
Stan1218.¶1: Do you realize what you've done? ...

112 Before I continue, let me respond to your letter of December 18:

113 Well, Stan, I certainly know what I *tried* to do. But I must confess that my "dedication," as you put it, was mostly due to a compelling realization that, finally, I could no longer avoid a vigorous defense of the LINC's primacy. I have never before taken on such a role, but you got my attention! Ordinarily I would have dismissed matters with a sigh as just one more tale whose author wanted not so much to get it right as to get it written; but the quality of your work and the scope of your story immediately convinced me that here was something serious to contend with, and contend I did. I was quite annoyed (to put it mildly) to find the LINC epoch tucked into what was being represented as a de-mythologizing of history but which gave every indication of being mostly a story about the wonders of -- could I believe my eyes? -- Time Sharing! And Licklider's Dream, yet! Now, I yield to no one (wow!) in my high regard for the enormity of Lick's influential thought and action; but wasn't this the man who, despite the Dream, settled for -- and "eagerly promoted" (note 129) -- the Big Deal Time-Shared Computer's unfulfillable promise of a free lunch? Was the LINC's seminal confutation simply to be subsumed within a meta-myth, merely a historical signpost passed by on the wrong road to the real-time interactive, graphical, personal computer?! (You'll observe that I fairly shout my aggravation and dismay from time to time!)

114 Have I got *your* attention yet? Bear with me!

115 See, your letter still leaves me wondering whether my dedication will have had the effect I intended. I'm gratified to read that you'll be attending properly to a definition of PC, but this isn't the only point I hoped you would especially take to heart. What I tried to do was convince you that the story you were telling so far was really about the corrective countermarch of personal computing rather than about the origins of the personal computer. Sure, 'personal computing' has now come to mean 'using a personal computer'; it finally became obvious to even the loudest of the early Time Sharers that theirs hadn't been the best way to go after all, and of course integrated circuit technology was then well enough in hand for the Apple explosion. But the LINC, sans hoopla, had been abroad in the land quietly doing its thing over many earlier years, to the delight and enlightenment of thousands. Well, all right, so it wasn't millions; but those few, those happy few, had at their disposal a true personal computer of exactly the kind, if not the size and power, that is now so commonplace. No wonder Bill Calvin and other early LINC-ers were incensed!

116 You can see that I am still fighting the good fight against the tides of hype, despite the vindication of my steadfast position regarding the better way to go. [Much less energetically I am now at war with, among other computerhyperiffic insults to humanity, what are laughably called 'windows' and 'desktops.' I guess I've always been driven by E. M. Forster's observation that mankind has long been satisfied by the not quite good enough. (What he actually said, in his disturbing 1914 short story *The Machine Stops*, was a bit less punchy: "Something 'good enough' had long since been accepted by our race.")] Your draft forced me to re-confront the hype of the Time Sharing era, something about which I had hoped you would seek more background from, say, Severo Ornstein, who saw it all happening. Since your letter gives no hint that you intend to do this, and because in any case Severo travels a lot and therefore may be hard to find, I probed into my Poon Hill file to see what I could find. Not much, I'm afraid, but I've attached copies of a couple of his communiques anyway. (I see from the first of these items that I forgetfully borrowed his 'money/mouth' phrase without attribution; the second, though it reports the saddening death of the man who

indirectly encouraged me to move on to MIT, includes a response that made me want to send it as well, just for fun, lest you write me off completely as an old grouch -- and to treat you to a winning snippet of Molnarian wit into the bargain.)

Stan1218.¶2: As you requested, I won't mention where you live, although the devil in me urges me to hype things up a bit and say that you really live in a fabulous penthouse in Monte Carlo ...

117 Hype of this type is delicious! Go ahead, indulge the devil -- with the straightest of faces, I trust. I think your casino image is great, and no doubt you've thought of others as well. I'm a great believer in fun!

Stan1218.¶3: The reference to 4,000 hours of failure-free run time comes from you! ...

