ORAL HISTORY PROGRAM

Raja V. Ramani: Penn State, My Home Away from Home

2024

PREFACE

The following oral history is the result of recorded interviews with Raja Ramani conducted by Barbara Arnold on May 12, 2022. This interview is part of the AIME Oral History Program.

ABSTRACT

Since moving from India to attend graduate school at Penn State in 1966, Raja Ramani remains an active retiree at Penn State 56 years later. Ramani has spent his life's career with Penn State, where he has had the opportunity to explore all his interests. Ramani has had a continuously evolving career at Penn State, serving as Head of the Department of Mineral Engineering, working on multiple interdisciplinary research ventures, chairing numerous committees, and researching sustainable mining practices to combat health and safety hazards. Co-director of three centers of excellence, Ramani believes in a research to practice philosophy, stating, "If it is not applied, then it remains a report on the shelf." Ramani was appointed to eight National Academy of Engineering committees, setting the stage for their area's future research, and has served on several expert panels for Federal and state governments. He has also served as a consultant to the United Nations, World Banks, the National Safety Council, and international mining companies. Ramani recounts his impressive career through admiration for his mentors and opportunities in SME and AIME. A recipient of many distinguished awards, Ramani is most honored by the recognition from his peers.

Readers are asked to bear in mind that they are reading a transcript of the spoken word, rather than written prose. The following transcript has been reviewed, edited, and approved by the narrator.

TABLE OF CONTENTS

PART 1

00:14 Introduction
01:09 Why Mining – A Fascination of Rocks & Minerals
04:59 Why Graduate School – Motivation to Go Beyond Industry & Explore the Theory of Mining
08:31 Why Penn State – Wanting to Study Ventilation Explosions & Underground Coal Mining
12:04 Penn State Mining in 1966 – An International Department
15:20 Choosing Academia Over Industry – Teaching What I Am Passionate About
18:06 A Period of Intense Growth – Learning from Stefanko, Falkie & Frantz
21:43 Land Use Planning – My 20-year Interdisciplinary Venture Developing Sustainable Mine Practices
25:40 Admiration for My Mentors & Professional Societies
29:42 Starting Up Large Multidisciplinary Projects – Standard Oil Research Proposal
33:14 Co-director of Three Centers of Excellence – National Mine Land Reclamation Center
35:11 Respirable Dust – A Complex Health Hazard Problem in Underground Mining
39:15 The Expertise of the University of Minnesota – A Leader in Dust Control Studies
41:01 The Challenge of Managing Multidisciplinary Research Teams & Progressing My Career
42:47 Becoming Head of the Mining Department & Forming New Undergraduate Programs
45:53 Penn State's Miner Training Program – A Leader Since 1974
48:55 Starting Off Miner Trainers with Research – Improving the Health & Safety of Workers
53:02 Bleeding Blue & White – "Penn State Allowed Me to Pursue All My Interests"

PART 2

00:32 Research to Practice Philosophy – Applied Research to Develop New Techniques for Mining
04:40 Research to Practice – Identify Stakeholders' Needs and Tackle Big Problems
08:09 Research to Practice – Keep an Open Mind & Incorporate Others' Ideas into Experiments
11:34 Making Research Practicable – Penn State Mine Ventilation Simulator Example
13:59 Research to Practice – "If It Is Not Applied, Then It Remains a Report on the Shelf"
15:46 SME Committee Service & Raising Money for the SME Coal & Energy Division Endowment
21:58 My Appointment to Eight National Academy of Engineering Committees
25:06 Defining Technologies for the Mining Industry & Evaluating the NIOSH Research Program
27:24 Health & Safety Committees – Respirable Dust & Offshore Drilling Safety Management
29:34 Committee Responsibility & Commitment – "It's a Service You Should Gladly Accept"
31:24 Quecreek Mine Inundation – Called to Answer by Penn State & the Pennsylvania Governor
35:13 Chairing the Quecreek Commission – How to Avoid Mine Inundation Incidents in the Future
37:56 A Six-Week Commission – Recommendations That Changed Pennsylvania Common Law
39:50 "Eggheads from the University" – Be Prepared for Criticism
41:32 Distinguished Awards – Valuing Peer Recognitions & Nominations
46:25 Use Awards to Learn – "Encourage Everybody to Do Even Better Than What We Have Done"

PART 1

00:14 Introduction

Arnold:

We are here today to continue the AIME Oral History series. My name is Barbara Arnold, professor of practice in mining engineering at the Pennsylvania State University [Penn State]. Today, it is my pleasure to interview Raja V. Ramani, emeritus professor of mining and geo-environmental engineering, emeritus George H. Jr., and Anne B. Deike Chair in Mining Engineering at Penn State. I've had the pleasure of knowing Dr. Ramani since I studied for my Bachelor of Science degree at Penn State, now some 40 years ago. I can report that I got an A in his ventilation class, so I suspect that makes me worthy of this great honor. I also had the honor of introducing him as Inductee 257 in the National Mining Hall of Fame in Denver, CO, last October.

01:09 Why Mining – A Fascination of Rocks & Minerals

So let's begin. Dr. Ramani, we've had several discussions over the past months about your career in academia, both education and research, as well as your professional affiliations, but I'd like to begin our interview by asking you about your youth and your path to your career in mining. So why mining, why Penn State, and what motivated you?

Ramani:

Thank you, Barb, for this very nice introduction. Time does fly. I do remember the time when you came to Penn State in the early '80s. I thank AIME for inviting me to be a part of the Oral History series. I'm honored to be invited and share my thoughts on my career and my views on mining education, the mining industry, and in general, on several mining topics.

Well, you asked me why mining, why Penn State, and about my early youth. To many mining students, mining is usually a family tradition. Both my grandparents were not miners. They were, in fact, landlords with extensive landholdings, and they were from the southern part of India. But my father decided to go to school and earn a bachelor's degree in economics in 1928. He was the first in the family to go to college. My mother did not complete high school, rather married early, and, as usual tradition, was responsible for raising the family. I had a brother who was seven years older than me and a sister who was four years younger than me, and we grew up in Kolkata.

My father was an accountant by profession and was the chief accounting officer of a large private firm in Kolkata. I had one uncle who was the chief personal officer of a copper mining company in India, and as a child, I used to visit my uncle and aunt quite often. What impressed me during these visits was looking at material being transported, from the mine, over the aerial tramway, or aerial ropeway, 15 miles across a hilly terrain and across the river to a milling and smelting plant, and copper coming out from rocks. One end was the mine; at the other end, there was the metal; in between, I was looking at minerals and rocks, and this fascinated me. And in fact, it was this fascination of rocks and minerals that led me to my career in mining.

