

An interview with  
PAUL GARABEDIAN

Conducted by Philip Davis  
On  
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Courant Institute, New York University

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## ABSTRACT:

Paul Garabedian talks with Phil Davis about a range of topics, both mathematical and personal, in this two-part interview. Garabedian grew up in an academic family: his father earned a Ph.D. in mathematics at Harvard under G.D. Birkhoff and his mother had a Masters in history from the same institution. His father passed on his two passions, music and mathematics, to Paul, and encouraged him to consider a career in mathematics as early as age ten.

After initially being rejected from Harvard as a sixteen year old, Garabedian instead attended Brown, which boasted a world-class faculty, including R.G.D. Richardson, Jacob Tamarkin, and William Feller. It was at Brown that Garabedian met his longtime (and current) colleague and collaborator, Frances Bauer, who was dating Garabedian's lab instructor in physics, Louis Bauer. Garabedian eventually made it to Harvard, receiving his PhD there for work he did under Lars Ahlfors on Szegő kernel functions and Robinson's conjecture. Garabedian also worked extensively with Max Schiffer, however, and learned much from his role facilitating communications between the two men. He then went to Stanford, where he worked on a grant secured by Al Bowker. Garabedian brought Schiffer and Stefan Bergman to Stanford as well. He left several years later for the Courant Institute, where he has remained ever since.

Garabedian has worked in numerous areas, including transonic flow, which was spurred by questions from David Young at Ramo-Woolridge, which was working on ICBMs. He attributes part of his early success to the work of his first wife, Gladys, who was a programmer that went on to have a long career at IBM. Indeed, Garabedian tells about how he didn't realize that creating a program that worked first time around was a very unusual outcome. He has also worked on the Bieberbach Conjecture. Garabedian attributes his success to luck and lots of hard work. He has had a number of outstanding students, whom he credits for contributing to his success, especially during the 1970s and 1980s. Garabedian also remarks that teaching is crucial to his productivity in research.

Davis and Garabedian briefly discuss a mutual acquaintance, Clifford Gardner.

Besides mathematics, Garabedian is also a skilled pianist, though he believes that he was not talented enough to make a successful career in music the way he did in math. He is deeply disappointed with the current state of the public school system, especially music education, which Garabedian believes is at least as important as instruction in mathematics.

DAVIS: This is an interview with Professor Paul Garabedian on November 16, 2004, conducted in his office at the Courant Institute in New York City. The interviewer is Phil Davis. Since we had a little bit of overlap many many years ago let's do a little bit of nostalgia reminiscing. I think that I was in a couple of classes with you –

GARABEDIAN: Could be. I don't remember.

DAVIS: I think you and I were in a class that was given by [Lars] Ahlfors on minimization and so forth. What are your memories of the mathematical faculty up at Harvard in those days?

GARABEDIAN: Didn't you also work for Stefan Bergman?

DAVIS: I did indeed, yes I did. Before and after I got my degree.

GARABEDIAN: Well, I came to Harvard after Brown and so did Bergman. And I roomed at that time with George Springer, whom I met at Brown. He went over to visit Bernie Epstein, who was working for Bergman, and he found Max Schiffer there in Bergman's office. And he came back and he said, "Look Paul, I found a yummy over there. I found Max Schiffer, a really smart friendly man who's available. Go see him." And I went to see Schiffer. And I went a lot into Bergman's office after that. And I talked to a lot with Schiffer, who worked on complex analysis.

DAVIS: I had a number of courses with Bergman. I liked Bergman. I thought he was an okay, a very sweet man in fact. A little bit mixed up from the American point of view, but a very nice man. I think he did me a number of favors over the years. I didn't get my degree with Bergman.

GARABEDIAN: I got my degree with Ahlfors but I worked a great deal with Schiffer, and they really didn't know enough about each other at that time. Ahlfors was in Finland during the war and Schiffer was in Palestine during the war, and they came together. And it took a while before things settled up in this country, and I was running back and forth between Ahlfors and Schiffer and my career just went way up in no time flat. I was working with both of them and they were talking to each other through me and I just took off upward.

DAVIS: You were the middleman there.

GARABEDIAN: I ended up on the top of the stack doing so well. I was there about two years, and then Schiffer recommended that I go to Stanford and work with [Donald] Spencer and [Gabor] Szegö, and I did that.

DAVIS: Schiffer himself went to Stanford?

GARABEDIAN: Well, he had gone to Stanford and then he sent me there. Then after that Schiffer got together with Ahlfors without me and I think Harvard offered Schiffer a job. Meanwhile, I was at Stanford and when I was at Stanford that's when the Korean War started.

DAVIS: So this would have been around 1949-50?

GARABEDIAN: That would have been more like 1951. And when the Korean War started I was very young, I was a child prodigy. I'm still am a child prodigy, but there are very few people who know that, perhaps yourself and a few others.

DAVIS: I know that. [Laughter]

GARABEDIAN: But there are not many who know that I'm still a child prodigy.

DAVIS: Is this something you advertise?

GARABEDIAN: Oh yes, but it doesn't do me much good – people don't believe it. So, I wanted to do some kind of war work, you know, and work on a project and not go in the Army. And there was a man there, Al Bowker, who got together to form a big project for the Korean War and I became involved in that. All the other people kind of disappeared elsewhere, and I was left as the applied mathematician.

DAVIS: What was Bowker's project?

GARABEDIAN: It was partly applied statistics and partly applied math, and we were going to do war work because there was going to be World War Three. And that didn't shape up. But the ONR [Office of Naval Research] liked the whole business and they decided to try to establish applied math as well as statistics at Stanford, and they put up a lot of grant money.

DAVIS: Going back a little bit to this child prodigy business. How old were you when you first realized that you had a talent –

GARABEDIAN: Oh, when I was ten or eleven my father, who had gotten his Ph.D. at Harvard under G.D.Birkhoff, showed me the Harvard catalog. And he said, "Look at this catalog. They've got complex variables and they've got real variables and you've got to go there and take those courses, but you probably shouldn't do applied math because that isn't so highly regarded, so I couldn't get a job (in applied math)."

DAVIS: Really –

GARABEDIAN: That's what he said. That was when I was ten, which would have been the middle thirties.

DAVIS: The middle thirties. This was before the war.

GARABEDIAN: Yes. And my mother told me, “Well, you’d better watch out,” because she knew that the Holocaust was coming and she knew what that meant. And she told me, and that was back in the thirties.

DAVIS: How was she aware of this?

GARABEDIAN: She read the various left-wing sheets. There were places where people like I.F. Stone, were spilling the whole beans and telling everybody that would listen.

