ORAL HISTORY PROGRAM

Charles Fairhurst: Series of Serendipitous Encounters

2023

PREFACE

The following oral history is the result of recorded interviews with Charles Fairhurst conducted by Charles, Jr. Fairhurst and Margaret [Maggie] Fairhurst-Durenberger on May 20th, 2022. This interview is part of the AIME Oral History Program.

ABSTRACT

Charles Fairhurst, founder of ITASCA International Consulting Group, has established a remarkable 75-year career in mining and rock mechanics spanning rock drilling, subsurface developments, and nuclear energy testing. Fairhurst has worked across the world with top rock mechanics people from Brazil to Sweden and reminisces on the series of serendipitous encounters that evolved and shocked his career. Charles grew up in a mining community in England at the height of World War II, but his journey into mining engineering didn't begin until he signed up for the mines to complete his mandatory national military service. Fairhurst went on to complete his PhD at the University of Sheffield, and he was asked to come to the University of Minnesota to pursue a post-doc. After coming to Minnesota, Fairhurst decided to stay in the US and embark on a 40-year journey with UMN going from professor to department head of civil and mining engineering to now professor emeritus. Fairhurst established the PhD program in rock mechanics at UMN and built a community among his students through the support of his wonderful wife, Margaret. Fairhurst's career extends beyond research to his work on the Board of Radioactive Waste Management and as President of the International Society of Rock Mechanics. At the request of the President of France, Fairhurst formed an international research coalition and was honored by being indoctrinated as an Officer de Légion d'Honneur. An author of over 100 publications, Charles remains excited for the future of mining technology and the role of professional societies in the careers of next generation engineers.

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.

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PART 1

0:00:14 Introduction

Charles Edward:

Good afternoon. Today is Friday, May 20th, 2022. We're at the home of our parents, Charles and Margaret Fairhurst, in South St. Paul, Minnesota. I'm Charles [Edward] Fairhurst, CEO of ITASCA International Inc., and I'm here with my sister Margaret [Maggie] Fairhurst-Durenberger. We'll be interviewing our father for the oral history of AIME about his long career in mining, rock mechanics, and rock engineering.

Maggie:

We were asked by AIME to interview our father because I am the chair of the Southern Minnesota subsection of SME, and my brother, Charles, as he mentioned, is the CEO of ITASCA International.

Charles Edward:

To start with Dad, could you share with us what role AIME has played in your career?

0:00:56 AIME's Influence – Underground Construction Research Council & Underground Space

Charles:

Yes, I can think of two things directly that are quite important. In 1972, AIME and ASCE together decided that there was a mutual interest in subsurface developments. And so, they established a joint committee, which was called the Underground Construction Research – actually, Council [UCRC]. It was composed of mining engineers and civil engineers with a common interest in how to develop subsurface space, you know, for mining and civil engineering applications. I was asked, at the time, as a young professor at the university, to help with some difficulties on what we called at the time the Eisenhower Tunnel – excuse me, the Straight Creek Tunnel -- now known as the Eisenhower Tunnel, which takes I-70 under the Great Divide in Colorado.

They were trying to develop a 50-foot diameter tunnel, full face, that was the whole excavation at once and got into some considerable trouble. In fact, the governor, I think, of Denver said, "The mountain is on the move. " I didn't know how they were going to stop it.

Charles Edward:

Yes, and I recall that you brought my brother, David [Fairhurst], and me there with you on a visit once when we were little kids.

Charles:

Yes, you went skiing while we were doing the other work, and, in fact, you got to be able to walk through a pilot tunnel from one side where all the water flowed to the Atlantic. And then, the other side, all the water flowed to the Pacific United States. But, during that period, I met a number of very

interesting civil engineers, and they asked me if I would be willing to join this Underground Construction Research Council.

There was a report put out in 1972, the very first thing they did, by Baker and a number of other groups. I know that they had projected that there would be an annual savings to the United States of somewhere of the order of $70 to $80 billion every year for underground space development. Today, in today's dollars, that's about $400 billion per year savings by proper use of the subsurface. And, if you think today, with all of the infrastructure developments, global warming, etc., I think if they redid that study today, they'd find even greater use. I mean, it's amazing how many of these environmental effects of downed power lines, earthquakes, and temperature changes, they, all of these things are associated with climate change. They're all very superficial. They don't go much below the surface, and all you have to do is to go 10, 50 meters below the surface, and many of the benefits that UCRC identified are realized then.

