PRESERVING MEMORY: NEWARK AND RUTGERS IN THE 1960'S AND 1970'S

An Interview with

CHARLES PINE

Conducted by

Gilbert Cohen

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GILBERT COHEN: This is December 18, 1990. Tuesday, December 18, 1990. This is Gil Cohen. I'm meeting with Dr. Charles Pine in his home in West Orange, New Jersey. Okay. Dr. Pine, we were talking about your involvement in the New Jersey Algebra Project. Could you go into that? Tell us what it is, when it got started. When did it get started? Let's start with chronology.

CHARLES PINE: Well, it officially got started in the classroom in 1984-85 where teachers were actually trying a different approach to teaching algebra. But its origin goes back a long time before that. And the start of it…. well, in one sense the start of it goes back to about 1968. What happened then is that we for the first time started giving a placement test in math and in English—the students had to write an essay also—to students entering the college. And we saw from that that many of the students really weren't as well prepared to work with math in college as perhaps they should have been, judging from the fact they have three or four years of high school math. And we kept on doing that placement testing at the college year after year, and we saw that it was essential to do that, that you had to take account of what students actually knew how to do and then place them in appropriate courses. Don't let them get into something they weren't ready for. Give them the right course to prepare them. So this started quite a long time before. It began to be recognized around the state that so many students needed help and guidance in this way.

And what happened…. You know the more direct involvement leading to this project was that the state of New Jersey started to test all students entering public colleges in math and in English, verbal skills, in 1978. And because I had been involved with this at the college for ten years at that point, you know, testing students and doing placement and so forth, I was asked to become a member of what's called the Basic Skills Council, which was to design these tests and the whole program involved with it. I did that for the next nine years, until 1986. And from our analysis of the test results—we were testing about fifty thousand students a year, and we could analyze the results and see where the students were having their trouble and then try to figure out why. And this was all done at Rutgers. This analysis was supported by Rutgers and the Department of Higher Education. So it happened at NCAS [Newark College of Arts and Sciences]. We saw that changes were needed in the way students were taught algebra in high school. This accounted for why so many of them were deficient when they got to college.

And so a group of us began to plan, how would you change the standard curriculum so that more students would learn? And we ended up having to write a textbook. And the first tryout was in 1984-85. And we had sixteen school districts that volunteered to work with us, and we had thirty teachers. And they tried this out during the first year. We analyzed the results, and then made some improvements for the second year, eighty-five, eighty-six. And we kept on doing this. And the project has grown since then. As of this year—we're into the seventh year of the program—

we're supported by both the New Jersey Department of Education and the New Jersey Department of Higher Education, and of course Rutgers is continuing to support this, the project is based at Rutgers in Newark. We are now involved with sixty-seven public school districts in New Jersey and nine public schools. We have over two hundred teachers working with us, and about eighty-four hundred students in the program this year. So it's a continuing effort to improve mathematics education by trying things out in the classroom, changes that seem to be needed and then assessing the effect of those changes. Do they in fact cause students to learn more? Are the students able to think better? Are they more enthusiastic about mathematics? Do they want to study math? Are the teachers more enthusiastic about it? And so it's an ongoing process where we continue to make changes.

We're learning from it in two different ways. One, and the original purpose of it, was to go back to the high school to find out why students were having trouble and the actual cause of it. It would also indicate how you could better do something for them once they were in college. If they came in having trouble in mathematics, what do you do for them? If you give them the same material again in the same way, is it going to do any good? So should you teach differently? So that's one thing we've learned from there is something about the approach you need to take at the college level. And then that's so important because there are so many students everywhere who come in needing help with mathematics or they're not going to be able to go on in any kind of field that involves quantitative reasoning.

The other thing we've learned going the other way from the testing at the high school level—and we're working both at the high school level, ninth grade, and we're also in middle school in eighth grade—the other thing that's become clear is that it isn't sufficient to try to improve things at the Algebra I level in either eighth or ninth grade. That the real improvement, if you want many many more students to be able to learn mathematics, to understand it, to be able to go on in science or economics, whatever it is--but to be able to do quantitative things—That the answer has to come earlier. We can see that in the United States, as opposed to other countries abroad, we start in with algebraic reasoning much too late. It's too late to wait 'til the eighth or ninth grade. That if you want people to be able to reason, to use algebraic reasoning, not just concerned with manipulation algebra, but the sense of working with unknown quantities and being able to translate a verbal statement into a mathematical one—that's algebraic reasoning—it has to start much earlier.

And you also have to give students a sense of what learning mathematics really is, and that it can't remain an abstraction, that they have to learn how to form pictures for themselves. They have to learn how to make mathematics a concrete thing, and it has to start when you're young. And it has to be an ongoing thing where mathematics becomes common sense. And if we can accomplish that, then we'll make the changes that are needed. But until we do that, it's a losing battle. I mean you've got to go earlier. So what we're learning from what we've done now in eighth and ninth grade is what kinds of things to do earlier, that people need to get a number sense, that feeling for numbers, that they're good with numbers. They have to learn to picture abstractions. They have to learn to tackle problem-solving, particularly word problems by common sense. And that you can do a lot of mathematics verbally. And one of the things that we're seeing that's gone wrong is that people are being taught to do things by manipulation, to set up relationships or equations or just set things equal to one another, and do manipulations

with them, without actually having an understanding of what they're doing. So you can take that away, remove the crutches that setting up a proportion and cross-multiplying, things they're teaching the way they shouldn't by having them do things verbally without using these manipulations. And then they've got to learn to think for themselves.

COHEN: Could you give an example? You said word problems. Could you illustrate that?

PINE: Yes, yes. Let me give you an example of that, of what we've found that goes wrong, and it's a very striking thing, that students are actually much more capable intellectually with regard to mathematics than would seem to be the case. What's happening is they're simply not using their heads. Because from what they've been taught, mathematics is something you remember and isn't something you do by common sense. We saw this kind of a situation. In the testing we do for the students in the Algebra Project Program, we give all the students a test at the beginning of the year, a test in computation. We want to see where they stand with regard to fractions and decimals and percents, simple word problems. And here's one question that we have on the test, and it goes about like this: If five pounds of hamburger cost $6.05, how much will three pounds cost? And students do pretty well on that, compared to what they do on other problems that may seem to be similar. But if you look at what they do, if you look at their scratch work on the test paper—because these are multiple-choice tests. You can't tell by the answers exactly what they think. But you can see what they do; you find out what they do is use common sense when they do that. You'll see somebody divides $6.05 by five, and you get $1.21. Then you see—without any words, explanations. Then you see next they put $1.21: three times $1.21, $3.63. But what's happening is they're doing what someone would do in the supermarket. They figure out, well, if I want to know what three pounds cost, I'll figure out what one pound costs and then multiply by three.

But then when you go over to a similar problem, there's another problem on this pretest we give, this computation test. There's another problem that has something to do with a recipe. If you mix powdered milk and water, and it takes three cups of powdered milk to…. Or whatever it is, you know. How much would five cups, you know, to get…how much water would you use for five cups? They don't do that that way. But you could do it the same way. You do it exactly the same way. And instead what you see them do is this: They'll set up a proportion which is the way they're taught to do these things. They're going to say five cups of powdered milk is to—three cups of powdered milk added, so many cups of water is to X. And then they cross multiply, and they get it wrong. They don't use common sense. They're trying to remember a way of doing that. So we've seen that there are a lot of things like that; where instead of figuring it out, in other words you do it…. The student who does that I think what does one pound cost, they see exactly what they're doing, with the hamburger. They see. It's clear. They know exactly what they're doing. And with the other thing, they can't.

Then we see this at a higher level in algebra. So you see the progression of what's happened. When you ask a question on the algebra test that, for example, if X pencils cost $7.00, how much will Y pencils cost? There's a complete collapse. [Laughter] You see? Because then they don't have the numbers to work with, there's a complete collapse. And what we found is this—and that tells you what's at the heart of the problem, that if you take the best students who are entering public colleges in New Jersey, and those are the students who got all the way through calculus—

so each year, if you take the best students who are entering these colleges, and they're on the order of about twenty-eight hundred students each year who are coming to New Jersey colleges, just fresh out of high school, that have had calculus, those are the well prepared students, how did they do on that? And for the best students, about half of them can get that right, see? And it traces back to the way they're taught to attack problems at the beginning, that they cannot reduce an abstraction to common sense to things like that.