04:59 Why Graduate School – Motivation to Go Beyond Industry & Explore the Theory of Mining

Arnold:

So you've been at Penn State for almost 60 years, and you certainly bleed blue and white like I do. I know that you've contributed greatly to the education of undergraduate and graduate students through courses on mine ventilation and mineral engineering management, to name a few, and by conducting professional engineering licensure review courses for decades. What did you find the most fulfilling?

Ramani:

Well, the interesting thing about my mining career was that I entered the Indian School of Mines in 1958 as an undergraduate student. Indian School of Mines was structured by the British in line with the Royal School of Mines, and [it] opened in 1926. Basically, it was an academy for mining, with the objective of developing mine managers for the Indian mining industry, particularly [with an] emphasis in coal mining and underground coal mining. I graduated in 1962 with a bachelor's degree; I was second in a class of 90 students. But the mining career in India is really based upon obtaining two certificates of competency to manage mines, and these were government-issued certificates that you had to pass exams [to receive], very much like the PE exam. The second-class manager's certificate I obtained in 1963, the first-class manager's exam I cleared in 1964, and continued to work in the same company where I started as a [post-graduate mining engineering] trainee in 1962.

By the time I decided on higher studies, I had a feel for higher studies from four different sources. While I was growing up in school, a couple of my senior students had left for higher studies. A couple of my professors were from England, and they talked about schools in England. My own feeling was, as I started work in India, that I needed to know more about the theory of mining. I knew a lot about the practice of mining. And finally, there were a couple of major disasters; about 600 miners were killed in two explosions, one in 1958 and one in 1965. I realized that safety was extremely important, particularly ventilation and explosion control, and this motivated me to [go to] graduate school.

08:31 Why Penn State – Wanting to Study Ventilation Explosions & Underground Coal Mining

Ramani:

Well, my own experience was students from [the Indian] School of Mines had gone to England and Australia; very few had come to the US. And in 1965, I applied to the Colorado School of Mines because the name, Colorado School of Mines, Royal School of Mines, and Indian School of Mines, we were all schools. I wrote to the head of the department saying I want to do ventilation study in underground coal mining, I wanted to study safety. Very fortunate that the professor wrote back to me saying, "You should be applying to West Virginia and Pennsylvania rather than Colorado School of Mines." I wrote to Penn State, and Bob Stefanko, who was head of the department at the time, wrote back to me, and that was the reason why I came to Penn State in 1966.

After about four years in the mining industry, the last job I had, I was manager of a large underground coal mine. There were 30 engineers reporting to me, and 2,000 miners were working in the mine. It was a large mine, producing one ton per worker per day, very small compared to the US but one of the largest mines. So I was a mature graduate student when I appeared in Penn State. My Penn State career, which I'm very happy to say, is still continuing, and it is over 50 years, in fact, 56 years since I came to Penn State as a graduate student.

I "retired" in 2001, almost 20 years ago, but the Penn State experience is absolutely fabulous. From '66 to '70, I was a graduate student; from '70 to '78, I was a young junior faculty member; in '78, I got promoted to professor. From 1987 to 1998, I was head of the Department of Mineral Engineering, which had five different academic programs and pretty close to 15 academic degrees: bachelor's, master's, and PhDs. In 1998, I was appointed to the first chair in the college [the Deike Chair] as the inaugural appointee, and as I told you, I retired in 2001 but continue to be active.

12:04 Penn State Mining in 1966 – An International Department

Ramani:

Well, let's talk about Penn State in 1966. It was a very small program. There were 25 undergraduate students and an equal number of graduate students. The majority of the graduate students, about 75%, was from four countries: India, China, Iran, and several South American countries. The remaining 25% of the students were Americans, that's about six or seven. And in fact, when I joined the department and went to graduate school to pick up my admission papers, the dean of the graduate school called me in and said, "Tell Bob Stefanko that he should start the mining graduate program in India and admit Americans as foreign students. That would be better."

Well, let me tell you, the faculty was one of the best: Stefanko, Manula, Hardy, Kochanowsky, Pariseau, and Howard Hartman. The program had four areas of emphasis: rock mechanics, systems engineering, ventilation, and mining methods. The graduate students were outstanding. Several of the graduate students went on to become faculty in the United States. The undergraduate students were absolutely marvelous. Many of them became presidents and vice presidents of mining companies. And I was so happy to be back in academia. It was wonderful; I had a great four years.

I started my master's program with Chuck Manula in systems engineering. Well, I once again felt I was in kindergarten learning ABC. Computers, systems engineering, and rock mechanics were new to me. Though I was a mature graduate student, I felt I was back in kindergarten learning mathematical modeling, computer simulation, and all that. More importantly, I learned a lot about American mining systems. [I was] amazed at the ventilation systems, the production systems, the large machinery, and the work ethics.

15:20 Choosing Academia Over Industry – Teaching What I Am Passionate About

Ramani:

Well, I had two heads of the departments in graduate school. Bob Stefanko was my head from '66 to '69, and Tom Falkie became head of the department in 1969 and started talking to me about, "Raj, if you are interested, we are looking for a young faculty member to join the faculty." And therefore, in 1970, I was still thinking about whether I wanted to go to work in the industry or go back to India or continue [with academia]. But I really enjoyed my discussions with fellow graduate students, really enjoyed the visit to the mines, and the productive atmosphere.

One of the most interesting meetings at that time I had was with Dr. Frank Aplan. When I talk about a mature graduate student— Frank Aplan was coming back to teach at Penn State after spending 20 years in the industry as a leader of research. He was looking for help in selecting graduate students for his mineral processing program, and Bob Stefanko told me, "Ramani, go and help Dr. Aplan with his Indian

applicants." That convinced me that being in industry was good, but getting back to academia is probably much more worthwhile, and Frank was motivating to me to stay in academia.

Fortunately, Stefanko assigned me to teach mine ventilation, which was a passion of mine; and then Falkie came in and asked me to teach systems engineering, which was a second passion of mine. Ventilation was something that I had done work in, in underground coal mines in India, on which I had also done some research. Systems engineering was something I had learned from the fundamentals in the US. After teaching these two courses and helping fellow graduate students, I thought academia was my future and decided to stay at Penn State.

18:06 A Period of Intense Growth – Learning from Stefanko, Falkie & Frantz

Ramani:

You asked me about my career at Penn State. Falkie brought a new dimension to Penn State. Falkie was the first systems engineering PhD in the country. He got his PhD from Penn State in 1961, worked for a few years as a systems engineer for International Minerals and Chemical [Corporation] in Chicago, and then worked for about a number of years in the phosphate mines in Florida. While he was in Florida, he started teaching courses on mine investment and cost analysis, yet another area where I became a kindergarten student for Dr. Falkie. I learned a lot about mine investment analysis, cost analysis, cost estimation, and cost management. When he left Penn State in 1973 to become Director of the Bureau of Mines, I took the responsibility to teach the courses on mine investment and mine cost analysis. In 1974, Tom Falkie was replaced by Bob Frantz as head of the department.