DAVIS: Was your mother an academic?

GARABEDIAN: She was. She got a Master’s in history; her specialty was medieval history. She met my father at Harvard, and as a result they thought that’s great. I met my ex-wife at Stanford, as a result I thought that was great.

DAVIS: Your father taught math at Wheaton [College]?

GARABEDIAN: He taught math and he conducted a choir. He did both math and music.

DAVIS: I didn’t know him. I knew your uncle a little bit.

GARABEDIAN: Yes. So he was the younger brother. My father made my middle uncle and my younger uncle do math. My middle uncle did applied math, he became an actuary in John Hancock. My youngest uncle, Henry, he did applied math, he worked for Westinghouse and General Motors after the war.

DAVIS: I met him at General Motors. Henry L. Garabedian, right?

GARABEDIAN: Henry L. Garabedian.

DAVIS: Right. There was some connection out there at General Motors with Garrett Birkhoff, as I remember.

GARABEDIAN: That’s right. He went the rounds of companies and he hired Birkhoff as a consultant. Usually he got in trouble with the companies, with people like [Admiral Hyman] Rickover, you know, and he lost a job and went to another company. But Birkhoff kept the job so he had lots of consulting jobs.

DAVIS: Henry left General Motors?

GARABEDIAN: He left Westinghouse because he got in a row with Rickover and he went to General Motors where they were going to do reactors. But then they gave up

reactors, so he worked on fenders. Carl de Boor worked for him, and developed splines, so that they would have nice formulas for the fenders.

DAVIS: Carl de Boor is one of the people who's being interviewed, or hopefully will be interviewed in this –

GARABEDIAN: Well, he can say whatever he remembers of that.

DAVIS: Right. Did you ever intersect with Birkhoff, Garrett Birkhoff, professionally?

GARABEDIAN: Yes.

DAVIS: In what way?

GARABEDIAN: My father did his Ph.D. with G.D.Birkhoff in the twenties. And then they, my parents, educated me and they wanted me to go to Harvard. But I had never been to school and Harvard turned me down as an undergraduate in 1944. And my father took me to see G.D.Birkhoff in this dark office in Widener, and we had a big discussion. I was sitting there and G.D.Birkhoff told my father all about Garrett Birkhoff and concessions that were made for him, he went on to do math and never got a Ph.D.

DAVIS: That's true.

GARABEDIAN: At the end of the discussion G.D.Birkhoff said, "Well that's all right for my son, but not for yours."

DAVIS: Very interesting. How old were you at this time?

GARABEDIAN: I was sixteen. But later on I came back. I went to Brown, and came back and got my Ph.D. as we were describing, with Ahlfors with a big assist from Schiffer, and at that time I did not see much of Garrett Birkhoff.

DAVIS: Did you do a thesis on invariant conformal measure, the stuff that Ahlfors was –

GARABEDIAN: No, not the stuff that was in the course that we took together. I worked with, back and forth between Schiffer and Ahlfors and there were problems running around there in Bergman's lab, and I solved one of those problems and that became my thesis.

DAVIS: Reproducing kernels –

GARABEDIAN: Yes, I wrote an article about Szegő kernel functions –

DAVIS: The Szegő kernel functions, yeah.

GARABEDIAN: And I wrote another problem about Robinson's conjecture. So I wrote two papers, one about the Szegő kernel function and another about Robinson's conjecture. I got two job offers: one from Szegő and one from [Raphael] Robinson. Robinson was at Berkeley. He was the husband of Julia Robinson, who became a President of the American Mathematical Society.

DAVIS: Let's go back a little further then. So anyway you didn't go to Harvard as an undergraduate, you went to Brown. Since I've been at Brown for a number of years, but I was not there in those days, can you say a few words about the math faculty at Brown? This would have been in the mid-forties?

GARABEDIAN: What happened is that I couldn't get into Harvard but they were sending my father – that was in 1944 – they were sending my father announcements of the mechanics program at Brown, which was an applied math program not unlike the one here at NYU –

DAVIS: This was [William] Prager?

GARABEDIAN: Operated by R.G.D. Richardson, and he was coming into New York and going to the city colleges and collecting the smart undergraduate students, largely Jewish, people like Frances Bauer, Sam Karp, Al Novikoff – people who are here now – and bringing them to Brown on government grants to do war work. And those were my friends; those were the people who picked me off the wall and made my life pleasant at Brown. And those were two glorious years. But those were the days of the Holocaust and there was a large amount of anti-Semitism running around. They wiped out that faculty at the end of the war, and that's when I went to Harvard. They replaced it by a new group. Now Prager stayed on. Some of it's left, but not Richardson. Not the people I knew, not the people I was learning from like –

DAVIS: Bergman was there.

DAVIS: Bergman was there but he ended up at Harvard. That was how I got into his office.

DAVIS: Let me see who else was there. There were a number of the refugees from Europe.

GARABEDIAN: Yes and those people were gathered at Brown, but after the war they dispersed to all the places in the west. This was a change in the American culture.

DAVIS: Yes, but part of it was that the job opportunities just blossomed, there were jobs galore.

GARABEDIAN: Yes, in the country as a whole. But the Ivy League had been firmly embedded in an anti-Semitic climate. And that meant that the further places – places like Stanford – grew up quickly to match what had been the established older universities.

This was a change in this country: the GIs came back, there were students, and there was money.

DAVIS: There was a remarkable change.

GARABEDIAN: It was a remarkable change, and I rode to glory on that. I succeeded, and then jobs were easy. People appreciated my work; I had friends everywhere, completely unexpected success.

DAVIS: And there's what's-his-name that went to Princeton, who was a writer on a very influential book on probabilities and statistics? <sup>1</sup>

GARABEDIAN: Feller?

DAVIS: Feller, William Feller, was at Brown.

GARABEDIAN: Yes, I had a course from him. There was a course... [Jacob] Tamarkin's last course was taught on Galois Theory. And I sat there and took the course on Galois Theory. Tamarkin was too sick to come the bulk of the time, so he sent Feller in to teach the course.

DAVIS: Was [Richard von] Mises there?

GARABEDIAN: No.

DAVIS: Mises was not there.

GARABEDIAN: No.

DAVIS: Mises was just, was at Harvard.

GARABEDIAN: So I learned, I had this course in Galois Theory, first from Feller and then for a while from Tamarkin. I got an A grade in the course – maybe I was the top student in the course – I understood NOT ONE WORD. [Laughter]

DAVIS: This is group theory.

GARABEDIAN: It was some kind of group theory.

