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COMPUTER KIDS

TED HALL DROPS ANCHOR

FICTION/EVENTS/MPR'S PROGRAM GUIDE FOR SEPTEMBER

GROWING UP WITH COMPUTERS:

THE HARDWARE GENERATION

YOU MAY HAVE TINKERED WITH THE CARBURETOR OF A '56 CHEVY WHEN YOU WERE A KID. CARS, AFTER ALL, EMBODIED ADOLESCENT NOTIONS OF SPEED AND POWER. A NEW GENERATION, THOUGH, IS COMING INTO ITS OWN, AND COMPUTERS HAVE CAPTURED ITS AFFECTIONS. HERE'S WHY.

Photos and Text by Robert P. Kearney

I. POWER

The young are engrossed with power: of muscles, cars, stereos, words, themselves. They have to test their limits and everyone else's. Adolescence is the time to start a run at the world, and in doing so discover one's competence. With so much testing and experimentation, it's a confusing time. False leads abound; results aren't reproduced. Absolutes—any absolutes—become irresistable. Things matter or they don't; they're either right or wrong; the night is on or off; it's love or it isn't.

Little wonder that the computer should tantalize them. It challenges: despite its pervasiveness, the limits of its applications have yet to be reached. It cries to be used and that challenges the programmer and designer, tests his or her competence. At the same time there is a special elegance about the computer: everything is reduced to a one or a zero in its eyes. The magnetic charge is there or it isn't. It's either yes or no. Absolutely.

The appeal is not universal, and most of those who are drawn to the machine are interested only in the software, the instructions that tell a computer what to do: to run, to jump, to fetch data from one place and put it someplace else, to add, to repeat, to list, to print. A few young people are intrigued by the hardwafe, the machinery.

John Depew sprays copper board with a photo-sensitive material then lays an image over the board and exposes it to a sunlamp. "Then I develop the boards" in a solution "that removes the film on the copper that's been exposed." Then he etches the board, which removes the exposed copper, and "you get the final product."

This article is about six young men who know both the hardware and the software:

•Stephen Edwards is 11 and lives in south Minneapolis.
•John Depew is 16 and lives in northeast Minneapolis.
•Jerry Farm is 18 and lives in White Bear Lake.
•Tom Nurkkala is 20 and lives in Bloomington.
•Craig Carlson is 21 and lives in Fridley.
•Wayne Johnson is 23 and lives in Brooklyn Park.

To say that they are hobbyists is insufficient. Most of them make a living on the computer, and the others will soon. To say that they work with computers understates the case. They may get paid for their work during certain hours of the day, but there are other machines waiting for them when they get home from work or school. In part or in whole, there are computers and circuit boards in the garage, the basement, the bedroom, the den.

They tinker. They're the guys who found out about cars by tearing off the carburetor on dad's Country Squire. Except that when they pull off the plastic shield on their home computer, there aren't any moving parts, you can't *see* how it works. They can only reckon its design, the organization. Or they build their own machines out of wire and micro-chips and printed circuits. As often as not, they build a thing, test it, then tear it down. It worked—and that was enough— or it didn't.

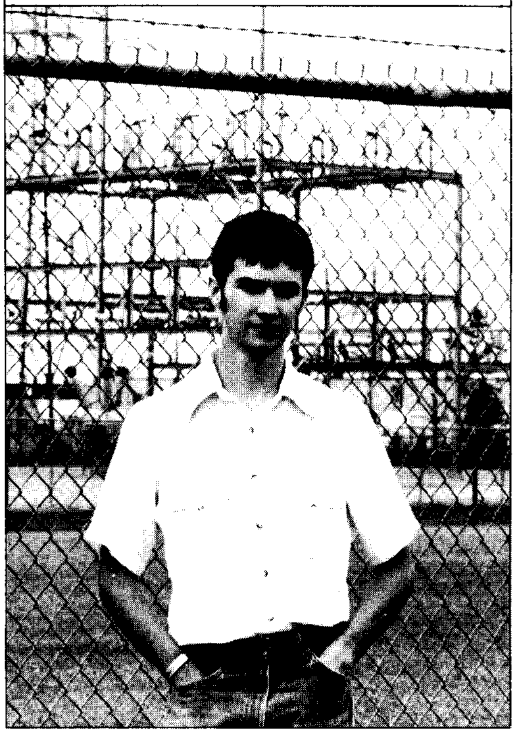
II. INFORMATION & INSTRUCTION

To work with the hardware, to be a computer mechanic, demands special abilities; these lie somewhere between knowing how to change base metals into gold and being able to pat your stomach while you rub your head. You must be both initiated and dexterous.

