A. Academic and Wartime Origins of the Founders

Academic computer science resulted when academics went to war. The war put them into practical jobs, with practical problems to solve, and at one level, they became as practical as any engineer. However, this was a matter of consciously choosing to be practical when the situation called for it. This was quite different from the engineer's unconscious practicality. When the academics eventually returned to their campuses, they took with them this capacity for controlled practicality.

In the 1930's, most of the future computer scientists were originally academics, rather than corporate engineers. Even apart from their qualifications, their background was disproportionately academic. They were not all "university brats," of course, but their fathers tended to be in cognate occupations (schoolteacher, minister, etc.). They tended to have degrees in liberal arts, instead of engineering. Some examples were Arthur Burks, George Forsythe, and Donald Knuth (at a later date). In the period before the war, academic science was much less well-funded than it would later become, and this tended to screen out the highly entrepreneurial technology manager.

Most of the people who got involved in computers at an early date, and stayed involved, were not destined to become academic computer scientists. They were destined to become corporate computer engineers, instead.

The future corporate computer engineers tended to have fathers who were engineers, or lawyers, or businessmen. Gene M. Amdahl grew up on a farm (BAB OH 107, P. 3-6). Robert Emmett McDonald's father was a mining engineer (BAB OH45, p. 4). William W. Butler's father was a lawyer in a a small town (BAB OH 92, p. 3). H. Dick Clover's father was a South Dakota farmer, until he failed in the depression, and then he went to Council Bluffs, Iowa, and worked for the streetcar system (BAB OH 113, p. 3).

The future corporate computer engineers attended college only so long as was necessary to get a suitable first job, and expected thereafter to develop their skills on the job.

The most usual procedure was for an aspiring engineer to get an undergraduate degree, and then find an employer which would offer further training. William W. Butler had gotten his undergraduate engineering degree at Iowa State. He belonged to a fraternity, and did not have any kind of mentoring relationship with the faculty, did not do research, or anything like that (BAB OH 92, p. 6-10). He spent the war working as a field engineer for RCA, having to do with radar, and practically attached to the navy, much of the time at sea and in the south pacific (ibid p. 12-18). After the war, he decided to get a master's degree because he had become typed as a maintenance engineer. He chose CalTech more or less by chance, and went through a course which essentially represented the difference between an early twentieth-century undergraduate engineering degree and a late twentieth century undergraduate engineering degree. A classmate got him a job at Douglas Aircraft (ibid p.18-22). Butler eventually got a job at Engineering Research Associates because his wife know William Norris's wife (ibid p. 29). College was a method of getting a job, and not necessarily

the best method.

Sometimes college enrollment was not even for academic purposes. Dean Babcock, a wartime graduate of the University of Minnesota in Electrical Engineering, had missed a few courses as a result of the accelerated program. When he was demobilized from the navy in April 1946, he went back to the University the next day, nominally to finish up these loose ends. His actual purpose was to plug into the old-boy-network, hanging out on the engineering school steps. Within a month or so, the old-boy-net passed along the news that Engineering Research Associates was hiring. He went there, and was hired (BAB OH 120, p. 3-7). Nowadays, universities have professional placement bureaus for the same purpose.

Then there were the career changers. Before the war, Robert Emmett McDonald had been in the process of becoming an electric utility company executive. He had taken both electrical engineering and business administration in college, and had taken additional graduate work in business while employed by Commonwealth Edison. In 1943, the war intervened, and the navy made him into a radar officer. After the war, he would up working for airlines in connection with the new electronics which were suddenly filling airplanes. In 1953, his employer, Braniff Airlines, consolidated its operations to Texas. McDonald did not like the idea of going to Texas, and looked for a new job. He found one at Engineering Research Associates (BAB OH45, p. 6-12). Except for the war, McDonald's career was a normal example of upgrading skills on the job.

It was not always necessary to have any kind of academic credential to get a job in the emerging computer industry. It was sometimes just a matter of being in the right place at the right time. H. Dick Clover completed high school, graduating in 1939. He took a "commercial course," stressing things like accounting. His hobbies were golf and fishing, ie. he was _not_ a radio ham. Clover got a job with the Social Security (Bureau of Old Age and Survivor's Insurance), marking time until the war which he imminently expected. This involved working with punched card tabulators. After Pearl Harbor, when Clover was about to join the navy, his supervisor intervened to find him appropriate work. This turned out to be Naval Intelligence, and specifically, cryptanalysis, the American equivalent of Bletchley Park. When the war ended, he continued the same work as a civilian employee of the Navy. Engineering Research Associates was effectively a spin-off of the naval operation, and Clover went with it, as a matter of course, and in the company of large numbers of his colleagues (BAB OH 92, pp. 4-21, 25-27).