118 Oh! I plead *nolo* to the charge of forgetfulness. No second thoughts.

Stan1218.¶4: By the way, I've decided to footnote the manuscript ...

119 Goodonya! I think the footnotes in the new material add a great deal. By the way, I trust you'll feel free to dip into my commentary in whatever manner you think might be helpful to the story.

Stan1218.¶5: I recently finished two more chapters, mostly dealing with Englebart's extraordinary work at SRI. ...

120 Got 'em, and your mini-biographical treatment of Doug is terrific. The endless forbearance under the trying circumstances that seem to have characterized his professional life, no less than the extraordinary vision and creativity that sustained him throughout, come through loud and clear. Good work!

121 So once more into the breach. Perhaps I'll have less to say, having already been so diatribously voluble. I'm glad you find my comments helpful anyway, and I do appreciate your tolerance and amusement. To continue, then:

IV THE LONELINESS OF THE LONG DISTANCE RUNNER

p79.¶4: But how? One thought led to another ...

122 Hmmm ... "Other people could be sitting at consoles tied to the machine... ." *The machine!* Let us all pray fervently that Englebart's prescience doesn't foretell a Forsterian world, however accurately he may have predicted Time Sharing and modern workstation networks.

p80.¶2: This was an astonishingly vivid and prescient vision of the future of computers ...

p89.¶2: There were obvious advantages to this approach, since magnetic-core logic circuits would possess the same qualities ...

123 You go on to say, "At the time, computer logic circuits were mostly made out of transistors... ." If you're writing about ~1957 here, then your statement is wrong; computer logic circuits were then mostly made out of vacuum tubes and associated components.

p91.¶1: In early 1961, Englebart managed to obtain his first contract. ...

124 Did SRI really pay Doug Englebart only \$13,000 for his salary and expenses in 1961? Shocking!

p92.¶2: "We see the quickest gains from (1) giving the human the minute-by-minute services of a digital computer *equipped with computer-driven cathode-ray-tube display* [italics added] ..."

125 Right on, Doug!

p93.¶2: It's the second part of the agenda that's most intriguing, because it sums up the enormous difference between Englebart's approach and that of almost every other computer scientist, then and now. ...

126 If the difference in approach is enormous, then it seems to me the reader is entitled to some value judgement on your part; yet in scanning through the remainder of the draft I find nothing to tell me whether we are to think it a better approach or a poorer one. And perhaps your "then and now" is a bit too strong. If you check with Bob Fano and Corby, I bet they'll tell you that the MAC folks also liked to talk about how Time Sharing fostered new ways of thinking and working -- the old 'machine-aided cognition' and other mystiques. For that matter, today's millions certainly think and work differently now that they have PCs. All new tools affect the way we think and work, no? Furthermore, whenever we want any computer's results badly enough we all have to adjust to whatever it takes to get 'em. A lot of the burden has *always* appeared on our side of the screen, far too much, some say -- but then, after all, the computer is our most complex tool.

p93.¶3: As he liked to point out, you don't need any training to learn how to ride a tricycle—you just climb on the seat and start peddling[sic]—but the return on your investment is proportionally small, because a tricycle is slow and cumbersome. ...

127 I think that Englebart's "enormous difference" is instead one of degree and emphasis, although it does seem that he would have us tool-designers push the adjustment requirements much farther toward the disastrous extreme of fully-computer-adapted humankind than most of us ought to think either realistic or desirable. But despite the clarity and, arguably, the validity of his philosophical goals, there really isn't a whole lot of "intellect augmentation" going on yet, is there. The need for better tools is still more compelling -- and we can't even manage to re-do a keyboard layout that was deliberately intended to slow down the operator to prevent jamming the mechanism of the earliest typewriters!