Bob Frantz came with an extensive background in international and national consulting, an expert in management, mine exploration, mine development, and international consulting. And I learned a lot from him about teamwork team spirit. For me personally, as I told you, the 1970 to '78 period – the junior faculty period – was one of intense growth. Learning things from very, very senior people, Bob Stefanko, Tom Falkie, and Bob Frantz. I learned a lot about teaching, research, graduate student direction, continuing education, and involvement in professional societies and other organizations.

I was promoted to associate professor in 1974, appointed Chairman of the Mineral Engineering Management Section in 1974, tenured in 1976, and promoted to professor in 1978. I started teaching several new graduate and undergraduate courses. Did extensive research on systems engineering, particularly ventilation, production engineering, dust, diesel, long wall mining, and land use planning.

21:43 Land Use Planning – My 20-year Interdisciplinary Venture Developing Sustainable Mine Practices

Ramani:

I'm particularly proud that in 1974 I looked at land reclamation and surface mine reclamation as an area that is likely to grow into great importance. But reclamation of lands has been practiced in the United States for about 40 years, and still, there were questions. A couple of things that motivated me to look at surface mine land reclamation from a different perspective, from the perspective of land use planning rather than surface mine land reclamation was my first venture into looking at mining more as a land use rather than as an industry. Mining has been an industry from the time human beings were evolving because the products of mining and products of agriculture sustain [the] economy, and still, people do

not have an appreciation for mining.

They still carry around banners, "ban mining," and I felt that mining, while promoted as an industry, was really a use of the land and not an ultimate use, only an intermediate use. That led me to the next 20 years, looking at land use planning and sustainable development of mining practices as one of my future goals. Fortunately, I had a project from EPA in 1974 in which I was able to bring together the geography, the mineral economics, the geology, and the mining engineering departments. The mining engineering department from a mining point of view, the geology department from groundwater resources, the mineral economics department from economics of land use planning and cost analysis, and the geography department from a larger perspective of landforms and land use. This was my first large interdisciplinary venture into research, which really had a big impact in my research after 1980.

You really have to look at my career as it continuously evolved. [I] started as a mining engineer, interested very much in underground coal mining, gradually expanded into surface mining, where I had little or no experience, started in equipment selection, went into reclamation, and finally into land use planning, environmental planning, and gradually into ecological planning.

25:40 Admiration for My Mentors & Professional Societies

Ramani:

Well, 1980 to 2000 was the time I became a senior faculty member at Penn State. '81 was a very sad year. My mentor Chuck Manula passed away in six weeks from being diagnosed with cancer to his death. Six months later, Stefanko passed away. He had a bad kidney. He lost one kidney in an accident in 1948 and the other kidney started failing. Stefanko and Manula were like my dad and my brother in the US. When they both passed away, all of a sudden, I became the senior faculty in the department, and Bob Frantz started increasingly relying on me to take the load of these two faculty members.

Stefanko, I fondly remember. Every time I think of SME, I think of Stefanko. Walking into his office in fall of 1966, he gave me the SME and AIME student application form, and that was the time I became a student member of SME. In 1970, he was becoming Chairman of the Coal Division and asked me to become a part of a unit committee in the coal division. He became President of SME in 1978 and had me moved up to Vice Chairman of the Coal Division. Bob Frantz was another stalwart who ensured that my service to SME continued; Manula also did the same thing. He started me in SME in the Operations Research Unit Committee, which was the systems engineering committee.

Falkie asked me to take a lead in the APCOM symposium series, which was just a budding symposium for computers and mining. Hartman was starting a Mine Ventilation Symposium Series, and Hartman asked me, "Raj, would you join me?" So, I look at these people and look at that professionalism and their commitment to what societies can do, technical societies and professional societies can do and how an education institution can link up with these professional societies.

I admire these people. Well, so every time I think of Stefanko, Falkie, or when I think of me as an SME Legion of Honor member, I guess. I would not have been a Legion of Honor member if I didn't have that student application pushed in 1966 by Bob Stefanko.

29:42 Starting Up Large Multidisciplinary Projects – Standard Oil Research Proposal

Arnold:

So, Dr. Ramani, some of the things that I am now starting to get into on respirable dust with my research is really building on the center for respirable dust [The Generic Mineral Technology Center for Respirable Dust (GTCRD)] that you led back in the 1980s and '90s. Can you tell me more about your experiences with that center and others at Penn State?

Ramani:

Barb, that's a very interesting question. After I worked on that surface mine reclamation project with funding from EPA, I always felt that we have to have large interdisciplinary, multidisciplinary projects that will produce more interaction among people interested in common ideas. [We can] make progress much faster in some areas which are quite interrelated, and the 1980s afforded good opportunity for such ideas.

The first to come through was The Standard Oil of Ohio. This company decided that they were spending about 40 million dollars on research every year and not getting a big bang for the buck; and therefore, they advertised in all national newspapers, around 1981 or '82 timeframe, that they would like to support five ideas for research at any university over a period of five years at $500,000 a year. That was big money [for universities] at that time on energy-related projects. And this advertisement was a full-page ad in New York Times, Washington Post, Wall Street Journal, all major newspapers. I came back to the department that afternoon and told Bob France that I'm going to write a proposal on mine systems research. We batted around ideas.

Fortunately, over the next one-year, Standard Oil got pretty close to 1,000 five-page prospectus for their invitation. They narrowed it down to 37 full-page proposals from which they selected five for funding, and the Penn State proposal on mine systems research was one of the five that they had selected. And we started research on Standard Oil Center for Underground Longwall Mining.

33:14 Co-director of Three Centers of Excellence – National Mine Land Reclamation Center

Ramani:

Around the same time, the US Congress decided that some of the mining problems are so generic that they should establish centers of excellence on these areas of research, and one of the centers they identified was the center for respirable dust control [GTCRD]. And again, Penn State was able to join hands with West Virginia and write a proposal, and this center came along.

The third center that came along was National Mine Land [Reclamation] Center. Again Barbara, if you remember, national mine land reclamation was a raging problem. The Surface Mining Control and Reclamation Act was passed in 1977, and I had already worked on land use planning. And therefore, when Office of Surface Mining [Reclamation and Enforcement] decided that they will support this national mine land research center – addressing not only reclamation, but water pollution, revegetation, land use planning, and many other areas. So this idea of a center with a lot of areas addressed by different faculty, but in a coordinated manner, was very timely. We had three centers, and I was fortunate to be co-director of all the three centers.

