by Fred Hapgood

They favored rock-climbing boots, kept crazy hours, and spoke a special language of their own (*kludge, glitch*)

THE COMPUTER HACKERS

Their strange projects showed computers in a new light: not as a threat, but as sophisticated playpens

In the semi-darkened room the forms sparkled across the display tube. One had a sense of looking at a swarm of intergalactic insects glittering in deep space, or of a cloud composed of thousands of brilliant points that combined and recombined with themselves, furiously forming patterns and breaking them down. Bill Gosper, bone-thin, intense, his hair boiling from his head, punched a code into the computer. A stream of light-darts flew across the screen, pierced the amorphous border of the cloud, and threw it into a churning, blooming confusion.

"Now it's casting about for some means of dealing with this invasion," Gosper said. Gradually the cloud began to extend a pseudopod down the stream of darts, feeding and recoiling from them at the same time, but slowly creeping closer and closer to the small forms at the corners of the screen that were generating the darts. Then, as we watched, the cloud swarmed over the generators and destroyed them.

"Other forms build dart-eaters and destroy the stream," Gosper said. "A third kind generates its own darts and shoots them at the generators."

Instant evolution. What Gosper had been showing me was a phantasmagoria called The Life Game, a bizarre computer entertainment. Invented nearly three years ago, it has since swept the fraternity of computer hackers.

The Life Game is difficult to explain in words. It is a part, if only a small one, of the culture of the McLuhan Age, instantly comprehensible to the eyes, but more of an enigma to those attempting to grasp it through print. It works by dividing a computer screen into some number of two-state dots or cells (i.e., they can be either on or off). Each cell has eight neighbors—two each along the horizontal, vertical, and diagonal axes. A cell flips on if it has three, and only three, neighbors that are also on. Otherwise it stays off. Once on, it stays on if, and only if, either two or three of its neighbors are also on. More or less than that, and it returns to the void state.

Those are the only rules. Simple as they are, in practice they generate a universe of forms, that interact in so many different ways that the game is limitless. Eventually Life may arrive in the penny arcades, or even in the home via cable TV, and its narcotic-like fascination will be accessible to all.

But for the present, the game is the plaything and triumph of the hackers, a Pythagorean subculture that has grown up around the increasingly powerful computers built over the last twenty years. I have been hearing about the hackers for some time without knowing what to make of them. Some thought them the first true Cyborgs: men joining with machines to create one imagination. Others said they were bright technicians, no different from their aerospace colleagues, simply luckier in their career bets. Whatever the case, they are something of a legend by now, both in cybernetic circles and in the counterculture.

For one thing—entirely aside from their technical achievements, or their impact within the industry—the hackers are credited with having helped move the culture at least a small distance away from the perspective of computer-as-lord-and-master, and towards thinking of it as a sophisticated playpen.

The word "hacker" may seem slightly self-deprecatory, as though those who identified themselves as such were putting their interests down, confessing their insignificance. But that is only protective camouflage. Hacking implies the antithesis of the curriculum-bound student, of the industrial engineer with no time for his own projects. It suggests that what I do is my own business, that it is of no interest to anyone else, and does not have to be justified or evaluated; that what I do is between me and my imagination.

It is possible that the first computer hacker was the late Howard Hathaway Aiken, former professor of applied mathematics at Harvard. Professor Aiken, who died last March, was more responsible than any other individual for the invention of the computer. (At least in this century; Professor Aiken would have insisted on sharing credit with Charles Babbage, who worked out a great deal of theory in the nineteenth century, in an effort to build a steam-driven "analytical engine.") In the early forties, Aiken contacted the late Thomas J. Watson of IBM, and convinced Watson that his ideas for an Automatic Sequence Controlled Calculator were practical. Watson gave

Computer hacker Michael Speciner stares at what seems to be an umbrella drawn by Rowland Emett. Actually, in The Life Game, it is two glider guns (far end of umbrella) spewing spots (or "gliders") at each other. The spots have collided in the center, and are bouncing back. What happens next is anybody's guess. It took two weeks to get this far.


