The Henry Ford

Collecting Innovation Today

TRANSCRIPT OF A VIDEO ORAL HISTORY

INTERVIEW WITH

STEVE WOZNIAK

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COMPUTER HISTORY MUSEUM,

MOUNTAIN VIEW, CALIFORNIA

Interviewer: Barry Hurd

Producer: Judith E. Endelman

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STEVE WOZNIAK:

01:01:59;21   [We all had Segways and we] just went on and said, "Well,

what could we try doin' with paddles and goals?"

BARRY HURD:

01:02:04;06   Interesting.

STEVE WOZNIAK:

01:02:04;11   And balls. And we figured out what kind of ball size works,

how to make a paddle, then how to buy a paddle.

BARRY HURD:

01:02:10;26   So this is, like, your latest invention, a new [game]

STEVE WOZNIAK:

01:02:12;14   Oh, we've been doing it for years, about four years or so.

BARRY HURD:

01:02:14;18   Is it catchin' on?

STEVE WOZNIAK:

01:02:16;17   Yes, it is, actually. We used to have one team for quite a

few years, and then there was a team in New Zealand that

we'd play. And now there's teams all over Europe, a

bunch of places. And there's three teams in the Bay Area.

BARRY HURD:

01:02:28;06   Is this like--

STEVE WOZNIAK:

01:02:28;19   But we don't really play team versus team. Usually just

whoever shows up today, we'll break everybody into a

bunch of teams that are about equal and we'll play for fun.

BARRY HURD:

01:02:36;27   Now, what would a score be? What kind of scores you

guys rackin' up?

STEVE WOZNIAK:

01:02:39;26   It could go up to as high as ten to ten, it could be as low

as two to one. I don't know--

BARRY HURD:

01:02:46;14   Okay, so it's pretty--

STEVE WOZNIAK:

01:02:46;19   --if I've ever seen it that low, but it's like [soccer]

BARRY HURD:

01:02:48;06   So it's pretty competitive

STEVE WOZNIAK:

01:02:50;09   Oh, yeah. It's very much like soccer, and you're tryin' to

                     be in the right place to block the shots and tangle for the

                     ball, and who gets the best control. And hit a fast one

                     right by the goalie, all that sort of stuff.

BARRY HURD:

01:03:01;29   Okay, let me ask you our test question. That's interesting;

                     I was gonna ask you something else. You know, in your

                     autobiography, you talk about how music's influenced a lot

                     of your life. And I think one thing you talked about when

                     you were younger, like a lot of people, Dylan was big.

STEVE WOZNIAK:

01:03:12;04   Yeah.

BARRY HURD:

01:03:12;14   Right now do you still have a favorite kind of music, or a

                     piece, a song, something that you like?

STEVE WOZNIAK:

01:03:17;10   The music that usually gets to my heart is something a

                     little bit country-ish in its flavor, a little bit folk-ish, and

                     good, strong words that you feel a person is really talking

to you about a real life experience, some real life advice, and not just made up a song to sound pretty. So it's not the major, well-known groups that get to me usually. It's somebody-- an expressive guitar too.

01:03:39;14   Certain people, like the Nashville guitarists that can strike, you know, chords deep inside of ya, right with a guitar. I love that. And so it's hard to pinpoint the type of music, but usually singer/songwriter because that's the person that writes the music, plays it, and sings it. They do the whole thing. They can do it singly with nobody else around them, or make it a little pretty with some other instruments.

01:04:01;11   And I respect them, because they've got the most talent in my mind. Somebody can come up to a microphone, have a beautiful voice, and sing and hit the notes and carry it just right. And that's great too. But it's just they didn't do the job of creating the music.

BARRY HURD:

01:04:15;12   So it's that creative feeling you sense that--

STEVE WOZNIAK:

01:04:19;00   Yeah. And the words re often very important to me. If the words really kinda strike home and have a meaning to you that's significant, yeah. You know, that really gets me.

BARRY HURD:

01:04:28;00   Sounds like-- why you probably like Dylan.

STEVE WOZNIAK:

01:04:30;24   Yeah, well, that's where I started. I don't like Dylan that much anymore, but-- there's so many groups that-- and I try to listen to the esoteric channels. You listen to the mainstream FM channels and you'll never hear the stuff I like that really gets me the most. I like to hear somethin' new. "Who the heck is that? That's a great song!" And maybe they only have a couple-a songs that can affect ya that much, but I go online and I purchase 'em and go to their-- I have a list of 200 lesser known artists and I try to go to their-- for the last couple years, I've been tryin' to go to their shows in the small places in San Francisco, in

Hollywood. Around Felton, there's a place I go to a lot.

01:05:09;06   Goin' to one up at Freight & Salvage in Berkley-- on the 22nd, even though I have tickets to see Credence Clearwater Revisited at Mountain Winery, which is great, but Steve Forburton (PH). I wanna, you know, check off my list, you know, one at a time the-- the ones that I like. Just get a chance to see them as real people.

BARRY HURD:

01:05:26;06   Do you buy your songs from iTunes?

STEVE WOZNIAK:

01:05:28;08   Yeah, but that's the biggest waste of money in the world. Because I buy the song from iTunes; I instantly go to Amazon and I buy the CD. So I'll get a clearer, unprotected version of it, but I'll get the whole CD; actually, I'll buy the artist, all of their CDs usually, and then listen to all the songs and rate 'em. So now the iTunes one is wasted money because you know, I got the same song off my CD unprotected.

STEVE WOZNIAK:

01:05:56;12   And I still play Tetris on the Game Boy. Every concert, I

play all concert long.

BARRY HURD:

01:06:01;23   Were you one of the original videogame players? Was

there something about videogames that just turned you

on?

STEVE WOZNIAK:

01:06:07;10   I got into videogames, seein' them early, and admiring the

fact that a game could be made on a TV, Pong. And then I

designed my own. Because the only way I could ever have

a videogame was to build my own, and a long time before

I had thought that everybody has a television. And you

could theoretically make television, or oscilloscopes, make

the patterns stream out and draw in a certain way to draw

letters.

01:06:30;02   And then I thought, wow, I knew how television signals

worked. I knew how to-- I was such a good designer.

Built this little thing with just 28 cheap little $1 chips, and

put Pong on my TV set. Then I met the guys at Atari and they wanted to hire me, and I said, "No, I work for Hewlett Packard." And they had me design a game-- commissioned me, and I designed Break Out for Atari. That's where you hit the ball against bricks and they disappear. It's a very popular, successful game.

BARRY HURD:

01:06:56;19   Yeah, I remember that. Take me back-- maybe it was even before that. The things that got you started-- some inspirations maybe, or the things that motivated you. Was it people, or other technology, or?

STEVE WOZNIAK:

01:07:08;00   Well, oddly enough-- and, I mean, I had a father who was an engineer, and that was a key part of it. But he didn't push any of us to be an engineer. I mean, my brother and sister didn't wind up going that direction. I think I lucked out in school at first and I was acknowledged as good in math. So I started thinking of myself as good in math.

01:07:24;15   And then my father-- we had science fairs. My father just

suggested a couple electronics projects. We went down and got a book, and he explained a little bit how electrons go through a wire and made a project for a science fair. And then I discovered by accident a journal in the hallway, and it was a journal only for high-level engineers 'cause computers weren't known to any normal people (there weren't even undergraduate courses in colleges) and it described ones and zeros and how they were added. And it described formulas of logic to make things work, make decisions, and logic gates, and had a type of algebra.

01:08:00;02   And I learned it all and I said, "This is weird. These computer things that are way beyond rocket science"-- back then, they were way beyond rocket science. I was like ten years old. I said, "This stuff is easy for a fifth grader. You don't need high level math. You don't need multiplication. You don't need algebra, you don't need geometry and trigonometry and whatever comes beyond that, calculus and things. All you need is the same sort of math you have in fifth grade."

01:08:25;05   So I decided computers were gonna be my favorite little

                         inside personal-- intrinsically rewarded, my head feels

                         good doin' it, my whole life. I would never have it as a

                         job, I loved writin' those ones and zeros and figurin' out

                         how they worked. And that was a big start.

01:08:40;00   And then my dad got a bunch of parts and I built science

                         fair projects that were big computers way back in early,

                         early days. I mean, I had no idea that-- how far advanced

                         I was, buildin' stuff that was, you know, (LAUGH) so good.

                         And my eventual career. I just thought-- did it for fun.

                                        BARRY HURD:

01:08:57;15   Did you take any inspiration from some of the great

                         inventors? Did you ever pay any attention to, like-- an

                         Edison or a Da Vinci or somebody like that?

                                        STEVE WOZNIAK:

01:09:04;21   I have some friends who are bright, and they went and

                         they studied all the history of these inventors and step by

                         step the processes they did, and can talk about it. And I

wasn't that sort of person. Or, I don't remember doing it.

I read books, you know, at a very young age that were,

like, TV shows, like movies, or books. Stories. And I read

a series of books called *Tom Swift, Jr.* about a young, you

know-- almost a teenager who had teenage friends, but he

owned a company with his dad.

01:09:32;23   And he was an engineer, and he'd go into the laboratory

and hook up wires and oscilloscopes and measure things.

And two weeks later, he'd come out with a device he'd

built. It might even be a submarine or a spaceship or a

plasma field to hold an alien presence. And all these books

were just thrilling books to me. They were the thrilling

books, you know, of my life.

                          BARRY HURD:

01:09:53;25   So it was sort of the books, those stories, compelled you to

keep moving forward and--

                          STEVE WOZNIAK:

01:09:57;18   Yeah, they made me feel that, wow, engineering's where

it's at. And I really respected my dad. I had a really good

father. Spent a lot of time talking about, you know,

everything in the world, ethics and how you live as well as,

you know, values in life, as well as when I had a question

about electronics, how does a transistor work? He'd pull

out a blackboard and demonstrate how the electrons went

through crystals and how they'd make more electrons go

another path, and it turned things on and off. And here's

how you make an amplifier. He would teach me that stuff.

01:10:27;24   So I really respected him. And I decided-- in sixth grade, I

told him, "I'm gonna be an engineer like you. And second,

I'm gonna be a fifth grade teacher," 'cause he had talked

to me about how important my teacher was, you know, to

where I was gonna go in life. And I just really respected

teachers.

BARRY HURD:

01:10:43;09   So when you were young, you sort of had a feeling that

this is what you were cut out for. I mean, did you ever

kind of

STEVE WOZNIAK:

01:10:48;08   Yeah, it's so strange. I look back to-- you know, memories

can change over time. But I remember in sixth grade

tellin' my dad, "I'm gonna be an engineer. I'm gonna be a

fifth grade teacher," which I did for eight years with no

press around. And always had a sense of humor, and

sense of humor's come out great. And just pretty much

exactly where I would have said, "Here's where I'd like to

go in life," I've just really done really well at those areas.

BARRY HURD:

01:11:11;23   When you did all this, were you carrying on, like, an

internal monologue with yourself, talking to yours-- I

mean, what was that process where you knew?

STEVE WOZNIAK:

01:11:18;07   Yeah. No, there was all accidents at a very young age.

But by the time I was around 20-- you know, when you

start to form, you're gettin' outta high school and you're

gonna be independent at college for a while, you start to

form, "These are my ideas of who I am, what's right, and

what's wrong. And how we should do things." And I

started havin' a lot of internal discussions. Walkin' home

from school, I'd run a lot of concepts through my head and

evaluate them and come out with, "Here's who I wanna

be." And it was very--

BARRY HURD:

01:11:44;20   And can you share any of those? I mean, do you

remember--

STEVE WOZNIAK:

01:11:46;07   Oh sure. Oh, yes, yes. First of all, I had been a little bit--

through most of school, I had been an outsider. You might

call it a nerd. You know, I was a techie, so you might call

it a geek. But-- people kinda didn't talk to me the same

way. And they had their small, little discussions, and

somehow I didn't learn how to socialize. I was shy.

01:12:06;09   So I had my group. My group of people would be just

weird guys that were interested in building an electronics

project. And as a result, that made me-- I think that

made me-- very independent. And I read books like

Walden Pond in ninth grade and started thinkin' about

being very self-sufficient and on your own. And lots of, you know, the philosophies are still with me today. You know, you can do somethin' on your own and you don't have to listen to everybody else. They can be wrong and you can still go your own way. That came to me very strongly in high school.

01:12:35;02   We had a lot of philosophies. I was very tuned into the counterculture philosophies that were in all the papers. The "summer of love" things and the music of the times. And to me, it was like people are thinking of a whole different way that life could be organized, and yet a lot of what they say makes a lot of sense.

01:12:55;19   But we had this thing, one of the big principles was don't be a follower, don't conform. Okay, don't conform to the values of the parents, really. You know, don't conform to what you're supposed to do. Well, really, to me, I looked around and I saw all these kids in school goin' to parties, drinking, using drugs, and they were conforming to each

other. They were doin' it because the others were doing it, not because they felt it was intellectually right, like they had read some great theories about why it's a good thing to take these drugs or whatever.

01:13:24;23   So I decided I would not do anything. I would not drink, I would not go to parties, I would not have sex, would not do these things, if other people were around because I might be doin' it because of them and then I'm a follower. And I decided, no, I was going to think for myself and be a good person. And if I decided it was right to drink, I should drink totally alone and not with others.