35:11 Respirable Dust – A Complex Health Hazard Problem in Underground Mining

Ramani:

Let me answer your specific question. The respirable dust research center looked at the respirable dust problem. It's what I call as a very complex health hazard problem in underground mining. We have known that respirable dust is a health hazard ever since we started mining. The Neolithic man who was mining stone for making spears suffered from silicosis. That was 2,500 years ago. We knew that silica was hazardous. We have been trying to control it, but not very effectively. Even to this day, we have that problem. It is not strictly an engineering problem, it is not strictly a basic science problem, it is not strictly a medical problem. Finally, because people have to work in such environments, it is also a social problem, a management problem.

If you're not looking around, unsafe practices may creep in. It doesn't matter whose fault it is; an unsafe practice is an unsafe practice, and therefore, to tackle this problem, we need all approaches. Mining engineers have to work at reducing the dust problem in mines. Mineral processors, chemists [and] physicists have to look at it from a control point of view, but the control is not engineering control but the toxicity control. But to control the toxicity, you have to characterize the dust. Finally, the doctors have to look at and see, is there any medication that can be given that will prevent the damage to the lungs? And finally, we have to look at how can we train the workers better. How can we provide them with better tools and techniques to avoid breathing dust?

So you can see that when we put together the team, we had the medical centers at Penn State and West Virginia, the mining programs at Penn State and West Virginia, the mineral processing section, the physics [and] chemistry departments, the mechanical engineering departments, they're all involved. And we did, for the next 20 years, concentrated research, one project feeding on another. In that, we worked along with the former US Bureau of Mines, the National Institute of Occupational Safety and Health, as well as mining companies. We did underground sampling. We did in-mine experiments, we did large controlled experiments. There were a lot of experiments done in wind tunnels at the University of Minnesota.

39:15 The Expertise of the University of Minnesota – A Leader in Dust Control Studies

Ramani:

Just to give you an example [of] the expertise at the University of Minnesota. You talk about dust problems in mines. You know, when these spaceships go up for 20 days and 30 days and human beings are in this confined environment, there is a tremendous amount of dust in those cabins, and these dusts have different characteristics. They have a biological origin, and they have to be monitored, measured, controlled, and [there is] no place to dispose of them either except in that environment. And the University of Minnesota was a leader in these kinds of studies, and they were involved in underground dust control.

Underground dust is not just coal dust or mineral dust, there is diesel dust. There are dusts from other sources. Blasting dusts, blasting fumes. As such, it's a very complex study, and I'm glad that this area of study has continued and we are still solving the problem. But let me say the dust problem continues to persist. We have made tremendous progress, and we will continue to make progress only if we make this kind of systematic team approach. Engineers working with scientists to control the problem.

41:01 The Challenge of Managing Multidisciplinary Research Teams & Progressing My Career

Ramani:

Well, coming back to the Standard Oil Center of Excellence, we attacked the longwall problem from the machine, the nature, and other aspects. In general, the team of investigators and the interaction of this inter – and multidisciplinary team, while very difficult to manage [and] coordinate – I don't have to tell you researchers are very strong-minded, strong-willed people with very strong ideas as to why their idea is very important. Managing a team of researchers is more difficult than managing a team of kindergarten kids, but it's very worthwhile.

Well, let me continue further with my career in Penn State, as you have asked. Well, as my career in Penn State progressed, my career in SME progressed. I became the Coal Division chairman in 1980 with my first stint on the board of directors. I was getting exposed to the problems of professional societies as well; some fundraising activities, and the new building in Littleton, Colorado, was just completed. And in 1987, I was appointed head of the department after a national search.

42:47 Becoming Head of the Mining Department & Forming New Undergraduate Programs

Ramani:

The most satisfying aspect of research with center funding was the ability to provide continuity to my research. The most satisfying aspect of my becoming head of the department was creating two new undergraduate programs. The Geo-Environmental Undergraduate Program, which is now, I think, called the Environmental Systems Engineering Program, and the industrial health and safety program.

The reason I felt that these two programs will complement the mining, mineral processing, and petroleum engineering programs in the department was that a lot of the stuff that we were doing, with regard to separating the valuable materials from the other materials in rocks and minerals, is very similar to separating the hazardous material from the waste. Some of the things that we were doing in the dust center, with respect to health research, was very relevant to research in mine environmental control, mine systems engineering, industrial health and safety. And therefore, creation of these two new programs, I consider it as one of – exploitation of what I call as opportunity.

But a word of caution here. Some programs should always be considered as parasitic programs. A mine environmental engineering program, a mine reclamation program, or an industrial health and safety program cannot exist in isolation without a mining engineering program. I realize that it is the mining industry; it is an industry that can support these programs. The problems exist because of the industry, and we have to be careful that we do not consider these new programs, which become very popular overnight, as programs that can survive. The parasitic community can survive only as long as the main body survives. If the mining engineering program does not survive, the mining environmental engineering program cannot survive.

45:53 Penn State's Miner Training Program – A Leader Since 1974

Ramani:

One other aspect of my career in Penn State was the Miner Training Program, another program in which

I got very interested. Penn State was a leader in miner training. As you know, Pennsylvania has a long history of mining. No wonder Pennsylvania was one of the original thirteen colonies. We had a long history of anthracite mining, a very long history of bituminous coal mining. We had the second oldest health and safety laws in the United States, and the Pennsylvania state government was very progressive and recognized miner training as important.

Penn State, ever since the founding of the mining school, placed emphasis on miner training, and we became a leader in miner training around 1974 when the union contract with Bituminous Coal [Operators] Association called for miner training. And miner training was a required function of every company according to the federal 1977 mine health and safety act [Federal Mine Safety and Health Act of 1977]. Penn State took the lead in forming a miner training program to train all miners.

You were talking about your dad graduating from Elders Ridge [Academy] mine mechanic school, which was a school started by Penn State. On the surface, room and pillar section was actually developed with a full-scale continuous mine and shuttle cars so that people looking for work can be trained as mine mechanics. This was done by Penn State, and this was done as early as 1974. Fortunately, I was the director of the Miner Training Program from 1992-2001, and I cannot emphasize the importance of knowledge, skills, and attitude to safe work habits. And all these three, knowledge, skills, and attitude, they require education and training.