DAVIS: Some kind of group theory –

GARABEDIAN: I didn't know what was going on, but I could pass the courses. I could predict easily the questions on the exams, but I didn't understand them, or what was the work going on –

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<sup>1</sup>William Feller, *Introduction to Probability Theory and its Applications*, vols 1,2, John Wiley, New York



DAVIS: You boned-up some how, in a way –

GARABEDIAN: Well, I was a child prodigy. I had been groomed to do that, and I did it very well.

DAVIS: There were a lot of people there at Brown – all of them became distinguished professors in math and statistics and so on. Was this where you met Frances Bauer?

GARABEDIAN: Yes.

DAVIS: She got her Ph.D. from –

GARABEDIAN: She was getting her Ph.D. –

DAVIS: From Brown?

GARABEDIAN: And she was going around, her boyfriend was Louie Bauer, they later became married. Louie Bauer was my instructor in physics. He was the teaching assistant; he was my instructor in the physics lab. I remember distinctly the first month or two I was there, I was in the elementary physics course and I got the sniffles, so I went home for the weekend. My mother put me to bed and I felt rather sick and she didn't let me go back to class, and I came in the next week and I asked Louie Bauer to give me a makeup in the exam they had. He looked at me kind of quizzically and said, "Well, you know, I think we gave you an 'A' on that one." [Laughter]

DAVIS: Without the makeup.

GARABEDIAN: And now I work with Frances everyday. I had a big discussion this morning for an hour with her about my numerical mathematics. That's what I do.

DAVIS: {phone ringing]

GARABEDIAN: Ignore it.

DAVIS: Very good. So, would you say that applied math dominated quite early, as opposed to pure math?

GARABEDIAN: In my career?

DAVIS: Yes.

GARABEDIAN: No. My father showed me the Harvard catalog; here were real variables and complex variables, and don't do applied math. And I couldn't understand this course on Galois Theory. I had a very fine course at Brown from Gilman in complex variables. He allowed me to discuss all the time at the board what was going on –

DAVIS: From whom?

GARABEDIAN: Gilman [Ray Edwin]

DAVIS: Gilman, oh my God, I haven't thought of him in a long time.

GARABEDIAN: He was a very smart man, absolutely confident, and not afraid to deal with someone else who was smart. He didn't want to be bothered doing what I was doing in class. We got along great, and I got great confidence in that field. And I worked on complex analysis, not applied math. When I went to Stanford I got involved with a big grant for the Korean War which became a basic applied math grant, and I was all that was there, so I was the man who ran it. I was about 22 years old, and I was running this grant. I brought in Schiffer, and I brought in Bergman, and the people that maybe really wanted the support there, that's how they got there. I got there first and they came.

DAVIS: Going back to Richardson. Do you think that he bounced out these people?

GARABEDIAN: No. He went and collected them, and they bounced. He was a really unusual man. He was not anti-Semitic, he a lot, he built up something comparable to the Courant Institute, but it was thrown away after the war and he no longer had the job. He had to leave the graduate school.

DAVIS: He retired or something. Did you know him?

GARABEDIAN: He lost the battle.

DAVIS: Well, there was this president –

GARABEDIAN: Wriston.

DAVIS: Wriston?

GARABEDIAN: He's the father of the one who ran Citibank.

DAVIS: Citibank, yes. Walter, is it?

GARABEDIAN: Walter Wriston ran Citibank. Henry Wriston –

DAVIS: Was the president –

GARABEDIAN: Yes.

DAVIS: Say a word about that.

GARABEDIAN: I think it might be better not to.

DAVIS: Okay.

GARABEDIAN: This was World War II, and there were these two factions, because Richardson had gone out and recruited the people from the city colleges. Those were the kind of people in other fields who went on to win the Nobel Prize. I mean, they brought in the refugees that Hitler spewed out; this country became first class scientifically –

DAVIS: It all started there.

GARABEDIAN: But we had students coming from the city colleges, from that environment, who rose to the occasion and became the leading scientists. It all looked very rosy, but Wriston was not as excited as Richardson was. He did many fine things for a lot of us and all that was unforgotten, but you can ask Frances about it; she knows quite well. That was a rocky period.

DAVIS: Yes, that's right. Let's talk just a little bit about some of your work. I noticed that you've been into transonic flows –

GARABEDIAN: Yes.

DAVIS: They're shooting up something for Mach 10. Do you have feedback into that?

GARABEDIAN: Well, that came much later. So then at Stanford there was this big grant and I was doing work for the Navy on naval hydrodynamics. After a while that led to working on the reentry problem. In the late fifties, well around 1956, they were building the first intercontinental ballistic missiles for the A-bomb, and they had planned how big the missile had to be to get it back in. They needed to know about the bow wave and that was a problem of transonic flow, and the engineers had figured that out and the whole thing was being built and that was a major investment. Then they came to the math community to ask, "Have we done it right?" This involved solving the bow wave problem, and transonic flow. At that time I was asked by David [M.] Young, who had a team at Ramo-Woolridge Corporation [later became TRW], how about working on some free streamline flows for us that Birkhoff had spoken about. That didn't work out, but they asked me how to do this bow-wave problem. I told them right away, but nobody understood. And after they had asked me several times, then I thought, "well, maybe this is a worthwhile problem," and I worked on it. It took me about a month to figure out what to do and it was a computation. That was my first really important paper on computational methods.<sup>2</sup>

DAVIS: What sort of digital computers were around in those days?

GARABEDIAN: We had, at the beginning, something called the Icebox, which was a CPC. It was a hard programmed computer. It was just a business machine from IBM, it was three large squares. And then Stanford acquired an IBM 650, that was through Al

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<sup>2</sup> P.R. Garabedian, H.M. Lieberstein, On the numerical calculation of detached bow shock waves in hypersonic flow, J. Aero Sci. 25 (1) (1958) 109-118.

Bowker who had gotten the major grant proposal done, and my ex-wife worked on that 650.

DAVIS: She was a programmer?

GARABEDIAN: She was a programmer. She had a masters in statistics. She worked with Al Bowker on applied statistics and I took her this problem. It had taken me a month to figure out what to do to solve the bow-wave problem, and I took her the problem page of formulas, and I asked her could she do something on the IBM 650? She said, "Okay, I'll try," and in two weeks, she wrote the code that worked. Now it took me a month to figure out the math, it only took her two weeks to do the code. It's generally speaking the other way around. It takes a long time to do this code, and that worked perfectly well. I wrote up the thing, and it was this lady who really had done this hard piece of work.

DAVIS: Were you married at the time?

GARABEDIAN: Yes. Now I have not seen her that much in recent months –

DAVIS: Let's get a name on the tape here.

GARABEDIAN: Her name is Gladys Garabedian.