01:13:45;21   So I was really kind of a pure type person. I mean, I even got to where I'd cross streets only at the corner. But, you know, you're proud of the things you do that are good. But everybody does some really good things, just, "See how good a person I was?" Well, we also do some bad things, and sometimes I might jaywalk and-- nobody's perfect. You just wanna look at the good things and so

everybody says they're a good person. But I was

extremely clean. Yeah.

BARRY HURD:

01:14:07;25   So even later on in life, most of your inspiration,

motivations came from this internal strength that you had

as opposed to looking externally?

STEVE WOZNIAK:

01:14:16;07   That strength let me-- well, I did a lot of work in high

school. I had a teacher that saw that my electronics

education would be beyond the school. And that's great.

Whenever teachers do that, it's like interns in companies is

a great thing. Kids that are in college as students get to

be in the real world.

01:14:34;02   Some companies have total co-op programs. Some

colleges like Kettering University, it's an engineering

college in Flint, Michigan. The students go to school for six

months, they work for six months. They go to school for

six months, they work for six months. So they're already

gettin' both sides of the real world considerations of a

business with bosses, with projects, and they're getting

the education in school. And I believe in that strongly, and

I forgot what I started out to say.

BARRY HURD:

01:14:58;19   I was asking you about, even when you got older, did you

still sort of use your inner strength for inspiration and

motivation as opposed to [an outside strength], looking at

something somebody else had done.

STEVE WOZNIAK:

01:15:07;02   Yeah, okay. So I was goin' back to high school to point

out that what happened was I discovered this teacher

arranged for me to go out once a week and program a

computer at a company in Sunnyvale. And I came to love

programming. I wanted to do that for the rest of my life,

and I set a goal. I am gonna have a computer that I can

type in a program and run it someday in my house. I

don't care-- sure, they're millions of dollars and that it's

the impossible dream.

01:15:30;22   But I told my dad that dream. And he said, "Well, these

little mini computers would cost as much as a house," that's what he said. And I said, "Well, I'll live in an apartment." And-- while I was there, I discovered manuals to computers. A manual to a computer describes, like, the shape of a computer. The architecture is the holding areas, like the rooms of a house.

01:15:51;16   But I knew design from my elementary school and middle school science fair projects. And I sat down with chip books, looking at these little logic gates, they're called, and I would draw them on paper in a way that eventually I taught myself to design a computer. And then I taught myself how to design the computer, instead of on ten pieces of paper, on three pieces of paper. I made 'em smaller, and smaller, and smaller, and I got in a little game, and I got manuals for all the mini computers of the late '60s.

01:16:19;16   These were mini computers from Hewlett Packard, and like the 21-14 and Varian 620-i and Digital Equipment had

theirs, the PDP8 and [so] on. And Data General came out

with the Nova. I would order manuals to all these

computers, close my door at home. Didn't include my

father in this, didn't include teachers, didn't include

friends, and I just sat down for no reason I could explain

to ya, and I'd just start tryin' to put together little logic

gates that you could buy on chips. Although chips cost,

you know, way too much for a person to buy back then.

01:16:49;28   But I would design 'em on paper, and here the end, I

finished designing this computer. I got (CLAP) so good at

it. I did it over and over and over and over, and I would

redesign the same computer with a goal of, "Can I do it

with fewer parts?" And it made my mind think, "Is there a

way I can get an inverter? I just need one more chip.

01:17:08;28   "Here's a weird-- here's a part of a little register, it doesn't

invert, it's not an inverter, but it'll actually do the inversion

and it doesn't matter that it's a cycle--" I would do these

weird things in my head that you'd never find in a book to

make every little part used 100 percent. And I became very good at designing computers, extremely good. I mean, my designs were half the chips of what they were shipping.

BARRY HURD:

01:17:32;11   Now, obviously it was good engineering, but it's almost like it was an art form. Did you did you feel more like an artist or an engineer? Tell me about that.

STEVE WOZNIAK:

01:17:38;21   I always thought of myself as an engineer. In later life, after we started Apple, I'd looked at it and saw that I did the same things that an artist trying to make a piece of music so perfect, correcting it, having all this talent and getting-- knowing when something is so perfect that almost no other human could do it. And so then I realized I took engineering as an art. I was an artist at engineering.

01:18:01;06   And I ran into a few others of those. In the early days of Apple, about one out of ten engineers, one out of 20 would

be this artist type that everything they could show you was so perfect, they would just show it off. And it's rare.

01:18:13;25   And usually, they were classical musicians. I don't know how I was the one who wasn't. I played guitar but I was not a musician. But for some reason, the artistic-- engineering and musical—[went together], real good music talents. I mean, some of them were professors of classical music. So they were that brilliant.

BARRY HURD:

01:18:35;14   Think it's 'cause the math and music's a mathematical language?

STEVE WOZNIAK:

01:18:39;21   I think it probably is. Probably somethin' in the mind of all these little pieces that add up to something larger, like a bunch of notes might add up to a chord, and they might have little timing differences between them. And they add up to a stanza and they add up to a longer piece of music and they add up to a whole song.

01:18:55;16   I think that sort of-- that's how you build computer

                         programs. You start with computers themselves with

                         hardware. You start with very small elements, build a little

                         bigger structure out of that, combine it with another bigger

                         structure; eventually you can build it up to a full computer,

                         or a full program.

01:19:10;05   And also, the people that were that type of people, that

                         had these incredible techno-- they could apply their -- I

                         don't know what you call that, intricate, artistic thinking, to

                         designs and computer programs, they also were the ones

                         that were the most humanist. That spoke the greatest

                         words about how society should be affected by computers,

                         how computers should treat a person. How you can make

                         the human being more important than the technology.

                                        BARRY HURD:

01:19:39;11   Did you have a philosophy like that when you were

                         developing your computers?

                                        STEVE WOZNIAK:

01:19:42;23   I didn't. I did not have that sort of philosophy. I tried to

make them simple in terms of the fewest parts, and I got

very good at that. And I always tried-- and I believed in--

and as part of that process, I learned that if you're-- say

you're writing a program, leave out a whole bunch of

things that almost don't matter, but do the core of it very

well. And sometimes you could think of ways to have

fewer elements but do as much as the more elements

would have done.

01:20:09;16   And sure, a lot of people would look at it and say, "You

don't have 500 things." No, I've only got 20 things, but

they do all the job. And I got good at that, and so

indirectly, I was ready for it. But really, when these

people exposed us to-- Steve Jobs and I, we were first told

by Jeff Raskin that when you build a computer, it has a

certain amount of electronics in it. And that electronics

can do a certain amount of calculations for other people.

01:20:34;26   And yet, you can take extra time, put some work into

programming harder and harder, to making a program so

beautiful that a person who knows nothing can walk up and use it successfully without having to be trained, "This is here, that's there, this key does that." We're-- you know, like, the geek world was full of switches you'd never understand on the old big computer front panels. And this museum's full of a lot of those.

01:20:59;00   But-- it's like how do you get away from that? How do you make somethin' so obvious a person walks up and it's intuitive? I want to do a certain thing, I want to add some numbers. Maybe if I just type in a formula like I do in math, five plus six equals, it'll give me an answer. You put in enough software, you can make it work better for the person, and yet it's still just as good a computer.

01:21:19;28   And that was one of the big influential days of my life, when he was telling that simple-- story. Because I said, "Yes, all computers should be made that way. We are the computer experts. We're tryin' to make life easy for people." Electronics, it should make our lives better. And

we don't get happier than the caveman, okay? We don't

get happier than people were a couple hundred years ago,

but we're driven to try to find these ways to make life

easier and happier.

01:21:46;09   And, boy, the computer should do the thinking, not the

person. If the person has to think to-- "I remember how

to do this and this and this step, and those 20 steps on

this computer," then the person has had to conform to the

technology, and the technology's been made the master.

BARRY HURD:

01:22:00;06   Now-- at that time, that was very innovative thinking. I

mean, we know some of it now retrospectively. Did you

know you were being that innovative? Tell me a little bit

about that process.

STEVE WOZNIAK:

01:22:08;29   Well, that wasn't-- actually, a lot of my thinking of

designing the first computers were even before those

kinda concepts really took me over. But I was in a

computer club, and the club was full of academics,

professors from Stanford, Berkley. And a lot of people that

had been involved in social movements, and even anti-war

movements and the like.

01:22:30;13   And they wanted this new technology to free the people, to

get to, like, a better, further state. And they spoke about

how we were gonna change as people. How we were

gonna be better educated with a machine that can answer

us back, instead of just a book that can only present data

one way. And how we were going to be able to

communicate and leave messages that hundreds of people

could read and all know that a meeting place got changed.

01:22:57;15   And, you know, these great social goals really-- even

though I was too shy to ever talk at the Homebrew

Computer Club, I sat in the back row and I just was so

inspired thinking, "This is the good that we're doin'. And

I'm good at designing computers. I wanna put my talents

in that direction. I want [to help] all these people that are

listening to these stories--" I didn't realize it was really

only a few scattering ones that were super bright. Super

bright, futurist, social evangelism thinkers.

01:23:27;00   And I figured that everybody here must be so affected like

I am. And I wanna help them build their own computers.

So I took it as my goal to design a very simple, affordable

computer which I knew how to do, and give it to the

others.

01:23:43;09   And I did, I passed it out for free. No copyright notices, no

nuthin'.

BARRY HURD:

01:23:47;11   Yeah, we're gonna-- we're gonna pick up-- I just wanna

stop for a second now.

* MEDIA ID: WOZ2.MP3

BARRY HURD:

02:01:07;26   Well, let's start out with this, tell us about that path of how

you're in your 20's now or a little bit older, you've decided

you want to be an engineer. You want to build this great

computer. Just, sort of, take me through that path that

that led up to the Apple I and II.

STEVE WOZNIAK:

02:01:21;17   Yeah. I never really had to think about a path career,

what I would do, because I was so smart in electronics, I

always had an easy job that was satisfactory to me. I was

always real happy. I had a lot of jokes in my life and

humor. And I wound up getting a job at Hewlett Packard

designing hand-held calculators, the first scientific

calculators that all engineers and scientists had to start

using instead of slide rules. And I didn't have a college

degree but they interviewed me.

02:01:49;18   I just knew all the design electronics and all that and that

was good enough. And I feel so grateful that I didn't have

to have some certificate proof that I knew it, that I just

had to, you know, I didn't have to have my fourth year of

college. So, while I'm working at Hewlett Packard, I still

loved electronics at night.

02:02:05;26   And I was still shy and awkward and not socially-- I'd

never have a girlfriend or a wife, probably. So, when I

came home, I did electronics projects at home. And one

early one, wasn't even electronics but it was jokes. And I

started the first Dial-A-Joke for the San Francisco Bay

area.

02:02:21;14   And I'm so proud of that 'cause that was back in the day

when you could not, in the United States, legally own, use

or purchase your own telephone. In the United States,

you could not legally own, use or purchase your own

answering machine that people could call for a joke. The

one I had to lease cost as much as my apartment rental.

02:02:41;21   Can you imagine a young engineer pay an apartment

rental twice just to run Dial-A-Joke? That's why nobody

ever did it. And, eventually, I did have to stop it for lack

of money. But-- I ran it for a couple of years, told jokes,

told Polish jokes. Then when the Polish organization said

they were going to sue me, I said, "What if I switch it to

Italian jokes?" and they said, "Okay."

02:03:02;03   This was back before political correctness, so, you know,

go along with the times. Anyway, after that I saw a Pong at a bowling alley and I said, "I have to have one." And I said to my fiancé, I'd met her on Dial-A-Joke, and now, I said, "Oh my gosh, I can build one of these. I know television signals from high school and I know digital electronics and I designed my own Pong."

02:03:24;13   And around that time, oh, we skipped a step that I, also, worked briefly, in between college years for a computer company. And while there I mentioned to one of the engineers, "Oh yeah, I used to design all these computers back in high school and I could never get the parts to build them. And he said, "I'll get you the parts. I know-- I have connections with chip companies."

02:03:44;08   So he got me the parts and I, actually, built a computer of my own and built-- down the street with a friend and the friend said, "You've got to meet this guy, Steve Jobs, because he knows digital electronics like you do and he plays pranks like you do." So he was, like, the brilliant,

technical geek of his high school but-- the school I went to [but a] later year.

02:04:03;17   So I met Steve and we sized each other up and became such good friends. So after I saw Pong and I had driven Steve up to his college in Oregon, when we finally came back from that, I'd tell them all about Atari. This company's making video games out of televisions. It's the newest thing. He went down to Atari, he's the brave guy.

02:04:21;15   He went down and just got a job, like that. So he was inside of Atari fixing up their games, adding features to them, that sort of thing. And I'd go down and visit and do the games and he came up with a deal where the head guy from Atari, Nolan Bushnell, wanted a game design. And he didn't want his engineers to do it because his engineers were using 50 chips, 80 chips, 100 chips, 120 chips, 150.

02:04:44;00   They were using 200 chips to make a game. And he knew that I used very few chips for anything. So I got the job to design Breakout, did it in 45 chips. And Steve Jobs and I

went in every night, four nights in a row. It had to be

done in four nights. And that was impossible. A game

took six months back then.

02:05:01;08   It was hardware, it was not a program you can write. It

was chips with wires that have voltages on them. And I

didn't think I could do it. I was, like, the best designer in

the world, in my mind, but to do that, in four days and

nights, I didn't think I could do it. We didn't sleep, we

both got the sleeping sickness, mononucleosis, Steve Jobs

and I did, turned over a working Breakout.