48:55 Starting Off Miner Trainers with Research – Improving the Health & Safety of Workers

Ramani:

Our miner trainers, I thought, had very special skills. So I suggested that they get into research, not research for which specialized qualification in health and safety training, higher education in health and safety is required. But we do a lot of things in mining which are very unique. For example, the personal protective devices miners use are the devices that almost all emergency services use in responding to an emergency. For example, when the World Trade Center accident happened, the two planes crashed in, and the centers collapsed; everybody who responded had to use respirators. And there was a project—What was done during the emergency? What kind of devices did they use? What were the agencies who responded?

I told my miner trainers, "Why don't we respond to this proposal and write a small proposal?" So we decided to do an analysis of the personal protective equipment used by emergency responders at the World Trade Center, emergency response. We contacted 54 agencies [and] got exactly what was provided to them. What training was provided to them; what equipment was provided to them. We did an analysis of it and submitted a research paper.

Another one was people working in the stadiums when they are building the stadium. Slipping, tripping, and falling accidents from scaffolding and other places. Mining is a very dangerous place. We have low clearance, slippery floors, steel floors, coal preparation plant, electrocution hazard. We responded to a proposal along those lines. When training of workers in non-metal mines became necessary, when the government was looking for developing guidelines, we had our workers respond to it.

When you look at the educational program, my feeling is, educational institutions have to take a much broader look. Training is a very essential component of improving the health and safety of workers. One component of training is developing resources for trainers. Penn State developed the mining

engineering program, developed resources for foreman training. I can proudly say my 10 graduate students worked to develop mine foreman training resource material, and foreman exams training resource material, and our trainers and my graduate students also developed mine foreman automated exam resource materials for the Commonwealth of Pennsylvania. These, we thought, were also essential functions of academic programs.

53:02 Bleeding Blue & White – "Penn State Allowed Me to Pursue All My Interests"

Ramani:

Well, in a long winding answer to your question, I have tried as a teacher at Penn State to educate and train on mining and related topics. All students I come into contact with, whether they're undergraduates, graduates, fellow professionals, practicing engineers, or lay persons. We taught a course called Mining for Non-mining People because we felt these non-mining people should know the importance of mining, the unique aspects of the environment, and the work of miners and work in mines.

One of those courses is professional engineering, that you know very well. I want to tell you my own development there is very interesting. As I told you, I was a licensed first-class mine manager in India. Because I consider that if licensing is important if that is what is required, we should get it. Professional engineer is a very, very important step for an engineer.

I got my own professional license in 1971. Subsequently, I have encouraged all my graduate students, all my students, to get a professional engineering license. I started teaching a course in 1973, and I have continued to this day to teach the course. I'm very pleased that Penn State provided me this opportunity. That Penn State allowed me to pursue all my interests. Allowed me to travel to 35 countries. Investigated mines in many countries. Went underground and spent time with engineers there, learning their techniques, their training programs, their educational programs. So let me say, looking back, Penn State is my home away from home.

PART 2

00:32 Research to Practice Philosophy – Applied Research to Develop New Techniques for Mining

Arnold:

So I know you've worked closely with industry and have a research to practice philosophy. How can I, as a new faculty member and others, foster such collaborative work?

Ramani:

Yeah, research to practice is something that comes with the territory of research and what you choose to do research on. Research has been defined in many different ways: basic, pure, or fundamental research versus applied research, theoretical, or what they call as practical research. The essential difference between the two is that applied or practical research is primarily focused to address a specific problem, whereas pure, basic, or fundamental research is just research for itself to find some knowledge, and that knowledge may be applicable to all areas of science, engineering, or society. So in my view as a mining investigator, I have often chosen a problem that is a problem that affects mine

safety, mine productivity, and the mine environment. I try to see what is the specific problem that which can be solved that can lead to improvement of conditions in safety, in environment, or in productivity.

This can be a new tool, can be a new technique, or even a new method. So what you find is people looking for a monitor, something that can give you a warning, or looking for a new technique. Instead of doing this job this way, let's see if we can orient it differently and do it in a different way, or finally, let's use these tools and techniques and develop a new method. For example, when they invented the longwall method of mining, they changed the machine a little bit a different continuous miner. They changed the roof support a little bit, a different roof support. But the method was so dramatically different compared to what we were doing previously that it improved safety, productivity, and recovery very much. But the problem that they attacked was one of a very specific problem, we wanted to improve mine productivity, mine safety, and all that.

So the key thing is if you want to take research to practice, keep in mind that people who are practicing should look at it favorably. If they don't look at it favorably, it'll never become a practice. If my son is not going to like the pudding I make, he's not going to eat it. From the beginning, I had to develop in my son an interest in my cooking, in my pudding, and in what I put in, how I make it. And in turn, he may like it, he may eat it, he may try it, he may modify it, but he will certainly know a lot of thing goes in it is good.

04:40 Research to Practice – Identify Stakeholders' Needs and Tackle Big Problems

Ramani:

Therefore, the first thing that one has to do in research to practice is, keep the practice in mind and see what is going to help the practitioners. In fact, we call it a fancy word, stakeholders. Get all the stakeholders in the room and see what they want, what is their need, and try to satisfy their need. It is difficult to expect that the research problem that you have defined is the problem that they are facing, and if it is not the problem they are facing, it is like helping the grandmother cross the street when the grandmother didn't want to cross the street in the first place. You might have done a good job as a boy scout, but you are going to get beaten for it. That's number one. Over the years, I have used a number of approaches to ensure that the research to practice either directly or indirectly incorporates this step. That is, what I do is really helpful to them, to the practitioners.

Perhaps the most important aspect is the choice of the problem. There are problems. There are problems and problems, and therefore problems that will solve big issues, they are more important than problems that are going to solve small issues. Very often, small issues get solved along the way when one tackles a big problem. When people tell me that big problems are too difficult to solve, too intractable, and therefore, they are not the problems you want to attack, I keep telling [them] this mentality may often lead to tackling small problems. Which after solving, you found you need not have solved in the first place, and therefore, choose a fairly large problem but try at least three or four different approaches to tackle this problem.

Small-scale lab experiments, full-scale lab experiments, math modeling, and computer experiments. These are very important today. A lot of things that we used to do in the lab, we can simulate on the computer, but don't get fooled. Math modeling and computer modeling are very good, but they cannot point out the practical difficulties of modeling. When you do a physical model, you will know the real practical problems of implementing a solution because you have to do it. You are not doing it on a computer. You are doing it underground. You are doing it in the mine.