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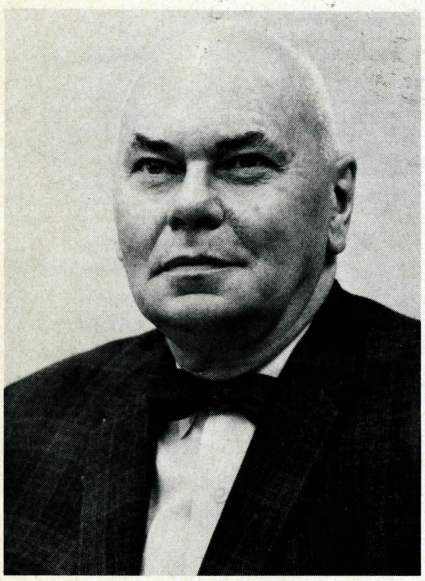

The late Professor Howard Aiken may have been the first computer hacker. He built the first truly programmable computer in Harvard's Lyman Laboratory, while fighting a running battle with his patron, Thomas J. Watson of IBM.

"We had this phrase, the Real Thing, capital R, capital T, which was just the right solution to a problem..."

Aiken a million dollars to work with, and during World War II, Professor (then Commander) Aiken built the Mark I, the first truly programmable computer, in Harvard's Lyman Physics Laboratory.

The collaboration between Watson and Aiken was not a happy one. Aiken had a profound respect for the ideas that went into the Mark I, and no respect at all for Watson, his company, or the purposes to which the new invention might be devoted. This distrust flared on several occasions, but one of the most revealing was a battle that Watson and Aiken had when the Mark I was nearing completion. Watson, who planned to donate the machine to Harvard, wanted it encased in shaped stainless steel for the dedication. To the IBM president, it was his company's newest and most prestigious product, and he wanted it to have a futuristic feel. Aiken wanted no case at all. The workings were the Mark I's true glory, he felt, and they should be exposed. Watson won that round, as he won all the subsequent disagreements: it was his million dollars, and Harvard President James B. Conant appreciated what a good relationship with IBM might yield over the decades. But the split between the two continued, with different actors and different issues, during computer developments for the next thirty years, with the hackers carrying on Aiken's viewpoints and IBM carrying on Watson's.

All through the fifties the computer gathered prestige and glamour. IBM split *54 times*! Every cocktail party and faculty lounge in the land rang with deepthink prophetic visions. Robot slaves ministering to our every indulgence. The masses succumbing to the disease of leisure! A workless world in which we would while away the hours with poetry, madrigals, and the weaving of hammocks. Millions of unemployed proles seething with Bolshevik discontent! We would all be plugged into a Superbrain and be as bright as McNamara. Group think! The end of individuality! Coup d'état by the Superbrains! The human race kept as garden pets! Grants were swung, papers writ—*The computer: boon or bane?*

In point of fact, the early machines were so crude that they were confined to a very narrow range of data-shuffling and computation operations. Byron's daughter, in commenting on Babbage's Analytical Engine, had grasped the truth perfectly. "[It] has no pretentions to originate anything," Ada Augusta, Countess Lovelace, wrote. "It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths. Its province is to assist us in making available what we are already acquainted with." But the mass media never managed to learn that. The machine was called up to judge everything from dating to education to stock portfolios. "Harvard computer finds English language fuzzy," reads the title of an article on early efforts to work out a speech-recognition program.

While there are obvious emotional satisfactions to be derived from submission fantasies like this, one must recognize that the technology struck, by chance, at our most vulnerable point. The new machines were fast, they never hemmed and hawed, and they seldom made mistakes. At least, as long as I.Q. tests have been with us, those have been the working features by which we detect "intelligence." The machines were fast, decisive, and infallible only on the most trivial problems; but as wisdom and breadth of interests had never been, to use the technical jargon, "ground in" to our definitions of "brightness," we were mightily tempted to worship the computer out of all proportion to the actual capabilities of the technology.

The industry set up to exploit the computer reinforced and reflected this attitude. A user would punch out cards containing the information he wanted to have shuffled and the directions for shuffling it. He would then turn them over to a computer attendant who would schedule them for a run. Usually the machine would be stopped by some error in the punched cards, and spit them back, whereupon the user would correct the error and return the cards to the operator to start the cycle turning over again. Contact with the machine was kept to a minimum.