02:05:20;08   And then after that, we went over to a friend's house. And

this friend had to do with some things we'd been involved

with in my year at Berkeley in college, making tones into a

telephone so you could dial free calls anywhere in the

world, weird, little device called the Blue Box. And this

guy was called Captain Crunch and we went down to a

basement and he's typing on a big, huge, metal teletype

machine, the machine you see in military stations in

movies, usually, you know, big, clunky machines, typing

away, clunk, clunk, clunk, clunk, clunk, clunk, clunk, clunk,

clunk.

02:05:49;24   They have that hackerish sound to them. And he said,

"I'm playing a game with a computer in Boston across the

country." And, oh my God, he printed out a list of

colleges, about 12 colleges, Berkeley, Stanford, UCLA,

Chicago might have been in there, Boston had a couple

schools, New York.

02:06:07;16   I'm saying, "Oh my God, you can reach out like a

Superman." I love it when electronics makes you a

Superman. "You can reach out to all these-- " and I said I

had to have it, just like the Pong game. My formula was,

use my home TV, which was free, a free device for output,

wired a little wire inside and put pulses on the wire to

cause balls and paddles appear on the screen. Now, I

designed a circuit that would put letters of the alphabet on

the screen so you could have a certain number of letters

across each line on the screen.

02:06:38;00   And I could, actually, type on the keyboard in the end,

went through a little modem I built into my telephone,

dialed the number over in Palo Alto at Stanford. It got me

on this thing called the ARPANET, with 12 colleges. And

the ARPANET was gonna grow into today's internet but

these were much earlier years.

02:06:54;15   And I had my own device now and I could, actually, type--

talk to computers and program them. And they could run

programs. And the output would appear on my TV. So

this was an exciting, exciting time. I'd worked at Hewlett

Packard the whole time. But at night I was doing these

incredible, interesting things, just for my own fun and

interest.

02:07:11;07   And that's when a friend said this club started up, that was

the Homebrew Computer Club that had a lot of big social

thinking combined with computers that were affordable. I

went to it and I was very disturbed the first time. I was

embarrassed. Everybody knew about a microprocessor

from Intel.

02:07:28;13   They knew the part numbers, that it was being sold in a

thing that called itself a computer with switches and lights

for ones and zeros and buttons to push the ones and zeros

into memory. And it was really the equivalent of that little

computer that I built when I met Steve Jobs, five years

earlier. Just about the exact same specs, you know, the

number-- 256 bytes of memory and eight switches for data

and buttons to push.

02:07:51;02   And-- I had all the same stuff done before. And what I

realized was, these microprocessor chips are out now. A

microprocessor is, like, the whole computer I used to

design. Oh my gosh, I buy a microprocessor chip, I have a

keyboard at home and I have a TV that displays words.

I've got my own computer. It's all done.

02:08:11;22

And then, I knew, right then, that the computer that I told my dad I'd have some day in my life, I would have it. So I had to learn what a microprocessor was, by the way. I was scared. That's why I was scared. Everybody knew microprocessors and I took the data sheet home and studied it.

02:08:25;07

And I said, "My God, this microprocessor is like those computers I used to design." So it was just a pure accident. One accident after another was so lucky for me and I couldn't afford the Intel microprocessor, $400. And they had a program at Hewlett Packard, you could buy a Motorola one for $40. So I went in at night and used my drawing table at Hewlett Packard.

02:08:48;03

And I drafted out the design for a computer based on the Motorola microprocessor. Then another company came up with their own microprocessor for $20. So I used theirs instead, cheaper, I mean, the cheaper you can go and you look at it as an engineer. This processor will do as much

as-- $20 one will do as much as the $400 Intel one, or the $40 Motorola, I mean, it'll do just as much calculating.

02:09:12;05   So then I finally got the tools one night. I got the time, I'd draft-- I designed everything, thought it out, went in and started plugging chips in a board, soldering every wire on, testing and looking on oscilloscopes, debugging. "Oh, oh my gosh, I'd made a mistake in the design," fix it over here and move a couple wires, put a new chip in.

02:09:31;21   Or, "Oh my gosh, there's a problem here. Oh, two wires must be touching each other." And I'd fix it. And I'd get the thing working and, all of a sudden, finally, I was running. And I said, "I don't want this big, ugly front panel." I like things small, you know-- consumer electronics if it's a hi-fi you like things smaller and smaller.

02:09:49;14   You know, when we got the CD players, we wanted them smaller and smaller, Sony was good at that. Well, transistor radio, you can get them big or you can get them smaller. I like something small. I don't like huge

monstrosities that are mechanical. I've got to get out

drills and I'm not mechanically oriented very well, drill

holes for all these switches, plug in the switches and do

them.

02:10:07;25   I did that back in elementary school for science fair

projects but I didn't want to do it. And I said, "Hewlett

Packard makes this calculator. I helped design it." And

what we have inside is a little computer. When you turn it

on, the computer runs a program saying, "Are any buttons

being pressed?"

02:10:22;12   If you press the five button, the program says, "Ah ha, the

user pressed the five button, I'll put a five in the display

and go back and see, is any key being pressed." So I said,

"Why don't I write a little program that's always built into

my computer." When you turn the switch on, the program

says, "Is anything being typed on this human keyboard?"

02:10:41;01   And then, it reads in what you type and when you hit

return, it tries to figure out what to do. And it stores data
in memory, it looks at what data's in memory or it runs a
program, the same things this big, huge, ugly front panel
did in the past. So every computer before the Apple I had
a front panel, front panel full and every computer since the
Apple I.

02:11:01;20   These are all since the Apple I. They all have a keyboard
and a display, a video display. And that's-- that's how the
world went so that day the thing's changed. Now, I didn't-
- we didn't call it an Apple I. Steve Jobs wasn't going to
the Homebrew Computer Club at first, and I started telling
him about this interest, this computer I had built. "Look, I
can type stuff into it."

02:11:20;14   He started coming to the club and he saw there was
interest in it. And I was passing out my schematics for
free. I was passing out my code listings for the little
program I had written for free saying, "Build your own.
You can build your own." And I thought that 50 people
would build their own. And almost nobody did.

02:11:35;05   One high school kid, Randy Wigginton, I went over to his

                                   house and I soldered it together for hours and hours and

                                   built it for him. But Steve Jobs came and he said, "You

                                   know what? These people don't want to spend the time

                                   building it. They want to buy it already built. So here's

                                   what we do. We make a PC board, this blank PC board is a

                                   green board with little metallic silver traces on it, wires

                                   that are connecting things.

02:12:00;14   You plug the chips in. Maybe it takes you five minutes. All

                                   the chips are in the right place. We assumed that the

                                   people could get chips from their companies or whatever.

                                   Plug the chips in, solder the bottom where the chips plug

                                   in and you're done. You don't have to add one wire." So

                                   that was his idea that we build this PC board for $20, sell it

                                   for $40 and call ourselves Apple Computer.

02:12:24;21   And I said, "Well-- I'm too scared to sell anything because

                                   I have a company, Hewlett Packard and they own what I

design. And I implored Hewlett Packard, I said, "You can

build a little machine, that looks like a typewriter and you

can write basic programs on it. And you could sell it for

$800 and it works with the person's home TV."

02:12:44;07   And they turned me down. They thought about it, they

thought about it, they knew it was an intriguing idea.

They knew it was gonna be one to change the world but it

didn't fit the Hewlett Packard culture, the corporate

culture. And they didn't see the way, a formula to make it

outside of the culture. You know, Hewlett Packard

products, back then, were only sold to engineers.

02:13:04;18   They had to be completely finished, very rugged, have a

certain very official look. Engineers don't have a fanciful,

this is fun, look to it. It would have to be, kind of, almost

boring and say, "I am a work machine," instead of, "I am a

fun machine." And what I was designing was fun

machines.

02:13:20;16   So Hewlett Packard turned me down for the first of five

                                     times and Steve and I were in business. And we put

                                     together quite an operation around that Apple I. Right

                                     away-- well, we were gonna sell just PC boards at first. So

                                     we didn't start as a computer company.

02:13:34;13   Right away, the guy who owned the local computer store,

                                     Paul Terrell, had seen me at the club, with all these people

                                     interested and seen that I had one little board with only

                                     about 30 chips on it and I'm typing in programs and

                                     running them. How could a computer be so small?

                                     Nobody'd ever imagined it, a full computer that could run

                                     programs could be that small.

02:13:55;24   There were a bunch of hobby kits, like the Altair 8800

                                     being sold. They were monstrosities and they were so

                                     expensive and they still wouldn't compute. You had to add

                                     a whole bunch of memory cards that went off to these big,

                                     huge, clunky teletype machines that cost as much as a

                                     car. So you were really far from a computer that could

really be used by any other approach. And I'd hit on the lucky good formula and Paul Terrell said, "I'll buy 100 of these for $500 each," worked out a deal with Steve Jobs. So Steve Jobs called me at work and said, "I've got a $50,000 order," and I fell down. I collapsed. No, just kidding.

02:14:30;11   But that was the biggest financial shock. That scared me, 'cause my salary was only $24,000. And we've got a $50,000 order? This is the bigger thing ever in my life. I was scared. I was just gonna be an engineer, my whole life. And so, we were doing this on the outside.

02:14:46;24   And the way we did it, we had no money. Steve and I were in our young 20's. We had no bank accounts, no savings accounts, no cash. We didn't own any cars. We had no way to get any money. So what we did was, we got the chips on 30 days credit, for these computers, built them up in about 10 days and drove them to the store and got paid cash.

02:15:07;25   We had arranged a C.O.D. with the store owner. So he

                               was really taking the credit. That's how we got the credit.

                               The parts companies knew that he'd pay. And that put us

                               in business. We built about maybe 150-- probably sold

                               about 150 Apple I's. But you have to understand, the

                               Apple I wasn't really a Wozniak computer design.

02:15:30;20   I already had a machine designed to talk to a computer in

                               Boston, over a low speed modem, that could only pass,

                               maybe 30 characters a second. So across the line you'd

                               see the words forming on the TV screen. That's slow; it is

                               the fastest it could go. And I designed things to save

                               parts, taking advantage of knowing how slow it was. That

                               was for a terminal.

02:15:54;23   Now, all of a sudden, I decided, "I'll put my little

                               microprocessor, some memory and a little program on the

                               board." So now, I'm typing to my own computer and it's

                               typing to my TV. But it was still at that same slow rate.

                               See, I just, sort of, quickly adapted a microprocessor to

make my terminal into a computer.

02:16:13;27   With the Apple II, I designed the thing from the ground

up. And that was the great machine and, I don't know, I

hit on so many unbelievable things. I just cut the chips in

half. I kept thinking of ideas to save parts and do the best

design of my life and, still, nobody had ever imagined color

would ever come to a low cost computer.

02:16:34;05   And here it was, I had a weird idea with a one dollar chip,

making color for American TVs. And in the past, color

would be a couple of big, huge boards full of hundreds and

hundreds of parts and doing weird, little mixtures and you

need specialized engineers and I had this clever, little idea

for it. And we had graphics. If you've changed numbers

in memory, like, you went into every computer has

memory, that's one section of the memory was just

presented on the screen.

02:17:00;14   And if you change the number to a five, a grey square

would pop up. If you change the number to an eight, a purple square would pop up. And, all of a sudden, you realize that if you write a program to move the numbers around, you can make animated cartoons, animated games, like the ones I'd done for Atari, right on your screen.

02:17:17;29   And then I even had a mode in there that had pixels, real pixels. We called it high resolution. I mean, almost, you know, not quite photographic standards of today, 2008, but pretty unbelievable what you could do with pixels, make tiny, little shapes that look better.

02:17:33;09   And we didn't even know if the world would use this, what they'd use it for. But if it only cost two chips, put it in. And this Apple II, we knew, was gonna change the world. First of all, the Apple I was the first machine that came out with a keyboard and a video display. After we did that, another group at the club, who was always looking over my shoulder, processed our technology, came out with the SOl computer, keyboard and a video screen.

02:17:59;06   That Sol used the Intel chip and it had taken over the

                               computer stores in the country. They were selling a

                               thousand a month. A thousand a month of this little

                               microprocessor computer? And Steve and I had the Apple

                               II and we're looking at ourselves, "We didn't give this one

                               away without copyrights."

02:18:15;07   We didn't pass it around, showed it off very seldom. And

                               we said, "You know, this Apple II is ten times the

                               computer. We're gonna sell a thousand a month." A

                               thousand computers, maybe, a $1,000 each. That's

                               $1,000,000 a month. And when you're young and have

                               no money, that's very, very big time. But we had to

                               explore getting money to do it.

02:18:40;06   And yeah, to this day, the Apple II was just an incredible

                               design. The color idea, it was really an accident. I was

                               down at Atari for those four days and nights, working on

                               Breakout when I had gotten no sleep and I got

mononucleosis and my head is, sort of, in and out of

consciousness. And I went up to the factory floor.

02:19:00;16   Back in those days, Atari could only use black and white

TVs. That's all they could afford for their games. They

didn't have color TVs. But this one dot moving across the

screen was changing colors, red, purple, blue, yellow, red,

purple, blue, yellow. And it turns out they had put Mylar

overlays on a TV screen.

02:19:17;09   The Mylar overlays made it seem to change color. And I

just was dazzled. And I said, "This is kind of psychedelic."