128 In the view of the tool designer who follows the "other" approach, Englebart overestimates the willingness of humans to be inconvenienced when they have other things they'd rather do -- and indeed it does seem that many people would rather have their hair styled than their intellect augmented, as Alan Kay might have put it. Good tool-designers have always recognized that in their expectation of investment they must very heavily weigh the convenience of the human who is to use the tool; if the tool isn't convenient to use, it isn't a very good one, though many will nevertheless find it "good enough." Good design is terribly hard; that's why there's so little of it.

VII THE MOUSE THAT ROARED

p98.¶3: In any event, the project fared badly. ...

129 Doug sensibly wanted a computer under his own control to develop his ideas with. But wasn't he still thinking about "consoles tied to the machine"? Yes, he was (note 122). In any event, Lick was putting the Federal Government's push

behind the Time Sharing bandwagon. Talk about *Goliaths!* Stan, not even DEC -- and they had all the keys -- saw the personal computer as the way to go!

p98.[#6]: The term *workstation* probably originated in SAGE ...

130 I never heard the term 'workstation' used in the days of SAGE; 'console' was the descriptor commonly used.

p99.[#8]: The CDC machine resembled Digital's PDP-1 ...

131 Well, yes and no. The PDP-1 was an 18-bit machine and came with a big, Gurley-designed CRT. The CDC-160A was a 12-bit machine, had no display (I believe). [See AHPW page 192.] The two machines must have had fairly similar instruction repertoires, though.

p101.¶2: Word processors (in the sense of today's term) didn't exist back then, although every time-sharing computer had programs that enabled you to manipulate text. ...

132 You ask, "Right?" about this paragraph. Let me take it sentence by sentence: 1) Your lead assertion is true as far as it goes -- though you'd better check with Corby about just how many Time Sharing computers there were back then! But the LINC certainly had such programs as well, and there may have other early computers, in one or another institution, that could also manipulate text on-line (though nothing springs to mind). 2) Re 'editors' and 'formatters': Yes, on-line program preparation required (and still requires) editors; but no, it didn't (and doesn't) require formatters, at least not in the sense of today's term. 3) *Of course* editors and formatters became more powerful as time went by; what else is progress supposed to mean? The formatting program RUNOFF was written in the early sixties for CTSS at MIT; the program 'troff' and its elaborations, written by UNIX guys at Bell Labs in the early seventies, are still in use today. [Kernigan and Pike write (in *The UNIX Programming Environment*, Prentice-Hall, 1984) that editing & formatting was one of the first applications of UNIX, and that in fact Bell Labs management acquired the first PDP-11 -- for UNIX, on which work had begun in 1969 on a PDP-7 -- under the promise by staff that it would be used for document preparation.] 4) On-line editing of LINC programs and text was a very simple process, not a cumbersome one; the early Time Sharers, on the other hand, did indeed have to struggle, given their very limited teletype access. 5) Yes, glass teletypes did not relieve their editing bind. (See note 46.) 6) Cryptic commands may indeed have been characteristic of on-line teletype editing, but they certainly weren't of LINC editing. The LINC's keyboard included a key for deleting any of the short lines of text appearing on its small CRT, as well as keys for scrolling forward or backward by single lines or by frames; all this made the insertion of new text at any point trivially easy. Great job by Mary Allen Wilkes, who wrote not only the editor/assembler but the entire operating system. 7) Yep.

p102.¶1: To Englebart, all this was nonsense, a gross underutilization of the computer's capabilities, especially for displaying information. ...

133 Doug evidently didn't know that the LINC had done away with all this nonsense for its users a couple of years earlier; but then neither was I aware that he was out there taking the next logical steps along with his giant ones. In any case, the LINC's CRT was much too small to display such a thing as a "knowledge domain."

p104.¶3: In addition to taking a fresh look at the structure of information, Englebart also reconsidered the way that information was being entered.