So you could do that the same way. You see if you want to know how much any number of pencils cost, what do you have to know? What one costs. You see? That common sense approach. So what seems to have happened is that students have viewed mathematics as something to remember. So they're trying to remember where did they see that problem before instead of using their heads. What we think is they could use their heads if they only used their brains. That's what's happening.

COHEN: What were the circumstances in 1968 that led to the development of the Algebra Project? Something was happening or what?

PINE: Well, I remember what happened—and this I do remember. Some of these things I forget going way back. But I remember—it was a very specific thing. Yes. And you asked me that question. A very specific thing triggered that off, why the college got into this. Because we didn't think about those things in those days. You know everybody came in. They picked what courses they wanted. There was no advisement system. There was no advisement system. They picked what courses they wanted. And as a matter of fact, it was automatic. If students had had four years of high school math, they automatically went into calculus. No questions asked.

COHEN: If they had had what?

PINE: If they had had four years of high school math—

COHEN: High school math.

PINE: —they were placed in calculus.

COHEN: Oh! Mm-hmm.

PINE: And at that point, I think fifty percent of the students were flunking out of it.

COHEN: Flunking calculus.

PINE: Yes. See, that was one of the things. It was a terrific attrition rate. That was one thing. But the other thing was—and I remember this vividly, now that you ask me it comes to mind. That Sam Agron in the Geology Department got up a faculty meeting and presented—I think he used an overhead projector—and he wanted to show something. He'd been looking at the records, and I don't remember why or what it was. But he said he was looking at the scores I don't know whether it was SATs or other things—for students entering the college. And they were going way down. This went back a long way. Whatever it was, it was that kind of thing

where…nobody had looked at the student preparation in other words. Nobody was really worrying about it, were students prepared? And nobody advised them. We didn't have an advisement system. So I think—this might have been back even like a year before that or something like that. But I remember it got to be something that the people in the faculty decided to talk about. Well, should we be worried about the preparation our entering students have? Should we…. you know, should we do something about it?

And then some people got together. And I remember it was—I remember one who played a key figure in that was Bruce Robertson who was, I think, at that time assistant dean and later became associate dean. But he played a key role in that of pushing to do something, you know. And some of us…I know I was interested in doing something about that as far as the math. And then I don't remember exactly who it was in the English Department. But what we decided to do was to try giving a test, a placement test, to students coming in for the next year, for September sixty-eight. And it didn't have anything to do with admissions or anything like that. Once the students were admitted, let's give them a simple test in math, and they had about an hour for an essay. And see how many of them really need help. And should we, you know, advise them? Like maybe they weren't ready for a certain—maybe they weren't ready for chemistry or something. Maybe you'd say, well, you ought to take some math first. You know it might help students. And once we did that, the first year, that was clearly—yes, you really had to do that. It was clear you really had to do that.

As a matter of fact, we tried something, and it comes to mind now. We were so…we looked at the results because we were testing—we brought the people in for testing in the spring. They were asked to come in for testing in the spring—so maybe it was April or May. And we said, gee, we've got to do something about it because you could see there were a number of people there who had had four years of math, and yet they really would have trouble going right into calculus. But at the same time, if you could do something for them, maybe they would be ready. So we decided to try an experiment. Yes, I remember it. It was the first year—it was September; it was sixty-eight. What we did was, you know, this was with the cooperation of the dean's office and other people involved. Let's try something to help these students. Just, you know, find out what you can do.

We sent a letter to over a hundred students saying, from the way you tested—we see that you had the appropriate courses in high school and everything else. Yet we know you're going to have trouble, judging from the things you did. But maybe we can give you enough help before September that you could, you know, go into calculus if you want to sign up. And so we sent them a letter inviting them to come in, and we were going to give them a two-week course; I was going to give the course. Made it up from where I saw the weaknesses were…. And this was for students—they weren't really terribly weak. But if you went over to trigonometry and logarithms and some of the algebra, they'd be much better prepared; you could see a number of weaknesses. And we had over a hundred students accept, agree to come in.

COHEN: Mmm, yeah interesting.

PINE: Yes. And what the…we got I think it was ten of our math and physics majors to agree to serve as helpers during this thing. They were paid by the dean's office, you know, to help out.

And we did this for two weeks. I would work with the students in the morning we were in one of the… like Conklin, I think, in one of the lecture halls. And then we broke them up into ten groups, a hundred people, ten groups. And then they'd spend a couple of hours with one of our students going over homework problems and so on. And then we tested them all—and in fact I have all the records on that stuff.

COHEN: Oh! That's really great.

PINE: Yes. We tested them all at the end of the two weeks. And we thought they were ready at that point to go into, you know, the calculus course if that's what they wanted. We said they could. Other than that we suggested they take, you know, an appropriate course before that, a math course. And there were quite a few of these students who did well enough that they went right into calculus. They did well. So we found that you could do a great deal. That proper advisement was such an important thing, placement, testing. And the college kept doing that. And then ever since then it's been a tradition at NCAS that you have a good advisement system. There's been a lot of effort put into that because the freshman year is the crucial year. You lose people then. But if you can get them so that they're prepared for the courses they want to take, they're going to do much better. If they're not prepared…it's unfair, and it's just too difficult.

COHEN: How extensive was the advisement system throughout the—throughout all the departments in your opinion? How extensive was advisement through the seventies?

PINE: Well, there were two different things. There always was, as far as I can recall, you know it fades in my mind, but I can recall, even before 1968, there was always advisement of majors in the department. I think that that was always true, going all the way back. Where if a student wanted to major in something, then he would talk to an advisor what courses to take and so on. But there wasn't this general advisement for all freshmen.

COHEN: Yes.

PINE: And that was the key thing.

COHEN: Yes, yes.

PINE: Before they got to their major, in many cases they would be out of the college before they got to major in something. But after 1968, then it became something that the college emphasized very much, and it's been true to this day that there's been a lot of emphasis. And the college has done things—I'm not sure of the exact status now because I'm not in close contact with that. But there have been designated freshman advisors who are trained and paid extra to do this. Generally these have been faculty members who have a great deal of interest in working with students; they've been selected. Usually there'd be ten or twelve of them, and they were paid a certain amount each year. And I think it's probably still true. But what it was was each freshman would have an advisor. As a matter of fact, we did something, and this started after sixty-eight, and we kept improving upon it. But we had a placement system that did the following; we would test all the students coming in in math and English. Then we would go over their records. I did that as a matter of fact. I just somehow decided to do that, and I kept on doing it. But what we

would do is go through each student's high school transcript, look at the courses they'd had and the grades they had in their courses. Take the results of the placement test. And then figure out how to advise the students. That was done before they even came in to register. And we would suggest—in some cases they were premed and they were supposed to take chemistry the first year—hold off because your math, you're not ready for it. Take this instead of that. Or in some cases don't carry a full load carry twelve credits instead. And we would also—because I mean any testing is subject to error—when the students came in, we would offer to test them again, saying, well, they hadn't done so well, but they felt they could do better. And then they would come in for registration. And then we had freshman advisors there, and they would sit down with an advisor when they came in. The advisor would have their record, would have the placement results and the recommendations, would talk to the student about it. And our feeling was that this did a great deal of good because I think that it saved many students from trouble they would have had by getting them to take something before that. And this started well before the general state effort which was in seventy-eight. And now of course there's a great deal of it. But it's been a tradition at NCAS going back over twenty years.

COHEN: When you say we would test, was this a committee of the faculty? Was it the Admissions Committee? I don't quite understand what—well, you were physics and math?

PINE: It was the dean's office and particular people who happened to be interested in that sort of thing. I would do the math part of it.

COHEN: I see. I see.

PINE: And then somebody from the English Department would do the English.

COHEN: I see.

