

A PASSION FOR MATH

AN INTERVIEW WITH DALJIT SINGH AHLUWALIA

INTERVIEWER:
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DALJIT SINGH AHLUWALIA CAME TO NJIT IN 1986 WITH A VISION. He aimed to build a first-rate applied mathematics department. Today, NJIT's Department of Mathematical Sciences is a testament to his energetic commitment to excellence. The department Ahluwalia chairs has an increasing number of undergraduate and graduate students, growing grants and notable research. All of these achievements reflect Ahluwalia's basic formula for success: Love what you do.

While Ahluwalia is passionate about mathematics, his life encompasses other deep commitments. They are his wife, Devinder, their four children and six grandchildren, and his efforts on behalf of the Sikh community in the United States. Much of Ahluwalia's time has been devoted to organizations that promote mutual support among Sikhs and intercultural understanding of their faith. The personal recognition achieved by Ahluwalia over the years has included first-name relationships with individuals such as Indira Gandhi, Zubin Mehta and former New York City Mayor Ed Koch.

It is Ahluwalia's engaging combination of idealism, drive and keen intellect that energizes a remarkable academic enterprise on the sixth floor of Cullimore Hall. As everyone up there likes to say: May the power of math be with you!

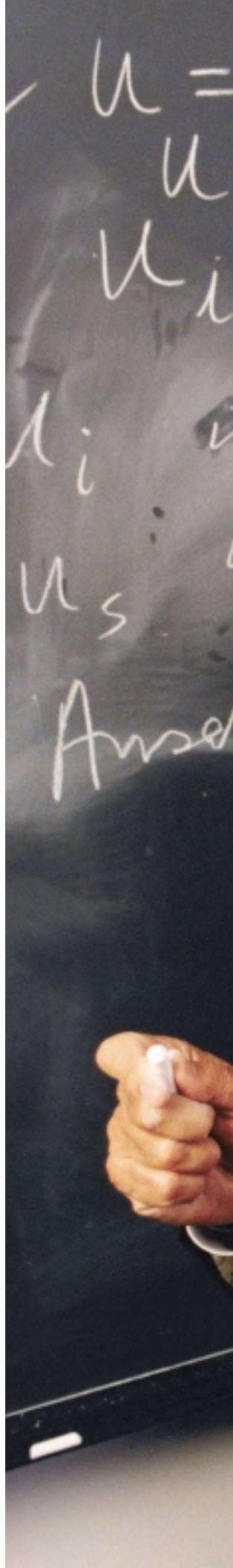
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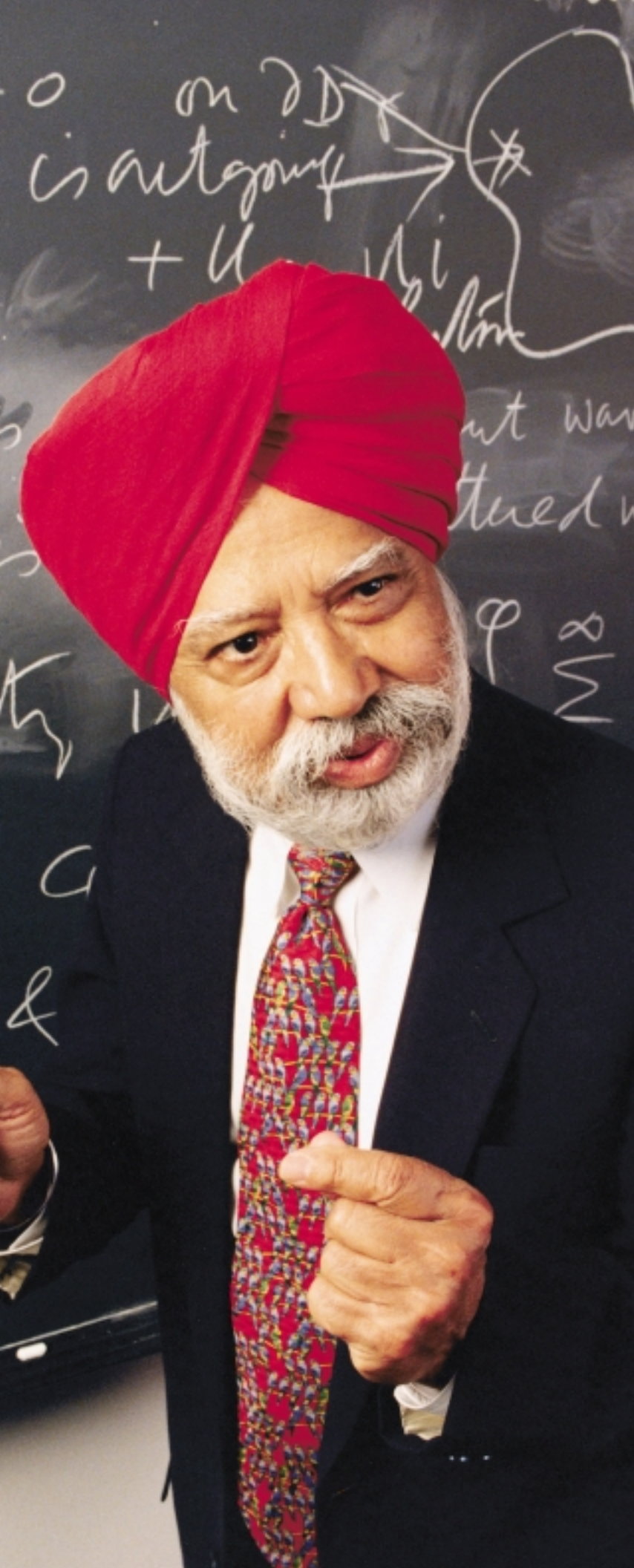
Weinstein: How did you become interested in mathematics and in teaching math?