So, later I became Chairman of UCRC, and we found that we needed a journal to advertise what we're doing. And so, I then from [since on] became the editor of *Underground Space*. That was my first contact with Robert Maxwell of Pergamon Press because he was looking for innovative ideas and founded his whole company on them. So, that was that. This has later now been taken into, for example, the Rapid Excavation and Tunneling conventions, and it has Rapid Excavation and Underground Space in the title. That's where all that started.

0:05:55 AIME's Influence – Rock Mechanics Award & the Future of Excavation Technology

Charles:

The second thing is that in 19— mid-1960s, AIME established the Rock Mechanics Award, and it was given internationally. You didn't have to be a member of AIME or any of the mining groups in the US. [It was] given internationally to the best people in any field that were contributing to rock mechanics. The first two awards were given to two members of the Bureau of Mines, Leonard Obert and Wilbur Duvall, who had actually been the only people I knew doing rock mechanics work before World War II. But, it was a very distinguished group of people on it. Several of the people became president of the board of ISRM [International Society for Rock Mechanics and Rock Engineering]. I was happy and very surprised when I received that award several years later. So, that was the second one.

And now, although it's not a direct benefit to me really, I would urge AIME, particularly with the fact that petroleum engineers have developed a remote excavation extraction technology. And, you can see that the petroleum technologies are, in fact, now being applied for things like geothermal energy for hydrofracking and so on, and many minerals will have to be extracted in the future by remote procedures. The mining community has not done an awful lot with this. Some of this may have to be chemical extraction, so the metallurgists and people like that can contribute, too.

So, how are we going to get minerals out of the ground in the future? We've had big surface excavation procedures, then underground procedures, now remote procedures are being used. But, remote mining, remote extraction from boreholes is the third development. And petroleum [engineers] are very well placed to help us understand and develop them.

0:08:29 Serendipitous Encounters – Meeting Professor Pots and Neville Cook

Charles:

Before getting into too much detail, I would like to make a comment about something I observed when trying to look over my career, and that is the remarkable ability or remarkable serendipitous events that seemed to happen. Let me try to summarize them for you very quickly. I came here in June 1956 and found that, unknown to me, Professor Pfleider, who had asked me to start developing rock mechanics, had invited a professor from England to come for three months. He was a professor in coal mining rock mechanics from Newcastle Professor Pots. He arrived here at the time of the Suez oil crisis when fuel was rationed in England. We decided that we would drive from Minnesota to Denver for the conference. And he loved to drive fast. He was frustrated that he hadn't had the fuel for his car in England.

So, it was quite a journey from Minneapolis to Denver along roads, and I won't tell you how fast the car was going at the time, but we became good friends en route. Then he went back to England, but we stayed friends. Then a couple of years later, I was in charge of the Fifth [ISRM] Symposium on Rock Mechanics and noticed in the papers, there was a paper from a person, Neville Cook, called “The Seismic Location of Rock Bursts.” I immediately recognized that this was an exceptional piece of work, and I was thinking at the time to go on sabbatical leave to England. As I was wondering who I could get to replace me to teach the students, I tried to contact Neville Cook.

Unfortunately, he didn't attend the conference. He wasn't able to come, but we had a long telephone discussion. At the time, that was a very expensive proposition to call from the US to South Africa, but it was worthwhile. Anyway, he agreed to come and spend a year at Minnesota whilst I took the family to England on a sabbatical leave to work with Dr. Barry at Nottingham University and also to get the family acquainted with the English side of [the family] – a lot of people had not met my wife nor the children, etc. So, that was part and parcel. But Neville came; he stayed for a year while I was gone. And then, I got back, and we overlapped for a couple of months; but he, at the tender age of 26, was offered the job of directing a new rock mechanics lab in Johannesburg to deal with the rock burst problem.