You know, and I wasn't a drug user, but I thought, "This is

just so unbelievable to watch." And, you know, and I'm

kind of almost asleep but it's mesmerizing.

02:19:31;03   And that's when I thought, "I wonder if I have this chip

with four little bits, ones and zeros, and I spun it around,

what would come out one end would be 1100, 1100, 1100

and it goes up and down, just like color TV signals on

American TVs do. If I spun it at the right rate, it would be

interpreted as color."

02:19:54;04   Even though it didn't-- hadn't followed all of these

                       incredible mathematics and differential equations and

                       calculus that define how American TV did color, this one--

                       the signal would look pretty much like the ones that

                       represent blue and light blue and dark blue and green and

                       orange de-- depending on what codes you put in. And I

                       didn't know if it would work, but the day that-- when I was

                       building the Apple II and tested it and it worked. I called

                       Steve over. I mean, we were shaking. We knew, at this

                       point, we had something that was not gonna be given

                       away. It's gonna be secret and it's gonna be worth a lot of

                       money.

02:20:32;07   And I was still being turned down by Hewlett Packard, by

                       the way.

                                        BARRY HURD:

02:20:35;10   And it became the largest selling computer in the world,

                       the personal computer at the time, right?

STEVE WOZNIAK:

02:20:39;17   Yes, it became-- it was, you know, the first one to say that

a computer can also be a game machine and it can be fun

and it can be in the home. And we were just so lucky.

None of the big companies thought that a little computer

based on this little chip would be doing the useful tasks,

ever, so they passed it by. And they didn't see that there

were a lot of people that wanted something less than a

useful computer.

02:21:03;21   A lot of doctors and lawyers and school teachers and

plumbers and everybody in life, they didn't talk to those

people that just wanted a thing called a computer and

learn how to use it and write programs that dazzled things

on the screen and play games. So games was a big part

of that kick-off for the Apple II and it became, yeah, and

eventually we had competition. At first, we had

competition from Radio Shack and Commodore.

02:21:28;05   We went to Commodore and tried to sell them what we

had, the Apple II. And, "Give us a bunch of money, give us some good jobs and give us some good positions and to run the project." And they said, "No. People don't want color, they don't want all these fancy things. They just want the cheapest machine there is."

02:21:46;19   And they built their own machine. And I still say that their machine cost more than ours, anyway. So it was a mistake and Radio Shack. But their machines were not color. They had lousy keyboards. They weren't expandable in any way. We had huge expansion.

02:22:02;18   And, you know, whenever you write-- you have computers, you have a certain level of programs and amount of memory you use. But next year, you're gonna use more memory. You're gonna find ways to use more and more and more. And we had the ability to plug in extra memory and we had a huge amount of memory and those machines didn't.

02:22:16;26   And we had the ability, you know, you're gonna want

something new. We started out the early, low cost computers had to store all the data, including programs, on cassette tapes, very unreliable method, very slow. Well, we moved up to a floppy disc. We had plug-in cards in our Apple II.

02:22:34;00   The Radio Shack and the Commodore had no way to plug things in and they were stuck. They had to go back to the drawing boards and we gained, like, a year, year and a half on them and that was really big. So that's when we became the number one selling computer in the world. Eventually, machines like the Commodore 64 came along. They were cheap, they were colored, they were games, they had more graphics, more speed, more ability and they even sold more than the Apple II in quantity.

BARRY HURD:

02:22:59;27   Let me ask you a little bit about when Apple went from-- it was your design and then you guys started small, you got bigger and bigger and bigger. You had to hire people. You're a very innovative company, in the early years, at least and now, again, I suppose. Tell me about that

process of how you took this design and brought other

engineers and the kind you hired, what you looked for.

You still wanted that innovation, tell me about that.

STEVE WOZNIAK:

02:23:18;23   It really started with seeking money. And Steve and I

having no experience, we'd had no business experience,

no business classes in college. But we started going

around, talking to companies, talking to venture

capitalists. And we ran into an angel that looked at the

technology, he knew it.

02:23:37;15   It was an area he wanted to go in his life and he had made

his money marketing for Intel. And he wanted to,

basically, come out and start this company and put the

money in. And it would cost $250,000 to kick off a run of

1,000 computers. So Mike Markkula joined us. And he

said, "Well, you need to fill out the other key departments

of a company."

02:23:57;21   And I'm sure we could still stay small, like ten people for

awhile but we had to hire a president. And Mark made a recommendation, we interviewed Mike Scott. Steve and I interviewed him, and liked him as a person. And we liked the way he talked. He was forceful, he could take direction, he was a good president and thankful we had him.

02:24:15;08   He took us-- Apple, from when it started to when it went public with one of the biggest, most successful public offerings ever. Steve likes high technology, you know, the state-of-the-art stuff? And, of course, I did all the hardware and software for the computer, but Steve wanted to make a plastic case.

02:24:36;11   And he saw his role in the company being in design more than anything else. And he worked with it, he found the guy that could make a very cheap plastic case. It almost sunk Apple because we had to, eventually, go and make real molds and get a real case, but this guy could do it like they make motorcycle seats. He could do a few a day at

his place over at Menlo Park. And Steve worked with him to design pictures of the shape. What should it look like? And the Apple II, actually, came out very attractive even to this day. I just think it's an attractive case. It was a really big step. But Steve likes-- there's a plastic case and there'd be so much heat inside, it might overheat.

02:25:12;12

And we'd need a fan to cool it. You put in a fan, that cools it. Steve wanted to skip the fan and he knew this bright engineer at Atari that could design what's called a switching power supply. Today, all power supplies are switching supplies, they're all tiny because they have chips that do it. But Ron Holt joined us and he designed a little circuit that took power out of the wall and let little bits of it at a time charge up circuits to get their voltage up to 12 volts, up to five volts.

02:25:40;18

It's all inside going on. And when it's at 12 volts, it stops charging it and when it drops a little charge it'll give it another pulse to keep it charged. And it's so efficient that

you'll lose very little of your energy to heat. You have

very little waste and we don't need a fan.

02:25:54;23   So it became a really good example of-- use the brain and

                       you save the fan and you, basically, wound up with, you

                       know, in the end, the way things are made in electronics

                       are basically the same price. So we had a state-of-the-art

                       power supply. And Rod Holt, the engineer who designed

                       it, joined us as a member of our executive staff.

02:26:14;07   So we had five people that ran the company for the first

                       couple years. I did the engineering. Steve did whatever

                       the company needed, every role of the company, having

                       oversight and because he understood the digital stuff even

                       if he didn't design or he didn't write programs, he

                       understood when somebody was on to something good or

                       when somebody was slacking off, just doing a lousy job.

                       Mike Scott was our president.

02:26:38;16   Mike Markkula joined us with his money and he ran

marketing. And well, I mentioned-- I think I mentioned all five of them. I can't remember. Yeah, it was Mike Markkula in marketing, Mike Scott was president, Steve, myself and Rod Holt, the analog engineer came in. And one thing I liked about Rod, although he wasn't a digital engineer of computer programming, he hadn't really written programs.

02:26:59;24

He started playing around with the basic programming line on my Apple II. And he, being an engineer, he learned it very quickly and easily. And that's what I liked about the whole Apple II design, was I intended it to be a learning machine. Anyone could sit down and, right away, be learning how to make programs that they could think of.

02:27:18;21

You know, I had learned all my stuff in computers by reading other people's journals. I never took a course, never read a book on computer design. I would look at their design and see what they had done and I got it from others. So I wanted to pass that on.

02:27:32;25   And in our manuals we put in all my schematics, all my

                               code listings, everything in the world that I had time to

                               write, just instructions because I wanted it to be a learning

                               machine. This is what computers are. This is the parts

                               they're made out of, here's how you write a program.

                               Here's how you write a program in another language, go

                               do it, it's ready to use.

                               BARRY HURD:

02:27:51;03   Do you think in those early days being small like that

                               made you guys more innovative? I mean, did the size of

                               the company have something to do with that, sort of,

                               direct design it as opposed to marketing a product, you're

                               actually engineering something?

                               STEVE WOZNIAK:

02:28:02;13   I would say yes. When you're small, just everything

                               you're doing-- but remember, everything we were doing

                               had never been done before. So we didn't have

                               roadblocks. We didn't have obstacles saying you have to

                               design a certain way. Stores were opening up. We didn't

have to go in and say, "Oh, we'll buy the shelf space so we will have it instead of Radio Shack."

02:28:19;21   They didn't have any agreements like that. We have a good product. You want to sell it? Here it is. We were very lucky time-wise that we were ahead of the rest of the world so it was easy to sell. Any device we decide to make, let's make a printer interface. Let's make something that will talk to modems.

02:28:34;12   Let's make something that will print out on serial buses. Let's make a floppy disk. Everything we ever designed instantly would have a lot of sales. It was gonna be profitable. You couldn't go wrong. So you couldn't make wrong choices so we didn't have a lot of structure saying, "Don't do this and we'll get a spec and we'll approve every bit of the specs."

02:28:51;24   "And then you go build what's on the spec and don't try to change it if you get another idea."

No. We just went in with, " I'm gonna work on a floppy disk for the next two weeks and go in and work hard on it and do a good job and get something to work and to show off and we're done."

BARRY HURD:

02:29:06;03   And then did it come to a point where Apple got bigger and bigger and you started having to follow some of those procedures you just talked about? It got a little less fun or innovative?

STEVE WOZNIAK:

02:29:13;04   Yeah, I was in, yeah, Apple had gotten to a point with maybe a hundred engineers or so. We had different buildings and labs. And I was in one lab and-- and, boy, I saw all of-- we had a lot of structured type thinkers, and I'm more of the artistic, almost the right brain approach to engineering.

02:29:29;16   But a lot of these left brainers, every little thing was documented on paper in advance, like, "How can you know what you're gonna do in advance?" When I was creating

things, it was like, "I'm gonna try this chip and see if it works roughly, and get an idea of what it can do. And then I'm gonna try to do the max and put another idea that comes into my head."

02:29:46;16   And I don't flow like I'm gonna follow a script. And, of course, I could do anything I wanted. So I could sit around and, "Hm, I think I'll try to come up with a program to make the disk more effective or faster today." And I could just go to work on anything I wanted.

02:30:00;08   I didn't really have equivalent of a boss. So I was outside of that structure but it just wasn't something that I would fit into. I like little start ups when people are talking, "Rough ideas," and, "You don't even know if it's possible or not. Let's go try it."

BARRY HURD:

02:30:13;27   So the lack of structure is a better way to create innovations is what you're telling me.

STEVE WOZNIAK:

02:30:18;00   Well, yes. I would say you're more-- there's a lot more

innovation and it goes in a lot more directions. And it's a lot more fun and interesting for the people doing it. They're motivated differently. They're motivated because they want to do something to show it off or because it's gonna be good.

02:30:33;10   And they're not doing it because they're being paid a salary and, you know, and able to do it. But, not everybody can be that innovative either. So a large corporation doesn't really have a choice. A large corporation turns out they're protecting their market, making sure you don't lose your market and your sales. It's a money machine. Keeping the money machine going is much more important than trying to innovate and come up with something new. What if something new-- all your effort on something new and you've got known for it and you lost some of your real income, your money.

media id: woz3.mp3

BARRY HURD:

03:00:59;17   Okay, Steve, I handed you a sheet of supposed quotes of

what was said to you when you guys went around to sell

the Apple II was it?

STEVE WOZNIAK:

03:01:05;22   Well, different times.

BARRY HURD:

03:01:07;07   Okay, read one of those quotes and give me your reaction.

STEVE WOZNIAK:

03:01:09;04   The first quote I glanced at, "We don't need you, you

haven't got through college yet." That has, actually, been

taken a little bit out of proportion. It was said by Hewlett

Packard to me. Francis Rohde, one of the original

developers of the HP 35 handheld calculator, wanted me.

He saw what I had done with the Apple projects and all

that. And he wanted me to be the designer [of a device]

that you could hold in your hand with a little display on it

and doctors [could] take it around to patients to type in

questions that patients could type things back, answers

back, just a simple communication tool.

03:01:42;05   And he wanted me to design it. Now, it had to be

designed in Hewlett Packard labs. And they had five labs of mostly, you know, PhD research top guys. And I went over there and interviewed for the job. And I could do whatever was needed for this thing.

03:01:56;06   I wrote a computer language without ever having a course in it. I figured everything out. And they knew I could. But they had turned me down because I didn't have a degree. I'd be really low on that scale over at Hewlett Packard labs. So I didn't get that job.

03:02:13;04   But it wasn't like they didn't turn me down for the Apple II because of that, no.

BARRY HURD:

03:02:16;13   So that context is a little bit off the mark.

STEVE WOZNIAK:

03:02:18;00   As a matter of fact, the engineers in my lab, the calculator lab, would come to me and say, "That Apple II is the finest product I've ever seen in my life." And they knew that their company, Hewlett Packard, couldn't sell it and had turned it down repeatedly.

BARRY HURD:

03:02:31;23   What about the next quote?

STEVE WOZNIAK:

03:02:32;27   Next quote, "Get your feet off my desk, get out of here.

You stink and we're not gonna buy your product." I wasn't

around any kind sort of horrible thing [like that]. And

that's supposedly by Joe Keenan, president of Atari,

responding to Steve Jobs' offer to sell him the rights to the

new personal computer. Oh, that's totally wrong, totally

wrong. I know the real story.