Sometimes a corporate engineer would get a Ph.D., due to circumstances. After the ENIAC team split up, the leader of the Princeton (Institute for Advanced Study) faction, John Von Neumann, had to get replacements for Presper Eckert in order to build the IAS computer. Eckert, the ENIAC team's circuit designer, had gone with the other side. (BAB OH 37, p. 13) Among other people, Von Neumann recruited Willis Ware, who had spent the war working on radar, or more precisely, "Identification-Friend- or- Foe" (IFF) (ibid, p. 6). As Ware put it:

> In all honesty... I went to Princeton because it was an almost-free Ph.D. The deal was, we could work for Johnny von Neumann during the day and get paid as an engineer, and take whatever time off that we needed to go off to campus and work the degree. But I was the only one who did that, as it turned out. It was a deal you couldn't say "no" to. (ibid, p. 7)

On closer examination, however, not all that glittered turned out to be gold. Ware goes on:

> ...it became clear that we were sort of fifth class citizens around there... they stuck us in the second basement. And when you go to the social events... you would go to the social gatherings, and they's say "Well, I'm in mathematics" or "I'm in physics," or "I'm in --" -- "What are you in?" And then when one answered, it became clear that you were a social outcast... I think most of us thought at the time that it was professional snobbery (ibid, p. 10-11).

When he had his degree, he found an industrial job, and left, without waiting to see the IAS machine to completion (ibid p. 39-42).

Gene Amdahl presents an even more interesting case. In 1949-50, he was a graduate student in physics at Wisconsin, and in an effort to find a better way to do his calculations, he formulated some ideas about automatic computing. His academic superiors responded by changing his thesis topic and sending him off to Aberdeen for the summer to learn more about computers. He returned with fully developed ideas about better computers, and built a small computer (within Wisconsin's modest means, sans government support, using war-surplus tubes). IBM came to hear of this, and promptly recruited Amdahl, simply on his potential (BAB OH 107, pp. 27-40).

What runs through these cases is the extremely utilitarian attitude that engineers took towards universities. They asked about pay, about skill upgrades, and about the chance to do interesting and original work, in no particular order. The answers tended to come out in favor of the giant corporation doing government-contract work, or acting as a public utility.

Academic computer science was founded by men who really wanted to be in universities, whose values were profoundly academic. That was why they returned to universities in the face of all kinds of practical reasons not to. These kinds of values were commonly inculcated at an early age, to the point that in later life, they were simply not open to discussion.

Arthur Burks, the first Chairman of the Computer Science Department at Michigan, was born in 1915, in Duluth, Minnesota. His father was a city school teacher (first in Duluth, then in Chicago). His mother was a substitute teacher, probably about the most substantial employment that a married woman could have maintained at the time. Burks' father taught mathematics, but was interested in history. Both of Arthur Burks' brothers became historians (one at Wayne State, the other at Hunter College). In

a very real sense, one can say that Burks was "to the schoolhouse born." Arthur Burks attended DePauw as an undergraduate, from 1932-36. He majored in mathematics, and minored in physics, but he also took excursions into philosophy, and became certified as a school teacher. Graduating into the depths of the depression, he could not get a teaching job, unsurprisingly. He therefore went to the University of Michigan for a masters degree in philosophy. In choosing to go to Michigan, he passed up an offer of a fellowship in statistics at Iowa State, even though it was the only one he had received. He spent a year teaching high school after getting his masters, and then returned to Michigan for a Ph.D. in philosophy, doing his dissertation on Charles S. Peirce (BAB OH 75, pp. 3-6, 8).

George Forsythe, the founder of the Computer Science department at Stanford University, had a lifelong connection with academia. As his wife put it: "George's father was a doctor; he ran a health service at the University of Michigan... George had grown up in Ann Arbor." (BAB OH 17, pp. 3, 9). In 1941, He got his Ph.D. in mathematics at Brown University, where the emphasis was on pure mathematics rather than applied, (John Herriot, BAB OH 21, p. 3).

