expected *us* to design the system for them automatically including the profile. So we decided to meet that challenge. We looked up the subscriber's last five published articles. We picked out the key references and keywords they had used. We also made sure to include their own names and some coauthors, to "automatically" design a search profile. Not only did these profiles work, most were used continuously without changes for over a decade or more, even though one can change profiles weekly. I myself have used the same basic profile for over 30 years, and only occasionally add new terms and references as my interests expand or change.

Irv also designed ASCAmatic (Garfield, 1968). We estimated that even a well-designed, highly specific profile would produce at least 50% false drops. The idea of ASCAmatic was to send out citing articles with the *ASCA* report. So if we sent all the tear sheets for articles that were "hits," the user would not even have to order them. If 50% of them were thrown away as "false drops," it would be faster than requesting the articles after receiving the reports, and in the long run it would be cheaper, because it eliminated the cost and delay of ordering through the library. It was, in fact, the first personalized journal, an idea J.D. Bernal had promoted in the 40s.

However, ASCAmatic never really caught on. Many profiles were intentionally quite general and somewhat ambiguous. The average user only ordered a fraction of the articles listed. That is certainly true in my own case. And because users receive many of the journals citing their work, they simply retrieve those articles from their desk copies as I do for *JASIS*, *JIS*, and other journals, unless they are delayed. Using today's large-scale memories, these problems can be solved easily but this was in the early days of computer science.

Irv Sher also invented the Request-A-Print card. It is remarkable that these so-called RAP cards are still in use (Garfield, 1972). These are reprint request postcards that contain a self-addressed preprinted label that can be sent to an author.

I often wondered what Dr. Sher's life was like as a child. It seemed as though every new idea was for him like a new toy (Koenig, 1977). He had to try it out and see how and if it worked. He arrived at the office quite early, many hours before me. His enthusiasm when he announced a new discovery was incredible. He would always precede its unveiling with a philosophical statement demonstrating how this new idea would revolutionize the world. After he discussed the idea, you would have to slowly bring him back to the real world.

Irv was the first author listed on one of the most-significant articles we published together (Sher & Garfield, 1966). However, you might not appreciate its significance from the small number of times this article has been explicitly cited. We were invited to give a paper at an Office of Naval Research Conference on Research Effectiveness. The report included our primordial study of Nobel Prize winners. We

determined that Nobelists wrote five to six times as many articles as the average author, and their work was cited 30 to 40 times the average. This article led to a subsequent study of the 1967 *SCI* that included a list of 50 most-cited authors. Twelve became Nobelists (Garfield, 1970). This demonstrated the forecasting powers of this unique database, and led to dozens of similar studies.

The reason for the relative uncitedness of the ONR article is simple. I myself cited it so often that it was obliterated by incorporation as Robert Merton, the eminent sociologist, would say (Garfield, 1975; Merton, 1968). Others cited my articles and the articles of other authors who did cite it early on. And it did not help that it was published as a book chapter rather than a journal article. We only recently added this article to our home page on the Web because it had been added as an appendix to Volume 6 of *Essays of an Information Scientist* [www.eugenegarfield.org] (Garfield, 1966).

Sher was also my key collaborator in the design of the journal impact factor (Garfield, 1955). We realized that we needed a simple means of comparing the quality of small journals with large ones. It would have been possible to use the number of pages or pages published. But we found them unreliable indicators, especially as some foreign journals were quite large but rarely cited. So we looked at the chronological distribution of citations, especially in biochemistry and molecular biology. We observed that about 25% of citations were to articles published just a few years back. That 2-year impact factor has proven to be a remarkable predictor of future performance but is certainly not flawless. However, it served our purpose in selecting journals first for *Current Contents* coverage and then the *SCI*. This work would eventually lead to the compilation of the *ISI Journal Citation Reports*, which has become a standard tool for libraries and publishers.

Since then, ISI has developed rather sophisticated means for evaluating journals. A staff of six experts are involved and impact is but one of many indicators. The outside world is mainly oblivious to the impact that these procedures have had on elevating the quality of journals. One of the most important elements is timing. We refused to include journals that were chronically late. This was self-defeating behavior because citations to those articles would occur 3 or more calendar years later.

A large literature on the subject of impact factors is now available, but it only gives a hint of its widespread use. There is still much misunderstanding about these metrics that we have tried to dispel. Since Irv's death, it has become an even more enervating job to deal with the torrent of literature pro and con that is published almost weekly. Ever since their snide editorial in 1970, *Nature* (Anonymous, 1970) has opened their correspondence pages to any disaffected or misinformed reader wishing to complain about impact factors or the use of quantitative data. However, *Nature* has never seen fit to send such manuscripts to us to referee. The irony of this is that they have been one of the

most aggressive journals in citing their own impact numbers to promote sales of advertising.

Another indicator of Sher's influence on my work is not only the number of times his name shows up as a coauthor but also as a cited author in my published works.

Irv Sher was a genius, with a passion for invention and discovery. His enthusiasm for problem solving and innovation was infectious, and it spread to all who had the pleasure of working with him. He has left a legacy of successful research that will serve as a strong foundation for future innovations in the field of information science and technology. Even more importantly, he has left the indelible imprint of a friend and mentor, and given inspiration to those of us who traveled the road to discovery with him.

I want to acknowledge the help of everyone who helped with this reminiscence but especially Larry Hackett, Bonnie Lawlor, and Helen Atkins.

The most beautiful thing in the world is, precisely, the conjunction of learning and inspiration. Oh, the passion for research and the joy of discovery. (Wanda Landowska, Polish harpsichordist and music critic, 1879–1959. Resout, *Landowska on Music*)

Appendix A: Source: Web of Science

Pre-ISI Work of Irving H. Sher

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