0:12:10 Serendipitous Encounters – Building Connections That Put Minnesota on the Map

Charles:

He invited me back to South Africa, and there I met Evert Hoek, who was working at the CSIR [Council for Scientific and Industrial Research] in Johannesburg, He was a mechanical engineer, but he developed into a first-rate mining engineer – first-rate rock mechanics person. And Professor Pots invited me back to England. When I was there, I met this man, Salamon, Miklos Salamon, who was a PhD student. He had been a leader of the Hungarian uprising against the Russian invasion and was targeted by the Russians and was under a death sentence because he was a student leader.

So he, his wife, and a young son – who, by the way, later became director of BHP Billiton, the biggest mining company in the world – he was recruited, Miklos was recruited, to finish a PhD at Newcastle where Professor Pots was. So, I went there, and unfortunately, Professor Pots on the day I went there had another appointment. But Miklos Salamon said, "Professor Pots insists that I take you to dinner." So, I met Miklos that way. One year later, Evert Hoek, who I'd met in South Africa, was invited to lead the group in Imperial College.

So, obviously, when I went to London, I went and chatted with Evert and also his students. It was there that I met one of the students, Peter Cundall. It was obvious to me that Peter was just brilliant, and the

way in which he was attacking rock mechanics problems with his so-called distinct element method was far superior to anything else that I saw. So, I was able to talk him into coming to Minnesota.

That small group of Cook, Hoek, Salamon, and one or two others with Cook – a professor of geophysics who had been at Cambridge, John Jaeger – they together wrote a book. But, all of them, plus a few others, came back more or less every summer to Minnesota to help me put on a short course up at St. John's Abbey in Collegeville. It attracted many of the practicing engineers from the civil engineering community and mining engineering community and really put Minnesota on the map.

0:15:25 Serendipitous Encounters – Leopold Müller and the Salzburger Kreis

Charles:

So, I say there was one other part of it that is not connected with that small group. But, when I went to the third symposium, the rock mechanics, I heard Dr. Müller, Leopold Müller from Salzburg give a talk called “European Approach to Slope Stability.” I think he was over here actually also as a consultant to Kennecott Copper Corporation, who were having concerns about steepening the slopes of their open pits. I remember, at the time, they said every one-degree angle increase in slope saves us 1 or 2 million dollars, so they were very concerned about how much they could do that. Well, I heard Professor Müller talk, and then I got into conversation with him afterward. He proved to be very laughable, and he agreed to come back and spend several days with me at the University of Minnesota, talking about how rock mechanics should be developed.

He had established a group in Salzburg in 1951. It's the oldest one that had the conference; now, I think, [this year] is the 72nd. It's been 72 years since '51 or something, will be in 2023, and he has held that every year. It was called a “Salzburger Kreis," or Salzburg Circle, and he invited me to join it. I was the first non-native German person, both Austrians and Germans. I could speak German, but it was not my native language. And a couple of years after I went there, he moved forward to establishing that group as the founding group for the International Society for Rock Mechanics in 1962. He had been a consultant on two big, on some big projects that were major failures, like two dam failures that occurred. He said, "People in rock mechanics, people in civil engineering, and in mining engineering, do not understand how to deal with large-scale fractures and faults, and we've got to have an international society to deal with it."

So he asked me then to be co-editor with him on the journal, and we brought Minnesota again into the limelight, but through a chance discussion at a symposium and getting him to come to Minnesota. There are probably others. But, throughout, I have been amazed at how just some chance encounters affect a person's career. Now, it's interesting that to me, though, I have to say that was in the formative years of the whole discipline of rock mechanics, and there were just a few people internationally involved. But, bit by bit, that group expanded, and Minnesota was certainly able to profit internationally from that whole, what I call, a series of serendipitous encounters.

0:19:06 How My Parents Found Love Despite Class and Religious Differences

Maggie:

Dad, you grew up in Widnes, in the Northwest of England. Please share with us what your childhood was like, your parents, your siblings, your family life.

Charles:

Well, first, let me say that Widnes was the headquarters of the Imperial Chemical Industries, heavy in sulfuric acid, all kinds of very heavy and not very nice things were being made. My brother said once that if you had anything wrong with you, all he had to do was to go walk down against the wall and lick your finger and slide across on your lips. He said it would cure any disease, all of the chemicals that were on the side of the walls. You can leave that out if you like.