Marvin Stein, the founder of the Computer Science department at Minnesota, was a freshman at UCLA in 1941, intending to study philosophy of science. However, he was becoming aware that one could not study philosophy of science very well without knowing science, and that, to understand science, one needed to know mathematics. So he switched to mathematics, the aptly named "queen of the sciences," in conscious or unconscious imitation of his hero, Bertrand Russell (BAB OH 90, p. 12).

The founders set the pattern for later recruits-- they recruited people rather like themselves. An example would be Donald Knuth, whose father was a Lutheran church organist and a schoolteacher (BAB OH 332).

Academic computer science was founded by people who were profoundly academic. Their values, their ways of life, their work habits, their recreations, were all geared to the university, and this academic orientation was essentially impervious to any subsequent experiences they might have. They might never have gotten involved in computing if it had not been for the Second World War.

The Second World War, by actual or de-facto conscription, drew vast number of academics into much more practical concerns. The emergent computer scientists were not particularly unique in this regard; they were not even very exotic compared to the anthropologists who became OSS officers.

However, vast numbers of academics became involved in engineering, of which the engineering of computers and software was only one instance. They became accustomed to the idea of spending comparatively vast sums of money, and building elaborate apparatus. However, if they changed their occupation, they preserved much of their academic orientation (see Andrew Hodges, for Alan Turing at Bletchley Park).

It was quite possible to penetrate into the very depths of engineering without losing one's liberal arts orientation. Arthur Burks was a mathematician and physicist before he was a

philosopher. When he got his Ph.D. in Philosophy, in 1941, no employment was in immediate sight, and the Second World War was obviously about to begin. So, reverting back to his undergraduate credentials, he applied to a summer training program at the Moore School of the University of Pennsylvania. As he explained afterwards:

> "The war, of course, was raging in Europe and so I thought that I would be better able to contribute to the war effort by getting this training in engineering. The idea of that course was that it would take a person who had a bachelor's degree in physics and math and make that person into somewhat of a engineer." (BAB OH 75, p.8)

This course, and additional night schools during the war years, made him into an electrical engineer. In the fall, they had him teaching quiz sections of similar courses (ibid, p. 11)

In December 1941, he moved into his first actual engineering project. The navy was developing a coil which could be mounted in an airplane to trigger German magnetic mines. Burks and John Mauchley, were assigned to do a series of mathematical calculations of the coil's power. When that project finished up, he worked on radio antennas (ibid, p. 12,15-16).

In 1943, he was assigned to work on ENIAC. Now, he worked, in effect, as one of J. Presper Eckert's apprentices, being trained on the job as an electronic circuit designer (ibid, p. 27-34). In the process, he became one of the few computer experts in circulation.

During his extended residence in Philadelphia, Arthur Burks had become acquainted with the University of Pennsylvania philosopher Glen Morrow, and they talked about Plato at lunch, off and on. Morrow was a specialist in Plato [verify this], apparently in the economic dimensions. (OH 75, p. 66).

At the end of the war Aberdeen Proving Ground offered Burks a job, and the Moore school matched the offer on the spot. When Burks expressed a desired to get back into philosophy, Dean Pender of the Moore school negotiated with Glen Morrow, and Morrow attempted to set up a joint appointment, This came to nothing, however. Even though Morrow was the dean of the liberal arts college, the rest of the Philosophy department would not agree. Burks then did an aggressive job search, that is, sending out query letters to strangers in the modern fashion, instead of relying on friendly connections, as was the norm then. He sent out fifty queries, covering practically all possibilities. He got job offers at Swarthmore (where he already had a part-time "visitor" teaching job) and at Michigan (where he had gotten his Ph.D.). He accepted the offer at Michigan, beginning in fall, 1946 (ibid, p.66-67, 75; "A Philosophical Computer Man," Datamation, Dec. 1977, p. 32).

The computer people did not take this as the last word, however. Von Neumann and Goldstine got him an offer of a permanent position at Princeton, however, this was not a joint appointment. Given the politics that was obviously impossible. Eckert and Mauchley also made an offer of a job in their new

company. The emerging computer establishment simply did not have any philosophy positions in its gift, and even though it was quite willing to allow Burks time to work on philosophy, the computer establishment could not come up with philosophical colleagues. However, the computer establishment did the next best thing. In 1948, Burks was offered a consulting contract with Burroughs, on a one-day-a-week basis, as well as summers. Burroughs was in Detroit then, so Burks could commute from Ann Arbor by bus (ibid, pp. 89-90, 102-104).