PINE: But what happened, the way it was done was that they would give an essay topic, and everybody had an hour to write an essay. Then members of the English Department would grade those essays. And then based on the results of that, there would be a recommendation, either you're ready for a regular English Comp, or you would have—you need some remedial work—or there was something in between called Intensive English 101, where you had English Comp but an extra hour a week or something. And it was designed to get students to be able to get the help they needed to succeed. And so it was done officially by the dean's office, but with the English Department and me working with people in the Math Department. So it was like kind of an unofficial but yet official. It was of interest to people who felt concerned about this sort of thing.

COHEN: At what point was that formalized?

PINE: Well, it really became formalized after sixty-eight. When we tested in sixty-eight and we felt that this is the…. then it became official policy of the college, that you test all entering students, and you do advisement, and it's been a big thing at the college ever since then. I mean it's been a major point of emphasis on the part of the dean's office that there has to be proper testing and there has to be proper advisement. And so if you're interested in the retention of

students—but beyond that, more than just retention, but having students able to learn well—then you've got to do this sort of thing. And the need had become greater over the years.

COHEN: When did the New Jersey Algebra Project, when was that established? That grew out of this.

PINE: Yes. As I say, it had…the beginning that led to it was 1978 with the statewide testing, with so many students—I mean after all in NCAS, we were testing six, seven hundred freshmen a year. But now, you know…. so you could do analysis there. But when you test fifty thousand students a year and they're from all over, then you get a better sense in terms of math education. So the analysis began then. And then a couple of years after that some of us there began seriously to think about what changes could be made to offset what we were seeing. It actually started as a program being tried for real teaching in the high schools and the middle schools in 1984.

COHEN: Did the people who established the New Jersey Algebra Project, were they in touch with NCAS faculty like yourself who were involved in advisement?

PINE: I was the one that established it.

COHEN: You established the contact between the two…..

PINE: I set up the Algebra Project.

COHEN: You set up the Algebra Project!

PINE: Yes, yes. I set it up.

COHEN: So this was 1978.

PINE: No, in eighty-four.

COHEN: In '84! Okay.

PINE: But it came from—

COHEN: Oh, I see.

PINE: What it came from was a lot of people working together on the state….

[Break in recording]

COHEN: Okay. We were discussing, among other things, student advisement as you were involved in, among other things, as chairman of the Admissions Committee. Is that correct?

PINE: Yes. Well, it wasn't directly related to that. The admissions and also I wasn't always chair of admissions. But it was just, you know, it was something I was very interested in. The placement and advisement I was interested in all those years beginning with 1968.

COHEN: What was the effect of this advisement—it seems to be close advisement—on academic achievement? Taking into consideration the students' scores on the SATs, let's say. How did it affect achievement ultimately?

PINE: It was actually much more than the SATs. The SATs were just one ingredient of a lot of other information. More important was the high school performance, the rank in class, the nature of the courses taken in high school. As far as the math went, the number of years in mathematics, which mathematics courses…but what was directly relevant were the placement test results that we gave. Our own testing which were achievement tests. You know what could you do on certain things? Not how fast can you do things or tricky things. But, you know, what kinds of things can you do?

COHEN: How were these tests designed?

PINE: Before 1978 we designed our own. I worked with people in the Math Department for the math, and then the people in English gave an essay topic each year, and then they graded them. The faculty members in the English Department graded each essay. And we put that information together and used this to advise the students as to what courses to take, whether they were ready for certain things. If not, what courses in English or math that they needed to take to better prepare themselves. Then we would follow up to see how well the placement system was working, how the advisement system was working by looking at how students did. How did they do in these courses? We were placing them in math courses. Now what grades did they get, and was it a good placement? What was the effect on their cums at the end of the year? At the end of two years? We followed them. At the end of four years? And what we felt was that it was an absolutely essential thing to do. That students needed to have this kind of help and advice. They needed to know how well their work in high school had prepared them for college courses. And if they weren't as well prepared as they should be or could be, what we could do for them in the college.

So the advisement and placement—the testing, placement and advisement system, that triple-pronged effort—was, we feel, the most important thing that was done at the college. It was something that had been emphasized all along going back twenty-two years now. That's an essential thing. And this is something that, of course, has been realized now, all over the state and all over the country, that this is being done. Colleges test people, they do placement, they do so-called remediation, all of this. But it's absolutely necessary that you give students help where they need it. You give them advice. Even though the state started providing tests in English and math—there's an essay and there are other tests, multiple-choice tests in the verbal area, and there are tests in math—we continued at NCAS in giving our own math tests in addition to that. They went beyond the level of the…. because the state tests are only in computation and elementary algebra. But that's enough if you want to place somebody. Are they ready for calculus or not? You've got to go beyond that. So we'd always give them an additional test that goes beyond that in algebra; it goes into trigonometry and logarithms. But one other important

thing was that the state tests, the majority of student tests, they're multiple-choice tests. That really isn't enough to tell you what you need to know about students. So the test at the college was one that wasn't multiple-choice. They had to actually do the work. And then we would look at each paper and grade it. And by seeing how do people work—and it takes more time to do that. And try to do that statewide with fifty thousand people, of course, it's a very difficult matter. But when you're dealing with seven, eight hundred students, it's well worth the time to do that. So there's been this continuing recognition of the need to work with students when they come in and an emphasis on advising students, helping students at the college. And I think it probably precedes anything at any other college in the state.

COHEN: How was the state test administered? Was that required?

PINE: Yes, yes.

COHEN: It's required for all new admissions to the state university or all the state colleges?

PINE: All the colleges in the state. This was mandated. It was mandated by the Board of Higher Education that every student attending a public college in New Jersey must take these state tests. Now, it's gone beyond the state colleges. It's not only the state colleges, the community colleges, Rutgers, and NJIT—in other words all the public colleges—but there are at this point, I think, a dozen private colleges who avail themselves of this service. And they get the results. It doesn't cost anything to the college. It's paid for by the state completely: the testing, the development of the test, the scoring. But now it's got beyond that, you know. We've started to development of the test, the scoring. But now it's gone beyond that, it started quite a while ago that not only do you have to test, but you have to account for what happens to the students. So that the Basic Skills Council has an assessment committee. And each college has to report what they do, the results of the placement test and then what they do for the students. If the student comes in and they're lacking, the college is required to do something and have to account for what they do with the student. And then they are supposed to assess the effectiveness of their remedial programs.

COHEN: Yes. How did the remedial program work in the College of Arts and Sciences. I mean Academic Foundations was established in the seventies, and then there was a…. How did that tie in with the advisement and admissions?

PINE: It tied in directly because…. See, at first, the first couple of years, we just did this very much off the cuff, and there was no official program. There were no remedial courses. So we just gave some extra courses before school started, a two-week course, a one-week course, and so on. But then there were programs actually set up, you know what ultimately became the Academic Foundations Department was started back around 1970 or so. And there were remedial courses set up that were targeted at certain levels of preparation. And then of course this now is something that happens all through Jersey and all through the country.

COHEN: Sure.

PINE: That this has to be done. And part of what needs to be done and one of the things we're concerned with in the Algebra Project is how best to do this. I'll give you some views I have on that I have some strong feelings about. I think that from my own feelings about teaching, my own experience with teaching, but even more so from what I've learned over the last seven years from my involvement with the Algebra Project. That it's a mistake to think of the help that students entering college need in terms of skills. That was the way it was originally thought of by, I think, by most people. That students coming into college lacked certain basic skills. That was the name given to them, basic skills. There were certain skills that were basic to being able to do college level work, that was the way it was phrased. And I think the thought behind it was that if you could just give these people those skills, then they would be able to do the college work, and they wouldn't have any problems. And I think the very—the language that came into it, remediation, remedy. You see the idea is we would remedy these deficiencies and skills. But what's turned out, I feel and a number of other people feel, that that's not enough, that the problem is not really one of skills. That the lack of certain skills that happens when you do placement testing is a symptom of the problem, but not the problem itself. You see, well, somebody has trouble with decimals or…. the idea was that presumably you would just diagnose those things that were missing, and now you just teach those things, and…. but that isn't it. Those were symptoms of the student's problem. And that simply doing something specifically to remove certain deficiencies in the sense that these are skills that are lacking, is the wrong idea.