Ahluwalia: I was inspired by my grandfather to love mathematics as a child and was nearly always first in my class in math. So I knew I wanted to do something with mathematics from a very early age. When I went to college I realized the power of mathematics for many applications. I also found that I liked the freedom of academia. If you have the appropriate frame of mind, you can spend 24 hours a day thinking about subjects that you love.

Weinstein: Were there individuals along the way who inspired you to go into teaching and research?

Ahluwalia: I have been blessed at every stage of my life in this respect. There was always one teacher who was a special mentor. In high school there was one; in college in India there was one. When I came to this country in 1962, I was made to feel at home at Indiana University where I had a fellowship to pursue my Ph.D. Then I was fortunate to have a post-doc position at the Courant Institute of Mathematical Sciences at New York University, where I became a full professor. So I've been blessed, especially with mentors like Professor Joseph Keller, who was director of the Division of Applied Mathematics at the Courant Institute.





Weinstein: Where is Keller today? Is he still alive?

Ahluwalia: Keller is alive and kicking at Stanford University. He is professor emeritus but still very active in research. We collaborate even now. He has always inspired me.

Weinstein: Given the importance of such mentoring in your life, fostering the same relationships at NJIT must be very important to you.

Ahluwalia: It is very important. As soon as I came on board from the Courant Institute, I took it on myself to help younger faculty members grow in their work, to become future leaders. Coming to NJIT was an opportunity to start something unique, to focus on a department that would help NJIT become a great technological university. It's also important for you to know that we are very competitive when it comes to hiring new faculty and seeking the best people for all positions. Then we do everything we can to help newcomers feel as if they were always here. I cannot overemphasize the value of collegiality among our faculty and support staff. We all work together.

Weinstein: What are some of the changes that have taken place in the department since you became its chair, changes that are especially significant for you?