08:09 Research to Practice – Keep an Open Mind & Incorporate Others' Ideas into Experiments

Ramani:

Full-scale mine experiments are very difficult, but you have to do it. Involve more people. The more people you involve, the more objections you will get to what you want to do. They will bring their own ideas but be open-minded because it's a research problem. There are many different ways to approach it. In tackling a research problem, one cannot be close-minded. As a mining engineer, to solve the dust problem, my choice is fit everybody with a mask. Because as a mining engineer, I feel breathing the dust causes all problems. So, filter the dust out. How are we able to get astronauts to the moon and bring them back? All the time they are in, they are in some kind of a mask, controlled atmosphere. Anywhere you go, to an extremely dangerous place, you are wearing masks. Well, it is said simpler than done. Miners may refuse to wear it. Miners may wear it when you are there. When you are not there, they may not wear it. Oftentimes the mask may fail. It may obscure their vision, and they may get into other problems.

There are a lot of practical problems involved, but my belief that masks will solve a lot of problems is very, very clear. On the other hand, there are people who believe they can reduce the toxicity of dust. While I agree to it, I still believe it's a later step. If you don't breathe dust, you don't have a problem. But I cannot be opposed to toxicity research. If I'm going to solve this problem, I have to incorporate that idea as well. Once maybe, when the person breathes even less dust, let it be less toxic. Let's try to coat it. This is another important point – if you want to make research to practice, the person working on toxicity should not be working in the lab. They should try to find ways and means by which that dust can be made non-toxic in the mine atmosphere. I should work with this toxicity person as to develop techniques by which this can be made less toxic in the mine atmosphere. So to bring myself around, if you want to bring research to practice, [have an] open mind [and] accept others.

11:34 Making Research Practicable – Penn State Mine Ventilation Simulator Example

Ramani:

Finally, let me give you an example of the Penn State mine ventilation simulator. Remember the early 1970s, how many mine ventilation engineers knew, for one thing, computers, and computer use? How many ventilation engineers knew the ventilation simulation model, and how many ventilation engineers knew how to apply them? Not many, very few, precious little few. In '75, we completely revamped it, made it applicable to the 1969 Health and Safety Act, put out the model, and put out five different volumes of publication. I decided the model will never be applied if I don't take an active interest.

The first thing I did was offer seminars and short courses. I called it a computer ventilation simulation model application in mines. Secondly, I decided to introduce it in undergraduate education. Third and most important, I decided to invite very, very senior ventilation engineers. Told them I will help them set up their mines on the computer and help them apply it, as long as they will help my graduate students [with] access to their mines and [to] do some research. All three, within a span of about six or seven years, became so popular that Penn State's ventilation simulator was widely used in almost all the mines in Pennsylvania and Eastern United States. This I consider as one of the key steps.

13:59 Research to Practice – "If It Is Not Applied, Then It Remains a Report on the Shelf"

Ramani:

So research to practice is not an afterthought. It should be a task that should go along with the research proposal, it should incorporate your graduate students, some practitioners in the field, some ideas for in-mine testing, and some ideas for seminars and short courses. It is like teaching. My philosophy in teaching is if I assume that teaching is, “I have done my lectures, and it is done,” I have not done my job. If you have not learned what I have taught, I have not taught. So my goal in teaching is you must learn.

Similarly, research, particularly for somebody like a mining engineer doing mining-specific research, the practice end should always be a part of it. A certain portion of time has got to be devoted to application. If it is not applied, then it remains a report on the shelf. Now all research may not be applied immediately, but eventually, if you have devoted a portion of your life to do research and you think it is worthwhile, you would like to see it used. Let's work towards that. That's what my idea is.

15:46 SME Committee Service & Raising Money for the SME Coal & Energy Division Endowment

Arnold:

So, Dr. Ramani, you have many professional affiliations as well. For example, you served as the 1995 President of the Society for Mining, Metallurgy, and Exploration. You don't find yourself in that position without having served on many committees within the organization and in other roles, and I know these have included significant efforts on health and safety for the National Academy of Engineering, as well as for the government. Can you tell me about that work?

Ramani:

Let me tell you that working on committees is a task that you must accept willingly. Very often, the rewards are the work itself, and at the end of the day, you see the committee has achieved its objective. You have only so many hours of a working day, and you have teaching, research, graduate students, and administrative work in the department. Then you decide to work for, say, your professional society, then you decide to work for your community, then you decide to do other things. The important aspect of working on committees, as I told you, is I had some excellent role models. I never knew any one of the people that I had worked with, like Stefanko, Falkie, Manula, or Bob Frantz, turn down anybody who requested a service from them, and I had seen them. I saw Falkie and Frantz in 1973, I guess when they started the coal division [Coal & Energy Division of SME] scholarship fund. I'm laughing because they thought they would be able to raise $500,000 in about five years. That was the goal.

And as I told you, I was a young member of the coal division at the time, getting into the executive committee. Falkie was head of the Department of Mining at Penn State, and Bob Frantz was Chairman of John T. Boyd. I thought these two guys should know how to raise funds. Of course, my prior experience was Bob Stefanko trying to raise money for Penn State room in the new SME building in Littleton, and that was an experience in itself. Bob Frantz used to come down from Pittsburgh, and Tom and Bob used to prepare this big spreadsheet as to how to approach who to get this $500,000. And the coal industry, you know, was buzzing. They were just coming out from 550 million tons per year. The production was increasing about 50, 60 million tons per year, each year, and the industry was doing very good, and the mining schools were increasing in enrollment. We had six scholarships in the coal division. The aim was to increase it to 18 and from something like $100 to $500 or something like that.

This $500,000 goal was reached after 20 years. People like George Luxbacher was very critical in starting the Coal Division luncheon auction, which you continued for a number of years. The whole idea was while money was coming, they were trickling in, but Bob Frantz and Falkie worked at it for about four or five years, then the Coal Division leadership decided to take it over. When I became Coal Division chair, I kept a close watch on it. Then others kept a close watch. We said while our goal might not be reached, the endowment will remain endowment. We will spend only the earnings, and today it is the largest endowment in a divisional scholarship fund. Those were the leaders that provided me their background, and I served in about 40 unit committees in SME.

Some unit committees took a lot of my time. Some of these were program committees, where it required a tremendous commitment, a program for the fall, and annual meetings. I organized a symposium— Short Wall, Long Wall, State of the Art— in 1980. That required a tremendous amount of support from many different groups. This required committee work far beyond ordinary commitment. It's a labor of love. You should not assume committee work unless you have time to do it. It is not a line on your resume.

21:58 My Appointment to Eight National Academy of Engineering Committees

Ramani:

Appointment to National Academy of Engineering committees, which is the question you asked, is very special because when National Academy invites you to be a member of a committee, they go through a tremendous selection process. From what I understand, they probably get about 10 or 12 nominations for every member they select for a committee, and they put together committees of very wide background. It may be a mining committee, but you may find a union member there, you will find an economist, you will find a mechanical engineer, you will find a medical doctor, you will find a sociologist, a psychologist, a couple of civil engineers, and maybe your mining engineer and a chair who is usually a member of the academy. When a National Academy report comes out, it's probably the Bible to what is going to happen in that area for the next five, six, ten years.