But, my parents, my father was a coal miner. The coal mining region was actually north by about an hour's ride on a bicycle, there weren't many cars at the time. But, it was a very distinctly separate community; mining, and my mother's family, came from a group of people who were sort of tradesmen, civil servants, etc. Not very high-level, but they had a sense of pride. The class structure was amazing, even small differences. If you were a laborer, you were down at the bottom. If you had a desk job, you were somewhat higher, et cetera, et cetera. But, at any rate, my mother and father married.

My mother was from a staunchly Catholic family of Irishman, Irish people, and my father was the only son of a miner and his wife, who had worked on the surface of mines, separating coal from slates and so on. They called them "brow girls". They came from a mining community, and he was a member of what they called the Orange Lodge. You won't know that too much, but it was King William of Orange, who was the person who invaded Ireland to put down the Catholics and establish Protestant regime, and that had led to everything right up to the fighting with the IRA and so on. So, it was a very visceral opposition to Catholics. When we went into my grandparents' home, over the door was a very large picture of King William of Orange crossing the Boyne to show how he conquered the Irish. So, it was a difficult time. However, my mother and father were very much in love with each other and kept to society separately. So, we grew up, even though my father mined, not knowing very much about mining. And, my father had gone, had given his parents, certainly his father, the ultimate insult because he had converted to Catholicism; so, he was banned from the house, but a side story. Later, he got quite sick, my father, and he had to go into hospital for about three years. And, at one time, they said it was tuberculosis, but I think his working as a boy from the age of 12 on in the mines [that] had really had a bad effect on his health. But, he joked with my mother, saying, “I'm probably the only Orange, the only Catholic ever, to have been paid to get well again by the Orange Lodge.” Because his insurance, for medical insurance, was through the Orange Club.

So, anyway, my parents had been married; it was 1929, I was born in August 1929 – I mean, they were married in '28, I was born in August 1929. It was right at the end of the roaring twenties. Three months after I was born, there was a great Wall Street collapse, and it was a collapse that spread globally. There was massive unemployment in the US and in England, and so on. And then, my father became ill, and he'd had a good job in mining. It was well paid. But, my mother had to move to a smaller house in the countryside, and there were four children and my mother. There was no hot water, it was cold water, outdoor toilets, et cetera, et cetera. But, it was a very, very tough struggle during the Big Depression [Sic]. But, to us as children, there were four of us, three boys and a girl; it was wonderful because we were in the farmland, and the farmers allowed us to go out and help bring in the cattle, et cetera. And, to us, it was just heaven. But then, my father came back.

0:25:14 My Village School Teacher’s Dedication to Tutoring Me for the 11 Plus Exam

Charles:

I was in the local village school, as were my two brothers (my sister wasn't old enough), but we went to school there. It was a two-teacher school with 40 students, 20 each from the age of 5 to 14. One teacher took them from 5 to 9 and the other from 9 to 14; and, individually – not quite, maybe there were two or three at the same age – but had to teach each one different parts of a curriculum. Two wonderful teachers.

The headmistress, Miss Mooney, took a particular interest in me because she said, “I think you have some special talent.” And so, she said, “I'm going to put you into the exam,” so-called 11 plus exam, and that determined whether you were allowed to go to so-called grammar school or whether you continued in that school and just went to work after 14 and go to what they called a secondary modern school, where they prepared you for trades and so on. But, if you got through the 11 plus exam, you went to this grammar school, which prepared you for university.

So, she took me home at night and made me solve mathematics problems, et cetera, in her front room. She lived there with her sister, both spinsters, dedicated teachers. Well, eventually, I got through, I passed the exam, and I was allowed to select any school to go to. But, the nearest, and interestingly, there were Catholic schools and there were Protestant schools, and my mother said the local Protestant school, she felt, had a far better standard than the local Catholic school. So, she said, “Your religion will not keep you; you go to the better school.” And, that was probably the high point of my education because I had, it was a five-year high school, it was actually two schools in one. You went through the front door – if you turned to the right, it was the girls' school. If you turned to the left, it was the boys' school. The boys' school emphasized the sciences; the girls' school emphasized the arts.