Obviously one starts somewhere. Jerry Farm was driven by a sort of pure curiosity, though some might see it as making big junk out of little junk. "I started buying these micro-chips. They had data on the back about what each pin did. I tried hooking them up and seeing if they worked. I made a few simple, useless things to get familiar with the stuff." Later he made a meter to measure the power of the signal his stereo was putting into the speakers. "I watched it a while, then took it apart and put it away."

Tom Nurkkala was 16 when he started. His school had a terminal hooked up to a central computer. "I worked with an ancient teletype, slow and loud. I didn't understand how it worked or why.

Jerry Farm is building a computer based on the Z80 micro-chip. "I'm working on a total hardware video circuit. Some circuits use a lot of software but I didn't want to use software to run the video because it takes time away from what the machine could be spending on other things."



It fascinated me and I wanted to know about it. So I read a lot. Then I started buying stuff and working on it. Junk integrated circuits and parts and boards and printed circuit cards. Kits. Anything I could get my hands on."

A school teletype also lured Wayne Johnson."You're talking to this mysterious black box on the other side of the telephone line and I was trying to figure out exactly what it did. When I got to high school, there was quite a collection of old junk parts from various computers that they'd cannibalized. I started rearranging parts, putting them back together a little differently."

Like sports and band and the newspaper, this type of learning is at school but after school. Unlike those other activities, though, using the teletype was not an organized extra-curricular when John Depew was 13. He had to learn on his own and over his teacher's protests. "She discouraged me from using the teletype. I'd come in every night and she got fed up. She felt she constantly had to supervise me, that when she had her back turned I was going to pour stuff over the keyboard. When I came in, it kept her from doing her own thing after school, going to the teachers' lounge or whatever. I guess I was sort of a burden on her."

Stephen Edwards, at age 10, saw the

HEY KIDS! BUILD YOUR OWN COMPUTER!

Many people who are not intimidated by technology (including those who do their own brake work and replace the cartridge on their turntable) take one look at a computer and come down with the weak trembles. This is foolish. When you stop to consider it, a computer is only a little more complicated than, say, a spoon. Most of the home micro-computers (such as the Apple, TRS-80, and Pet) can be broken down into three components: the central processing unit (CPU), memory, and input-output devices.

The CPU: This is one or more silicon wafers, each about the size of your thumbnail, with hundreds of thousands of transistors on it; its function is to retrieve instructions and information from the memory, execute logic and arithmetic maneuvers, and other acts too mysterious to worry about. Some of the more elaborate CPUs are self-contained. Others need additional "support" chips to aid the CPU in performing certain tasks and communicating with other components.

Memory: There are usually two types of memory. The first is internal, directly linked to the CPU as one of the support chips. Internal memory usually holds permanent information that tells the CPU what to do, and transient memory that changes every time the programmer talks to it or new information is brought in from the external memory.

External memory is used for long-term storage of data and instructions. Because it is more economical than internal memory, it is also useful for holding large amounts of information. Years ago, external memory was on punch cards or punch tape, but now magnetic devices such as floppy discs or tape are more common.

The two kinds of memory work together somewhat in the way your mind works with a telephone book. Since it is impractical to memorize all the numbers you might need, you have a long-term storage device (the book). Internally, you have certain permanent information (how to use the book, how to use the phone) and transient memory. You look up the number, repeat it three times to fix it momentarily in your transient memory, then dial.

Input-output devices: Now you need a way to put information into the machine and get something back. *Input* could conceivably be as simple as a toggle-switch (computers reduce all information—from stock reports to "Hamlet"—into a series of on-off, yes-no signals), but is typically a keyboard, or a number pad, as on a simple calculator. Depending on how you are using the machine, "joy sticks" or heat or smoke sensors could be employed to signal the machine.

Output devices allow the computer to respond. An electronic printer will type output (or requests for more information) on paper, while electronic media—like the LED displays found on calculators or cathode ray tubes such as your TV screen—present the data in less permanent form. Instead of spitting back a number or paragraph, the computer may respond with a noise (alarms, music, or a synthesized human voice) or a graph. In addition, there are many "real world" devices that could change the temperature of your house, turn on lights, or, eventually direct the family robot to fetch the paper.

OK. You've got all these pieces laid out on the kitchen table. Now slap them together, and don't forget the interface cards that allow the components to communicate with each other. For aesthetic appeal, mount the finished product in an old box or on a scrap of sheet metal and begin writing software. You're on your way.

(For those with a little less ambition, the Heath Company markets several micro-computer kits that take from 28 hours to an eternity to assemble, depending on your abilities). □

teletype differently: "We had the teletype and a communications interface and some support programs. So we sort of wanted a printer so we sort of hooked up the teletype. It was a little tricky. I worked with a friend who's a year older." How did a ten and an eleven year old manage that? "We had manuals." The teacher must have helped. "No. As a matter of fact, we probably knew more than the teacher did about it. Matter of fact, I'm sure we did. But the teacher thought it was a good idea."