From a user's point of view there was a tremendous amount of wasted time in this operation. A programmer might spend a day waiting for a machine to find a mistake that would have taken him a minute to correct. But to the administrators, the machines were being efficient: they were computing something or other 24 hours a day. It was the *humans* who were inefficient—they couldn't think straight.

The very inefficiency of the operation, or the stupidity of the programmers, whichever you prefer, meant a tremendous crush on the facilities, as the machine detected mistake after mistake in program after program.That meant, in turn, that it was hard to find the computer time necessary to design a monitor-

ing program that would test proposed programs as they were put together. Even when the time was available, the stop-and-go, hurry-up-and-wait mode of operation made work intensely frustrating.

That was the historical situation about the time John Kennedy was elected. However, as Hegel observed, within each historical thesis lie the seeds of its opposite. And the seeds of this antithesis lay, of all unlikely and unimaginable places, in the Model Railroad Club of the Massachusetts Institute of Technology.

To most people, MIT probably represents dedicated researchers like the Excedrin man on TV, who probe the wonders of the atom, the mystery of life, etc., etc. To others, most of them living at the other end of Massachusetts Avenue, MIT is a mighty army of wonks, all in rock-climbing boots and flannel lumberjack shirts, who sleep on lab benches using their slide rules for pillows.

The truth is that MIT is the game capital of the world. One example. When I was in college, a game called Diplomacy was invented. It was meant to recapitulate as nearly as possible the intrigues and double-crosses of Europe in 1905. My friends and I played the game often, and conceived several minor improvements; we thought we were pretty well in command of the thing. Then we heard what the kids at MIT had done with the game. They had blown it up to world size and fantastically expanded the range and variety of rules. Whole dormitories took over nations that, in the original game, had been played by one person. Secret agents, counterspies, codes, and code-breakers! Manipulations of the national credit! International monetary crises! What are the military implications when a country loses access to natural rubber? Titanium? Molybdenum? On and on...

The Model Railroad Club was one focus of this activity. It gathered to it bright young men whose imaginations called out for systems more and more complex and elaborate. I dropped by the club recently and asked about some ongoing projects. "Well," I was told, "take that yard over there. There are 35 separate switches in that yard, and naturally we have passenger and freight-handling capacities. Now, what we would like to do is have both capacities working at maximum, while at the same time routing trains into and out of the yard, which means every piece of track will have to do several different things. Also, we want to be able to control the whole operation from any one or any two of the five control blocks, while locking people out who don't belong in there, and retrieving and displaying all the information people would like to have about what's happening. Over here we're going to install an annex routing capacity. That means that a computer will hunt for the optimum track schedule for any one load, depending on priority of cargo and the general line schedule. Once it finds it, it will check to see if there are any problems with that network of tracks. If there are, it will search for the second optimum, and so on."

Now it happened that, fourteen years ago, Lincoln Labs wrapped up a project involving a research computer, and gave the computer to MIT. At that time, MIT was doing no computer research of its own. The attitude of the university was that "computer science" was about as interesting as checkers; the administration could understand someone spending spare time on the machines, but departmental money was better spent on the wonders of the atom, the mystery of life, or whatever. The gift computer drifted through various departments, and ended up in a room with a Coke machine and a blackboard, not far away from the busy fantasts of the Model Railroad Club.

When the MRC members (and a small group from the MIT radio station) discovered this new toy, they dropped everything else. "It was a great new extension of our minds," Bill Gosper told me. "People were dropping out of school on all sides. We ran day-night, day-night. We had this phrase, the Real Thing, capital R, capital T, which was just the right solution to a problem. We would divide up logic and aesthetics on a blackboard and argue about which was more important..."

