

A Tribute to Ken Iverson

By Donald B. McIntyre

A progression of great thinkers has moved the human race towards the adoption, first of an economical and efficient number system containing zero and based on place value, and then of a universal algebra, APL, which operates on arrays or multiple quantities, and is totally devoid of words.

There have also been those who resisted the inevitable progress, who found it difficult to adopt new and improved tools for thought. In our own time we hear appeals to revert from this high intellectual level and use English words, and to submit to the tyranny of scalars, as if Sylvester's eloquence a century ago had fallen on deaf ears.

Unlike its predecessors, APL is an executable notation. APL represents, in a phrase used by Babbage, the "triumph of symbols over words." As so many of our distinguished predecessors predicted, it makes reasoning easier. APL is the result of brilliant insight, careful thought, and hard work through at least 5,000 years. Iverson is the latest in a succession that includes Peano, Sylvester, Cayley, De Morgan, Boole, Newton, Leibniz, Napier, Stevinus, Fibonacci, Diophantus, and the unknown Egyptian whose work was copied by Ahmes the scribe.

In 1866 Sylvester proclaimed that: "To attain clearness of conception, the first condition is 'language,' the second 'language', The third 'language' – Protean speech – the child and parent of thought."

In reflecting on the significance of APL I have adopted a historical approach. Having done so I find that Sylvester had something to say on that subject also. The occasion was his Presidential Address to the British Association in 1869 when he said: "the relation of master and pupil is acknowledged as a spiritual and lifelong tie, connecting successive generations of great thinkers with each other in an unbroken chain."

[Ken Iverson is our master and we are his pupils.] We think in a different way because of APL.

The preceding paragraphs are from p.576 of my paper: **Language as an Intellectual Tool: From Hieroglyphics to APL** (IBM Systems Journal Vol.30, No.4 1991, p.554-581). They are copyright and are incorporated here with permission of IBM. The paper, which is referenced in the J Dictionary, is available on www.mcintyre.me.uk. It was written in part to justify the change from traditional APL symbols to the new notation used in J. The references to APL include J, as was stated explicitly by Ken Iverson in his important **A Personal View of APL** – the paper that immediately followed mine. (IBM Systems Journal Vol.30, No.4 1991, p.582-593)

An article in *Datamation* (May 1975, p.13) said “that the efficiency of APL today is due to Iverson’s tight control of enhancements and to his insistence on ‘bending only to what was right, not what would sell.’ Associates talked of Iverson as a ‘highly moral and genuine person’ who appealed to people’s sense of good taste, and convincingly so.” Three decades on we echo that judgement.

On learning of Ken’s death, a former colleague at Pomona College – an economist whose students use APL – reminded me of an APL course that I taught for Faculty Members some thirty years ago. He recounts how, in that distant past, a colleague had commented that perhaps I could be likened to Paul in relation to Ken’s Jesus! It was 7 April 1964 that I saw the light on the road to my Damascus. On that day new doors opened when I attended the *Announcement of IBM System/360* and initiated one of the first purchase-orders! As a result I received a copy of the *IBM Systems Journal*, Vol.3, Nos.2&3, 1964, containing Ken’s *A formal description of System/360*. Just as, when a stone is thrown in the air, you can determine its position at any moment of time provided you know its mass and initial velocity – so the formal description, like a mathematical equation, answers every question regarding System/360’s behaviour. To discover that such a complex machine could be described in this way seemed miraculous.

For years I have pored over this remarkable document and shared my enthusiasm with everyone who would listen. Moreover, the *formal description* sent me to Ken’s *A Programming Language* (1962) – there was an unused copy in the College library! Being already familiar with the IBM 7090, I was delighted to find that this computer featured as principal example.

Pomona College was, I believe, the first general customer site where System/360 was installed. Although ordered on the day System/360 was unveiled, we waited until October 1965 for delivery. For part of the time I had access to a System/360 at IBM’s Data Center in Los Angeles, and enjoyed informal tuition from IBM system engineers. This helped me understand the machine’s architecture and master System/360 Assembler Language. With Ken’s formal description at hand I was in a favoured position.