III. PROCESSING

When lots of information is fed into an uncluttered mind, things can happen. First, perhaps, there is a simple recognition of circumstances, of realities. Then additional factors are added: a change in the environment, a new desire. Finally, there are leaps of logic so grand as to border on intuition.

John Depew: "I wanted something for when we went up north on vacation. I wanted a computer to play with on the way up there." He found a small electronic game on sale for $10. Then he tore it apart. "The game had a nice little keyboard and an alpha-numeric display, so I figured I'd hook it up to a computer I'm making. I've already wired the prototype. Now I plan to make a circuit board so that it'll all fit inside the game case."

He is not talking about running a few wires. First, he'll make a circuit board by etching a copper sheet with a design, which he will have tested using a temporary "proto-board" that allows easy assembly. After he's etched the circuit, he'll drill holes for mounting the microchips, including several EPROMs (Erasable-Programable-Read-Only-Memory). Information is "burned" onto the chip (using a device Depew made to work with his Apple II home computer), where it will stay until the chip is erased with ultra-violet light. Instead of typing instructions or information each time he uses his hand-held computer, John will plug in an EPROM. The keyboard will be used to supply additional data.

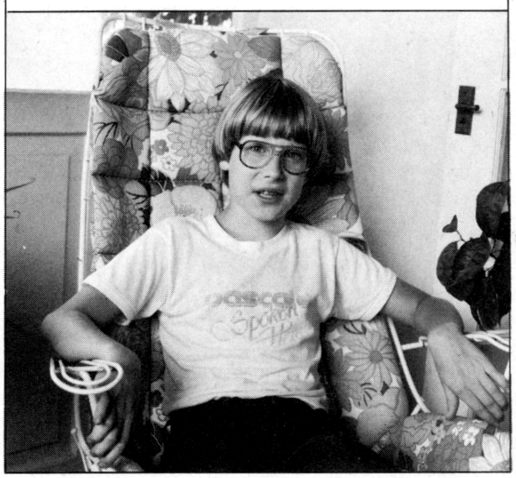
(Besides keeping him amused on the way to the lake, John sees other uses for his pocket computer. He thinks he might make EPROMs that would contain the formulas for his electronics and math classes. "I wouldn't have to carry around a notebook. I'd have it all on the computer. It'd sure take the headache out of trigonometry.")

John's concoction seems like a simple hybrid. But consider Craig Carlson, whose first interest was ham radio. Later, he began to play with computers, patching them together out of parts and ultimately mating them to the radio.

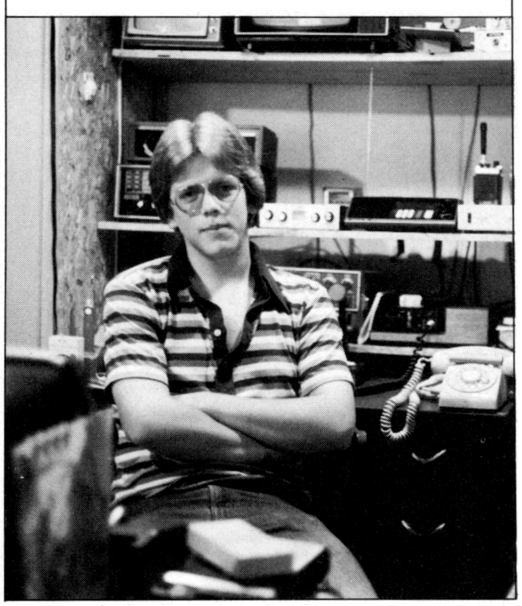
His bedroom has more electronic gadgetry than an intensive care ward. "This CRT (there are four cathode ray tubes in open view) I picked up from a surplus store in Massachusetts. You can see that the screen is severely burned—it was probably sitting on some dedicated function all the time—but I don't notice it when I use it. And I've got two more monitors over there in those boxes. They cost $15 without covers. The keyboard I have isn't just a plain old board. It's got its own micro-processor chip and it can do the whole bit. We put new floor tile in the kitchen and I found some scraps" which explains why his keyboard is in a case of Congoleum.

Wayne Carlson holds a computer he's been working on. "I started this from scratch, whereas a lot of hobbyists start with a kit or a design from a magazine. I bought all the chips and started wiring them together. I've used about a mile of wire so far."

Stephen Edwards "was originally thinking of making a sound board" for his Apple II, "but I've decided against doing it with hardware. I got a book about programming the Apple and I've written a sound program that's about as good as the hardware although it's not quite as controllable."