BARRY HURD:

03:02:56;02   Correct the record.

STEVE WOZNIAK:

03:02:56;27   The real story is we have the Apple II. We didn't have

money to build 1,000. We're looking for how to make

some big money off of it. And Steve and I went and

visited Al Alcorn, not Joe Keenan, in his home. And Alcorn

had a projection TV, one of the earliest ones ever. You

know, techie guys like to be state-of-the-art. We hooked

it up and it played in his house. And we showed him how

you could write little programs on it. And Al was intrigued.

But they were about to come out with the first home Pong

game in the United States, big money. Atari was finally

gonna be making big money. And they didn't have time to

diversify and do another thing at the same time. And

that's the truthful reason. So that one is very wrong.

That one's just wrong.

BARRY HURD:

03:03:42;04   Well, now, we know.

STEVE WOZNIAK:

03:03:43;29   'Cause I was there. Quote, "There's no reason for any

individual to have a computer in their home," Ken Olsen,

Digital Equipment Corporation. That is probably true. It

was a quote going around. And it made sense from some

points of view. In other words, if Digital Equipment

Corporation whom he was-- he was president of that

company, what did they sell computers for?

03:04:09;12   They sold computers that cost as much as a house to

factory floors, to people doing scientific research

evaluations. And these little tiny machines wouldn't do the job. That's right. And by the time they did the job, you'd have to put all the money in again to buy printers. He didn't, you know, have the [vision] he didn't see that, "Wow, for $1,000, a price humans could afford, a lot of people would want something that was close to a computer, a starting point. A lot of people would love that starting point." And he didn't see that it would eventually be a good platform to innovate on because of the low price. So he was right and wrong.

STEVE WOZNIAK:

03:04:46;00   It's an interesting quote.

BARRY HURD:

03:04:47;26   Let me ask you about your Hewlett Packard experience. We're not in any chronological order. But tell me, that was supposedly the company at the time, was it not?

STEVE WOZNIAK:

03:04:55;02   All my life from when I was in elementary school doing science fair projects, my dad might bring home an

oscilloscope to use. And it was a Hewlett Packard. He explained that they made the most precision equipment. And they were very bright engineers out of Stanford. Everything about their company spoke engineering calculation, the perfect parts, make machines that worked so well.

03:05:15;08   They're better than just the junk you buy normally. And when I went to Hewlett Packard, they had many divisions across the country. And all of the divisions built the equipment and the tools that engineers used. So it was an engineer's company building the stuff for engineers.

03:05:31;22   I mean, we were the market. We understood what they would be using our stuff for. Even scientific calculators was almost the first break towards a consumer appliance. They built power supplies. They built tone generators that would put a tone on a wire to feed into equipment to test it. They built the oscilloscopes that had displays of signals that you could get things-- your circuit working perfectly.

I mean, they were really an engineer's company.

BARRY HURD:

03:05:58;03   How was their management there? They had all these innovative engineers. How did they support you and keep you guys cranking out the good stuff?

STEVE WOZNIAK:

03:06:03;18   I never wanted to move up in management. So I never got a real good insight as to how the management worked. At the bottom, it was excellent. We engineers were respected. They—management--would come up to us and say, "Can you come up with some new ideas for the next calculator?" And we'd sit down and toss out our ideas and come up with the new ideas. It would be the new product that would drive the division of a company. It didn't get forced down on us. Sometimes above one on certain things, but generally, yeah, the flow of new products came from both directions.

03:06:32;26   And I liked that. I felt very respected there. The engineer's company, started by engineers, infiltrated with engineers in every level of management. And they

respected good engineering abilities and thinking. Every

single division of Hewlett Packard had its own IC

manufacturing plant built in so they could get little

advantages, you know, built the absolute finest products

possible, not just buy stuff off the shelf. We'll package it

up and we'll sell it.

BARRY HURD:

03:06:59;18   And are they still like that today? Are they changed?

What's your opinion about it?

STEVE WOZNIAK:

03:07:02;11   That's a very different company. They sold off that part of

Hewlett Packard. And it's called Agilent today. It still

makes test equipment, it's still well respected. But

Hewlett Packard followed more where the money flow went

once they got into printers. They had a new printing

technology, the inkjet printers.

03:07:20;02   And, boy, have they done just-- you know, taken the world

to different places with that. They kept some of their older

businesses of larger computers, the sort that businesses

buy. And they have the personal computer line. Personal

computers, though, get to a point that you're competing against a lot of other companies that have almost the same product.

03:07:40;16   So it becomes a big marketing game. And instead of being an engineering driven company, we have these extra engineering features, now, we have these extra marketing points. You know, we're blissful. We're a new day in the sunshine. We're the path to outer space. And the words don't necessarily mean anything to an engineer.

BARRY HURD:

03:07:58;23   Tell me a little bit about even though you said you weren't a manager that if somebody had a company. They're trying to foster this innovation and make people wanna discover new things. Well, I mean, you've been around. What would you think would be a way to do that to keep people on it?

STEVE WOZNIAK:

03:08:09;26   Well, first of all, try to hire the bright engineers. Try to hire the ones that have, in themselves, the ability to invent

the engineering technology, not ones that just already know how to do it, that have already-- you know, right now, companies go out and they [say]-- "I want an engineer who's done this and that and the other thing and that'll have all three of those disciplines in the right place."

03:08:31;01   Find the engineer that's young, that whatever new discipline he doesn't know already, he'll learn it or invent it on his own and make the most out of it. Try to find those real bright ones, hard to find them. You know, it's kinda like trying to find the ones I was when I was an engineer. It'd be hard to find them.

03:08:47;11   But you know what? I can tell when I go around colleges and talk to young people, there's a few that just strike me. They've got something-- it's an extra drive in them that's gonna take them to, you know, more than just the standard place that is expected of an engineer who gets a degree in engineering.

03:09:01;11   They are solidly inside, they wanna be an inventor and a

                     designer and they're often very independent. They're

                     harder to manage. Give them a lot of freedom. Let them

                     build devices for their home and their own. Give them

                     some of the parts.

03:09:15;19   You know what? You can pay for them to take courses at

                     Stanford or you can give them a few parts which is another

                     form of payment and let them build what they think. And

                     they're gonna-- their mind is gonna develop techniques of

                     designing things and building things that is gonna show up

                     in your own company's products.

03:09:31;16   Now, when somebody comes up with something like the

                     Apple II, recognize it for how great it is. And even if it

                     can't be done within your company, it doesn't fit your

                     whole product road map and everything, marketing,

                     selling, find ways to be a big sponsor to start them up as a

                     small start up on their own and recognize the good ones.

03:09:49;07   In other words, a little bit of venture capital, a little bit of

entrepreneurship within the big corporation and those sort of elements will lead to a lot. Of course, number one, still has to come your profits. So, you know, your basic market-- you've still gotta have maybe some standard-- enough standard engineers that can do that. But Google gives the engineers, what is it, one day a week, 20 percent of their time just to work on things of their own idea, you know, let them, you know, dream and-- and I think that's really a good road to innovation.

BARRY HURD:

03:10:19;20   Now, at Apple, they let you do that, obviously. You let yourself do it, I should say.

STEVE WOZNIAK:

03:10:22;16   Well, I started out doing it.

03:10:27;18   Well, I had projects in the end. I had schedules, yeah. And, of course, and sometimes I would work so hard and, oh, my gosh, I'd say, "I'll get it done tomorrow." And I couldn't do it that night. I'd stay up till 2:00 or 3:00 and the next night and the next night and the next night. And

once that happened and I finally-- I almost-- every night, I did the same things I had done the night before trying to build this one complicated, complicated solution. Finally, one night, I stayed up till 6:00 and got it working. Everybody was coming in the doors. And I was going out. And I said, "I got it done."

BARRY HURD:

03:10:59;25   You know, you have this quote. I think it's [in] your autobiography, it says, "Technology always moves us forward." Can you tell us a little bit about the real meaning of that to you?

STEVE WOZNIAK:

03:11:07;27   Well, technology-- one of the things is when it comes to computer type technology, I mean, some technology, it's just a better tool that saves us labor. And that helps us. Computer technology saves working of the mind. You don't have to think to add two numbers.

03:11:23;26   You can just push the buttons or to calculate the [tip] at a restaurant. You can multiply it out. And it, basically, did

the job for you. Technology shouldn't force you to remember a whole bunch of things either, save it for you. Today's personal computer is the best example. I think my computer means the most to me of any technology in the world.

03:11:44;02   It is storing all this data that's important to me, that I know where it is so I know I can find it. And even if I forget where it is, I know that I have methods that will get me to find it. Plus it makes my life fun, more entertaining.

03:11:58;00   And when I'm doing work, I always believed in my life and the Apple II is a big part of this philosophy that what you do for work should be fun. So I made the Apple II a very fun machine, a machine you could program in jokes right along with work. You could enjoy it. It was in color. And you could play a game and then go back to work on the same machine. I believed very strongly in that and, you know, the personal computer is certainly an-- an outtake of entertainment.

BARRY HURD:

03:12:27;13   So that's why you liked the pranks. I mean, is there some

correlation of the pranks and the engineering, the artistic

design?

STEVE WOZNIAK:

03:12:35;02   I don't necessarily think so. I think the person could do an

artistic design and not have to be a professional prankster

like I am. But in my own case, it might've been just a

psychological release. You know, you're an engineering

technologist. You kind of speak geeky talk.

03:12:55;09   You don't relate to normal people. You've got your little

engineering friends. You develop inside words. You

develop your own little inside jokes. And very often with

engineering, it's a building science. It's like auto

mechanics. And you actually are making little devices

other people don't understand. Very often, you can design

a device that will make a radio knob go backwards instead

of forwards.

03:13:17;13   And it's, like, a joke. And it sounds funny. And you laugh at it at lunch. So once in awhile an engineer goes back and does one of those little projects that sounded like a joke and has fun. And it's a prank. You've fooled somebody with your electronics.

03:13:29;22   And I just grew up liking humor, pranks my whole life. I learned in middle school that if you pull pranks or jokes at school, you get in trouble and you get caught even if you didn't do anything bad, you did something unusual, you get, you know, you made a face at somebody. You get sent home. You get punished by your parents. And I learned don't tell anybody what you did by the time I got to high school. So I did lots of pranks. And it was great. You can do a prank, have a little chuckle and there's no penalty.

                                             BARRY HURD:

03:13:59;00   Are there any pranks that are ongoing you, now, wanna admit that are yours that we can reveal?

STEVE WOZNIAK:

03:14:02;25   No, I do pranks every day, every day, to this day, I try to

make up a little joke. So just the other morning I kinda

got up and I had an empty plastic bottle of water. I stuck

it under my armpit, went back to my bed. And I got my

wife and I said, "Oh, my neck hurts."

03:14:17;18   And she looks up. And I squeezed the bottle and big

crack. And she jumped. And I laughed. And we both

laugh. You know, you gotta be with somebody that enjoys

your humor. Some people do not like humor. And they

should be around people that don't do humor.

BARRY HURD:

03:14:33;08   What was your Apple II of pranks?

STEVE WOZNIAK:

03:14:36;20   Apple II-- I don't have one. I get asked a lot, "Well, name

one prank." And there's so many hundreds of pranks I've

done. What means the most in my heart are two pranks

Steve Jobs and I tried to do before Apple that didn't come

off, either one of them. But they were just such great

ideas. And one was Steve had learned how the sprinklers

system at our high school worked. And he learned that if

you throw one switch it turns on the water supply.

03:15:01;01   And you turn on another switch and it turns the sprinklers

on the football [field] where the parents sit during

graduation. So a couple days before graduation, we took a

lock pick friend to try to pick his way into the building. I

climbed up on top and got in but the wrong part of the

building.

03:15:16;13   So we never pulled it off. But it was a really funny one.

And we had another graduation prank one year where as

the seniors came out of graduation, half of them came

around one side by the C building. And right off the C

building was this big sign that got unfurled that said, "Best

wishes." And, you know, some people would look at that

and say, "Oh, what sick people to do something like that?"

And I don't understand it. It's fun. It makes us laugh.

And to me, all laughter is good. I've been-- going around

with a Hollywood comedian recently, Kathy Griffin, who's

known for putting down a lot of celebrities. And the first--

right from the start, I said, "You can humiliate me and

embarrass me all you want. And if it's for laughter, it's

worth it."

03:16:01;15   If people are laughing, you know, all this, "Oh, my gosh,

you hurt somebody with that joke." Well, I don't know, if

they ever tell a joke about your ethnic group or something,

you know, that's very evil. And then you say, "Oh, my

God, that joke is evil."

03:16:17;00   And I told a joke at an engineering graduation that has

nothing to do with characteristics of an ethnic group.

What do you call four Mexicans in quicksand? Quattro

cinco, it's a very funny play on words. And somehow, they

said I offended 400 people.

03:16:34;02   And I'm thinking, you know, this offense is man-made.

It's not God-made, it's not nature-made, it's man-made.

You have to be offended if you hear the word Mexican without thinking it's a joke-- you know, a bad joke or a piece of humor.

03:16:48;22   Laughter is so good a medicine. You know, talking to people and laughing is the best psychology there is. I think that, you know, you use this kind of psychoanalysis, you use this other kind of psychotherapy. And you use being on the waiting list and talking to friends and talking to friends, you'll recover just as fast.