The end of the war left Burks back where he had started, in the philosophy department at Michigan. However, he now had engineering skills and industrial connections. Admittedly, Burks was a somewhat exceptional case, but similar things were commonly happening to mathematicians.

Mathematicians commonly went into industrial calculation of one kind or another. George Forsythe did meteorology in the military, and Alexandra Forsythe worked at Douglass Aircraft doing aerodynamic calculation (BAB OH 17, p. 4-8). Their classmate and eventual colleague, John Herriot, was at Ames Aeronautical Laboratory, as he put it, "doing sort of applied research in theoretical aerodynamics" (BAB OH 21, p. 3-4). The people doing this kind of work might have a business tabulator machine if they were lucky, and a bunch of ordinary clerks operating adding machines if they were not. In either case, the mathematical calculations had to be translated into simply arithmetic which the people or the machines could handle. This necessary translation bordered on being computer programming.

When the war ended, George Forsythe had offers from Brown University, where he had gotten his Ph.D., and Boeing. A major reason for choosing Boeing was that his wife had been the victim of sex-discrimination on the part of Brown’s dean, and was unhappy about the idea of going back to Brown. So they went to Seattle instead. It took about a year or two for Forsythe to become homesick for academia. In 1947, he moved to UCLA, where he had done some of his wartime work (BAB OH 17, p. 9).

Once he was at UCLA, Forsythe became involved with the SWAC computer which the Bureau of Standards was building on the UCLA campus. He remained there for ten years, until the Bureau of Standards got itself into political difficulties and had to retrench. At that point, in 1957, he moved on to Stanford (ibid, pp. 10-14).

If Forsythe was not back where he had started, he was back where he had been in 1941, on his first teaching job. The difference was that he was now an applied mathematician instead of a pure mathematician. He joined his old friend John Herriot, who had, since 1952, been dusting off his wartime computing skills (BAB OH 21, p. 4-6).

Burks, and Forsythe, and Herriot had all moved in the same direction, but they were all about the same age-- just old enough to have Ph.D.’s on the eve of war. The effect on a younger man was more drastic.

Marvin Stein, the UCLA freshman, was in the army at the end of 1942. He was assigned to the signal corps, and the signal corps was using tabulators for storekeeping. Stein was sent to the local IBM office to be trained as a keypunch operator (really, a

kind of typist). He talked his way into a more advanced course which was being offered, and had become the instructor's ad hoc teaching assistant within the week. When Stein got back to the army, his colonel, a reserve officer, allowed him to run the installation on the basis of sheer ability, even though he was a mere private-first-class. The NCO's had apparently not done very well in the school they had been sent to (Stein does not say what kinds of NCO's they were) (BAB OH 90, p. 13).

At the end of the war, Stein went back to UCLA, completed his undergraduate degree in 1947, and entered graduate school with a teaching assistantship. When the National Bureau of Standards SWAC center started up, Stein was given a fellowship associated with it, and became involved in numerical analysis, or applied mathematics. After he had gotten his Ph.D., the university, unable to pay him a living wage, found him a job at Convair. Convair bought a powerful new computer from Engineering Research Associates (Univac), and the machine's teething troubles brought Stein into contact with the ERA engineering staff, based in Minneapolis. They gave and/or got him consulting work. In 1955, Univac decided to make the University of Minnesota a present of a block of computer time, 400 hours (annually?), and introduced Stein as a suitable person to take charge of this allocation, run programming courses, etc. (ibid, p. 13-16).

Stein had been looking for an academic position while he was at Convair. As he later explained it:

> It was probably psychological. In those days, I believe, the professors used to brainwash the students. They said the good students will become the professors and the ordinary students will be out there working in industry. Consequently, when I found myself working in industry, I had in my mind the stigma of being an ordinary student. When an opportunity came for an academic position, I said, this is what I was educated for and I can always return to industry; so I will try it to see what I can make of it. (ibid, p. 16)

As we have seen, archetypal corporate engineers were impervious to this kind of brainwashing, if that is what it was. However, archetypal corporate engineers did not usually take Bertrand Russell as their hero in their freshman year of college. Academics, on the other hand, might very well do so.

The emergent academic computer scientists had approached the war effort out of a sensibility distinctly different than corporate engineers. They had learned what skills they needed to function efficiently. But, they did not become corporate engineers in the spirit. When the time came, they reverted to their original selves, while retaining a new potentiality.