Ahluwalia: To begin with, the number of faculty in tenure-track positions was 24 in 1986 and there are currently 41. Also, when I became head of the department, research was not a priority. The feeling seemed to be that an increased emphasis on research would mean less emphasis on teaching, that the quality of teaching would diminish. But my objective has been to promote research as well as good teaching. We now have more than 20 active grants from public and private sources totaling more than a million dollars a year. This is a very significant achievement for us.

Weinstein: How many National Science Foundation grants does the department have?

Ahluwalia: We have about a dozen NSF grants. There are also grants from the National Institutes of Health, NASA, the U.S. Air Force and the Navy. Then there are grants from private groups like the Whitaker Foundation and the Victoria Foundation.

Weinstein: How significant is it to get a grant from the federal government or a national foundation?

Ahluwalia: Such grants are very competitive, and getting them means that our faculty and NJIT have national recognition.

Weinstein: What about students and courses? How have the numbers changed over the years?

Ahluwalia: They have changed dramatically. When I came to NJIT, we offered only seventy sections of mathematics per semester. That would be maybe twenty different courses. We now offer more than 130 sections per semester, ranging from pre-calculus to courses at the Ph.D. level. The number of different courses has more than doubled.

Weinstein: How many students are taking these courses?

Ahluwalia: Currently about 5500 students per year. That's more than twice the number in 1986. Of course, we now have a Ph.D. program, which we started in 1994. We have produced twenty Ph.D.'s, and each of them has a job in industry or academia.

Weinstein: Have you seen any change in the number of female math majors? Attracting women to careers in science and technology seems to be a continuing challenge.

Ahluwalia: That's not the case in mathematics. More than 30 percent of our undergraduate and graduate students are women. Last year, three of the six students who completed their Ph.D.'s were women, and

Weinstein: You mentioned actuarial work for companies like Prudential. What other types of work are they doing?

Ahluwalia: Mathematical modeling is very important. For example, we now model the performance of new designs for ships and aircraft on the computer, and save millions of dollars by using a mathematical simulation instead of experiments with real ships and planes. That can also be much safer. Modeling is also used in many other fields, like bioengineering and weather forecasting.

Weinstein: What are some of the personal qualities of a good teacher, a good professor?

Ahluwalia: There are five in my opinion. To be a student yourself for life is the first. Second, you must be dedicated to inspiring your students. Third is being a creative researcher. Fourth, you should be a good mentor for students even after they have completed their degrees. The fifth is contributing to university and professional communities.

Weinstein: Tell us a bit more about contributing to the communities you mentioned.

Ahluwalia: Well, what is a university? It consists of groups of people expert in different areas, who have knowledge that must be shared with people outside of their own departments and their own university. Many of our faculty participate on NJIT committees. Looking beyond NJIT, we have faculty who contribute to editing fourteen journals, and two are chief editors. Also, for example, Greg Kriegsmann is vice president for publications of the Society for Industrial and Applied Mathematics. We are very proud of all of them.

Weinstein: Does research strengthen teaching?

Ahluwalia: Research strengthens teaching and teaching strengthens research. A good teacher must know about the latest advances in mathematics, and in order to know that you have to do research. And teaching makes you 'think out loud.' When you teach and interact with students, you are always examining what you know and what there is still to be learned. Researchers can be successful without teaching, but in organizations like Lucent, IBM and Bell Labs researchers have seminars where they interact with each other. They don't teach, but they do interact in a way that's similar.

Weinstein: How can research by faculty members be encouraged?

Ahluwalia: You have to provide the right environment. You have to establish that research is as important as teaching. For example, at the time I came to NJIT I observed that one professor, Denis

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they have started academic careers. We also take special pride in attracting women to our own faculty.

Weinstein: What are some career opportunities today for math majors?

Ahluwalia: We have graduates with bachelor's degrees working for companies like Lucent, IBM, Prudential and TIAA-CREF. At Prudential and TIAA-CREF they're doing actuarial work. Our Ph.D.'s have gone on to prestigious post-doc and academic positions, and in industry and government. They're at Caltech, the Georgia Institute of Technology, Johns Hopkins, the University of Chicago. They're also at Prudential, Dendrite International, which is a New Jersey software company, and Brookhaven National Laboratory. These are just a few examples.