I asked him what that first generation of hackers did. "We wanted to get control over the machine," Bill said. "To get it to do things. The problem was that the quality of machine language and soft-

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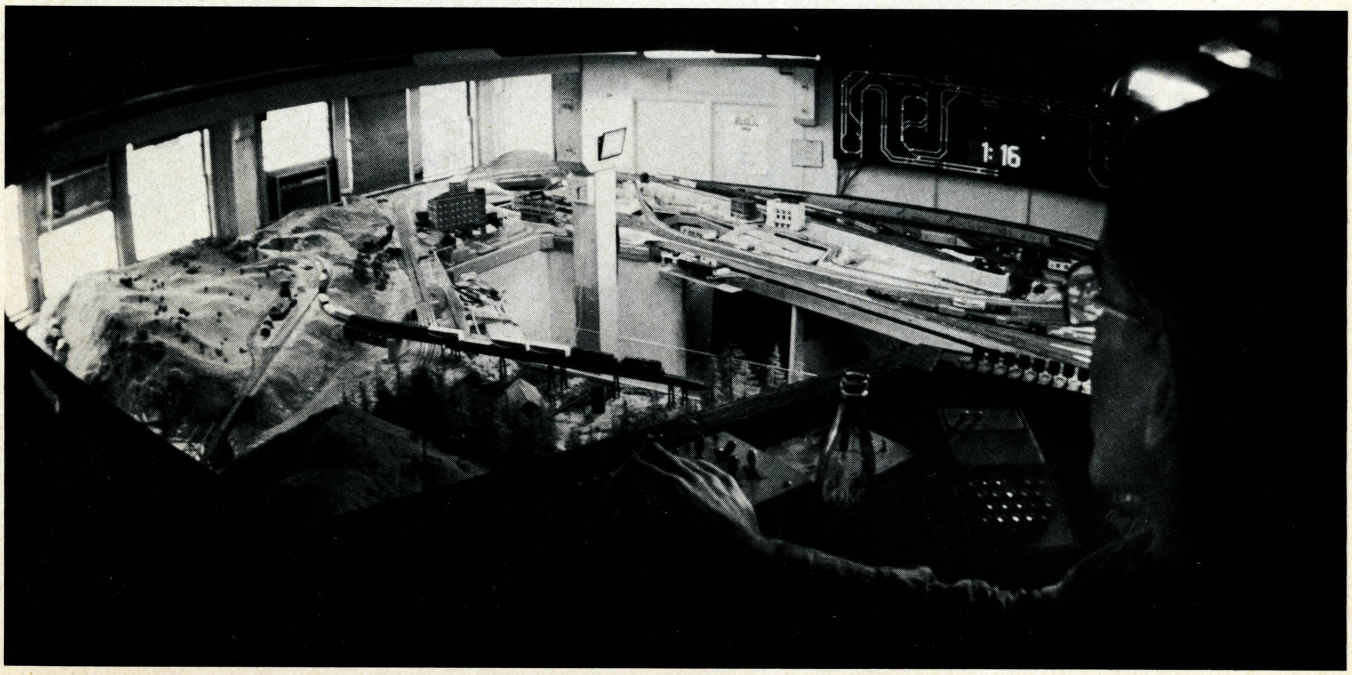
The MIT Model Railroad Club, where hackers make serious business of playing with toy trains.



The computer hackers

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ware—programs—was so low that it was almost humanly impossible to do anything with it. So only weird little guys interested in solving problems got anywhere...

From the beginning, then, there was a powerful counterculture aura around the MRC hackers. "It was a little like the status a guy gets in high school if he drops out and becomes a mechanic," Gosper offered, reaching for another level of explanation. The hackers, he said, were free to do what came naturally to a free spirit. And what was that?

"Take timing errors," said Gosper. "Once you have encountered and tracked down a timing error, you realize that all timing errors are trivial, and if your program doesn't contain any it's not very interesting. But timing errors, oh boy!"

Gosper was getting increasingly enthusiastic and I was getting increasingly glum. Tailing after a scientist discussing what he loves most about his field is like being blind in a tour of an art museum: an enthusiastic guide just makes it worse. "Do you realize that there are hundreds of errors in these programs here that will only happen once every thousand years? There's no way of catching them. And every good program has them. They're sending guys to the moon with those things and everything..." and he was off, bounding happily through the mysteries of a synchronous memory circuit while I waited on the ground for him to touch down again.