BARRY HURD:

03:17:06;00   Well, let me jump back. We were talking about innovations and you gotta find good engineers that are hard to find. Do you think America, which is classically a place for innovators, historically, is still a good place for innovation?

STEVE WOZNIAK:

03:17:17;20   Absolutely, I think we're the best. And it's strange. But sure, we have a lot of problems in our school systems compared to others. But a lot of these others societies

grow up a lot more strict and rigid about your behavior. You have to do good in life.

03:17:30;19   They put a strong pressure and you have to good in life. And we, in America, kind of like, "Well, you know, you'll probably have the life. Or it's a lot more random." And we don't grow up with as many parents, you know, directing, "Here's what your values have to be and blah, blah, blah." And in my travels, I've talked to a lot of young people in elementary school, in middle school, in high school, in college, and young people out of college. And I just see the sort of mentality that it's trying to think of new ways of doing things that haven't been done before.

03:17:59;07   And when I go to other countries, I don't encounter that as much. Or when I do, it's usually young people, it's like 15, 16 years old. And they might have all these great ideas. And they're things that, you know, I have real smart adults, too, that are clever and creative ones.

03:18:15;22   And they say that's a great idea when they hear the same

thing. So around the world, I see it. But in the United

States I see it everywhere I go among engineering type

people, interns at Apple, you know, maybe not managers,

maybe not ones that are trained in the business world.

But the ones that are trained in electronics, yeah. I would

normally say-- "There's a lot of reasons why we got these

big companies. And we've gotta outsource this on the

engineering. And we're not doing it ourselves." But, no, I

see so many influences for the push to do the new things

that haven't been done before.

BARRY HURD:

03:18:50;12   How important do you think teachers are to that whole

process? Obviously, you were a teacher. But teaching

that idea of freedom of expression and thought, doesn't

that encourage you to visit our young people?

STEVE WOZNIAK:

03:18:59;20   Well, there's two things, teachers and schools, and they go

together. And a lot of times, a school means the whole

system of education. Sometimes the system, in my day, I could play a bunch of pranks and be a little character in class and be a comedian in class.

03:19:15;19   And today, you get your hand slapped for the smallest little jokes. And pranks aren't allowed. And the schools tighten up. And it's gotta be almost kind of a religiously run life. And you can't have that kind of humor with your education that you used to have.

03:19:30;16   I mean, sure, kids are kids. You can't take away a lot of that. It'll come out anyway. But they're almost considered bad kids that do that sort of thing. And it bothers me a lot. But I know that education can be a lot better. Education's always gonna be imperfect.

03:19:46;09   Education in the United States largely comes in public education, say. Where does the money come from? The government. The government has a pie. And a certain percentage of the pie is gonna go into the military and according to how many people-- if more people want more

military, there's gonna be more military, more voters.

03:20:04;14   And some, it's gonna go into farm subsidies. And if there's

more people that want farm subsidies, the farm subsidies

will be bigger. But kids don't get a vote on education

money. A family of five gets no more votes than a family

of two. So you've got people in a community.

03:20:18;20   Some have kids and want more money in education. They

want a better educational system. Some have no kids or

they've already had their kids. And they don't wanna

spend any money on education. But the trouble is, both

the family of five and the family of two get the same votes.

03:20:32;27   So, you know, we don't have the right amount of money

that comes from the government to our schools. One

teacher that cares will never fail with one student. If we

can get the class size smaller and smaller, we'll always do

better. But if we have a system where teachers get paid

more for teaching 30 kids poorly, than they get paid for

teaching 20 kids well then they wanna teach 30 kids poorly

and get more money. That's a problem.

BARRY HURD:

03:20:58;03   When you were teaching, you weren't slapping hands were

you? Were you applying your philosophy to these kids?

STEVE WOZNIAK:

03:21:01;28   I was volunteering. We had a lot of fun allowed-- fun was

built in to the class. And anybody who did anything fun on

their own, you know, sort of got applauded, almost. I told

[the kids], "If you can, over the network, get into

somebody else's computer and move things around and

scare them, that's okay, as long as you can undo it easily."

03:21:25;29   And in eight years, every time they did something like

that, it was easily undoable. In other words, they wanted

the fun of doing something they weren't supposed to be

able to do because somebody hadn't protected their

computer properly. They wanted the fun. But they didn't

wanna destroy. And I was volunteering so I couldn't really

lose on that. My kids-- my classes-- I could even talk

philosophies and values of life and why you might discover

this later on. And you know, like a parent, "Boy, you can get in trouble-- as a teacher in a public school giving the kids some ideas of, you know, right and wrong."

03:22:10;03   (BREAK IN TAPE)

BARRY HURD:

03:22:12;09   You said that innovation wasn't happening in PCs today. Where is innovation happening?

STEVE WOZNIAK:

03:22:19;06   PC, itself, is what you take home-- yeah, it's kind of an incremental, step-by-step process, right now. And it's not coming out well. It is so much different than it ever was before. Now, you know, we have had tablet PCs I would call great innovation. But we're not having a great innovation every month like at the start of the PC revolution.

03:22:38;21   Every new program, every new little device that came out, whoa, the world is changed forever. Nowadays, I think it starts more with market has so much money going in from

the big companies. There isn't that room for the one guy who has all these creative little bright ideas because whatever he does is gonna look small and be judged small proportionately.

03:23:00;07   Software, look, we just opened up an app store on the iPhone. And a lot of people jumped out and wrote some of those early programs, simple ones. Some of them do very useful things. Some of them do entertaining, fun things. There's a lot of innovations going on in the areas of display. But big companies kind of control that because the display market is a multi-billion dollar market. And anything that's big gets the attention from money to make sure that the money wins and if there's an innovator out there, buy him in.

03:23:28;28   And the innovator disappears. In other words, it's not so much like the lone inventor that goes into the shop and comes up with something neat on their own. Look at recent times stuff, we've had small startups. And they're

usually young people like Steve Jobs and I were when we started Apple, starting, you know, working on something that becomes as big as Google or Yahoo or, you know, a few of these other net-based, you know, Facebook and Digg and those kind of websites that-- it's almost always somebody young and finds that there is a place to, also, at the same time, innovate. It first is the drive. And then after all the discovery, "Wow, we're gonna change the world so big." And that's always equivalent to a lot of money.

BARRY HURD:

03:24:09;12   Is there another big hardware thing, though, for PCs we should be looking for? I know you said display technology.

STEVE WOZNIAK:

03:24:15;26   You know what? There are people that will work on fast-- ways to make chips faster in the future and make a lot more memory available. And you won't need a hard disk, maybe. Everything will be on one chip, your entire life and every movie and everything.

03:24:30;10   But that doesn't really solve a lot of the world's big

                                 problems anymore. A computer can sit down and store

                                 your music. And it'll store your music in the future in

                                 about the same way. Well, there aren't very many steps

                                 different. It can run the finances of a company everything

                                 from parts and inventory to employees' salaries and their

                                 benefits and HR. And the computers have been doing that

                                 for a long time. They're doing that same step today. The

                                 computer, itself, can get a little bit less expensive. We're

                                 talking about the move to the cloud.

03:25:07;25   Right now, you know, it doesn't matter. You know, when I

                                 first typed on my keyboard, I was talking to a computer in

                                 Boston. And it was talking back to my TV. And we've

                                 gotten away from that with PCs. Starting with the Apple,

                                 we said-- we're calling it personal computer because it's

                                 personal.

03:25:21;24   It's you. You're not connected to a whole world.

                                 Eventually, we had reasons to wire people together so they

could share an expensive part like a laser writer printer.

And then we discovered the internet and the whole world

so we could share all the ideas of the world are at your

disposal.

03:25:36;23   So already, we're-- a lot of us is out there. Almost

anything I use the computer for is sort of out there. You

know, except for me when I send e-mails, me to you. It's

me to you. But we're using equipment out there without

knowing it. We're using programs that are out there,

sometimes, without knowing it.

03:25:53;06   And eventually powering it up and I can run a program to

play my music. Well, the program might eventually come

from out there. I don't really think so. I think a lot of the

programs are so cheap and so versatile and so-- you like

to have it in your possession, in your little laptop, in your

phone, whatever. You like to have the program there and

not have to depend on being hooked up to run it.

                                      BARRY HURD:

03:26:16;18   Okay, let me jump in. The question about--

STEVE WOZNIAK:

03:26:19;00   A lot of the innovation starts with researchers that are in

the chemistry, physics and those type of [fields]-- in

university research things discover a new material that has

a new property. And recently Hewlett Packard has

announced it has a new memory it's gonna make and

patent. It's called Memristor.

03:26:38;23   And it was a type of device, they didn't know if it ever

existed. And they finally found a type of atomic material

that does that job. So the people who are working on raw

elements and molecules that do new things. Now,

technology, making little devices that you almost need an

electron microscope to see.

03:26:56;27   They're developing new materials with new properties.

And I think it all starts there. And then after some long

period of years, some of those things, actually, they're

gonna make sense, economic sense. They're gonna make

a material that is a better value.

03:27:11;24   And then more years beyond that, they get implemented.

Like when I started out building computers, I looked at the

chips. And they had designed chips with certain features.

Those features, I was, now, gonna put into a device people

could use. But it was many years from where somebody

decided what features people would use some day until

they actually got it.

BARRY HURD:

03:27:29;26   Right, you knew that 6502 chip. . .

STEVE WOZNIAK:

03:27:33;09   Well, no, but-- there were other chips even besides that

that had certain capabilities. I go down to the atomic

level. And I almost developed all my own stuff, my way of

creating video signals. Well, somebody else might develop

a video chip or develop a floppy disk chip. And then a few

years later, it'll be in a floppy disk and make it cheaper.

BARRY HURD:

03:27:59;23   Let's start about with the story when you moved away

from Apple. Tell us about how that happened.

STEVE WOZNIAK:

03:28:05;03   Well, there were different times. I was in Apple. And I

was thinking, "Wow," all of a sudden, we have this

engineering structure with managers that get all this

feedback to them. And really, it was a way of putting the

control of the company up high in a few individuals instead

of all the engineers.

03:28:20;18   A manager will ask, you know, I want you to write up what

you can do and get this. And a manager can modify it and

approve it and say, "Okay, here's the final one that I'm

willing to sign off on. And my manager above me is willing

to sign off on." And then the engineer has a project to

work on. I don't work that way. I didn't like it.

03:28:36;21   So I was thinking, "Gosh, you know, Apple's-- all of a

sudden, Apple had about 50 projects going on. And I

could only be working on one at a time, of my own. Hey,

you know, this company is really going to go as well and

as far whether I'm here or not. I'm not the critical one

engineer that everybody needs anymore."

03:28:53;16   And I would've liked to find a way out of it. But I could

never say I'm leaving Apple. And after I had a plane

crash, amnesia for five weeks. When I came out of

amnesia, the first thing I did, I called Steve Jobs and said,

"I'm gonna go back to Berkeley and get my degree."

03:29:08;14   You know, I had enough money by then from Apple that I

had the freedom to make that sort of a choice. And that

was me. I stayed on the Apple's payroll book. I worked

out a light salary because I still go to trade shows. I speak

for Apple on occasion. I do something Apple would call me

and want me to do.

03:29:26;10   I might even work on a project now and then. So I stayed

on the payroll because I wanted-- and I got it in my head,

I always wanted to be on Apple's computer forever that

keeps track of how long you've worked for the company.

How long you've been getting some small salary. And I

am to this day.

03:29:41;17   After I went to Berkeley and earned my college degree and

                               I, also, ran some big rock concerts, I walked right back

                               into Apple. "Hey, you know, I'd like to work here again." I

                               walked into the division where I thought I had the most to

                               contribute, the Apple II 3 division.

03:29:57;17   When I had my plane crash, I had been working on the

                               Macintosh. But it was, now, in a separate division of its

                               own. And I hadn't designed it. So I wouldn't be able to

                               help it as much as the Apple II 3 which was still the bread

                               winner of the company.

03:30:10;21   And after a certain point in time, I was talking to some

                               friends and a really cool idea popped into our heads. Why

                               don't we make a remote control? See, I was at home.

                               And I had a lot of remote controls. Almost nobody had a

                               hi-fi with a remote control.

03:30:25;18   But I did. And almost nobody had a satellite receiver.

                               They weren't sold yet. You almost had to build your own.

And I had one with a remote. And I had a remote for my TV and a remote for my VCR. And it's enough remotes. And I had laserdisc players.

03:30:37;05   So I have like five remotes. How can I make one remote do it all? The universal remote idea hit me. I got another engineer that came out with a bunch of weird ideas. He was kind of a-- one of those crazy types, Joe Ennis. And that inspired me to think even more about the idea. "Man, I've got the sort of guy that thinks and isn't afraid to challenge-- do new things a new way." And I said, "I love these little startups when you have just a few engineers and a few other people that are talking wild new ideas for the world." That's where I like to live. I don't like to live in the world that's well-known because everybody in the world who knows how to put money in and build factories cheaper and this and that.

03:31:16;09   They're all winning that war. I don't like to, you know, get into competition either. I like to be out doing something

different because, then, you're not challenged. I don't like

to be confrontational. You're not in a confrontation having

to prove your better than someone else is not my thing. I

don't like to do it.

BARRY HURD:

03:31:32;12   You like to work alone, you're saying?

STEVE WOZNIAK:

03:31:33;21   I like to work alone and you're just-- yeah, whatever you

do is better because nobody else is doing it.