0:28:00 A Top Flight School of 140 Students – Studying Sciences, Mathematics, and French

Charles:

So, for the first five years, we studied a lot of subjects, and there were very good sports teams playing rugby. I played rugby, but the teachers were absolutely dedicated and top flight, sometimes very tough. But it was the highest standard of education for my age that I'd ever had, and I was just so excited. So, as I say, each year, they took in two classes of 35 boys and two classes of 35 girls. So, one year there was essentially about 140 students. So, when those 140 students had come at the end of five years, they took the school certificate exam, which was to allow you to leave if necessary and go to university. But, out of that 140, when the exam results were seen, they allowed some students to opt for a further two years, which was intensive preparation for university. And, if you graduated with what they call the higher school certificate, at the end of that, you would exempt the first year of studies at university. Out of the 140, the science group selected seven students, five boys and two girls; and we were given classes, I say just seven of us, in four subjects: mathematics, applied mathematics, physics, and chemistry.

I had actually been studying French; I was sometimes in the boys' school, sometimes in the girls' school because I was studying French and German. And, just as a side note, interestingly, there was no television at the time, but my German teacher said to me, said to the class, “If you want to learn how to speak German, you should tune in to Radio Berlin,” which we could do. You had the BBC and others, but you could tune to radio Berlin, et cetera, and I heard Hitler giving his speeches, the railing against what he called Juden, the Jews. He was a very good speaker, but it was obvious that he had this horrible mentality. But, anyway, we took the – I said, “I want to continue in French,” and they said, “But, you're

the only student who's interested."

I said, "Well, okay." They gave me a private tutor for two years. Now, where else in education do you see something like that? He was an ex-British military officer who had been liaising with the French during the war, a wonderful time. So, that was – I graduated with mathematics.

0:31:25 National Military Service – "Your Eyesight's Not Good Enough to be a Pilot"

Charles:

So, I had always wanted to join the Air Force because I had to do military, so-called national service after the war was over; I was graduating in 1947. This was, the war ended in '45 – but I went to see the Air Force examiners to see which branch of the Air Force I was going to go into, and I had trained for three years. It's like an ROTC thing, but a high school ROTC rather than university, as you have here. But, the person who examined me looked at me and said, "No, he's an Air Force officer. Your eyesight's not good enough to be a pilot." And, at the time, if you had to wear glasses, flying a plane was out of it.

I think because they felt if your glasses were damaged or something in an attack, you couldn't fly. But he said, "You've got a good background in physics, so we'll put you in as a radar mechanic." I was furious. I said, "I don't want to be a radar mechanic." He said, "You have no option. You've got to do military service." So, I walked out.

My best friend was this fellow named Colin Belshaw, and Colin came from a military family. His brother had been involved in the Navy, taking supplies to the Russians through the Murmansk convoy unit. His other brother, Jack, was one of the first pilots to fly a Meteor jet, one of the first jet planes. But, after the war, Jack, who was still in the military, was killed in a Meteor crash. And Colin was all set with me. He and I were going along to the Air Force, and he said, "You know, I can't do this to my family. We've just lost Jack. They don't want to see me going to be another Air Force pilot." He said, "So I've decided to go in the mines."

I said, "What do you mean?"

He said, "Oh, there's an option. You can spend your military service in the mines if you wish," because Britain depended on coal, and they also depended on food because their supplies were cut off during the war. So, mining and agriculture were what they called 'reserved occupations', and you could go there instead of going into the forces. Well, the war was over, and so I said, "Hmm, that's interesting. It's only for 18 months, and I don't even have to go to any place, I can do it from home." Just go on my bike. So, I came back and said, "Maybe I can do that."

0:34:25 My Journey into Mining Engineering – A University Fellowship from the National Coal Board

Charles:

So, I went to the mining recruiter, and I said, "I've just been told by the Air Force that I have to go to the Air Force; if you can change it so I can go into mines, I'm in." A week later, I got a request to report to the manager of the local coal mine. It was about 20 minutes ride on my bike, and it was the time all the mines had been nationalized. So, they had introduced what they call a DPT scheme. The government, the national government, had said the mines had been allowed to deteriorate during the war because…

When I got taken to the mines, it was one of 13 mines in the neighborhood; and, of the 13, only one manager had a college degree, and he had a degree in chemistry from Oxford.