In any case, this much was made clear to me. Over two or three years of working on their own intensely individualistic projects of quarrying after bugs and the Real Thing, the hackers began to make one breakthrough after another. They devised a time-sharing program so that many people could use a machine at once and not be the slave of schedules. They worked out a number of interactive debugging programs which saved the programmer's time. They invented the famous Spacewar program, which has recently begun showing up in pinball arcades and lunchrooms (that was not a breakthrough; simply good fun).

But the key thing the hackers did was to make the computer an instrument of their culture. They stepped neatly in between the gap left by the MIT administration, on the one side, which felt that computers were simply not very interesting, and the IBM executives on the other, who, with their THINK signs and Jehovah's Witness suits, felt that their machine ought to be at the center of the world. Both of the hackers' achievements are symbols of the other. Their technical advances were in controlling the machine, making it more flexible, adapting it to more direct use. "We wanted to take the mystery away," another hacker remarked to me. And they used the machine as a vehicle for their imaginations, as a sculptor uses an especially tricky medium. It was serious—again, the parallel with an art form works here—but it was intensely personal.

Despite their reputation as somewhat eccentric, the hackers began to acquire a certain professional renown. Programmers who had spent their professional life working on the narrow kinds of manipulations that were the stuff of early computer problems—actuarial tables, say, or payrolls, or even more complicated scientific problems—simply could not match the rich experience the hackers had acquired, working over their wide range of bizarre projects.

Some of the hackers went to work for a young computer company called Digital Equipment, bringing with them new ideas and a profound contempt for IBM. Digital Equipment became the company identified with the "mini-computer" concept: a line of smaller machines that allowed medium-sized businesses to own and operate their own computers. It stepped neatly into a hole left by IBM's fascination with size and computing power. Last year (not entirely through the efforts of the hackers), Digital Equipment grossed nearly 200 megabucks.

The largest number of hackers today are spread out across the country, working on the really hairy edge of computer research, artificial intelligence (speech recognition, machine learning, induction, analogical thinking, and so on). They have carried their counterculture style with them. Even IBM—or so it is rumored—has given up trying to get their research programmers to stop "playing" and start concentrating on serious work (THINKing).

The general public will come into its closest contact with the hacker spirit through some devices now edging towards marketability. One is the Dynabook, a portable computer with a display console that will be able to draw or paint, work with graphics, play spacewar, and have a dozen other capabilities, all of them working to extend the powers of the imagination.

Perhaps the clearest example of the hacker heritage is a new educational device called Logo. It is nothing more than a simple computer attached to a wheeled device carrying a pen. A child can send orders to the device through the computer. One way of stating the value of the machine is to say that it provides a rich experience in control. Earlier computer teaching-machines, expressing the computer-as-authority mystique of the sixties, tried to program the child; in Logo, the relationship is reversed. In the earlier machines, if the child made a mistake he was made to feel it—the machine *told* him he was wrong. With Logo, he sees something is wrong (usually blaming the machine, incidentally), figures out what to do, and does it. There is no authority, either man or machine, standing over him to catch him in an error. The Directors of the Artificial Intelligence Lab at MIT say this device will revolutionize education, and while that has become a cliché by now, no one learns faster to be more sparing of words like revolution than a director of an A.I. lab.

The days of the hacker counterculture are virtually over. They are too successful now, too respected. Every other large college has course upon course on computer science, recapitulating the pioneer work the Model Railroad Club members did ten years ago. One still sees certain ethnically distinct signs: a special way of dressing, running heavily to rock-climbing boots and flannel, shaving at two-week intervals, crazy hours, words ("kludge," "glitch") that evoke the language of boys' boarding schools, and a passionate aversion to smoking.

And The Life Game. "You never know what's going to happen," Gosper said, as the forms wheeled on the screen, sparkling against the black background. "It's determinate but completely unpredictable. Nothing scales. Look! Now you'd think that form would escape, wouldn't you? But, aha! An infection is going to spread right up the tail and eat it up!"

For two hours I crouched over the console as stunned as a deer caught up by a pair of headlights. I was fascinated, but I knew that ultimately I would lose it or it would lose me. I asked Bill to explain why it fascinated him so.

"God," he said. "It's like being a whole new scientist in a whole new world!"