"Looking Back" and "Reflections" are the titles for the opening and closing chapters. "Three Decades of Multiprocessors" by Gordon Bell is as informative as it can be, written by a man who confesses that he has "never really considered any alternative to the multiprocessor". "Technology and Courage" by Sutherland, "Problem Representation" by Simon, "What Is Scientifically Knowable?" by Traub are worthwhile contributions that widen the view. Dana Scott ends the book with an ecstatic report "Exploration with Mathematica", showing how a well-trained mathematician, logician, and more recently computer scientist can be absorbed by the glamorous beauty of a seductive program system; Alan Perlis would have loved to observe this happening—it happened to him also from time to time.

Back at Alan Perlis, to whom the work is dedicated. Even after he left Carnegie-Mellon for a position at Yale, he kept good contacts, and Carnegie-Mellon, in celebrating its 25th Anniversary of Computer Science, took a good opportunity to demonstrate through this book its scientific open-ness.

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William Aspray, *John von Neumann and the Origins of Modern Computing* (MIT Press, London 1990), 376 pages, Price $47.25, ISBN 0-262-01121-2.

In his paper on how to build reliable systems from less reliable components—how to rebuild reliable information from signal bundles that have become unreliable—John von Neumann has introduced the notion of the majority element: a logical function which (I use a simplified explanation) transforms a probability $p < (0.5 - \delta)$ into $p = 0$ and a probability $p > (0.5 + \delta)$ into $p = 1$. As long as unreliability over a bundle of digital lines does not exceed 0.5, unreliable information is transformed into reliable information. This majority element introduces democracy into truth value handling: the majority decides for 0 or 1. John von Neumann found a bundle size in the order of magnitude of 10^4 to be required for reliable results. (In my habilitation thesis I have shown that the application of feedback principles can reduce the bundle size to a realistic value in the order of 10^2.) All of that could be used for an interesting argument about politics as seen from a logical base, but here I want to discuss it with respect to evaluation of people.

Particularly in America, the consideration of people has a majority element tendency: good people are often upgraded, and less good people are downgraded. It belongs to the duties of the historians to correct the distortions produced by majority functions. For instance: if he can attribute something to upgraded people, the speaker or writer is on the safer side. In this way, people are classified into heros (1) and into zeros (0). John von Neumann is a hero. Corrections of the majority function are not yet tried. Admitted, such a correction is difficult and needs maybe more than forty years.

John von Neumann was already a hero of mathematics and physics when he met the computer. He therefore had a triple function: development of computers; scientific application of computers, and recognition of the computer. Development of software was not only too early a subject—he did not need it. It is reported that he yawned when the FORTRAN-developers presented him their programming language. For him the transformation of a mathematical structure into a program was simple, transparent, and a pleasure for his bit-precise memory. He did not need languages nor operating systems; in his mind, he saw the bits at work.

The application fields he was interested in were mathematics and physics, statistics included. Many mathematicians in the early days ranked the computer in the level of a calculating bureau, a mere handicraft device of high price and only exotic use. That a mathematician of the caliber of John von Neumann considered the instrument as a kind of working partner made deep impressions in the scientific world. It needed the personality, the hero John von Neumann to establish the scientific character of the new device. The early acceleration of information processing was greatly due to his spectacular involvement. For the recognition of the computer as the key for a new science, he has done more than anyone else.

The computer coined John von Neumann's work from the historic meeting—it rather was an accidental encounter—with Herman Goldstine on the railway platform of Aberdeen in August 1944 (a scene which Aspray quotes from Goldstine's book) until his last effort, the book *The Computer and the Brain*, published after his death in 1957.

There is not yet a comprehensive biographical work on John von Neumann, but the reviewed book covers the computer period, thoroughly and carefully researched. William Aspray produces quality in whatever he begins. After a relatively short general biographical introduction (1903–1928), he divides the book into:

2. An Education in Computing,
3. Planning a Computer,
4. Engineering a Computer,
5. The Transformation of Numerical Analysis,
6. The Origins of Numerical Meteorology,
7. The Computer as a Scientific Instrument,
8. A Theory of Information Processing,
9. Scientific Consultant and Statesman.

The book should not be missing in any library or book collection on the history of information processing. References and illustrations are an additional reason for this statement. (I do not understand why publishers save money by a picture quality quite below technically possible standards; compare the cover picture (it is also within the book after page 212) with the same picture in *A Computer Perspective.* A few glazed paper pages cannot drive the price unacceptably high?)

Now a few minor critical comments.