I have been on eight National Academy committees. I was fortunate to be chair of two committees. Both committees I was asked to be chair, the study dealt with defining research for the next decade on mining topics. In 1978, I was called by the National Academy to chair a committee on post-disasters survival and rescue. Ramani's knowledge on post-disaster survival and rescue at that time was some work on ventilation, diesel, Sunshine Mine fire, ventilation methane, and you had some knowledge of explosions in India.

That was my first National Academy of Sciences committee. After about two years, we released a report that had looked at the Bureau's research for the last 10 years, and that 10 years of research was the whole research that was done after the 1968 Farmington Coal Mine disaster by the Bureau of Mines. And therefore, they were looking at what they should do for the next 10 years, and it was very interesting work.

25:06 Defining Technologies for the Mining Industry & Evaluating the NIOSH Research Program

Ramani:

Subsequently, I did work on technologies for the mining industry, where we defined what are the needed technologies, say post-2000, in the 21st century for mining, mineral processing, and mine exploration. Milton Ward, who was the Chairman of Amax [Minerals Company] at the time, he was the chair of the committee. Tom Falkie and Ray Beebe were members of the committee. These were all members of the National Academy of Engineering, and I was a member of the committee. We defined solution mining as one of the future technologies of mining that will be extremely useful.

Remember that impoundment failure in Kentucky? That impoundment failed, and sludge flew all the way through Illinois and eventually drained into the Missouri—Mississippi River? This impoundment failure – they set up a committee on mining impoundments. I was a member of that committee.

NIOSH [National Institute for Occupational Safety and Health], in 2005, [asked] the National Academy for evaluating all the NIOSH programs. NIOSH had about eight major programs. Some were industry programs like the construction industry and agricultural industry, and some were specific programs like the noise program.

The Academy appointed an at-large committee to look at all the programs and then individual committees to look at each program. I was a member of two committees in the sense that I was a member of the at-large committee and a member of the mining program committee.

27:24 Health & Safety Committees – Respirable Dust & Offshore Drilling Safety Management

Ramani:

The last committee I served was a committee on respirable dust in 2018 to look at the standards, [etc].

I'll tell you one other committee I became a member, a committee that was appointed to look at offshore safety platforms after the disaster in the Gulf of Mexico. This committee was appointed by the National Transportation [Board], as a part of the National Academy of Sciences. This committee looked at offshore safety management. That disaster was so big that there was a Congressional committee, there was a Presidential committee. Then there was this National Academy of Sciences committee, and we were specifically looking at laws and regulations and the Bureau of Land Management, what it did. I brought in the idea of MSHA [Mining Safety and Health Administration], Department of Labor.

The interesting thing about my first exposure to the offshore drilling platform was I spent one night in a platform in the Gulf of Mexico. The previous evening, I was taken by helicopter and dropped off in this platform. I spent overnight in the platform. It's like a motel, a hotel, a small town. The canteen was always open. You can go and eat anything, drink anything. One part of the place was the drilling machine was drilling, and the oil was being pumped into a storage space.

The next morning after finishing work, another helicopter picked me up and brought me back to New Orleans. Safety on the platform is of immense magnitude.

29:34 Committee Responsibility & Commitment – "It's a Service You Should Gladly Accept"

Ramani:

Serving on these committees calls for a lot of outside work. So when you asked me the question, that is

why I said it's not a line on your resumé that you should look at, it's a lot of commitment, and the society depends upon you. Look at the staff of the society, they are overworked with their own work. So they look upon a committee member as somebody they depend upon to do a good job.

Let me tell you two other committees I've served, which are interesting. Again, one is the Belt Air Advisory Committee of the Secretary of Labor. Another one is the Dust Advisory Committee of the Secretary of Labor. In these two cases, the Secretary of Labor wanted us to advise on pending legislation or proposed legislation. These committees are formed of five independent members, two management members, company representatives, and two union representatives. So the nine-member committee—the meetings are completely open.

Serving in committees is very important, essential for a faculty member, essential for any member, and most important, it's a service. You should gladly accept it.

31:24 Quecreek Mine Inundation – Called to Answer by Penn State & the Pennsylvania Governor

Arnold:

Absolutely. So more specifically, though, can you discuss the work related to the follow-up on the Quecreek [Mine] Inundation and the recovery of the Quecreek six? I understand you were appointed by the Pennsylvania governor one day after the rescue to report on ways to avoid similar situations. How was that experience?

Ramani:

Yeah, the Quecreek Mine Inundation, a lot of people call it as Quecreek mine disaster or call it as Quecreek accident and all that. Actually, it's called Quecreek Non-fatal Mine Inundation because it is neither a disaster nor is it an accident. It's a non-fatal incident, and when Quecreek happened, I was actually not in Penn State. I was in Philadelphia, and I came back from an engagement in the evening, turned on the TV, and all of a sudden, I see this accident in this mine, and everybody gathered there. And, of course, for the next 48 to 72 hours, it was all crowded, and I was glued to it.

I remember one call very distinctly, and this was a call from a reporter in Los Angeles Times, I guess; he asked me – question was, whether the miners were alive or not. And I told him that the miners will not die due to inundation unless they have been washed away by the water, or they have been drowned by the water, or they are somewhere in the area of the mine where the atmosphere is very foul.

Otherwise, I said, "I'm not worried. They'll be alive for a reasonable period of time." So he asked me, "What is a reasonable period of time? Hours?"

I said, "No. Days." And he asked, "You know, there were some questions on that; why number of days?"

I said, "Generally, the atmosphere in the mine is pretty good, and people are not going to die due to hunger or due to water. People die in mines because the atmosphere is bad and they lack oxygen." So that's the reason why I said, "In mines in India, when they are flooded, we have recovered people after 10 days, 15 days, so I expect these people to be alive as long as they're in a safe place where the air is good."

And there were a few other questions. “Do you think the Pennsylvania authorities and Federal authorities are doing the right thing?” I said, "They're doing the best they can. What else do you expect them to do given the limited knowledge they have?"

35:13 Chairing the Quecreek Commission – How to Avoid Mine Inundation Incidents in the Future

Ramani:

Anyway, the recovery went very well. I think it was Monday morning, I guess, or Monday morning when the miners came out, I guess, or late Sunday night. I had a call from the governor's office on Monday morning that, "Governor wants to appoint a commission to look into the causes of Quecreek and how to avoid that. I want you to chair it."