DAVIS: Gladys Garabedian. What numerical strategy did you employ on that problem? Are there differences or –

GARABEDIAN: That was a problem that you tried to find a flow to see if this rocket would come back in. You started with a shock, where there was Cauchy data, and match the finite differences to the body and then tried to find it and put things together. Now that's an ill-posed problem: a Cauchy problem and subsonic flow and elliptic equations. And all you have to do to solve that is just to put, "y = it," make a complex substitution. In the nineteenth century, they did it all the time, but in 1900 people were told that on elliptic equations you could not do that; they are different, you can't do that. I had figured out that's what you do –

DAVIS: If you make that substitution then the distinction disappears to some extent –

GARABEDIAN: The distinction disappears. Now there is a hidden problem of analytic continuation that you do analytically. That's easy, and you have to say that to explain it to people. But that worked like a charm. At first, you know, the community was up in arms, "you can't do that," but after a while they found out maybe this is imperfect, but it worked very well. For me there was an intermediate stage where the funding for computing solutions in more details broke down, and I thought that was because people were criticizing the work. But it turned out that while we were doing the calculations the first missile came back in, there was this picture in the *New York Times* of [Dwight]

Eisenhower standing next to the missile, and the problem was solved. I think it had been okay all along.

DAVIS: This work that you did, was it a collaboration with aerodynamicists?

GARABEDIAN: No.

DAVIS: No.

GARABEDIAN: No, I went to Ramo-Woolridge to work with David Young on naval hydrodynamics problems, free streamline problems. That didn't work out – we didn't have the time or resources to do it and they asked me about the problem because I was on the premises and they were working on missiles. They asked several different ways at several different times before I realized that I should look into it. And I went to the library and figured out what to do.

DAVIS: You were talking about David Young – let's say a few words about him. He was one of the people that I was supposed to have interviewed.

GARABEDIAN: Yes. He was a student of Garrett Birkhoff.

DAVIS: Yes, he wrote a thesis with Garrett Birkhoff on iterative methods.

GARABEDIAN: That's right.

DAVIS: And linear algebra, linear –

GARABEDIAN: Yes: successive over-relaxation [SOR]

DAVIS: Right. He apparently, alas, is not in a condition to be interviewed.

GARABEDIAN: Oh, that's a shame –

DAVIS: I tried to get in contact with him.

GARABEDIAN: I don't think he necessarily got the amount of recognition that his contributions merited. He played an important part in my life because he's the one who had me there; he's one of the people who asked me about that problem. I knew right away what to do, but it took a while before I could get it all.

DAVIS: Was this before he went to the University of Maryland?

GARABEDIAN: I don't know about the University of Maryland. He was heading a math group at Ramo-Woolridge in Los Angeles. That's when I knew him. Then he ended up I think in Texas, I don't remember –

DAVIS: Yes, he was in Texas; he ended up in Texas.

GARABEDIAN: Ended up in Texas. And I saw him thereafter, but he played an important part in my life. But the one who really made the difference there was my ex-wife who took the page of formulas and converted it into a code that worked. I discussed it with her more recently and I said, "Look you should have been coauthor of that paper." And she kind of smiled, you know, and she said, "Well, Paul I really did spoil you that time, because it worked right away and you didn't realize that that doesn't always happen that way."

DAVIS: In those days it was quite traumatic to write a code, because with high probability there would have been a bug in it.

GARABEDIAN: Yes.

DAVIS: And you had to debug, and you had to go back and debug a number of times –

GARABEDIAN: That's right, so her work was –

DAVIS: When something worked for the first time that was very unusual.

GARABEDIAN: I had no idea how unusual it was or how important it was to me. Now I complained to a student. I should have made the lady a coauthor, and my student said well, he did look it up and in fact I did mention her in a footnote. Well, at least I did that. But I didn't know.

DAVIS: What was her subsequent career in the field of computation?

GARABEDIAN: Well, when she got really weary of taking care of me, straightening me out – which she did for many years – then she worked for IBM. She worked for IBM for many years.

DAVIS: Where, New York?

GARABEDIAN: First in New York, and then later in Gilroy and in San Jose. She lives near San Jose now. She had a very successful career with IBM. I think she made major contributions in the early days to the FORTRAN code, FORTRAN language.

DAVIS: Have you done over the years a lot of collaboration, or no?

GARABEDIAN: I have collaborated with many people at various levels. It started with Schiffer, who explained to me how that's done. He said, "Look you do things with people, you write the paper together, and you always put the names in alphabetic order, and don't squabble –

DAVIS: You were working on the Bieberbach problem?

GARABEDIAN: Yes. Well, I learned about that at Brown –

DAVIS: Eighty-three or eighty-four or something –

GARABEDIAN: I learned about that at Brown with Paul Rosenbloom when I was maybe 16 or 17. I was learning complex variables, and he said read [Karl] Löwner's paper on the Bieberbach Conjecture. And I did that. I thought that was a great problem, and in fact I was saving it for my old age, which would be now. I thought that's the kind of thing I could probably do in my old age. In the mid-fifties, with Schiffer, at Stanford, we did what's called...nothing had been done since 1923 with it. [Garabedian and Schiffer proved the conjecture for the 4<sup>th</sup> coefficient in 1955] There had been thirty years of nothing, partly because of World War II. So again, that was very good thing for me. But there, again, I used numerical work to do this proof, and again I was assisted by my ex-wife. She brought me the Marchant computer [hand calculator] and I did some of the estimates at the desk. Later Schiffer simplified it very much, you know, and it became a much easier matter.

DAVIS: Was there any relation between what you and Schiffer were doing then and the final solution, which was about ten years ago?

GARABEDIAN: Well, that would be a matter of opinion. What I did at that time, and later, was to do numerical experiments to see if methods that were proposed would work if you were able.<sup>3</sup> That was a success, and I think [Louis] de Branges did a comparable thing. He had a different arrangement and the proof is completely different, but my understanding is that he did numerical experiments at an intermediate stage, in the beginning, to see if he was on the right track [de Brange solved the general case of the Bieberbach conjecture in 1984] It came out very well, and he knew enough to continue. Now, he's entitled to dispute that –

DAVIS: I hear that Walter Gautschi had a finger in –

GARABEDIAN: Yes, that's right. I think Gautschi had a major finger in that. And his role in the Bieberbach Conjecture is like my ex-wife's role in my bow-wave problem. I think that's a very important part of the work and that kind of collaboration has not always been appreciated through interdisciplinary work. And one group is snotty about what the other group contributes.

DAVIS: So in the business there's a lot of ignoring of people that make substantial contributions to problem solving?