What we're seeing now, what we're learning, we're seeing this not only in the entering college level, but we're seeing this at the entering high school level, where we do the same kind of placement testing. In fact we use the same tests. We use past versions of the Cognitive Basic Skills Test. So we're using exactly the same test. And that these weaknesses that students have are indicative of how they've learned how to learn. And that I think—and I think this applies at the college level—that a good diagnostic test is not to diagnose specific skills, you say, well, you know, look for this one, that one, that one, and we'll fix it up. But rather it should bring out the way in which a student learns. And whether a student has learned—particularly in the case of math—how to apply yourself to math, whether a student has learned to be able to make math a concrete thing that that student can picture, or whether they're still trying to deal with it, that math is something you remember, and they're trying to remember how did you do this problem, or how did you do this procedure? And what's needed is not to remove those symptoms, but for those students who didn't know how to learn math in the first place to work with them so they learn how to learn. Otherwise you're going to go through the same cycle again. They're going to get short-term recall. You will appear to have helped them, but you won't really.

COHEN: Why do you object to the use of the terms, skills and remedy? I mean I don't quite understand. Isn't learning how to learn a skill? And if you can affect the learning, isn't that a remedy? I don't know.

PINE: The way you just said it, that learning how to learn is a skill, fine. That's exactly it. But I think the origin, the way you use words where you use skills or remediation, efficiencies, in the first place, when colleges first set up so-called remedial programs and so on, I think the thinking was that students are lacking the ability to perform certain operations.

COHEN: Mm-hmm.

PINE: Whether with how to add fractions or how to do percent or how to do this. And I think the thinking was if you could find out what those deficiencies were and then show the student how to do those particular things, then they would be on a par with students who didn't have these deficiencies. And I think that's a mistake. And I think people have found that to be the case, that these so-called missing skills…. and again I think it's when people use skills to talk about—particularly basic skills—to talk about specific operations to do, whether it has to do with fractions or decimals or percent or whatever it may be, is referring to particular processes, particular operations, the ability to perform certain manipulations, that it's missing the point. The real question is why they didn't learn how to do this in the first place. Because whatever caused them not to be able to do these apparently simple things is going to cause them not to learn something else. So what you have to get at is the root of the learning problem. And we think with math, a lot of it goes back to the teaching in elementary school, that there is a lot of rote teaching done. The emphasis has been on how to do certain things, perform certain operations. And there was not an emphasis on the concepts or a discussion of what was behind it. Why do you move the decimal point two places? Why does this happen? Why do you do this? Why do you do that? And it isn't that the students aren't capable of it, what we're finding. They are capable of thinking and thinking well beyond what they appear to be showing as a level of competence. But they were never made to do, never taught to think about things.

So what we're thinking is—and this affects I think a business of college now, my great concern, that it isn't enough…if people are still just remediating or looking to say, well, we'll test you and then we'll give you a course that will fix up those skills. That's not the answer at all. What you need is something that goes far beyond that, is to recognize that many people haven't learned how to learn. And I can only speak to the math. But haven't learned how to learn math in the sense of that you've got to be able to picture it. You've got to take an abstraction and make it concrete for yourself. And that it isn't enough to remember things, to be content with remembering how to do certain things, and then to try to think: How did I do? Where did I see this problem before? But the college has to take an active role in restructuring the way that student approaches learning. If they don't, then what's going to happen at the college level is exactly what happened in high school, that the students survive, and they pass courses; they're not really getting educated. And if they stick to it enough, with enough help and tutoring, they're going to survive. But that's not what you want. You want education, to go beyond that.

COHEN: Right. We were talking before on this very subject of your whole approach and philosophy of teaching, if you will. And you were telling me about your experiences as an undergraduate at Rutgers-Newark, and how you felt that perhaps there were certain things that happened to you that you didn't want to happen to your students.

PINE: Yes.

COHEN: And it was I think very germane to what we're talking about, and if you could sort of get into that.

PINE: Yes. Well, I think it was very germane in that it shaped me. I started at the University of Newark, which later became Rutgers-Newark, in 1940.

COHEN: Forty-six?

PINE: No, I started in 1940.

COHEN: Oh, oh, I'm sorry. Okay.

PINE: It became part of Rutgers in 1946. But I started before that. And there was no advisement; that was the first thing. There was no advisement. You just came in, and you signed up for courses. And there was no advisement—none! Nobody to talk to. And I didn't know what I wanted to be; and I just came in and thought, well, I'll be a chemistry major. And I took chemistry and I took some math and English, you know. And then at the end of the first year, I decided I don't think this is exactly what I wanted. I really liked math all along. I always liked math. But I didn't contemplate majoring in math when I went to college. I was trying chemistry because I didn't like physics in high school at all. So I figured something that's quantitative science. And I didn't contemplate at all going into mathematics because people always said to me, what can you do if you're a math major? All you can do is teach math, and I didn't think I wanted to be a teacher. That's why I didn't even dream of majoring in math. But consciously I was searching for something mathematical. So, you know, chemistry, it really wasn't that mathematical. So then I thought, well, I've got to do something. I like figures and numbers and so on. So I decided again…. There's no advisement whatsoever. I'm going to go into accounting because that's got a lot of numbers. [Laughter] So just like that I transferred into the school of business. Now, the school of business and the College of Arts and Sciences were coexistent in one building at 40 Rector Street. So it was very easy to take a walk in there. I walked into the dean of the business school, and I said I want to transfer. Okay. So then I spent the next year taking accounting and economics and whatever. Then I said there's not much math here, you're just adding figures… [Laughter]

So then I thought, well, what can I take next? I've already finished two years now, going into my third year. And there was no advisement. I talked to some people—I don't know who they were or anything. They said, why don't you take physics? It's got a lot of math in it. I said, "I don't like physics. I remember high school. All you do is you go like this with your fingers, and one finger, the thumb, is the current, this one is the wire, and this is the force. I didn't like it. But they said, no take it there's a lot of math in there, you use math. Well, this is my junior year; and I'm starting first-year physics. And so I took the first year of physics. And there it was 1943. And at that point I think I was the only physics major in the school. So I got a job as an assistant in the Physics Department, helping in the lab and cleaning up and doing things as the only physics major. And I went into the Army—it was World War II—at the end of the junior year. And I came back in 1946 after I got out of the Army. And the last thing I was a physics major, so I came back as a physics major. The only problem was that I wanted to get married, and I didn't have time to spend too much time there. So I got out in one semester with some Army credits and so on. And it didn't leave me time to take more physics because I went to the Physics Department, and they said, well all the physics courses are one year. I said I'm only going to be there one semester. Well, you can't take any physics. I said goodbye. So I got out in February of forty-seven. It was already Rutgers in forty-six with no major. They called me a natural science major.

COHEN: You were in the division.

PINE: Yes, I was in the Division of Natural Sciences. That was exactly it. And I was a Division of Natural Science major, it was the Division of Natural Sciences then. And I went to graduate school in physics. So that taught me a lesson, because the anguish I had in graduate school, going in there completely unprepared both in physics and math. Not even knowing I was unprepared! Nobody told me how unprepared I was. Now, this shaped me later because first of all, what happened was that I did get married in 1948. And, you know, I needed a job, I GI benefits to go to school, but I needed a job. So I came back to school. Do you need somebody? Yes. A physics major coming back, and I got a job as a lab assistant, you know, teaching lab. But I soon discovered that, you know, I didn't know anything. Because when I took the physics, I didn't really learn anything. All the tests were open book, and I just learned to look for formulas. I didn't understand anything about physics. I thought—and it was very embarrassing and traumatic when, you know, teaching a lab and students come for help with their homework, their physics homework. What I would do is I'd leaf through the book for the formula. I said, you can't do this, this is no good. And so I was forced to teach myself the physics, to conceptualize it for myself.

COHEN: This was before the doctorate or after the doctorate?