MEDIA ID: WOZ4.MP3

STEVE WOZNIAK:

04:00:33;17   Yeah, first computer ever with a plastic case.

BARRY HURD:

04:00:35;28   Tell me what year that happened. Or tell me a little bit

more about what happened.

STEVE WOZNIAK:

04:00:39;26   Sure, right now?

BARRY HURD:

04:00:40;12   Yeah, right now.

STEVE WOZNIAK:

04:00:41;14
Okay, well, we had already sold the Apple Is in 1976. But it was kind of build your own wooden case. And we had little wooden cases for it. First time we-- you know, you need a large volume to justify making a plastic case. So the Apple II, we decided we wanted a plastic case and came up with this great design. I mean, it looks kinda like a typewriter. It fits in all the innards of an Apple II including the extra parts you could plug in over time. We didn't know what people would design, what they would wanna use the Apple II for.

04:01:11;22
Would they go to have a board for a floppy disk? Would they have hard disk boards? Would they have boards for modems and this and that and scientific instruments? So we didn't know. But there's room in there for it. There's a very simple case removal.

04:01:23;15
You have to imagine, this is the Apple II computer that I'm known for. And it really did bring computers to the home.

It was the first one that had the features people wanted at a price they wanted. And you have to imagine you had a television set with it. And it could be your big home TV. And you type in here and see words on the screen. And you could run programs and have fun.

BARRY HURD:

04:01:45;22   Now, tell me a little bit how you came up with that disk drive.

STEVE WOZNIAK:

04:01:48;28   Yeah, when we first came out with the Apple II, like the Apple I, it stored programs through a little wire, there's a hole in the back and an earphone jack right into your cassette tape recorder. You'd press play, record on the tape recorder and record some data. Or you'd press play on the tape recorder and play a game off of cassette tape into your machine and run it. And that's how the first software was sold for the Apple II. Well, one of the programs-- as we worked on certain programs like a checkbook program for the home user-- a flash card program to demonstrate its abilities in schools.

04:02:22;10   We had these programs and we thought, "It takes too long

                                to read them. How do you speed it up?" And Steve Jobs

                                had, actually, been a honcho for the floppy disk before we

                                even started the-- the company for real. He'd be in with

                                Shugart. They had these things called floppy disks.

04:02:36;17   I had never worked with any kind of disk drive in my life.

                                And I had never worked with anything. But I knew that

                                was one of our high priorities to do some day. And I had a

                                few little weird ideas. When I see a chip that has a certain

                                feature, I think right away, how could that feature be used

                                in the real world?

04:02:52;12   And one of the ideas I'd come up with before leaving

                                Hewlett Packard even was to put data onto a floppy disk

                                and out using this one new chip. So one day, we had a

                                meeting. And turns out that the very first time ever the

                                big consumer electronics show in Las Vegas, the one that

                                all young technical kids wanna go to see the newest hi-fis

and speakers and amplifiers and car systems, the first time ever they were gonna allow personal computers in, Apple, Radio Shack and Commodore. And three of our marketing people who were going, Mike-- Mark Lewis, Steve Jobs and a sales guy-- I think it was Gene-- forget his name and they were all gonna go to Las Vegas.

04:03:30;18   And I thought, "Wow, I wish I could be in on that group. But they're taking marketing people." And so I said right there-- I said, "What if we have a floppy disk, could we show it?" You know, and the show was two weeks away. You don't design a floppy disk and controller and all that in two weeks.

04:03:47;00   But I do the unusual things. And they said, "Yeah, if we had a floppy disk, we'd show it." This was my in, my way to get to Las Vegas, to see the lights of the city that I had never imagined actually seeing in person. And I got to work. I worked every day, Christmas Day, New Years Day, this young employee, Randy Wigginton, came in and

worked on some of the software with me. And I got my little tiny design without knowing how disk drives were made or what they did, I got a design done that could, at least, write a program onto a disk and read the program off of the disk.

04:04:20;00

And then I said, "Well, I wonder what I'm missing? All the other designs have a lot more chips." So I opened up a competitor's design. I reverse engineered it. And I figured out mine did more in the end. So I knew I had another big winner just like the Apple II, a little board, floppy disk drive.

04:04:34;14

You type "run checkbook." And it would run the checkbook program. And that was a big step upwards for computers. We showed off the floppy disk. It got a lot of attention, immediate hit. We figured out ways to get the prices so much lower than everyone else. And part of it was few parts in the design. And that was a big step for computers.

BARRY HURD:

04:04:54;28   Okay, I mean, that's 1976, roughly.

STEVE WOZNIAK:

04:04:57;16   Yeah.

BARRY HURD:

04:04:57;29   So I mean, everybody was going. And then what are they

doing today? What can you tell us about-- the Apple 17 or

whatever?

STEVE WOZNIAK:

04:05:02;25   Well, I love technology and I love following gadgets. I had

20 hours a day to work every detail in my head of an

engineering design and just do engineering constantly

back then. Today, I can't be that way. I have obligations

you get as you get older. And I have families and homes

and you know, and I could be more of an idea person and

try to find engineers to do the final design.

04:05:26;00   And in that area, though, I get intrigued by the new little

things down at the lower levels, at the atomic levels, the

new ingredients and applying them in a new way to make

some new device that doesn't exist. And I've had some failures. I've started out trying to build devices that turned out to be-- that what was an excellent device was impossible to build today.

04:05:44;29   And I had to give it up because I don't wanna build just little junky, crappy device. I don't wanna put out another one of these, you know. I like to think about things that other people aren't doing.

04:05:58;26   One of the things that's intrigued me for about 20 years is, is it ever possible to have light signals switch each other around the way electrons get switched by electronic circuits? Could you build a chip that has a fiber optic cable in and fiber optic cable out and no battery, no voltage, you know, almost no electronics at all? And there's been some research breakthroughs. But most of those were a few years back. And they sort of dried up in print. They're hasn't been that much printed about them.

04:06:26;24   The other day I was reading that Intel is, actually,

                               pursuing this kind of a chip. Could you make a new

                               microprocessor that really works on light and is much

                               faster? Today, there's a chip being called photonics for

                               switching all the optical cables and the fiber cables of the

                               world and switching computers around.

04:06:44;29   There are a lot of uses for it. But I'm thinking of where

                               the photonics is the computer running on light. I have

                               some other intriguing ideas that I'm working on. There's

                               new architectures to computers; we're used to flash RAMs

                               in our iPods and we're used to flash RAMs in our iPhones,

                               devices like that. They're becoming big in the world. And

                               they've finally come down to very low cost. And you can

                               build a lot more memory even on one of those type of--

                               it's called flash memory. You can build these flash

                               memories.

04:07:13;01   We used to call them double E-PROMs. E-E-P-R-O-M,

                               "electrically energized programmable read only memory."

But it's not really read only. It's regret-- there's uses of those outside the computer as disks. But it turns out, there are, actually, some companies, Fusion-io, is one that I'm close to. And I don't have an official role there.

04:07:34;26   But I'm on the advisory board. And they make a board that plugs into the servers, today's modern high speed servers that serve all the Internet data and, you know, run the information of the world. And they do everything from e-mail to Microsoft Express servers for all your Outlook data. And when you put this board in and run it as not quite a real disk drive using the operating system as a disk drive would, but as a new type of memory substitute, disk substitute something that doesn't-- has a vague name right now-- write a little driver program for it, you can speed all those tasks up, all those computers up like two times, two X. You can speed them up faster than big multi-thousand dollar disk arrays. And it takes no power. This flash RAM takes no power.

STEVE WOZNIAK:

04:08:17;25   So that's another good application. It's a computer

architecture discussion, really. And it's one of the things

that, you know, I've loved my whole life.

BARRY HURD:

04:08:25;14   So there's a lot of things going on. If we had a bunch of

school kids here and they wondered if they could become

the next Woz, what would you say to them? What would

be your advice to them?

STEVE WOZNIAK:

04:08:33;03   Oddly enough, there's a lot of little surprises that you're

never looking for that people who start trying to create

something that they really wanna make that other people

don't believe is gonna be of much value. Well, after you're

done, you know, making it, you sometimes come up with

there is a value for this thing that we didn't see before.

04:08:51;29   And it's always a big surprise. The things that you can

predict, all the big corporations of the world are already

going into that are gonna be worth money. But-- yeah,

just young kids, you've gotta believe in yourself, believe in your own ideas, believe it's right. Keep working on it. Whatever resources you have, I know that all the best things I ever did for Apple was because I didn't have any money and had to think of inexpensive ways to get the job done.

04:09:14;04   I, also, know that by being smart but not having done things before, if it was the first time ever I tried doing something, I figured out better ways using today's parts to get it done than people had done that knew how to do it right out of their head. They would do it the old ways. They build a computer the old way.

04:09:32;02   They'd start with big mainframes and the switches and the lights and a bus. And we know that we can turn that into a computer. But it's not a computer in the form it's in. And so you know, believe in yourself and just work on it and use as few resources as you can for awhile.

04:09:48;14   You always need a few bucks to buy something. But try to

figure out the ways to do it cheaply at first even if you

can't do the complete job. You can do a part of it. And

that part of it you might-- you should be able to sell, earn

the money to make it bigger and finally get the real full

thing done.

04:10:04;26   Boy, I really look forward to kids of the future, especially,

trying to build robots. The Apple II of robots doesn't exist.

And I go and I judge the first robotics competitions in the

high schools where kids, you know, have teams and they

try to build human-sized robots to play a game.

04:10:20;18   But you control it with a little joystick. But those are the

kids that are gonna figure out how to build a robot kit that

could be applied to useful jobs in the home. We've already

got Roomba to clean our rooms. But that's one that a kid

might build, also, or to build their own Segways or build

their own dishwashing machines or car washing machines.

04:10:39;14   Sleep all night long and the thing goes outside and just

sort of goes around, little motors and washes every square

inch of your car and is done by morning. I sort of see that

coming from young kids or a machine that, you know, just

makes a cup of coffee and serves it and sets the cups

aside in the morning. You know, little robots-- the

mechanical motor plus electronics plus computer

combination is always intriguing. Also, another bit of

advice I would have is being multi-disciplinary, learn to do

all the jobs yourself.

04:11:09;03   You know, look at the build-it-yourselfers who go out there

and they melt some steel and then they design a plastic

part and go to a place that manufacturers this little plastic

round about and drill some screw holes. And they just do

the entire jobs themselves and wind up with something

built, put in a microprocessor, connect the wires, have a

little, tiny voltage power supply. But they did every bit of

it, hardware, software, everything themselves. You gotta

be that kind of make it yourselfer if you really wanna come

up with the unexpected device that's gonna be new and

startling, no one ever expected.

BARRY HURD:

04:11:40;08   So you're kind of saying work by yourself as opposed to a

team? What are the individual voices?

STEVE WOZNIAK:

04:11:44;12   Work by yourself up to a point. When one person can do a

lot of the different tasks instead of five different people

working like a committee, that's when you get the

greatness and the excellence. The product has one

uniform point of view, one thing it's supposed to do.

04:11:59;26   I'm thinking a hardware product right now. But it applies

to software. And it does it, you know, that's so right for

one person, yourself, the main developer, that it will be

good. And it will be what's considered excellent and not

just-- it does it. And it's good. It satisfies this guy. And it

satisfies that guy. And it satisfies everybody that worked

on the team. And, now, it's just a big conglomeration of

two messy things. You need one mind, at least, that

condenses it back down to what it should be, one strong

mind. I mean, at Apple we had Steve Jobs.

BARRY HURD:

04:12:29;25   Okay, good, let's stop. Let's go over by the Apple I board.

Nice answer by the way. When the camera gets over tell

us about the-- okay, Steve, we're at the Apple I board, tell

us some of the features.

STEVE WOZNIAK:

04:12:38;16   This is the Apple I that we sold minus a few parts that

were taken off so that it could be bolted on to this wooden

case. That's not really how it would've been implemented

and the wooden case would've been a little larger than the

board. And the board would've been inside. This was rev

two of the Apple I. Rev one is the one that I sat down and

hand soldered the wires and got working the prototype and

ran cables into my TV. You didn't have video in back then.

When Steve Jobs came along, it was his idea, "Let's build a

PC board and sell it for $40." That's the green board we're

looking at. And I sold my most valuable possession, my

HP 65 calculator.

04:13:18;02   Steve sold the van. We got a few hundred bucks each.

And we paid a friend of his who worked at Atari to lay out a PC board to draw. He had a little tape that he would draw around where all those little curvy lines. Those are little wires on the board. He laid them out on mylar.

04:13:34;21   And, then, that got manufactured into the PC board itself. On the PC board, we have all these components here. The microprocessor is the white chip. That's the heart of it all. And we chose the 6502 because at the date it came out, it was the most advanced, the best of all the little microprocessors even though it was the cheapest. And, you know, my whole thing in life was evaluating computer architectures and it was just better than the Intel chips. Right next to it is a very large chip which was, I believe, the one that connected to a keyboard.

04:14:09;09   That was the one that let the keyboard get into the microprocessor. And it wasn't too expensive. But it was a big chip. Most of the chips in here are just running circuitry that tells American color TVs when to start it's

vertical lines, when to start it's horizontal lines, when to

turn on and off the guns.