GARABEDIAN: That's right. I think that people don't understand. They like to think it isn't worth trying, and it's not important to them. It happens to me.

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<sup>3</sup> Computer experiments with the Bieberbach conjecture. Garabedian, Paul R., 1968 Proc. Internat. Congr. Math. (Moscow, 1966) pp. 627—628.

DAVIS: Let me change the subject a little bit. Have you ever introspected on where your ideas come from, where they originate?

GARABEDIAN: Well, in my case –

DAVIS: Yes, in your case –

GARABEDIAN: I'm lucky because there were all those surrounding friends, the war effort, and I had an easy and fruitful career. But I would say in my case – which I would not generalize and say that's everybody's case – I did a tremendous amount of hard work. I'm not that able to do things, if I don't do all that hard work. I always did hard work. I did hard work this morning before you came over. I came in at 7:30 – I had done three hours of work by the time you arrived.

DAVIS: What do you mean by hard work?

GARABEDIAN: I sit there thinking, I sit there trying to solve a problem, and I sit repeating today what I did yesterday. I would say that in all that work I make a fair number of mistakes and I make a fair number of discoveries. Those are coming about in equal amounts. And in that arrangement it's important to correct your mistakes, and when I find my mistakes I try to correct them. I think I'm pretty good about it. The other part is, you make discoveries but if you're working so hard, and it's numerical work, you may discover something and not even notice it. You're working so hard it just goes through, thrown into the wastebasket. And I have done that once or twice: had a discovery that I didn't inspect. It came easily and I didn't inspect it. And I did rediscover it later. So I know, I know that the first time I threw it away, but I rediscovered it, so then I noticed. I think the bigger error is to come on something and not realize how important it is and what it means. But what I would say is, I'm working hard and I'm a crazy guy and I do odd things: some of them are wrong and some of them are interesting. That's how I work, there may be smarter people – I think there are smarter people – who plan it out and know what to do and they don't make so many mistakes.

DAVIS: Is there a bit of luck in all this?

GARABEDIAN: There's a lot of luck in this. But also a lot of hard work.

DAVIS: Speaking of computing and so on, I take it that you use some of software packages that around like Maxima and MATLAB. Do you use MATLAB?

GARABEDIAN: Well, I use some packages. I currently use FORTRAN as a language, I use MATLAB occasionally for problems. I learned how to do a mathematic problem, but I am not using packages as other people do. I have colleagues here at NYU who use packages –

DAVIS: Mathematica?



GARABEDIAN: I don't –

DAVIS: Formula algebra and formal calculus?

GARABEDIAN: I don't do that as much as maybe I should. I don't, but what I have done in more recent years since I came to the Courant Institute, I have had a series of really good, hardworking, imaginative students who wrote our computer codes with me, or for me. Without them, I would not have done the kind of work I did. David Korn worked with me on transonics. Octavio Betancourt worked with me on magnetic fusion. Those people made major contributions. We had a nice team going. I was a member of the team, we had a number of students in the team, and Frances Bauer was part of the team. And in that climate, which was more of a laboratory, a computing laboratory, I did quite well.

DAVIS: You still have a group now.

GARABEDIAN: It's very small now. Frances is still here working with me. And she's very successful because she's very good at working with the new computer sets and language requirements and making them available and useful to people in other departments. She's very good and supportive of that work and that's driving – I'm still subsisting on some code my students wrote. In my old age I'm doing my business in engineering with those codes, but I would say my math methods are not up to date. I used to be twenty years ahead of my time, now I'm maybe five or ten years behind.

DAVIS: Well that's –

GARABEDIAN: That's getting old.

DAVIS: Yes. Let's go back a few years. When did you first come to Courant?

GARABEDIAN: In 1959.

DAVIS: So you knew very intimately, I imagine, all the famous people that –

GARABEDIAN: The old folks, yes.

DAVIS: You knew [Richard] Courant and [Kurt] Friedrichs and [Wilhelm] Magnus and –?

GARABEDIAN: Well, I came the year after Courant retired. After Courant retired they started hiring outsiders. They made offers to a number of people, and at the end of the season [J. J.] Stoker came out to visit Stanford. And I had my discussion with him and at the end he was sort of saying they're offering me a job, and I said "I'll take it," and that's when I came.

DAVIS: Cathleen Morawetz was here –

GARABEDIAN: She was here.

DAVIS: Is she retired?

GARABEDIAN: Yes.

DAVIS: She has retired.

GARABEDIAN: Yes.

DAVIS: Did you do joint work with any of these older people, Courant people?

GARABEDIAN: Well, I think with the older people at the Courant Institute I did not do joint work. I've done a lot of joint work, but at the time I came here, I was working very much with my students. And typically I would have a student who would get a degree and then hang around on my grants as postdocs. With those students with postdocs I wrote a lot of papers, but not so much with the colleagues in the building. When I was at Stanford it was colleagues, like Schiffer and [Halsey] Royden that I wrote papers with.

DAVIS: Could you say a few words about the personality of some of these older mathematicians, Courant, for example.

GARABEDIAN: Well, I would say in coming here, I always, in my youth, and that's what I warned you about at the beginning of the discussion, I sound off –

DAVIS: Very good, sound off.

GARABEDIAN: And I talked a lot to people and I had my opinions; I had my rows and so forth, had lots of discussions and got lots of stimulation. Times were hard, but what I found out after I'd been here a while is: my gosh this a place with lots of strange people around –

DAVIS: In the Village [Greenwich Village].

GARABEDIAN: But I feel very comfortable here, so I must be one of them. [Laughter]

DAVIS: You live around here?

GARABEDIAN: Yes, I live two blocks over. That's two blocks south in NYU housing, but I'm reaching a place where I have to retire, so I've moved two blocks north, in the building you see over there.

DAVIS: Yes my son lives in one of these –

GARABEDIAN: Very, very nice place to live.

DAVIS: They call it Varsity Express.

GARABEDIAN: Yes.

DAVIS: Right. Those are subsidized apartments.

GARABEDIAN: Yes.

DAVIS: But you have to leave when you retire.

GARABEDIAN: Yes. So my wife said we can't even discuss retiring if we don't get another apartment, and we lucked out completely. We are doing very well.

DAVIS: Well, that's very nice. What sort of a guy was Courant?