He was one of the most outplace managers I've seen. I don't know why, but this man that I resented had all taken night school courses and qualified, as you would say here today, like professional engineers, but they didn't have college degrees, and the National Coal Board [NCB] had decided to change that. They wanted everybody to have a college degree who could be a manager. You still had to have the underground experience. So, they were offering substantial fellowships to anybody who had graduated and qualified for university entrance to go into a mining program. But, anyway, that came a little later; and when I went, I thought I was going to this directed practical training program. Even the managers themselves of the mines weren't quite sure how it was all going to be organized, and they said the manager was wondering what to do with me.

I remember him; his name was Mr. Clark. I went into his office, and he said, “Oh, why are you here?” And I said, “Well, I've been told to come here.” He looked at my record, and he said, “You've done physics. Great!” He said, “My ventilation engineer just told me he's going to quit.” He said, “He's given me a month's notice.” He said, “So, you're going to work with him for a month. You are my ventilation engineer.”

And so, I spent time, I became the ventilation engineer for the mine. But, shortly afterward, I was taken by car to Manchester, to the local headquarters of the NCB, and inducted, if you like, into this DPT scheme. They offered me a scholarship if I would take mining engineering. So, I enrolled in Sheffield University, and that's how I got into mining engineering.

0:37:37 My Parents' Thoughts on Mining – The Lead Balloon of Careers

Charles Edward:

So, Dad, knowing how you've reacted to all of our careers, I'd be interested to know what your parents thought of you going into mining.

Charles:

It's a very good question because some time ago, one of the presidents of SME told me, or he actually wrote it in an article, I think, that he was in a meeting with about five or six hundred or maybe even a thousand [people] – it was an annual mining meeting. They were talking about the difficulty of recruiting young people into the mines. He said to them, these were all mining engineers, “How many of you would recommend your children to go into mining?” And, he said, of 700 or so, only two hands went up, and he said that's something we really have to think about.

Well, in my case, my mother felt that miners, with the exception of my father, were crude, rough, and not some people decent people would associate with. The point was, she'd never come into contact with them, but she just heard stories. And, even though she was not very wealthy at all, she had this feeling that she was several steps above them, with the exception of my father. And my father, who, I said, had worked from the age of 12 underground in mines, was actually a contract miner. Helping my grandfather dig the coal, and the more they got out, [the more they got paid]. My father was wheeling the tubs of coal as they got filled. He was a much slighter build than my father. I think that long-term working underground in coal mines, which at the time were not very well maintained, contributed to his

being in a hospital for several years when we were growing up.

So, both of them – they had liked it that I got to the high school and [was] going to go on to university. But, when they heard mining, my father was – they were quite happy I said I was going to make a career in the Air Force, I was flying. They didn't mind that, but [mining], that was like a lead balloon. Boom, you know. My God, you're going to go in the mines? I remember saying to them, don't worry. Look, I'll do military service, but I can stay at home, and I am only a 15-minute ride away on my bike. Well, they still didn't like it. But then, a little while later, they began to see that my career path in mining might be a bit different than theirs or their experience, and I was probably going to go up into management or something. So, bit by bit, they were mollified.

As they saw my career developing, they changed their attitudes somewhat. In fact, when I was offered the position at the University of Minnesota, my father came to the airport with me, and the last words he said to me was, "I wish I was coming with you." So, we were very close at the end. That was the last time I saw him because, about 12 months after I got, no 6 months after I got here, he went into the hospital and died. So, I never saw him again. But, let me now— Perhaps, that's as far as I go with that.

0:41:49 Being a Boy During WWII – Living Through the Liverpool Blitz

Maggie:

You were a boy in World War II. Can you tell us a little bit about your experiences?

Charles:

Yes, I was. Let's see, World War II broke out in 1939; for us in England, was a bit before [the US]. You know, it was the invasion of – Germany invaded Poland, and the British had said that, if that happened, they would declare war on Germany. And so, that's when that happened, and Britain was alone in opposing. Well, there was a war in Europe for a while. But, it was in 1941 that the Germans started their bombing campaigns against Britain, particularly London. Now, London was not really a military target, but outside of London, the most heavily bombed city was Liverpool because Liverpool was the main port. It was a real justifiable military target. It brought all of the food and military supplies that the British could get from wherever, especially to the United States. Although there were a lot of boats sank by U-boats in bringing that, nevertheless, Liverpool was the big center, and it's only 12 miles from the center of Liverpool to where we were living.