PINE: Oh, well before.

COHEN: Well before.

PINE: This is 1948 we're talking about, you know. In fact that's what saved it. This is the only thing, coming back to teach is the only thing that saved me. I didn't know anything. I wasn't prepared for graduate school. But the teaching forced me to try to understand physics and math. And therefore I began to learn enough to have some chance of staying in graduate school. But, you see, what that did, though, it burned itself into my soul hat this cannot happen to students. I mean you can't let this happen. They come out of there…you can't do that to students. And it had a profound effect. But it also had an effect on me as a teacher because I realized you can't let people take courses and not understand things. You can't let them just be able to manipulate or use formulas or look in a book because that's what I did, and I didn't know anything. You must get them to picture things, to conceptualize, to understand. You must do that. So therefore that's your job as a teacher, is to try to get them to do that. There was one significant thing that had a whole part in the curriculum later of the Physics Department and so on. But this business of being unprepared—see, I had very little math when I was there in my three years; I had very little math.

COHEN: Oh, boy!

PINE: And as a matter of fact, I recall something. You see, you know, when I came back to teach later, I was a student there so I had some of these people. And some of my colleagues later…. when I came back in forty-six, I was going to be there one semester, and I was looking for something to take. And so I'd had a year of chemistry, and I'd had a year of physics or

something. So I looked in the catalog. They wouldn't let me take any physics courses; they were all a year. So I had to take something. So I saw a one-semester course in physical chemistry. So I went to see the instructor, Gil Panson.

COHEN: Mm-hmm. Oh!

PINE: He had just come there, I think. So he let me take the course. So I had this one semester course of physical chemistry with Gil Panson. But because of the fact that…I realized how vital the math was, and I didn't know how vital for physics and so on, that I didn't understand it. There were so many things I didn't understand. I mean I went there, and I was taking graduate courses. And there were things in math I'd never heard of let alone studied. I'd never even heard of them. I'd never worked with vectors. I didn't know what a matrix was. I didn't know what determinants were. I mean I'd had so little math that I'd never even heard of these things, let alone not know them. I didn't even know what I didn't know. I would have never dared go near a graduate school if I'd known what I didn't know. Ignorance saved me then. In fact it was so bad off I didn't know what I didn't know. But anyway…. and what I realized, too, was that a lot of the math I'd had, I mean there were things I didn't really understand how to use them. And I could see that's why people had trouble with math. I mean not in an abstract way, but they didn't know what to do with it.

And so once I was teaching there full time—and it must have been three or four years later—they let me start my own course. And I put a course together that I taught then til I retired. I taught that—it became a standard course: Applications of Mathematics to Physics. And what it was was I took so many of the things that I didn't understand or didn't know what to do with or how to use. And remember all this time I'd been puzzling it out for myself because I had to to survive. And I put them all together in a course. So it included trigonometry and logarithms and then calculus and vectors, all kinds of things. Differential equations. All kinds of things. And I tried to teach this in an applied concrete way. Make math concrete for everybody. And probably…I would guess that…. What happened to me later on and over the years of teaching awards and so on mostly due to that course.

COHEN: Application of Mathematics—

PINE: Application of Mathematics to Physics.

COHEN: —to Physics. I see.

PINE: That so many students probably benefited from that because over the years most of the chemistry majors, most of the math majors would take it, and it was done in an applied way, you know, as a person who taught in terms of pictures and concretely. I'm not very abstract, and I can't think that way even. I don't understand things that way. I have to picture them. So it became a course where students would go to find out what you use math for and so on. I think that was probably the single best thing I ever did was…. But that came from my own ignorance and troubles and so on. So you shaped—what you do later is shaped by what happens to you, I guess.

COHEN: Yes. What were the circumstances around the awards that you won? You won several awards on campus and then there was the Professor of the Year Award. And what—you said before that it grew out of this experience. But at the time…well, let's pick out I guess the—what's the award that you're most proud of at this point?

PINE: Well, the Alumni Awards. What happened was the Alumni Association started in 1960. They established an Outstanding Teacher Award for NCAS. And they had the students write in and nominate professors they've had on the basis of their teaching, you know, and what they did for their students, got them to learn and so on. And I remember that the very first year, the first recipient was Henry Blumenthal.

COHEN: Mm-hmm.

PINE: A very, very highly-regarded history teacher. And he got that. And the second year—and, you know, he was a very good teacher. The second year it was Professor Richard Henry of the Math Department.

COHEN: Yes, I remember him.

PINE: And he was my mentor. He encouraged me as somebody with a haphazard math background. And he had a down-to-earth teaching approach to math which shaped me, I think, too. See, my problem was I just didn't have enough math in my undergraduate thing. But he was a friend. And then when I started to teach in 1948….

[End of Tape #1]

COHEN: Okay. We were talking about the Alumni Award and the circumstances.

PINE: Well, in 1962 I was the one chosen by the students for the Outstanding Teacher Award. And I was tremendously pleased by that, because, you know, I value teaching so much. That to me was a tremendous thing. And to follow-up…. First of all, Henry Blumenthal was a great, great teacher. And then my own idea, you know, Professor Richard Henry that taught me, and then to be the next one in line. But this was something that meant a lot because it came from the students. See, by this time I'd been teaching there, I guess, thirteen or fourteen years. And I'd been giving this Applications of Mathematics to Physics course for since about 1952. So for about ten years I'd been giving that. And evidently the students found that it was valuable. And also this concrete approach, because I can't picture things abstractly myself, carried over to my physics course. I guess students appreciated it. They felt they were learning. More than learning math and physics, but learning how to think about them, how to learn. So that meant a great deal to me at that time. And it was an important time because I think I was then promoted to full professor that same year. That was a big year for me. And then later on, about twenty years later, I received that award again. In 1983 I was given the Alumni Award again. And that was, you know, by that time I'd been teaching a long time. That was in 1983. I was teaching what? Thirty-four, thirty five years. And the fact that the students still appreciated, were still writing in to nominate me was a great thing. And there were a couple of other things, too, that were

appreciated. They didn't come directly from the students. That meant more to me, really more important. But Rutgers has the….

[Break in recording]

COHEN: We're back. You were talking about the Lindback Award?

PINE: Yes. I'm trying to think of when—I think it was around 1970, and it was university-wide. And then I was very pleased. In eighty-two I was honored by the Alumni Association again. And then maybe eighty-three with the Lindback Foundation Award again. Then eighty-four is what you were saying for the National Professor of the Year.

COHEN: Yes, how did that come about?

PINE: Well, I didn't know about it. I didn't know that was happening. But I learned afterwards that in progress that Rutgers had decided to nominate me for this national award. And that the people at the college in the dean's office and other people were busy putting together a nomination for me. I didn't know it. I didn't know this was going on.

COHEN: Oh!

PINE: But they contacted former students to write letters, alumni, people who'd had me. So they had that. And they had—I think there were people on the faculty and I believe Norman Samuels. I think he was still dean at that time. No, maybe he was already provost.

COHEN: That was what year again?

PINE: Eighty-four.

COHEN: Yes, he was provost by then.

PINE: So I think Norman Samuels voted for me, and I think David Hosburgh I think was already dean, voted for me. That was very nice. And then I think they probably brought into it the things I had done over the years with placement and advisement. And then I know what played a part, too, was what I was doing at the state level with testing. And then—because this was leading up to the Algebra Project, so the work there. I think all of these things played a part. In other words the idea of somebody trying to advance education.

COHEN: Sure.

PINE: And so that was nice. I got a five thousand dollar award for this. And I got to give a talk at the Smithsonian to accept this thing.

COHEN: Oh, that was nice.

PINE: Yes. So it's been helpful, you know. Things like that have been helpful in having people give you support for other things like they get involved with the Algebra Project. So, you know, sometimes it's getting one kind of recognition opens the door to other kinds of things and enables you to do other things, too.

COHEN: I wanted to go back. We were talking before about the core curriculum.

PINE: The funny thing is here's somebody who really didn't know anything. He didn't know physics. [Laughter] It's funny now. People never would have given me the award if they knew my background and how botched up the whole business was.