The chapter title "A Theory of Information Processing" is misleading. For John von Neumann the computer was a calculating device; text processing was not yet important, hardly in existence, and even his contributions to information theory do not yield a theory of information processing. To my knowledge, John von Neumann never used the term information processing. I suspect that this chapter title was produced by the publisher and not by the author. A much more appropriate title would have been "Automata Theory".

The book *The Computer and the Brain* requires, in my opinion, a far more critical evaluation. John von Neumann completed only the first part which could be named. "The Computer in View of the Brain". The section on the brain—which in the same line should carry the name "The Brain in View of the Computer"—is merely a sketch, and the promised comparison is missing. I believe that John von Neumann would not have permitted the publication of the book in its incomplete form.

The Table 9.1 would win if a general overview on the main positions of John von Neumann gave the frame for the presented information. I found, by the way, that the seven-year cycle which often occurs in biographies of distinguished scientitsts applies also to John von Neumann:

1903 Born. (6 years)
1909 Childhood.
1916 University studies in Budapest, Berlin.
1923 ETH: First paper on mathematical logics.
1930 Princeton: Top position in the scientific world.
1937 US Citizen: Involvement in government and military projects.
1944 ENIAC: Begin of the computer period.
Meeting with HHG.
1951 Last period: Hixon Symposium. (6 years)
1957 Dies.

1930 marks the middle of his life.

The parametron story falls a little short in the book; the word *parametron* does not even occur. The Japanese scientist Eiichi Goto invented it in March 1954 and completed a parametron computer PC-1 in the spring of 1958. An industrial model, called HIPAC (Hitachi Parametron Computer) was completed in 1960. John von Neumann's patent is mentioned (not quoted) in the book, but only as an asset in US-Japanese agreements. This history and the other side-effects of this invention—for a while considered as a big danger for the transistor computer and the American computer industry—is not yet properly documented (except, maybe, in Japanese language).

The treatment of formulas in the notes is not satisfactory. They are neither systematically explained nor systematically typeset—some cosmetics for all formulas in the book are proposed for the next edition.

There is a minor misprint on page 312: the mentioned book is of course by Shannon and Weaver and not by Shannon and Wiener.

On page 175: The basic Shannon formula is *exactly* Boltzmann's H-Theorem and Shannon even kept Boltzmann's letter H for the entropy (see Zemanek, *Elementare*

Informationstheorie (Oldenbourg, 1960)) although the letter H has no relation to the word entropy—a clear sign of Shannon's respect for Boltzmann's share in information theory.

On page 180: Ortvay proposed an axiomatic method for the systems theory: the same wrong line that McCulloch and Pitts pursued with their paper. Organic structures—languages included—do not have axiomatic nature; a systems theory cannot be built on such sharp logic (fuzzy logic is not much better). Logic and mathematical models must be included, but their interconnection has to be open or loose if the true idea of organization is to be modelled.

On page 186: A.D. Booth was not only a cristallographer; returned to England, he started to develop computers for exactly this purpose—a relationship that would deserve deeper investigation.

On page 187: Heinz von Foerster was charged by W.S. Culloch to edit the printed second half of the symposia (6 . . . 10). Von Foerster followed A. Samuel in the chair for electronics at the University of Illinois in Urbana and in a certain way he continued John von Neumann's work on the brain and the computer.

On page 200: Multiplexing here is neither time nor frequency multiplexing, but space multiplexing, an unusual application of the word multiplexing.

In summary: John von Neumann *is* a hero of computing—he does not need the majority element. His weight and his influence, however, have distorted a little the historic accounts. The public opinion majority elements have reduced the shares of other contributors in them and have increased the (already big) share of John von Neumann. A chapter on the weaknesses and on the negative influence of the hero would be of no less importance.

And the European reader waits for a collection of John von Neumann anecdotes. One can hear more than one in the US, but for some reason Americans do not cultivate anecdotes (except as footnotes like the section in the Annals). A genius like John von Neumann, I dare say, is difficult to present by his scientific achievements which extend beyond the horizon not only of the average reader. He could get a much more distinctive profile by a baker's dozen of anecdotes whose pointwise flashes would produce a three-dimensional picture of the extraordinary human being John von Neumann. A second volume by William Aspray?

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L.C. Paulson, *ML for the Working Programmer* (Cambridge University Press, Cambridge, England, 1991), Price £27.50, $49.50 (hardcover), ISBN 0-521-39022-2.

Based on his experience with teaching, the author has written a book for an audience which he omits to identify clearly. The title indicates an audience of