Blackmore, had great potential for research but did not have the encouragement that he needed. I arranged a research sabbatical at the Courant Institute for him. Since then, he's flourished. I also introduced him to a professor in the mechanical engineering department with whom he collaborated to obtain a \$600,000 grant from the Office of Naval Research. He has succeeded in getting many more grants and publishing many papers. If you create an environment that encourages research, everyone will want to do it.

Weinstein: You've referred to seminars at famous industrial research labs. Tell us about the seminar program that you initiated.

Ahluwalia: Shortly after coming to NJIT, I organized a weekly Friday seminar to promote interest in research in the math department and in cooperation with other departments. Now we have three seminars per week. There are also seminars and workshops during the summer. The seminars are given by faculty, graduate students, and invited speakers. On Friday, we now invite presentations by nationally and internationally known experts.

Weinstein: Who are some of the speakers?

Ahluwalia: There have been many distinguished speakers from academia and industry. Just a few that come to mind are Andreas Acrivos, who is at CUNY; Nancy Kopell from Boston University; Charles Peskin and Margaret Wright from the Courant Institute; Michael Weinstein, a senior mathematical scientist at Lucent; and Joseph Keller from Stanford University. Most of these individuals are members of the National Academy of Sciences and recipients of Presidential Science Medals. Some have also been honored with MacArthur Foundation Fellowships. Of course, Joe Keller, who I mentioned before, is known as Mr. Applied Mathematics.

Weinstein: Why is that?

Ahluwalia: Electromagnetism, biomathematics, statistical mechanics — no matter what field it is, Joe Keller has done work in it. Also, I must mention Robert Miura, who joined our faculty from the University of British Columbia. He has started a regular Tuesday seminar in mathematical biology. Bill Hunter, chair of biomedical engineering, has given seminars, as well as physicians from UMDNJ and people from the neuroscience center at Rutgers-Newark. We also have regular seminars in fluid mechanics and applied statistics.

Weinstein: What are some of the hot research areas in math today?

Ahluwalia: One is mathematical biology. Mathematical analysis is now very important in areas such as functional genomics and stem-cell research. The biologists are also getting together with mathematicians to study neural circuits in the brain. Several people in the department are working in this area. Large-scale computing is another hot field. That involves the collective use of very powerful computers for complex problems, such as in space flight and molecular biology, the protein-folding problem, for example.

Weinstein: What are your special research interests?

Ahluwalia: They include wave propagation, asymptotic methods, scattering and underwater acoustics.

Weinstein: What sort of work does each of these areas involve?

Ahluwalia: Let's start with wave propagation. It can involve the way waves travel from a moving ship. Underwater acoustics is part of wave propagation and important in technology like sonar. Scattering can involve the design of hydrophone arrays to detect submarines, for example, or the way electromagnetic radiation is scattered by an object such as an intercontinental ballistic missile.

Weinstein: Asymptotic methods?

Ahluwalia: Asymptotic techniques offer a way to quantify scattering from complex bodies. For example, such techniques would be used to study scattering by a convex body, which is neither a sphere nor an ellipse.

Weinstein: How do you rank your department nationally?

Ahluwalia: I believe that today we are definitely one of the top departments of applied mathematics in the country. Our goal is to be among the top five applied math departments in five years.

Weinstein: How do you anticipate achieving that?

Ahluwalia: The criteria would include the number of Ph.D.'s we graduate, our grants, publications and presentations at major conferences. You must remember that our Ph.D. program is relatively new, though we are doing very well. And we are making progress in all of the relevant areas. We're working to be up there with departments like Caltech, MIT, Courant, Georgia Tech, the University of Arizona and the University of Washington. ■