COHEN: Well, they weren't giving it for you background they were giving it for your achievement. That's what it was.

PINE: They didn't know that. [Laughter]

COHEN: I want to backtrack a bit. We were talking before about the core curriculum idea, about how do faculty developed an idea of a liberal education, of a curriculum that would provide a liberal education. You had some thoughts on that.

PINE: Yes.

COHEN: And where math and science fits into the overall picture. I wonder if you could talk about that a bit.

PINE: Yes. That's something that's come to mind recently. It's something that people are worrying about. Colleges all over again, What is the core curriculum? What should it be? But it's something that I see that goes in cycles. If you teach long enough, you live through this over and over again. And it's one of the things that sticks in my mind, you know, over my thirty-nine years of teaching, is that maybe about every ten years or so it comes up again. And I remember that we did that. The faculty would meet and discuss what should the requirements be? And of course the purpose was what should the requirements be so people will get a good education at the college. And that's the ostensible purpose, you know; that's what it should be. But what would happen is that there would be committees, and the committee would make a report, and the committee would…. and I served on some of these committees, and as I say it repeated itself. But we would talk over all these things and try to come out with something you felt was meaningful. And there was always the…you know people would, in one case, support, favor, something that was very, very rigidly constructed. We'll take this and this and this. Then other people would be much looser, you know, a much more general kind of thing. So you would end up with some compromise. Bu then there was something else that came into it that's a fact of life, that it was political. Because with what courses do students have to take, that determines how many students the department would have.

COHEN: Right.

PINE: So at the end, with the faculty that always played the major role. And then you had compromises there, the science people might gang up together to make sure there were enough courses in the sciences. And so forth. But in the end you went with something. And then maybe ten years later, they would go through it again. Let's improve the requirements, the core curriculum and so on. And it's happening now. There's a lot of discussion. But there's something that I realize now that I didn't in those various other times of going through this that has some significance for me. And it has to do with what I've learned now from working with this project, and working in the school, trying to see how people learn, what it means, whether they're going to learn or not. And the fact that it goes beyond skills and goes beyond other things. And what I think now is that setting a particular curriculum is not going to do the thing in itself, something more than that is required. So that, you know, what we used to think—I know I did; maybe I was naïve about it—but the supposition was that if you put together good courses, you know, that they had to take a certain amount of math and you had you had to take least one laboratory course in science, and maybe two other lecture courses. So you have one lab course and two lecture courses. And here's a year of math. And now you have to take two years of history, and you have to take English Comp and some literature course of some kind. And that that would make you an educated person, it would give you a liberal education. I wonder now whether in fact that will do that because what I'm seeing now is that a lot of students—and I can really speak only to the math; I can't go beyond that, I don't know—but what I'm seeing with the math is what we're finding, working with all these high school students. Is that a lot of them have not learned—coming into high school—how to learn math, how to study it, what to look for. In other words, that you have to make it concrete for yourself. You have to conceptualize. You have to have the confidence to think about it instead of just trying to remember things. And therefore, even if they take three or four years of math in high school, they're not really learning very much. It's not really doing them much good. They're not getting educated. There are simply things they remember and they forget. They're not any better off as far as how to learn something else.

COHEN: You're talking about rote learning?

PINE: It's a combination of rote learning and…. But what it doesn't involve is how to dig into something new and try to understand it. You don't learn how you learn things, and it isn't by listening to somebody and just trying to remember what they said or what they did or memorize problems. But you've got to make the abstract concrete. And as long as it remains abstract you don't understand it. A concrete thing is something you can picture. An abstraction is something you haven't been able to reduce to a picture for yourself yet. And if you can't do that, you're not going to really learn math. Or you're not going to learn how to use it in anything else. You're not going to be able to do quantitative reasoning. And so simply having a requirement, as we do now in the college, that everybody has to have College Algebra to get a diploma; but if they don't really learn how to learn math, they may just scrape through with tutoring and whatever else, and not really be any better off in the future this is what they're going to use math for or to go into anything quantitative than they were before. So to what extent is this true in other subject areas besides math and things related to math, where I'm saying it's just in the math?

But is the same thing that I see for some reason going on in other fields where students are learning on the surface but not learning to really begin and be able to go beyond. But if that's the

case, then a paper requirement, no matter what it is, is not going to assure anything. Just because you say if you have certain courses then you're assumed to have the core curriculum for a liberal arts education; but is it any kind of an education whether it's liberal or not? Is it any kind of an education? Or are you merely surviving courses somehow and hopefully getting a degree? But have you learned how to learn? Are you going to be able to educate yourself beyond that when you read, you listen, you talk in the future? So what I'm thinking to myself now merely picking out some assortment of courses, whatever it may be, no matter how loosely or rigidly or whatever it deals with, whatever subject area it deals with, unless you do something about student learning it may not do enough good. I think they've got to worry about that as well as worry about requirements. How good are you at learning?

COHEN: Now where does this…. Alright, so we're into learning theory. I mean is this something you've just drawn from your own experiences, teaching and being a student and teaching math and physics? Is there any theoretical basis for this?

PINE: Yes, there is. I'm not knowledgeable enough about that. You know there's a lot of people been working on this in education on how people learn. They've been taking into account the cognitive aspects much, much more. I think one of the problems has been with something like math that people in mathematics education focus much more on the mathematics itself, on the structure of the mathematics, how you should organize the subject when the new math came in. What things you should expose students to, what topics. And a lot of what has gone into formulating courses in mathematics had been along that line. What topics should we teach? Should you have quadratic inequalities as part of an algebra course or not? Or should you, you know, do this or do that? But from what I'm seeing, the real question is are you getting people to learn how to learn? Once you succeed in that, then you can pick up topics, you can worry about topics.

COHEN: How does one learn how to learn? What's your formulation, if you can?

PINE: A lot of people think about that. But from what I can see—and this is something I've been thinking about a great deal, talking about with people and so on—how do you bring this about? Because that's the issue, you see. There's just so far you can go in improving curriculum. We've been doing it. We've been trying to improve the algebra, the way we teach it better and better. And I think, you know, we've reached a point of limiting returns. It's not enough. It's not enough to do that. And we've somehow got to affect students as learners much earlier. And then, you know, you can do things with them. So you asked me what is learn to be a learner mean? I think, as I see it now, I don't know enough about it in a theoretical sense. But this is my gut feeling and what I'm learning. But I think it's getting students to think for themselves in the sense that you become an active participant, in the learning process, rather than a spectator. And as long as your view of learning and the teacher's view of teaching is that the teacher presents material, however elegantly and beautifully, cogently and succinctly, and puts it on the board, and the students copy it down, and then they try to…well, this is how you do certain things. Now practice it, so you have a lot of problems and so on. That's no good. It's not enough. I'm not just saying this for myself. A lot of people have talked about this for a long time, the idea of discovering something.

But what it really means is that you've got to get the students involved. And that what the teachers should do is lead the students on and present what needs to be conceptualized and then get the students to articulate, experiment. But in the end they have to form their own concepts. But you help them, you guide them. You can't just say, go discover everything. But you've got to present in such a way. And they have to learn that you're not going to really learn by listening to anybody. You don't sit in class and listen. You've got to be part of it. And this can be accomplished. And the way we're trying to bring this about with the algebra is through the homework that…. instead of having the homework…. One of the things that's been done in math, and I think it's been at fault, is you give a lot of problems of the same kind. So if they say do the even twenty problems or something like that, that's bad. You see what you're doing is drilling. See, if you've got a lot of problems just the same, what some people have thought was, well, if you give enough practice in it, then they're going to know how to do it. But, see, that's wrong. You don't want to know how to do it. What you want to understand is the process that goes into it, not how to do certain things, but what's behind them.

