the house. It was a very large, wooden house, and I would run wires all around the outside, and had plugs in all the rooms, so I could always listen to my radios, which were upstairs in my lab. I also had a loudspeaker—not the whole speaker, but the part without the big horn on it.

One day, when I had my earphones on, I connected them to the loudspeaker, and I discovered something: I put my finger in the speaker and I could hear it in the earphones; I scratched the speaker and I'd hear it in the earphones. So I discovered that the speaker could act like a microphone, and you didn't even need any batteries. At school we were talking about Alexander Graham Bell, so I gave a demonstration of the speaker and the earphones. I didn't know it at the time, but I think it was the type of telephone he originally used.

So now I had a microphone, and I could broadcast from upstairs to downstairs, and from downstairs to upstairs, using the amplifiers of my rummage-sale radios. At that time my sister Joan, who was nine years younger than I was, must have been about two or three, and there was a guy on the radio called Uncle Don that she liked to listen to. He'd sing little songs about "good children," and so on, and he'd read cards sent in by parents telling that "Mary So-and-so is having a birthday this Saturday at 25 Flatbush Avenue."

One day my cousin Francis and I sat Joan down and said that there was a special program she should listen to. Then we ran upstairs and we started to broadcast: "This is Uncle Don. We know a very nice little girl named Joan who lives on New Broadway; she's got a birthday coming—not today, but such-and-such. She's a cute girl." We sang a little song, and then we made music: *"Deedle leet deet, doodle doodle loot doot; deedle deedle leet, doodle loot doot doo . . ."* We went through the whole deal, and then we came downstairs: "How was it? Did you like the program?"

"It was good," she said, "but why did you make the music with your mouth?"

One day I got a telephone call: "Mister, are you Richard Feynman?"

"Yes."

"This is a hotel. We have a radio that doesn't work, and would like it repaired. We understand you might be able to do something about it."

"But I'm only a little boy," I said. "I don't know how—"

"Yes, we know that, but we'd like you to come over anyway."

It was a hotel that my aunt was running, but I didn't know that. I went over there with—they still tell the story—a big screwdriver in my back pocket. Well, I was small, so *any* screwdriver looked big in my back pocket.

I went up to the radio and tried to fix it. I didn't know anything about it, but there was also a handyman at the hotel, and either he noticed, or I noticed, a loose knob on the rheostat—to turn up the volume—so that it wasn't turning the shaft. He went off and filed something, and fixed it up so it worked.

The next radio I tried to fix didn't work at all. That was easy: it wasn't plugged in right. As the repair jobs got more and more complicated, I got better and better, and more elaborate. I bought myself a milliammeter in New York and converted it into a voltmeter that had different scales on it by using the right lengths (which I calculated) of very fine copper wire. It wasn't very accurate, but it was good enough to tell whether things were in the right ballpark at different connections in those radio sets.

The main reason people hired me was the Depression. They didn't have any money to fix their radios, and they'd hear about this kid who would do it for less. So I'd climb on roofs to fix antennas, and all kinds of stuff. I got a series of lessons of ever-increasing difficulty. Ultimately I got some job like converting a DC set into an AC set, and it was very hard to keep the hum from going through the system, and I didn't build it quite right. I shouldn't have bitten that one off, but I didn't know.

One job was really sensational. I was working at the time for a printer, and a man who knew that printer knew I was trying to get jobs fixing radios, so he sent a fellow around to the print shop to pick me up. The guy is obviously poor—his car is a complete wreck—and we go to his house which is in a cheap part of town. On the way, I say, "What's the trouble with the radio?"

He says, "When I turn it on it makes a noise, and after a while the noise stops and everything's all right, but I don't like the noise at the beginning."

I think to myself: "What the hell! If he hasn't got any money,

you'd think he could stand a little noise for a while."

And all the time, on the way to his house, he's saying things like, "Do you know anything about radios? How do you know about radios—you're just a little boy!"

He's putting me down the whole way, and I'm thinking, "So what's the matter with him? So it makes a little noise."

But when we got there I went over to the radio and turned it on. Little noise? *My God!* No wonder the poor guy couldn't stand it. The thing began to roar and wobble—WUH BUH BUH BUH BUH—A *tremendous* amount of noise. Then it quieted down and played correctly. So I started to think: "How can that happen?"

I start walking back and forth, thinking, and I realize that one way it can happen is that the tubes are heating up in the wrong order—that is, the amplifier's all hot, the tubes are ready to go, and there's nothing feeding in, or there's some back circuit feeding in, or something wrong in the beginning part—the RF part —and therefore it's making a lot of noise, picking up something. And when the RF circuit's finally going, and the grid voltages are adjusted, everything's all right.

So the guy says, "What are you doing? You come to fix the radio, but you're only walking back and forth!"

I say, "I'm thinking!" Then I said to myself, "All right, take the tubes out, and reverse the order completely in the set." (Many radio sets in those days used the same tubes in different places—212's, I think they were, or 212-A's.) So I changed the tubes around, stepped to the front of the radio, turned the thing on, and it's as quiet as a lamb: it waits until it heats up, and then plays perfectly—no noise.

When a person has been negative to you, and then you do something like that, they're usually a hundred percent the other way, kind of to compensate. He got me other jobs, and kept telling everybody what a tremendous genius I was, saying, "He fixes radios by *thinking!*" The whole idea of thinking, to fix a radio —a little boy stops and thinks, and figures out how to do it—he never thought that was possible.

Radio circuits were much easier to understand in those days because everything was out in the open. After you took the set apart (it was a big problem to find the right screws), you could see this was a resistor, that's a condenser, here's a this, there's

a that; they were all labeled. And if wax had been dripping from the condenser, it was too hot and you could tell that the condenser was burned out. If there was charcoal on one of the resistors you knew where the trouble was. Or, if you couldn't tell what was the matter by looking at it, you'd test it with your voltmeter and see whether voltage was coming through. The sets were simple, the circuits were not complicated. The voltage on the grids was always about one and a half or two volts and the voltages on the plates were one hundred or two hundred, DC. So it wasn't hard for me to fix a radio by understanding what was going on inside, noticing that something wasn't working right, and fixing it.

Sometimes it took quite a while. I remember one particular time when it took the whole afternoon to find a burned-out resistor that was not apparent. That particular time it happened to be a friend of my mother, so I *had* time—there was nobody on my back saying, "What are you doing?" Instead, they were saying, "Would you like a little milk, or some cake?" I finally fixed it because I had, and still have, persistence. Once I get on a puzzle, I can't get off. If my mother's friend had said, "Never mind, it's too much work," I'd have blown my top, because I want to beat this damn thing, as long as I've gone this far. I can't just leave it after I've found out so much about it. I have to keep going to find out ultimately what is the matter with it in the end.

That's a puzzle drive. It's what accounts for my wanting to decipher Mayan hieroglyphics, for trying to open safes. I remember in high school, during first period a guy would come to me with a puzzle in geometry, or something which had been assigned in his advanced math class. I wouldn't stop until I figured the damn thing out—it would take me fifteen or twenty minutes. But during the day, other guys would come to me with the same problem, and I'd do it for them in a flash. So for one guy, to do it took me twenty minutes, while there were five guys who thought I was a super-genius.

So I got a fancy reputation. During high school every puzzle that was known to man must have come to me. Every damn, crazy conundrum that people had invented, I knew. So when I got to MIT there was a dance, and one of the seniors had his girlfriend there, and she knew a lot of puzzles, and he was telling her that