04:14:29;12   This was black and white only, so when to turn it on for a

dot of white and then off for a dot of black. That's what

those chips were doing there. And they store the data that

was on the TV screen. Down here in the lower right

corner, there's 16 chips. And I designed it so you could

plug in what was called the 4K dynamic RAMs. This is the

RAM of the machine. One row of RAM would be at least 4K

bytes. As the chips got better and bigger, you could,

actually, plug in two rows of up to 16 chips for a total of

32K, that's one millionth of 32 megabytes. That's one-

millionth of 32 gigabytes, which is a small number today

for even an iPod.

04:15:16;05   So it was a very small amount of RAM. But it was enough

to run a computer programming language. You have to

have, at least, 4K bytes of RAM to run any computer

programming language that's ever been made. We've got

some big blue parts up here which are capacitors that

smooth out the voltages for the other chips.

04:15:35;17   And they started out at the wall. You plugged in some

transformers in the wall and ran in some up down signals

here. And that was the circuitry that created the voltages

for the part. There's a little crystal, a silver crystal, next to

the blue chip. And the silver crystal generates the clock. I

chose a crystal that was deliberately a multiple of the

United States color television standards because I had this

idea that some day I could come in and add an idea I had

back in here.

04:16:04;10   And you had to have everything working at a rate of color

television signals to wind up getting color on your set by

the simple method I'd come up with. I did apply that

method. I never did it to the Apple I. But applied that

method when I went to the Apple II. And it's all there.

It's actually very, very simple, especially if you take out

the free memory, there's very, very few chips. And they're

very inexpensive chips.

BARRY HURD:

04:16:31;02   When you look at that now, do you flash back to when you built that thing? Are you suddenly 20 years old again or whatever?

STEVE WOZNIAK:

04:16:37;17   Absolutely. Now, remember the Apple I-- and the amazing thing is, the Apple I was a big turning point for computers. We went from the big front panels with geeky words on switches and lights that only had one in zero meaning to something that was human with a real typing keyboard and a real television display with words.

04:16:56;20   That was a big step. But really this was kind of a little hack job. I took a product I already had that could type data to a computer far away. I added my own microprocessor and my own memory, a couple little ROM chips that had the program that says, "What's he typing on the keyboard?" And I put together a computer quickly.

04:17:18;20   But this was a very slow computer intended to go at very

slow speeds according to United States telephone lines.

So it was the Apple II was really a computer line from the

start up. But this computer was so useful. I could take it

into Hewlett Packard, run programs and get calculations on

circuits and design circuits better than the other engineers

right at my desk with my own little computer. This is the

computer I really-- wanted Apple-- Hewlett Packard to

start selling, too, a lot of turn downs.

BARRY HURD:

04:17:46;19   You tell me with all these, we got the Apple I, we saw the

II, that the disk drive-- all these different inventions that

have, you know, changed the world. I mean, how do you

wanna be remembered in like 100 years?

STEVE WOZNIAK:

04:17:58;21   Well, I don't wanna be remembered as much for the-- I'm

glad that I got to share the start of the personal computer

revolution. It was such an exciting time. And we cared so

much about it. I wanna be known for-- more than

anything else, is that people that opened this up and look

at a schematic and you'd never be able to-- nobody uses these kind of chips anymore to this day and says, "Wow, how did he hook those chips up so clever?"

04:18:20;26   And so, you know, it was my type of engineering. It was the thing that I was very good at my whole life was figuring out how to make circuits that did a lot with very few parts. Nowadays, you can make everything on one chip and it's got a million times this much complexity.

STEVE WOZNIAK:

04:18:34;26   So you never get to see how well was it done. It's the excellence of the engineering. Yeah, I'd want to be known as a good engineer my software had the same characteristics. I've wrote an entire computer language and having no training in it.

04:18:47;24   But I did it in a very structured manner. And it came out very small fast, good characteristics. I want them to respect the engineering more than anything else. My own children, that's what I would want them to see. "My dad did an excellent job and not just a slop job."

BARRY HURD:

04:19:02;18   Okay, now, we've talked a little bit before about-- we know

                     this interview is gonna last forever theoretically unless the

                     asteroid hits the earth, right? Is there something you can

                     say that it might be relevant to the people down the road

                     and stuff maybe you've never revealed before, something

                     about yourself, something you've worked on that you'd like

                     to sort of put out there for posterity?

STEVE WOZNIAK:

04:19:20;08   It's hard to say. People are people. You know what's in

                     your heart. And if you're being pushed in a direction that's

                     not where you wanna go, if you have some idea in your

                     head of something that you'd like to create someday that

                     may come out of you. You know, trust yourself. Don't--

                     and other people have-- you should be doing this and that

                     in life. But if you really wanna be doing what's in your

                     heart, follow it. More than anything else, you know, I just

                     sat there.

04:19:44;22   And I said, "I knew what I wanted." There were people

that saw this design that I showed it to and they said, "Oh,

no, no, no, we wanna build it the old, big clunky way.

That's how it's done." And I couldn't get them to even

come over to my way when they saw it, you know, a year

before this was sold.

04:19:59;08   You know, come on, look how simple it is. Look how few

parts it is. I couldn't get that many people interested. But

at least you get the buyers interested. You do have to, in

the end, you know, think about, you know, you're not

gonna get known for something very creative unless you

really have big sales and influence a lot of the people and

sell it to them. And the money that you make off of one

product like this lets you build the Apple II. And the

money from the Apple II let's you build an Apple III and go

and on and on and on and really get the world to move to

its advanced state.

04:20:29;10   So you know, you need a start and don't worry if your

start is very few bucks. We sold very few Apple I's. In

about a year, we might have sold 150 of them. We had a

bank account that might be $10,000. You know, it doesn't

sound like much. And we didn't pay ourselves. So you

know, we just did all this moonlighting. So we saved a

little bit of money. But it's the start that propels you to do

more in the direction you're going. I'm not good at advice.

But that's my experience.

BARRY HURD:

04:21:00;01   That's good. This is a strange question. But what does feel

like to be you, you know what I'm saying? I mean, you're

sort of a celebrity. But, also, in your heart you're this

engineer.

STEVE WOZNIAK:

04:21:11;23   Never understood it for a long, long time in my life

because everybody wanted to come up and get autographs

and things. Come on, I was a good engineer. Engineers

don't give autographs. You know, those are celebrities

and, you know, I just did a good engineering job.

04:21:25;08   Why would anybody respect that the same way? And then

one day I was at a little night club. And I was looking down at the people dancing. And it just hit. And this group Berlin was playing. It hit me, it was just a few years-- a couple years ago that of all those people down there, they had been the inventors of this technology and the inventors of this science and the inventors of this astronomical thing or the runners of NASA.

04:21:47;10   And one guy down there had just been, however significant he was known or not, he had invented the personal computer. That person would mean the most to me. The personal computer is just the most useful tool and toy of our life.

04:22:01;08   And for me it is, you know, even as a user. So I finally understood why people think that way of me that I'm so important in life. And I never wanted to be. I was very shocked. And I still don't like the publicity. But I have to do good things for other people, too.

04:22:16;08   I really hope that I'm a good example more than anything

                               else in life, you know, what you do, it's even more

                               important to be an example to others especially my

                               philanthropy, my giving, you know, early on. I didn't

                               really do this for money. I didn't want money and gave it

                               away. You try to be a good example of what's important

                               to you and what principles and values you followed to get

                               there and then others will turn out that way. And one of

                               the things that I like to do especially if I help other people

                               through their life, some of them write back to me. And

                               they say they remember that I told them, "You don't pay

                               me back with money."

04:22:46;24   "You pay me back by passing it on, if you could help other

                               people sometimes." And some of those people get further

                               in their life than they would have. And they write to me

                               about how they've taken some young kids and helped

                               them learn this and taught them that and given them

                               some, you know, accounts or useful things so they can go

                               somewhere with computers. And that's what I like, you

know, it's really, you know, the next generation of young

people.

04:23:08;08   I will always support young techie types that like to, you

know, know the mathematical and the little details of

things and never put them down. That's where I came

from. You know, I don't wanna say, "Oh, those people are

unimportant now. You know, now, I can be a big wig and

run things. And those people are just peanuts and you can

find a million of them," no. Their inspiration is the

important thing in life. It's what you feel. You know, it's

not what you accomplish, necessarily, on paper. It's what

you feel about it. Of course, I loved it, so. It's really nice

when, you know, the thing you love is your job.

BARRY HURD:

04:23:40;04   Okay, Steve, thanks so much. Great answer.

BARRY HURD:

04:24:32;03   All right-- tell us a little bit about the open source

initiative, is it, and your involvement.

STEVE WOZNIAK:

04:24:36;28   The open source movement, whatever. I'm not that

directly involved. It's a lot of longer technologists who

come up using Linux where you have to piece together

pieces of software and it's very technically challenging and

nothing kind of works twice or works the same the next

week as it did this week. But that's where I came from.

And I loved it. I learned how to build these computers by

looking at little diagrams and working things-- little

pictures on paper of how to put it together and figured out

how to do some things.

04:25:06;20   And I've learned it from other people, their publications.

When we came out with the computer, I told you, the first

one, the Apple I, I gave away every bit and piece of the

design and everything so that other people could, not only

build their own, but learn from my excellence how you can

design a computer, how you can write certain kinds of

software.

04:25:27;00   With the Apple II, we made money. We kept it

                           copyrighted. We made money off of it. We owned it. But

                           we published the documents so that other people could

                           learn. And that's part of this open source idea. If you can

                           see the program that went into something, you can modify

                           it a little, add the differences that would make it exactly

                           perfect for your needs and modify it and, you know, and

                           have rights to that. And, now, you've created something

                           on top of what somebody else created.

04:25:51;13   It's, like, one learning can lead to another to things can

                           build on each other, very proprietary type devices I've

                           always been very much against where, you know, it's

                           locked up. You can't use your own intelligence. You, the

                           technical genius, the engineering genius, can't use your

                           own intelligence to improve something somebody else did.

04:26:09;05   And that locks off a lot of innovators. When I run into

                           young people-- even interns at Apple, they talk about how

                           important it is, you know, some of the hacking that's going

on is really developing out minds and trying to think out

solutions that are complicated. And they sort of see this

whole open source world as not-- it's not like we're trying

to get stuff for free. We wanna make somebody else's

work all of a sudden be free and shared with everyone, no.

It's just being able to see how they did it so we can learn

from it and then take our own minds and take it even

further than it went.

04:26:44;00   You know, but when you shut off the learning, only a few

people are allowed to know how something works, that's

closed source, then how they wrote a program is hidden,

you can't learn from it. And-- I just think that's harmful. I

don't really see any good purpose for it.

                                    STEVE WOZNIAK:

04:27:00;21   It doesn't mean that a company can't be protected to their

rightful profits.

                                    BARRY HURD:

04:27:05;10   How does that relate, then, there was always this thing I

remember 'cause I grew up in this era where they said,

"The Apple's like a closed platform. The PC's an open

platform?"

04:27:13;03   I mean, what's that all about?

STEVE WOZNIAK:

04:27:13;03   It's hard to say 'cause, obviously, we were very open in

our early days. The Apple II had instructions and

diagrams, how to plug everything in and design your own

stuff and add on-- thousands of companies started up.

Sometimes they were just high school kids that sort of

knew how to put a couple of chips on a board. And we'd

shown them the formula and all of a sudden, they had a

music keyboard or something. Or they could write music

software or write a game.

04:27:34;29   So many companies started up from these young people.

And I'm so much for that. Nowadays, we're a lot closed.

You know, you can't see what we've done. You can't see

how we've done it. We wanna keep the secrets to

ourselves. And that hurts a lot of the smart people from

learning, you know, more-- you know, as much as they

would.

04:27:55;00   And it doesn't really help profits. I think it helps keep--

big companies can stay in a position of saying, "We are the

source of power. And you are not important. You don't

know how to do what we do." But-- you know-- it's

disrespectful to the people that I respect the most, the

creative young engineers that can figure out how to build

things, how to make things, how to make them new, how

to make them better.

04:28:17;10   And, you know, a company is not open to other people.

Here's an idea for you. Well, the problem is, a lot of

people have ideas that aren't really worth a lot and then

they'll sue you. So you know, and a lot of it is the whole

business system, the laws, the tax laws, the court cases.

And that almost forces companies to be very closed, too.

BARRY HURD:

04:28:39;19   Is it getting harder to be innovative because of that?

STEVE WOZNIAK:

04:28:41;21   In some areas, it's harder to be innovative in certain

areas. You're almost not allowed to. You're not allowed

to, for example, buy a computer and then redo the code

and the ROMs to make that computer have some neat and

new special little fancy features. Apple wouldn't like it.

We don't like people saying that they can build a

computer. Only we can.

BARRY HURD:

04:29:12;21   Yeah, he's closed the PCs. I wonder-- I wonder what your

take is on it.

STEVE WOZNIAK:

04:29:14;29   Well, the PC opened-- not exactly, Windows is not open.

BARRY HURD:

04:29:18;13   No, the hardware I'm talking about.

STEVE WOZNIAK:

04:29:19;23   The PC-- the hardware was not-- it's not PC. It's Intel's.

Intel had to make their hardware open to sell it to a lot of

companies. So it's a little artificial, now. Bill Gates went

to the president of IBM and said, "The Apple II is an

example of an open architecture. And look how well it

worked." And it really did. And he said, "So you should be

open and just build the best PC of all of the PC makers."

END