So you want to structure the homework so it isn't just something that duplicates what the students have been shown or what examples in the book. But what you want to do is take the homework problems and use them to lead the student on. That's what we've tried to do. And I still do that in my own teaching. I didn't teach from books mostly. In my math physics course, I didn't use a book, and I would just do it from homework problems. The idea was that the student, in attacking the problem, would then have to grapple with the concepts you were trying to get across and either figure them out or not. And if they couldn't figure them out, they had to come back and discuss it with you…until they figured it out for themselves. Then they had it, you see. If you do that, then you've got something for life. If you're just doing the other thing, is you're going to forget it again. So I think what we have to do is reach into the elementary schools and cause a lot more to happen, for youngsters to realize they really can figure things out. That math is accessible; it's common sense if you learn to do it for yourself. And that's what I mean about learning how to learn math.

COHEN: How far back into the elementary schools?

PINE: I don't know. I don't know. I don't know the answer. And that's the big question in my mind right now: Is it sufficient…I mean I don't know at all, we can only try. We're extrapolating back from where we are now in the ninth and eighth grades. We're extrapolating, you know, from what we've seen here. I'm envisioning going fifth or sixth grade at this point. And trying to do some reasoning. The question is, if you present math differently at that level, if you present things where students are going to conceptualize, and they're going to get some of the concepts you want…. In other words, you can force that by which material you choose to attack. So you can try to get a better understanding of our place value system, get number sense, get a better approach to word problems, the problem-solving and so forth. Okay. Fine. You can picture doing that in terms of how you would present material that'll cause that to happen. The question I don't know how to answer, I have no answer for it at this point at all, is will it work, is that sufficient? Or are the learning habits of students fixed much earlier? Are they fixed before they ever get near school in the sense of how they approach things in general? In the sense in which they play, in which they do things. Do they do things on the surface, or do they worry about them? Do they worry whether they understand them or not? And I think this starts before school.

Now, if it's something that is part of your personality, then it's shaped in your early years in the home and in your play with other kids and so forth, how you involve yourself with things, whatever you're doing. If it's not, in other words if you can at a later stage, fifth grade, or whatever, still bring that about under the proper stimuli, I don't know. So the thing is going to be—but you see there are other people working on this. I mean there are a lot of people concerned with early childhood education. Preschool and so and on. I mean we're not discovering anything new. So what we're doing is simply how do you bring this about with the math? How do you produce a better structure in terms of the way you present topics? Better homework. Better organization. But, you know, we're not…. there are a lot of more knowledgeable people who work in this area. What I don't know is how far back you gave to go. So I guess we'll try it.

COHEN: You mentioned a book before that you were…. You were involved as the author, coauthor?

PINE: Yes.

COHEN: What was the title of that?

PINE: Principal author.

COHEN: Principal author.

PINE: Yes. It's called *The Algebra Project*.

COHEN: *The Algebra Project*. Okay. It grew out of the Algebra Project.

PINE: Yes. What happened was that first we thought we would just restructure a bit. You know we were working on this in eighty-two and eighty-three. I worked with a group of people, college people and high school people, I didn't know anyone who was working on this by any means because I didn't know enough about it. I mean I wasn't in math education. I wasn't a mathematician. So I work with a number of good people. This is by no means a one-person effort. But we realized it wasn't enough just to rearrange, say, well, we'll do this topic and that topic. It was so much a question of how you presented the topics and the homework. So it required a more extensive restructuring. So what we did was write up materials: the materials on equations and percentages and, you know fractions, other topics that we felt needed to go into the algebra. And we used that the first year. Now the first year was…. I'm surprised that the teachers—there were thirty teachers in these schools—stuck with us because there was no book and the material was just typed. You know it was off a word processor. We were doing this, right, at NCAS. And what happened was that we started the year, but we by no means had the book, you know, the material done. I was writing all year trying to keep up with it. And what we would do is we gave them…we gave them, each school, one copy of this stuff off the word processor, one Xerox copy. They Xeroxed every page of it to give to every student. And they did all year long as we would produce it, sent them pages and they would photocopy them and give

them out to the students. I'm surprised they stuck with it because they didn't even see what was coming later. Then we met with them during the year of course, with the teachers.

But then that summer after we finished, we did some revisions based on what we found and actually put a book together. We had it photo-offset, and it was in softcover. And then they had a book. And we're still using the same thing. It's a lot cheaper to do it that way and so on. But at this point I think we know enough about it to make a full-scale revision, and now begin to look for actually publishing the book.

COHEN: What year was that?

PINE: Eighty-four. Well, eighty-five. Eighty-four was just the new sheets. The first softcover version of this that looks like a telephone book…. It's not written like your usual math book. A lot of math books are so closely spaced, and there's so much…. The material's spread out. It's easier for students. It's not as forbidding.

COHEN: Mm-hmm. Yes.

PINE: You know threatening. Because students, for so many of them, they've gotten threatened by math.

COHEN: Oh, yes.

PINE: They're afraid. So you've got to try to—that's among other things—you've got to try to get away from that and let them feel they can do it.

COHEN: Some story. Just a couple of general questions: Is there anything that we haven't touched on that you'd like to talk about?

PINE: Well, just personally I'm very happy to have the opportunity to do what I'm doing. I retired so I could put my full time on this. I'm very grateful for the support I've been getting all along from Rutgers. I mean they've supported this—I've had support there from the beginning. I mean starting back in 1968 with the testing, the placement, all the things that went on. And from 1978 on all the support in doing this analysis, all this work, you know, any kind of help I needed. Using the Xerox machine, using the computer before we were funded even, before any, you know—now we're funded by the—grant-funded by the state to do this. But Rutgers supported it all along when I was getting started with it, realizing that it was doing something to help the schools, the communities and so on. So, you know, I'm grateful to a lot of people. I think now—I wish now maybe I'd retired earlier and started this. [Laughter] But as I was saying, gee, you know, how many years do I have left to do it?

COHEN: Nobody has a crystal ball?

PINE: You see the only thing you can say to yourself, fine. I wish you, you know, if I'd been doing this longer, I would have more accomplished by now because there's so much to do. But on the other hand, I wasn't ready maybe, you know? Your experiences shape you.

COHEN: Mm-hmm. Absolutely.

PINE: And what I was doing on a volunteer basis and this testing with NCAS and all the placement shaped me because it gave me the experience—and I interact with a lot of students, I saw what their troubles were coming in. I experienced what to do with testing later and helping to design the state tests, you know, what to look for. And then my years of teaching, my own experiences in how not to go to school. You know what happens to you if you don't get advisement. And so on. They shape you. So maybe I wasn't ready to do this 'til now or whatever. But I'm, you know, very glad to have the chance to do it.

COHEN: Anything we talked about before that you want to go back to?

PINE: I can't think of anything right now, can you think of anything that you want to ask about, I ought to say? I'm sure there are a lot of things I didn't talk about I should have—or a lot of people I didn't mention.

COHEN: Well, we could maybe pick up on this another time?

PINE: Yes.

COHEN: If there's more that you might want to get into?

PINE: Yes, yes. What we think about it. I just in general think it's—I realize I've been concentrating only…. I really haven't talked about the school. I've talked more about what I'm doing and what I'm interested in.

COHEN: Well, you're part of the school, a very important part.

PINE: Yes, but I did over all those years, from 1948 so now we're talking forty-two years at this point, and I'm still there, I'm still associated with the school. I had the chance to work with a lot of people at the college who care. I've seen a lot of people over the years who've been on the faculty, in the library, in the admissions office, and the registrar's office, and the dean's office. But I've seen a lot of people who care for students, and that means a lot to me. And then I had so many students….

[Break in recording]

COHEN: I guess my question is what were some of the, let's say, some of the really thrilling teaching experiences you've had, if you can recall, either in a classroom situation or with a student? I guess that would be the first part of the question.

PINE: Well, I think the most important thing—this goes back to my own experience. See, again, you can't help but be shaped by…. Here was this person who hadn't really understood very much. And then was faced with situations that you shouldn't have to be faced with. I mean go unprepared and so on. It shaped my ideas about the necessity for advisement, the necessity for

placement, the necessity for really learning to understand something. See, it's not enough to just take in the subject of the course; that's the thing. You've got to get to have a feeling you understand it, and you've got to worry about whether you understand it. So maybe the greatest satisfaction…. See, I think…. I don't think this was all going on consciously. I think this was all unconscious on my part with all these…now that I look back, and I'm rationalizing all this. I didn't know these things then. But I think somehow—see instinctively, because of my own experience, I was trying to teach so people would understand, which meant concretely. Not abstractly but concretely in a way that they could think for themselves and that they could come out of the course, whatever it was, and be able to go beyond that and learn some more. You know? That they were educated. Instinctively that to me was education, but you had to be able to do that. I didn't know that. But I mean it was just, you know, from my own experience, that you couldn't just look in a book and look for the formula, see?