I told him that I will think about it – I will call back within a short time because I do want to call a couple of people and see what they think about it. Of course, I got some positive feedback, some negative feedback, but as you know, my thinking was, if not me, who? And can I be of service? Can I do something good? Is there something that I can do?

I didn't know much about what the commission was or what the charge will be. But anyway, there is time to discuss these things. So I called back, and then I was appointed. I was planning to go to India in about eight weeks. And I thought, the commission will be appointed, it'll probably take about two months to appoint the commission, and I will have some luxury of time.

When I went to Harrisburg and had a meeting with the secretary, I was told that they wanted the commission to be done in six weeks, and the terms of the commission he wanted was three public meetings. We discussed the members of the commission. A communication expert, a geophysical expert, a mining expert, and a legal expert. So we had a committee of seven. Our objective was: why did this accident happen? Technical reason. How did we miss this danger, hazard, and how to avoid it in the future?

37:56 A Six-Week Commission – Recommendations That Changed Pennsylvania Common Law

Ramani:

The committee had three meetings. The governor's office was very helpful. They assigned three staff members. We had three meetings. We produced a report with 48 recommendations. The most satisfying part of that was the governor rejected [only] one of our recommendations. Over the next six or seven years, all the 47 were incorporated in the laws of the [Commonwealth of] Pennsylvania, either by passage of laws or by directives. The one that he rejected was important because as soon as the Quecreek accident happened, the governor said, “Pennsylvania law says, between mines, you should leave 150 feet of solid coal.” That was the law. The governor increased that to 500 feet, and we suggested that 500 feet was not required. That if adequate drilling is done and proper drilling is done, 150 feet would have been adequate because that would leave 300 feet of solid coal between mines. The governor did not agree. In any case, the Quecreek Commission was one of the most satisfying experiences for me.

39:50 “Eggheads from the University” – Be Prepared for Criticism

Ramani:

I remember to give you one example. A local representative from Pennsylvania – the western part of Pennsylvania – called the president of the university and said that one of my constituents is complaining about longwall mining and drained of all his water and polluted his well. And he had gone to Penn State, and they had not done anything for him; why should I recommend funding for Penn State or something like that?

So the president immediately contacted the dean. The dean contacted the mining department, and Bob Frantz said, "Raj, what should we do?" I said, “Well, we can do a research project." Well, we undertook a research project basically for about $25,000 from the legislature of Pennsylvania to study subsidence. One of the conditions of the study was we had to give our results in a public forum in Western Pennsylvania. [In the public forum,] one of the guys from industry [upset with our findings] called us "eggheads from the university." I told my colleague, who was a water expert. He was very upset. You have to be prepared for criticism for doing a good job.

41:32 Distinguished Awards – Valuing Peer Recognitions & Nominations

Arnold:

So as we wind down our interview, I wanted to touch on the many distinguished awards that you've received. National Academy of Engineering, AIME Honorary Member, Fulbright-Nehru Chair, Howard Hartman Award, Howard Evanson, Percy Nichols, National Mining Hall of Fame, and this summer, the Penn State Distinguished Alumni Award. Can you tell us about these, and frankly, many other honors that you've received, and your perspective on these? As I know, you've also contributed greatly to nominating others for awards. I think that would be valuable advice for our audience.

Ramani:

Well, you don't work, [or] do some work, looking for an award. If an award comes along the way, it's good. Something that's very important for us to remember, and something that my religious as well as cultural background goes back to, our Lord Krishna in Bhagavad Gita says, "That for you, the responsibility is to do good work. Reward is not something that you should expect.”

Of all the recognitions that I get, or I got, the things that I value most are recognitions that I get from people who are immediately around me. I always appreciated my colleagues when they told me that, "Raj, that was good." That was the reward I expect. Awards from society, awards from professional organizations, awards from your educational institutions, these are all peer recognitions which one should really appreciate, and I appreciate it.

On the other hand, I know there are many, many more deserving candidates for these awards than I am, and that's how it goes. There are some who receive and many who don't, and therefore, think of all those who have not. There are many in this country who tell me, "Raj, India must be missing you because you could have contributed so much to the mining industry." And I keep telling them, "You don't know my classmates. There are so many of them who have achieved so much and who have contributed so much that you have not met them." And that's exactly the nature of an award. When you get an award, thank God somebody noticed you, somebody recommended you, and you got it.

By the same token, it is your responsibility that if you see somebody who you think deserves an award, don't waste a moment; nominate them. Nominate her or him for an award. It's only the right thing to do. I have enjoyed all my awards, particularly from my institutions, the Indian School of Mines, and Penn State. I enjoyed the awards that were given to me that were student nominated, like the Wilson Teaching Award at Penn State. Students thought that I deserved that award because they nominated me. Similarly, when I got an award for, say, a best paper presentation award, I feel that there were seven or eight papers or ten papers in our session, and at least the people in judgment thought that that was a good presentation and deserved an award.

46:25 Use Awards to Learn – "Encourage Everybody to Do Even Better Than What We Have Done"

Ramani:

So, where there are awards that I can associate with such nomination procedures, I very much appreciate it because I know what it takes. What I'm saying is there is a personal component to these awards, and there is an impersonal component. You don't know who nominated you, who selected you. Many of these awards are, in a large measure, done in secret.

You are not even supposed to know, and you are not supposed to tell the person to collect the person's data. On the other hand, let me say, I have also – again, go back to some of my mentors, and particularly Bob Frantz. It's from Bob I learned that you nominate people for awards. Bob was a great nominator. He will come around and say, "Raj, I'm thinking of nominating this person, would you support it?" And, of course, I will support if I know the person and I know I can support. And I found this attitude of Bob very refreshing, very rewarding. And I look at the person who gets the award and how happy that person is, and knowing that the person deserves the award makes you feel very happy about it. And therefore, we should be very generous in nominating people for awards. So if you wonder why I nominate people for awards because there are so many worthy people. I'm only sorry that there are not enough awards to go around.

What brought the happiness of awards to me much more clear than anything else was when my children were learning piano and violin lessons as very young kids, and they would perform and come back with a certificate. They were so happy, so delighted, that encouraged them to learn more and perform even better. There is a growing aspect of the awards, a desire to do even better. We should never forget that. We want to encourage everybody to do even better than what we have done. Barbara, it has been a wonderful time with you.

Arnold:

Well, thank you so much, Dr. Ramani. I really want to thank you for your words and wisdom. I'm sure that our viewers will enjoy this interview, and I hope that our audience is as inspired by your experiences and contributions as I am. Thank you for speaking to us today.

Ramani:

Yeah, and let me say one thing about my association with SME and the AIME. I could not have belonged to much better organizations than these. They are great organizations to belong. They are very large, but they are very personal to you. Thank you.