GARABEDIAN: Well, I knew him less well because he had retired. I made this deal with Stoker over lots of martinis at Stanford and then I talked to my ex-wife who was guiding me through life at that time. We decided that if I didn't do something about it there'd be a negotiation and we'd stay put. So we decided well resign, get it over with. So the next day after Stoker left I went in and I quit, they were negotiating that I would be chairman. I discussed all the complaints, troubles I had over the years, and I told them that things weren't so great and that I quit. I just left. Which was very good for the department – after that they got really good support – but I was out of a job. So I sat out of a job for about a month and then I called NYU, I got [Eleazer] Bromberg on the phone. I said, "Look I'm down here in Stanford, I'm out of a job, could I get a job?" Bromberg said, "Gee, I didn't know about that, I'll call you back.

DAVIS: Who is this?

GARABEDIAN: Bromberg. Eleazer Bromberg. He was Stoker's right-hand man. He called me back the next day and said, "Well, I went to the dean and we arranged it. You've got the job and you'll have to wait until next year, this is June, you'll have to wait until next year for tenure because we can't do that so quickly, but that's not a problem, don't worry about it. You come, be here after Labor Day." So I came and that worked out. So Bromberg really hired me.

DAVIS: And Stoker had been here first?

GARABEDIAN: Stoker was here since the 1930s, and he took over –

DAVIS: Stoker was here. Oh, I made a mistake, I thought you met Stoker while at Stanford.

GARABEDIAN: No, no. Courant retired in 1958, or so, and Stoker was the director. So officially he hired me, but the negotiation I made was with Bromberg.

DAVIS: Courant has the reputation, whether it's deserved or not, that he was a tough guy to deal with.

GARABEDIAN: I don't think that's fair. I think he was a very generous person. I think that he gave out ideas, he had these people who became privy to all, but he was dispensing ideas and knowledge and research right and left. He sat on top of it, he was a good manager. I think that all the stuff that went on here he had his fingers in. I think he was a very good scientist.

DAVIS: Is it correct that you played in the quartet with –

GARABEDIAN: No, no. I played in quartet out in Stanford, with my friends, but when I came here that didn't happen. The other people were playing music, but I didn't do that. I tried once at Courant's house and he was pretty disappointed with the way my piano sounded. I didn't read music easily. I could practice and play things that I had practiced, but I couldn't sight read very long.

DAVIS: He was what, a violinist, or what?

GARABEDIAN: I don't recall. I have lots of friends who played music.

DAVIS: I heard that music was a part of his life –

GARABEDIAN: Part of his life, but I was not – he was here and all but I was in some other group. I really belong in the group of people that Bromberg hired: Frances Bauer is one, Louis Bauer was another. He hired a number of people, and I was one of them.

DAVIS: There was a classmate of mine at Harvard, his name will come back to me. We were both at Harvard and then we were at the NACA [National Advisory Committee for Aeronautics] during the war, but he also was a bit of a wunderkind. Then he was here, at Courant, and then he went to Texas and met some wave guys. Cliff, Cliff –

GARABEDIAN: Clifford Gardner.

DAVIS: Clifford Gardner.

GARABEDIAN: Alright, that is a nice tale, that's a gorgeous tale. I knew him at Harvard, I knew him quite well when you knew him, and we were very friendly. His sister, his older sister, his sister went to college with my sister, at Smith, during World War II.

DAVIS: She was a musician was she not?

GARABEDIAN: She was an excellent violinist.

DAVIS: Yes.

GARABEDIAN: And she and my sister played in a quartet, she was the first violinist and my sister was the second violinist. They played quartets together and I went to Smith and visited and played the piano, and I knew her. Later she came to New York and she worked for Courant. Courant understood instinctively that she was a great violinist, and he had Clifford Gardner on the payroll and he had Lucille Gardner on the payroll, and I think later Lucille's son was here, but that ended in tragedy.

DAVIS: Lucille's son?

[End of Tape 1, Side A – Start of Tape 1 Side B]

GARABEDIAN: I also knew about Lucille through my sister. Later on he went to Texas.

DAVIS: Did he get married, do you know?

GARABEDIAN: He got married, and he was very happy for a long time, but then I think his wife passed away, as far as I know, but I can't vouch for those times, especially now.

DAVIS: You lost touch with him.

GARABEDIAN: Well, I didn't particularly lose touch with him. Later on, I got a certain amount of recognition, I won some prizes, and after that they asked me to be on a panel to choose a prizewinner. [ I was on that panel and we talked together and said, "how about Clifford Gardner for this prize?" and I said "great." <sup>4</sup> . And then we talked the rest of the panel into doing that and he got the prize, which I think was very good because I know that during the time when he was here he was doing a lot of work and talking to people. But he wasn't charmed with just publish or perish, he didn't follow through and make a big noise about the stuff he did. So other people were known, and he wasn't so well known. I think when you get the opportunity to give a prize, you've got to recognize the work of somebody who did excellent stuff and somehow didn't get the kind of recognition that –

DAVIS: Oh, this happens – alas, alas it happens often. Well, he was a shy person –

GARABEDIAN: Yes, he was shy.

DAVIS: Very shy and –

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<sup>4</sup> Most likely the AMS/SIAM Norbert Wiener Prize, 1985, awarded to Gardner for his work in supersonic aerodynamics, plasma physics, hydrodynamics, and the inverse scattering theory for nonlinear partial differential equations.

GARABEDIAN: Now his sister wasn't so shy. And we went to the house of a mutual friend – a friend of my wife's who also knew Lucille – and she came over and was talking to my wife and the issue of my piano playing came up. My wife was bragging about my sister, violin and piano. And then Lucille told my wife rather vigorously, "Well, Paul plays much too loud." [Laughter] I went home and I played...you know, I play much too loud. She was right, you know. So I got a better piano, I got a nice grand piano that will play piano as well as forte. I've been trying to play more quietly but it doesn't go that easily.

DAVIS: Talking about music, let's get back to that remark that you made earlier that in the schools – elementary and high school – music has gone down and it ought to be more important than math. Could you talk about this a little bit?

GARABEDIAN: I think it should be part of the schools at all times. My younger daughter, we had her in a group over here, singing. She had a beautiful voice, and a big part of her life was being in performances because she had this gorgeous voice and some acting ability. In the end her range and volume may not have been everything she wanted, and she didn't do that - but that was an important part of her training, and it was an important part of my training, but that was long ago. My sister was encouraged to go on to music and I was encouraged to go on in math. Well, the truth is my piano playing was loud and I could get them to sit up and listen for two or three minutes but not two or three hours. You know, I wasn't born for professional music. And after World War II with the A-bomb and all and my career in applied math went very well, I mean I couldn't have had a career like that in music. I tried to keep up my piano, now I also play the violin, but I haven't kept that up. But that was the training my father gave. He taught both math and music. He thought that's what you should do. And I thought it was great for me. If I hadn't been able to play the piano well, if I hadn't been able to do math, I might be in a nut house, you know.