So I guess the greatest satisfaction was in seeing people come into courses, whether it was this math physics course or general physics course or advanced physics but whatever, you know. Or math courses they let me teach from time to time. I took calculus and so on. Have people come in that you could see didn't really know how to learn. They had gone through the same things I had gone through in school, whatever it was, and seeing them become learners and having them realize they were—they were powerful. And they went out, they were now ready to be educated beyond that. And I guess I was very sensitive to that because I recognized me sitting there. And I didn't want them to become—you know, see what happened to me later when I didn't know anything. So I guess that was in what? And that's more important. If you have kids who are learners, students—they're not kids necessarily at that point—students who are learners, they learn almost in spite of the teacher. And if you present things well, then they…you know that's not really a challenge. But when you get the people who weren't learners when they came in and now they're learners when they go out, then you've educated them. That's education. See, I think what I'm saying, I'm saying to myself as I talk to you, now there's a distinction about what education means, that on the one hand education is giving people courses and having them learn a subject matter. But I realize now it goes well beyond that. That's not enough. That educating people should be teaching them how to learn beyond you for themselves later on. Now you've educated them. And so I think that if we don't do that in the college, if all they do is go through courses and to whatever extent learn the subject matter of those courses, that's not enough, and that's not a college education. It's not enough. They have to come out as learners able to go on in their own lives, through books, through tapes, through, you know, computers, whatever, and take information, integrate it for themselves, and go on beyond where you left them.

COHEN: What recollections do you have of some of your outstanding students, your outstanding learners?

PINE: Oh, there were so many of them. I have very good memories of so many students that I wouldn't even want to pick out particular ones. But the thing is that some of them go back. It's funny. I can remember—I'll tell one anecdote.

COHEN: Okay. Good.

PINE: I can remember back to my first years of teaching, I can remember students. I'm very student-oriented, you know. And I remember this, and it taught me something. I think it was the summer of 1950. And I was allowed to teach the general physics lecture for the first time. I'd just taught lab, and it was the summer. I was given my first flight on my own. Here I was teaching the general physics course. And, you know, I knew, I had learned then, when I was first teaching you can't just use formulas, and you've got to understand what you're doing or you're not going to end up good. You know it's no good, no good's going to come to you. And so I was trying to do that. And one of the things that I had had trouble with until I figured out a way to do it by common sense, one of the things you get in physics is conversion of units. You've got to change from miles per hour to feet per second. I mean that haunts you in physics and chemistry and so on, the changing units. And one of the troubles was the way people did it. There's a way you can do it by common sense. It's what I call the one, other approaches. Remember I was talking about with the hamburger before.

COHEN: Mm-hmm.

PINE: That if I want to know sixty miles an hour, how many feet per second is it? what I've got to know—I don't want a conversion thing from miles down to feet per second and cross out things and do that. All you have to do is say to yourself, what is sixty miles an hour mean? And what it means is it's sixty times as much as if you go one mile in one hour. That's what it means. So the thing is this, if I want to talk about feet instead of miles, all I have to do is say to myself, one mile is how many feet? I don't have to know miles per hour. One mile. If I know—I've got to know something, that one mile is five thousand two hundred and eighty feet. One mile is five thousand two hundred and eighty. Then I don't want hours, I want seconds. So I've got to be able to figure out…I say one hour is sixty minutes, and each minute is sixty seconds. So one hour is thirty-six hundred seconds. So now I know that one mile an hour the same as five thousand two hundred and eighty feet in thirty-six hundred seconds. And if I multiply that by sixty, it turns out to be eighty-eight feet per second. But I can figure it out by know simple things. I don't have to remember a complicated thing, a combination of. So I finally learned how to do that. I didn't know how to do that, but I was teaching it already. I learned how to do that. I could explain it to the people in the lab.

COHEN: Yes.

PINE: And here I was…I said I'm going to show people this. So I showed the class. I said, "You're never going to have trouble with conversion units. You're going to remove one of the major obstacles to learning physics, and you're going to be so happy." But I was showing them this thing. And to my great surprise I found there were people who didn't want to do it. I couldn't understand it, you know. How can you not want to do it? I mean it works better. It's easier. You can figure it out. You don't have to remember something, and you're not going to make mistakes. And so I was determined that people were going to do it that way, by figuring it out. And I could never remember conversions; you've got to figure it out. And I gave—see, I made the problem more complicated than that. And I remember what the thing was. If a steam shovel can dig out seven cubic feet of dirt in one second, how many cubic yards in a minute? And then you've got to convert—see, you don't convert cubic feet to cubic yards. What you do is you say you have one foot, how many yards is that? And then cube that. See, you can do

everything from knowing one little thing, that one foot is a third of a yard. You don't have to remember the whole conversion. So the first test I gave, I gave that problem. And I had a lot of people get it wrong. Okay. The next test, next week, I gave the same problem again, seven cubic feet per second, how many cubic yards a minute. The third quiz I gave it again. By the fifth quiz I had almost everybody convinced to do it that way and get it right. I still had some people not doing it and getting it wrong. Okay.

The final exam I gave that same problem with the exact same numbers. And I ended up with one student who all along refused to learn how to do it this way. He still got it wrong. At that point—Now remember…. I think I gave out five quizzes and a final. At that point if I were a student, I would've said he's crazy. I'm going to memorize that. I don't care. You've got to keep asking, and he's not going to give up. He didn't do it. So when the course was over—and this guy got it wrong on the final exam.

COHEN: He got it what?

PINE: He got it wrong on the final exam.

COHEN: Yes.

PINE: And I couldn't understand all along why he wouldn't do it, you know. And why I had so much trouble with other people when it's an easier way. I learned later that people cling—see, that was the problem. They were clinging to the ways they had learned things, and they didn't want to take a chance. They said, I know how to do it that way. I don't want to learn anything new. Don't bother me with something new. Don't confuse me. And I talked to somebody, one of the other students in the class, I had marked the exam and he came around and I was talking to him. I can still picture him, this guy, the other fellow. And I said to him, "You know," I said, "there's something puzzles me." I said, "Your friend—" This is his friend. I said, "I don't think…you don't know how many times I gave that question, that same question. Why did he at least memorize it!?" I said, "humor me." He said, "You want to know something? You know what he said to me yesterday? He said, 'That dirty dog Pine. He knows I don't know how to do that problem, and he puts it on just to spite me.'" [Laughter]

COHEN: Okay. One final question.

PINE: Yes.

COHEN: Going back—as you know, I'm a librarian.

PINE: Yes. I've known you for a long time.

COHEN: Yes. I just wanted to ask how you would characterize your experience with the Dana Library over the years in terms of services and collections?

PINE: Well, my experience…. and this is without the fact that I know you. My experience with them has been a very good one at the library all along because it was always there for what I

wanted. You know if I wanted help, whatever kinds of things I was into, you know, I'd get off on certain kinds of things. So with the physics research when I was doing that rather than this education research or, you know, you get into the thing of math education, the cognitive area. Then you've got to start looking to find out what people have done and so on. I always had all the help, you know, I could ask for. And even now I go in there, and if I want something interlibrary loan or even an article that we don't have. I've never had any problem at all; I've always had every kind of cooperation from the library. So I'm pleased.

COHEN: Nice to hear.

PINE: Yes, yes. I've been very pleased.

COHEN: Dr. Pine, thank you very, very much.

PINE: Charlie. You're always formal with me. Come on, you've known me so many years…

COHEN: Charlie! Thank you very much.

[End of Tape #2]

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Reviewed and edited by Catherine Carey 5/1/2013