134 I wonder if Doug ever realized that detailed cursoring would lead to the awkward, overly-picky selection of individual characters and words that characterize some of today's editing programs. The right 'tool' for pointing is the human finger; it's the screen's angle, location, and quality that are wrong. [For proper control, the size of displayed material can be made to depend on the proximity of the finger to

- ...
- p105.¶4: "In trying to be complete about my array of test devices," he recalled ...
- p106.¶1: ... although it took most people a little longer to learn how to use than the light pen."
- p109.¶1: ... Since this work was critically important to the development of the PC, it deserves a closer look.
- p109.¶2: The crux of the problem lay in the nature of the technology. ...
- p109.¶3: A non-video CRT worked differently, however. ...
- 135 Yeah, learning how to use the light pen is easy, but I never intended it to be a gadget for picking around in displayed text.
- 136 Surely, "... to the *further* development of the PC ..." or something.
- 137 The term 'pixel' dates from the late fifties and early sixties, when researchers were already trying out various image compression schemes to reduce the required number of magnetic cores per pixel, or (equivalently) the amount of information needed per picture transmitted over a communication channel. Some of this work was done on the TX-2 by Larry Roberts.
- 138 You're certainly not describing the Whirlwind/MTC/TX-0&2/LINC CRT technique here. These CRTs were not stroke-drawing but spot-intensifying, a much simpler and more general, though slower, technique in which the computer specifies the coordinates of every pixel to be intensified. Sometimes these coordinates were calculated on the fly, sometimes taken from a pre-calculated list. For character display, a set of "dot matrices" that encoded the alphabet was stored in memory and accessed by a display subroutine that converted a designated character's compact pixel-image representation into x,y coordinates by means of a programmed 'mini-raster' scan modulated by the matrix elements. The PDP-1 and many later DEC machines also used this simple MIT technique. I provided the LINC with a built-in, mini-rastering instruction that handled the conversion and display automatically. [I've attached a "xeroxed" copy of some Polaroid snapshots taken from a LINC CRT; they show examples of the built-in instruction's 4x6 matrix characters as well as a few other higher-resolution characters (which were generated by a richer subroutine).]
- 139 The TX-2 had a big enough memory to hold entire gray-scale photographs in coded form, with brightness and darkness achieved by proportionately repeating pixel-intensifications as required; the CRT display produced images of the near-photographic quality needed by Roberts for his research. [To get pictorial data in, a full-screen raster pattern was first generated on the CRT by computer program, then projected through the original picture's negative onto a photosensitive device whose output was measured and immediately read by the computer, pixel by pixel. We called this early scanner "The Eye." It was a bit shaky, and I believe that Larry subsequently had to find a considerably better scanner to use for data input.]
- 140 By the way, a display list is a list of *coordinate-data*, not instructions, though you certainly might have other lists of display *instructions* as well.

p109.¶4: Because of their technical difficulties, video monitors and calligraphic displays produced different images. ...

141 Wouldn't it be better to say, "Because of their technical *characteristics*...?"

p111.¶2: Englebart's lab was caught up in the spirit of the sixties. ...

142 I think you should note here that Dave Brown had come from Linclon Lab, where he had been in charge of the Advanced Computer Development Group in the days of the TX-0. This would help to clarify what the late Allen Newell would have recognized as an important historical connection. [AHPW page 342 -- and I apologize for so blatantly tooting my own horn in citing his comments here.]

p112.¶2: By the end of 1968, the computer system that Englebart had envisioned more than twenty-five years ago was finally in operation. ...

143 It may surely have been the most advanced, but it was certainly not "the only one that was based on CRTs, video or not."

144 "... anybody who was anybody in the computer community ... visited their lab ..." Sigh.

p113.¶2: The demonstration was a tour de force. ...

145 I wasn't at the conference that year; in fact, I've never seen Doug's stuff, in situ or otherwise. Alan Kay was among those present, though, and according to him the demo was quite a thrilling one. A couple of years ago I heard him describe the event, and his memory was still vivid: "And there sitting on stage was Englebart, *dealing lightning with both hands!*" It may be hard to get Alan to respond to even your most pleasant request for the verifications you ask for here, but surely there must be others, some of Bob Taylor's gang, say, who would be happy to answer your questions properly.

146 Okay, Stan, what's next?