Late in 1968, our IBM representative (Don Stanger), noticing *A Programming Language* on my desk, told me that IBM had implemented Iverson Notation and called it APL. W.J. [Bill] Bergquist gave me a demonstration of APL at IBM in Los Angeles. In early 1969 two of my students, who had designed a small computer, wrote a formal description using Iverson Notation. We rewrote this in APL, and Don Stanger arranged for us to access the computer at Yorktown Heights and run a working model of the students’ projected computer! What a thrill it was to see that Ken Iverson was signed on to the system we were using!

Ken, to whom I sent a copy, was surprised that it came from the geology department of a small liberal arts college! He was delighted and invited me to visit him at the Thomas J. Watson Research Center – timing the visit to attend the 1st APL Users Conference, *The March on Armonk 1969*, at Binghamton. Only one other attended from California.

In this way an extraordinary relationship was born – so that now I feel Ken’s death as though I had lost an older brother whom I will always remember, respect and admire. From then on Ken was a patient guide, always willing to answer questions and never showing irritation with a slow learner. He replied to my last questions on 15 October 2004 at 19:48. The following afternoon Ken suffered a fatal stroke while preparing a J tutorial on his laptop.

In 1969 I was en route to Scotland for sabbatical leave. There, without access to an APL system, I used an APL ball on an IBM Selectric typewriter and wrote a paper on *APL and the study of Data Matrices*. I presented the paper in Philadelphia at the Geological Society of America’s Annual Conference, using an acoustic coupler to link to the APL system at the Thomas J. Watson Center. Following the Conference I gave the Matthew Vassar lecture – *Hooked on APL!* – at Vassar College, and visited Ken and Adin Falkoff again at Yorktown.

McIntyre, Donald B., *Introduction to the Study of Data Matrices*, In: Models of Geologic Processes – An introduction to Mathematical Geology, P. Fenner, Editor, Washington D.C.: American Geological Institute. [Typed with an APL ball on an IBM Selectric typewriter] Invited speaker at Short Course on Models of Geologic Processes, American Geological Institute, Philadelphia, 1969.

In 1971, when Ken had become an IBM Fellow, he invited me to join him at the IBM Scientific Center in Philadelphia. It was a wonderful summer experience. From then on, wherever we were in the world, we never lost contact – in New York, Toronto, California, or Scotland.

1978 McIntyre, Donald B. *Experience with Direct Definition One-Liners in Writing APL Applications*, An APL Users Meeting. Toronto, September 18, 19, 20, 1978., Proceedings, I.P. Sharp Associates, Ltd., p.281-297 [IPSA Users Conference 1978, 1980, 1982]

1978 McIntyre, Donald B. *The Architectural Elegance of Crystals Made Clear by APL*, Toronto: September 18, 19, 20, 1978. Proceedings, , I.P. Sharp Associates, Ltd. [With Ken Iverson in the Chair]

1983 Keynote speaker: The first *Tool of Thought Conference*, Association for Computing Machinery, New York.

1983 Banquet Address: International APL83 Conference, Washington, DC.

After my retirement Ken visited us twice in Scotland and on several occasions I greatly enjoyed being Ken and Jean’s guest in Toronto and at the famous “Farm” where J was born.

On May 30, 1990, Ken sent me the original J system and the *Dictionary of J*. After APL90 in Copenhagen, he came to Scotland to share his enthusiasm for J – his new dialect of APL, brilliantly implemented and named by Roger Hui. Ken came in order to persuade me to write a paper entitled *Mastering J* – Ken

provided the title – for APL91 at Stanford. As the paper had to be submitted in the last days of December, it was a hectic rush, but Eugene McDonnell saved the day by shepherding the paper for inclusion in the APL91 Proceedings. It was probably the first paper on J written by a user rather than by a team member. There is a copy on my website.