At one summer job, Craig Carlson found "a bunch of broken meters. I managed to put together a couple and get an hour meter to work." He mounted it on his keyboard "but I ran it for a few days and found out how much time I was spending on it and decided I really didn't care to find out."



"The radio I have in my car used to sit up here, on the keyboard. I was experimenting with some circuit boards one day and came up with the idea of why does it go from one board to the other? Why can't the information go into the radio? I have a friend with a similar setup and we did it." Craig and his friend are now able to transmit the on-off signals of the computer over the air.

Carlson also has a board that will take those on-off signals and translate them into another kind of on-off language, Morse code. The same device will take incoming Morse code and present it as characters on the display screen.

IV. SOFTWARE

These young men are the mechanics, the pit crew of the computer age. But that doesn't mean they don't occasionally drive.

Operating a computer is a literary activity. You write instructions to the machine and it writes back to you. Because it requires no parts and no tools (other than the computer), software is cheaper and cleaner than tinkering with the hardware.

Stephen Edwards is spending more time on software these days. Besides writing his own programs and one or two for his school, he's also publishing a newsletter for Apple II users, in which he includes his own programs and asks for contributions from his readers. But, like his colleagues, he drifts between software and machinery. He needed both to expand the character set on his computer to include lower case letters.

That drifting is common; there's an acknowledged confederacy of hardware and software. Johnson: "They really go hand-in-hand. Usually, you get the hardware up and running and get it all fixed and then you start writing programs for it. Then after you get some programs written, you have a tendency to look at your hardware and say, 'Now, if I had this sort of an I/O device, I could do this....' "

And Farm: "Once I finish my machine I plan to write some good software for it. Then I plan on making some nifty peripherals. Like I want to build a digital-to-analog converter so I can make music with it."

Hardware and software go hand-in-hand; they can't be broken down into discrete categories. Sometimes the need for software can be eliminated by the right hardware, and some hardware can be circumvented or even "fooled" by software. The boundaries have been made hazy, by EPROMs and other programmed hardware called firmware. This is where computers become no longer absolute. It's probably not important to know that, but it makes the machines seem more human.

V. OUTPUT

And in the same human way, the result of all this tinkering can't be considered in simple terms, though there might be a tendency to judge it as either good (the technological path to salvation) or bad (unfeeling machines taking control of our lives). The machine, after all, is amoral. It's only a machine.

But it is powerful, and that power can be abused. Nurkkala: "Computers will tie in with financial institutions and that frightens me. I don't think it should be pursued but I know it will be. You'll be able to pay your bills and write checks and on the surface that looks great. But it also opens the door for corruption and governmental controls. 'We don't want this person to write any more checks,' so they get on the computer and type in a code and boom, he can't. That would be detrimental."

He's also concerned with the people who work on them. "They're weird. When I was a freshman at the U, I started to see some of these people. They looked like they'd had integrated circuits for breakfast and had just sold themselves out to computer science. When I was in high school I was involved but I didn't sleep, eat, and drink computers and I get the idea that some of these guys do. They're outcasts, of their own volition."

Yes and no. To the degree that that's true, it's a scary prospect. You don't want bright and powerful people outside the system. And most of them aren't. Johnson: "In high school, there were the kids that hung around the computer and the rest of the kids. But there wasn't any real isolation. It's like any other group of kids in a sport or hobby who gang together. When I first started programming, I was pretty much a loner. As I went through high school, I found out that sometimes it works better when you work with people. In real life, you almost have to."

It is these groups of young people working together who will test the limits of the computer in the near future. Craig Carlson has taken an interest in amateur video, and can see a time when he'll mate the computer to that medium as he's already done with his ham radio. Jerry Farm has a friend who's working on a computer-controlled robot. And Wayne Johnson forsees computers in every telephone, making the central exchange obsolete.

It's not surprising if laymen have trouble acclimating themselves. Consider this: until they move into their new house, Johnson and his wife Ruth share the bedroom in their apartment with a welter of parts and tools and machines that are partially constructed or half-dismantled. This is what a battlefield will look like when wars are fought by robots. There's one board that he's used a mile of wire on. There's a meter that tells you how much static electricity is in the air and how much voltage your body is generating. Yet a man this close to the machinery can shake his head and say, "I sometimes get a little shell-shocked. What are they gonna think of next?"

That may be a self-effacing pose to put the truly shell-shocked layman at ease. Or it may be that the machines are changing too quickly to be followed, in the same way that medicine can outpace some doctors and automobile mechanics is leaving the old servicemen in the dust. Moreover, it could be that at age 23, with a wife and a job and a new house, one has already begun to mellow, and though he be a wizard and a diligent worker, one must inevitably come to the end of a young man's furious run. Sooner or later. Bit by bit. Absolutely. □