DAVIS: Well, quite apart from your personal experiences with both, why do you suggest that at the elementary stage music might be more important than math?

GARABEDIAN: Oh, I can't imagine, when you have the resources as we do in this country, not teaching music to kids. It's just part of life and it's just very important. You don't just study math twelve long years so you can add up bills in a restaurant and fill out income tax forms. They teach repetitive math year after year, and I don't approve of it; I don't think that's important. And not teach music, because you don't need it for work, I think that's the most fallacious idea.

DAVIS: Why do you suppose that music has decayed in the elementary schools?

GARABEDIAN: I'm shocked at the state of our schools. You go into the schools in New York City and they let the building decline. You see the buses that barely work. People are too mean spirited about the amount of resources they put into the schools. They're too conservative about what they spend on daycare, how they take care of the little kids. If this country wants to keep going up in development and having the strength that we do,

we don't give half of the resources we need. If you're little kids, that's a winner, hand's down, and we don't seem to do it the way we should. Now there are other countries that do much worse. There are countries where women don't even show up in school. There are countries where they give them six years of education and throw them out. So we're doing better than most of them, but we don't do very well. But I will say, I really like it here and what I do. We have had students come in off the streets, we have offered courses teaching in a wide variety of situations, multi-cultural, and I am very happy here. But it's a private school, not in the public system. We aren't paid an outrageous salary.

DAVIS: Have you ever had, over the years, any interest in reform of the math curricula. Like the new math or that type stuff?

GARABEDIAN: Well, I participated on a committee about how it was organized, but I was on a panel with some physicists and engineers, what people should know in high school. And I came in wanting a pitch in there to teach some differential equations, a little easy, high-school level differential equations: force equals mass times acceleration and so on. I think that perhaps my goal was too ambitious, but I thought having calculus, differential equations, at some very beginning level, in that program would have been a good idea. And I didn't get that much encouragement from the rest of the panel members. I think in physics they wanted to say, "We can do physics without the differential equations." I don't see any advantage to learning physics without the differential equations.

DAVIS: Was this a national panel?

GARABEDIAN: Yes.

DAVIS: Not a local one then.

GARABEDIAN: And there were not people on that panel with a lot of experience in high school teaching.

DAVIS: I was very briefly on a committee of the new math, and I was essentially opposed to it.

GARABEDIAN: I was not enthusiastic about the new math, but they had me on a panel and I was putting in a pitch to have some form of applied math. I think it was a revelation when Newton discovered the differential equation, how to formulate physics as a differential equation. After that, you could not turn the history books back – it was too easy and it was too big a leap forward that you couldn't change back. And I think that that should be in a basic school course. I think music should be there. I don't think repetitive arithmetic should be overemphasized. If people have a math disability, and there are many who do, they shouldn't suffer through that, I don't believe in that. You can't all be the same, but there's a large chunk of the people who can do math, and they should have that in their program.

DAVIS: I was thinking of some of the better schools, better high schools, there is a certain amount of calculus that's taught.

GARABEDIAN: Yes. Well, my daughters ended up in Stuyvesant High School, fortunately that's a public school with a very nice parental group., and they learned calculus and they learned math very nicely in Stuyvesant High School. They had teachers, I went to talk to the teachers – you know, as part of the system I could go and talk to them. These were guys who had done some graduate work, they were successful with the masters [degree], but not with the Ph.D. They were doing an excellent job of teaching math in high school. My daughters went on to college. It was much different. There, the teachers had this stress on research. This was forbidding.

DAVIS: Well, of course, part of the reference to the repetitive teaching is that the teachers themselves don't know their stuff and don't like it.

GARABEDIAN: Well, part of it is that they don't like it. Certainly, there's this problem in math. There's an enormous calculus commitment. They have all of these courses to teach over and over again the same, and that's a bit of a problem. I can't really complain about the way that other people do it, because here I am at 77 still teaching and I have done precious little of that. So I've dodged some of the duties.

DAVIS: Well, what are your ideas about the relationship between teaching and research?

GARABEDIAN: Well, I have had a good life. I do research a large part of the day here, and I've had a very and pleasant, supportive teaching load here at NYU where I taught graduate courses most of the time – there used to be a separate graduate department – and we had night school students coming in. These were students who wouldn't let me get away with poorly prepared lectures because they were paying their money, and they fought back. Between six and eight at night, they fought back and caught me, come up to snuff. And I find now I'm teaching fluid dynamics and I find it very stimulating to go and prepare the lecture again and rediscover stuff that I had forgotten, and have students coming in to talk to me. I think it's part of the theme, but I can't say that I'm anxious to have a big teaching load. Now, at Stanford I had a very substantial teaching load. I was very arrogant. I used to prepare during the first five minutes of class, and then I used to succeed. Now I'm old and tired. Now I'll forget your name when you leave, you know. Now I have to prepare to get through a two-hour lecture. But I would not want to be in a place where you only do research. Because everyday you face four walls. I'd get frightened that I'll never have an idea again. I need stimulation – from colleagues, from the outside world – I need people coming in asking me questions and telling me about problems, criticizing my work, otherwise I wouldn't do it. I'm not a stand-alone person.

DAVIS: I think that I have covered pretty much the topics that I wanted to cover. But I wonder whether you would like to add something.

GARABEDIAN: I would say that during the period in the 1970s and the 1980s, I had two daughters and I spent a lot of time at the playground. I had very good students and I



didn't spend so much time in research and my students carried the work for me. So I had a relaxing twenty years. In the late 1980s, when the kids grew up, my wife got a job – she's teaching this morning – and I was thrown on my own, I went back to work. If I hadn't had an intermediate period of less intensive research, I think I would have retired, but I'm thriving. I'm now working on some problem in magnetics where there is a variational principle. It is very much like the Bieberbach conjecture. It is very much like the work I did on naval hydrodynamics in the fifties. And I'm writing it over again, but now in the context where I'm really trying to say, "How can you find a magnetic fusion reaction." Now that's a very speculative field. It's also an area where there's not that much experimental work around and it's –

DAVIS: Experimental work is very costly?

GARABEDIAN: It's very costly.

DAVIS: Very costly.

GARABEDIAN: There is now an international project planned to try to design a magnetic fusion reactor. But it means that for somebody to do computational methods, a computational novice, it's a free ride. Because they can't do what they should do, I'm still excited.

DAVIS: Well, wonderful. I think I am getting tired. I don't know about you, but I am –

GARABEDIAN: Okay.

DAVIS: I'd like to bring this interview to an end, and I'd like to thank you very much.