I took Ken to Edinburgh airport, let him off, and parked the car, but when I rejoined him Ken broke the news that he had misread the ticket – the flight had left the previous day! We rushed to Glasgow airport for an alternative flight. Ken's credit card failed to register – fortunately mine worked. Although I was very distressed, Ken's philosophic response was characteristic: "It's only money" he remarked – a balanced attitude that more of us should espouse!

In 1992 I conducted a *Tutorial Day: J Workshop* for the British APL Association, London. As a result of the success of this workshop, Ken proposed that I spread the word by going on tour in North America. Of course I agreed and in less than 2 weeks I ran J workshops in Toronto, The University of Waterloo, Lawrence KS, Dallas TX, Phoenix AZ, Claremont CA, Palo Alto CA, Washington DC, and the College of Wooster OH. I gave more J workshops in Toronto in 1993.

Ken had a genuine interest in people. When he asked how you were, he really wanted to know. He always inquired after our son, Ewen, whose life is complicated by cerebral palsy, and Ken went out of his way to ask questions when he heard how Ewen is able to use a computer without a mouse. Ken and Jean have always been generous and big-hearted. They opened their home as a halfway house to troubled youths, with as many as six living with their own four children. Some have remained life-long friends.

I have always been struck how Ken never indulged in hero-worship, and I have come to understand that this is consistent with his Norwegian heritage. It is a national characteristic of Norway that there is no place for heroes. Prince and citizen are equal.

Ken had a profound interest in the use of language. When told something, Ken was always interested in the speaker; he was honest, direct and straightforward. If he were bored his body language would show it. Ken used words as a fencer uses a rapier! He would have made a fortune had he received a commission on the countless copies of the American Heritage Dictionary's Indo-European Glossary that he persuaded people to use!

For Ken, a sentence is like a mathematical expression. He was laconic – using few words – and readers often complain of his terseness, as if this were a fault. [terse: AHD, Brief and to the point. OED, Neatly concise.]

Ken was generous in sharing unusual books that had interested him, and the use of words was a common thread. Here are some of the books Ken sent or recommended – all relate to words!

- Terrance Deacon: *The Symbolic Species: The Co-Evolution of language and the human brain.*
- K.M. Elizabeth Murray: *Caught in the Web of Words: (The making of the Oxford English Dictionary).*
- R.E. Friedman: *Who Wrote the Bible.*
- Simon Winchester: *The Surgeon of Crowthorne: A Tale of Murder, Madness, and the Love of Words.*
- Steven Pinker: *The Language Instinct: How the Mind Creates Language.*

I was happy to contribute to Ken's library: e.g, the Complete OED on CD, and Vol.2 of Cajori's *History of Mathematical Notations* – he already had Vol.1.

Ken had a fine sense of humour and often surprised with the pithy remark. I had given Ken a McIvor [son of Ivor] tartan tie, and when the APL Group in Philadelphia had a night out, and I was moved to give a spontaneous exposition of the Scottish Enlightenment – demonstrating to my own satisfaction that most good things (APL perhaps included?) were invented by Scots. This explains why in August 2003 Ken sent me a copy of *How the Scots invented the modern World* inscribed succinctly "For DBM @80 KEI".

Ken's great joy was to devise novel ways of introducing mathematics to the general public – using the spirit of his much admired Hogben's *Mathematics for the Million* coupled with his own J notation. While working at the frontier of mathematical notation and computer language, Ken devoted enormous thought and energy to devise ingenious ways of tutoring non-mathematicians. On my last visit I was fortunate to see Ken in operation at his Toronto home as he led an on-line session of *Mathematics for the Layman* for five or six adults with little background in the subject.

Such a many-faceted person! It is no wonder we all miss him so much.

We pay tribute also to Jean Iverson, whose dedicated support throughout Ken's professional life made his splendid contributions possible. Ken acknowledged Jean's assistance in preparing the final draft of *A Programming Language*. Anyone who has opened that book will recognise the magnitude of her task! For a while in the 1970s Jean also ran APL Press and produced an APL Newsletter. Jean quietly and efficiently kept Ken and all the extended family afloat. We who benefit from Ken's work owe her much gratitude.