GARABEDIAN: Well, I'd like to thank you for coming, and I'd like to thank the people who are going to listen to this and clean it up a lot.

DAVIS: Very good.

[Part II of the interview with Paul Garabedian conducted on May 2, 2005 at the Courant Institute in New York City. The interviewer is Phil Davis.]

DAVIS: Can you back up a bit as to what you were saying about your daughters last time?

GARABEDIAN: Yes. So you asked the question about the thirteen-year-old kid asking –

DAVIS: How do we tell when a problem is solved?

GARABEDIAN: This I relate back to logic and axioms. Well, at that time my daughter came when she was ten, and she had this project to determine the volume of a cone and they told her it's a third of the height times the base. Now if it's a triangle cone, it's half the height times the base and I think you can figure that out, but it's harder with the cone. So I thought, gee, I am going to teach her how you get that formula with calculus. So I asked her, "Would you do that," and she said, "Well, I'm going to listen daddy, but not right now." That went on for a while and then I took her on a trip with me, and we were in this hotel room. In the morning we woke up, and I usually got up and prepared a preliminary snack and closed the window, and she got up a little while later. And one morning I said, "Look how about the calculus this morning." And she was lying in bed and she said, "Oh, okay." So I tried to explain to her this calculus. And the trouble is that in that whole time I had not prepared the lecture. I thought anytime I could do that. But I had not prepared it so that it would be a good sound bite, such as it would sound right from the tape. In two minutes I was stumbling around, and after about two, three minutes I had not done it. And she looked up at me and she said, "Daddy I'm just a little kid." And that was the end of it. I figured that if I had prepared it adequately, in two or three minutes I could have gotten the idea across, but not if I didn't think about it. I should have prepared my lecture. If I wanted to do it with a kid that age I couldn't just make it up as I went along.

DAVIS: Going back many, many, many years, when I took a course in advanced calculus from G. D. Birkhoff, George David Birkhoff –

GARABEDIAN: Oh really, what year? What year was that?

DAVIS: Well that would have been 1941, I think –

GARABEDIAN: Wow –

DAVIS: 1941, anyway, he was not having a very good lecture and, you know, this stuff was elementary to him but he didn't prepare. He didn't prepare his lectures – he was a big man on campus and he had other things – and he used to flounder around a lot at the blackboard and so on, which was exceedingly boring, I can assure you, for the students. Do you have any recollections of teachers that didn't prepare? Or the reverse, that prepared very well?

GARABEDIAN: Well I like it both ways. In complex variables' I had a teacher at Brown by the name of [Ray Edwin] Gilman. He came in completely unprepared. He was lazy and he was as sharp as anybody around –

DAVIS: What was his name?

GARABEDIAN: Gilman –

DAVIS: Oh, Gilman. Do you remember his first name?

GARABEDIAN: Very nice man. And he came into complex variables with a book by Phillips, it's on the shelf over there, and he worked on it. I was an undergraduate, maybe a sophomore, and I was heckling him, you know. He knew that he was very smart, he was just lazy. He liked to do it, so he prepared on the spot and he was quite happy. I heckled him and told him how I thought it should be done and we worked back and forth. And that was my beginning in complex variables. At the end of that experience I felt utterly confident and happy and knowledgeable. But he was a smart man, and very pleasantly relaxed and encouraging. I don't think that can be said of G. D. Birkhoff, he was a different personality –

DAVIS: No, no. Was this Leonard Gillman?

GARABEDIAN: No, that's a different Gillman. But you can look it up out of the old Brown catalog. Now he was extremely nice to me and had a lot of things to say.

DAVIS: So, the fact that a lecturer is unprepared can –

GARABEDIAN: Can have an advantage.

DAVIS: Can have an advantage for the student.

GARABEDIAN: But on the other hand, now I'm 77 and I'm still on the payroll, and I still teach some classes and I definitely need to prepare because I am not quick and flexible the way I used to be. I can't run as fast as I used to, I can't solve the problems as fast as I used to.

DAVIS: There are some lecturers in mathematics that like to give the impression as they get up in front of the class, in front of the blackboard, that they are producing this material brand new out of their brain.

GARABEDIAN: Well, if they can do that, I think that's fine. I would say I prepare now and I'm doing all right. I think perhaps I'm better than ever because I used to be so quick and so sharp I would clobber the students before they got a question in. Now I'm much more sympathetic because things are harder for me. And I think I'm reasonably successful in a classroom. If it gets a little worse and I get a little slower, then I can retire. Now if they look impatient I'm going to have to give up.

DAVIS: Going back to your experience with your young daughter and calculus, did you have any intersection with Hassler Whitney?

GARABEDIAN: Yes.

DAVIS: The reason I ask is that after he retired from the Institute for Advanced Studies he had some ideas about how you teach young children things like arithmetic and so on.

GARABEDIAN: My impression of him – I’ve seen him since I was in school – was that he was a very kind, sympathetic person. I took a course in topology with him as a first-year graduate student. It went from fall to the end of the spring, and the first term was extremely enjoyable. I learned intuitive, practical topology in the way that satisfied me and nourished me. I took the course in the spring and it just was a total loss – the students weren’t very fast, it was in obscure stuff, I couldn’t follow. I got an A in the course, but it turned me off to topology for the rest of my life. I didn’t want to be involved in something that I couldn’t deal with.

DAVIS: Well, I thought that some of his ideas about how to teach young children were off-the-wall.

GARABEDIAN: Off-the-wall.

DAVIS: Yeah, really –

GARABEDIAN: Well, at a later time I went to a National Academy meeting and sat with him at the dinner and he was just very friendly and forthcoming, and I felt good talking to him and several other friends.<sup>5</sup>

DAVIS: He was a nice guy.

GARABEDIAN: He was a very nice man. I had not seen that as a student, but he just doesn’t come across as quiet and friendly. But in math a lot of those people turned me off because they went too fast or they didn’t show me any examples of doing anything intuitive, like point-set topology by axiom without a single example. I didn’t get it, you know. And if I had to go several weeks not getting it I went and did something else.

DAVIS: I think that some of these interviews are going to be very interesting twenty-five years from now, fifty years from now, when our descendants take a look at them. Well, I think we’ve wrapped up all the topics that I had on my list and you had on your list, so let me once again thank you for being a very, tremendously accomplished interviewee.

GARABEDIAN: No, no... [Laughter] Oh you haven’t turned it off –

DAVIS: No, it’s still on –

GARABEDIAN: [laughter] I was about to give up without a word and turn myself in.

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<sup>5</sup> In 1975, Garabedian became a member of the U. S. National Academy of Sciences, for his work in the Applied Mathematical Sciences.