So, it was in, I think, March 1941, by this time, we had moved from Cronton into Widnes, the Northern part of the town, not far from Cronton, and there were quite a few bombings in March 1941. They called it the Liverpool Blitz. It was the height of it, and the bombs were that you could hear Spitfires and so on. They had tracer bullets. Every once in a while, you could see where the bullets were flying in the air, and there were what we called balloon barrages, major balloons with a big steel cable attached to them. The idea being that if a plane hit those coming down, it would sheer off the wing. But they were all around, and there were mobile anti-aircraft batteries; the worst noise I've ever heard in the world was one of those mobile batteries firing just sort of halfway down the block from here.

Awful. So, as the war was going on in 1941 – my father, who was working in the mines, this was after he recovered, and he was back in full term – we'd moved to Widnes. He worked at the mines during the day, and at night he was a leader of what they called the rescue brigade. It was like the fire brigade, but

the job was to get people out of bombed buildings; actually, the miners were pretty good at knowing how to support things. So, he was in that. So, whenever there was an air raid warning, he had to go to be ready to help people. These raids occurred at night, and my mother was getting very worried that she was waking us all up in the night when an air raid [happened], and we were too tired to go to school the next day.

0:46:00 The German Heinkel Bomber Crash That Proved Humanity Remained During the War

Charles:

So, we had an air raid shelter, and it wasn't very comfortable. [My mother] put a large bed in there and made us all sleep in there for the night; whether there was an air raid or not, she felt that was better. I was 11 years old, 12; my brother was 10 or 9, and the other one about eight. When my sister was five or six, my mother gave me the job of controlling the other children while the air raids were going on because they all, they thought, the two boys in particular, thought it was really exciting to hear and see all of this. So, they'd run out of the air raid shelter, and there were pieces of shells, shrapnel it was called, fallen on the ground. They'd hit the roof and bounce off. They wanted to collect pieces of shrapnel to go to school the next day to trade them. They got a bottom of a shell and things, and my job was to keep them in.

Then one night, I remember, there was a German bomber, a Heinkel bomber, hit by a Spitfire because they knew who hit it. It was coming down, and it was coming right to, not far from where we were living. We could see it. Machine guns exploding, and my brother Hugh, he said, “Oh my God, I've got to go and get a piece of a swastika.” So, he ran away and was trying to run to see where the plane would land, and it was going to, of course, explode.

I always remember that the plane, as it was coming down, the police obviously were trying, they were running to try to prevent people from getting too close to it, but it went down inside a big fenced-off sports field for one of the local companies. And, I thought to myself at the time, I bet the police are glad of that because it stopped all of these people. Otherwise, the idiots would've run right up to the plane. So, that was a big event. I remember, I think, they were a crew of four; two were captured, they parachuted out, but two others died. It was horrible. It was war, but these were human beings, and I never forget that about two days later, the Royal Air Force gave a full military honors funeral to the two airmen, and they were buried in the local cemetery.

I even remember the name of one of them; it sounded non-German. It was Luzinski, sounding more Polish, but I don't know. They were just young, he was 19. If he was the pilot, I don't know, but their graves were in the cemetery, and, every day, there were flowers on those graves. At the end of the war, they located the families, the German families, and they were exhumed and taken back to Germany to be reburied. It came out that there were two families of English families whose sons were in the Air Force. And, the mothers said, if anything happened to my boy, I would hope that somebody would take care of their grave. So, they put flowers on the two graves. Humanity came out at the end. I've never forgotten that.

0:50:32 Circumventing Rationing – Getting Eggs from Our Neighbors & Trading Coal for Tea

Charles:

So, the war, there was another aspect of the war that was quite interesting. Everything was rationed, and it was very little. You got one egg a week, one ounce of butter, and so on. You had to go with a ration book, and when they were served to you, they crossed it off, and so on, in your book. But, my mother, who was a good cook, she could not get by with just one egg to feed this family of four. So, she sent us out. I'm not sure if we all went, but I went as the oldest to put my little sister, the youngest, Betty – Betty was born in 1939, she's 10 years younger than I was – in a little sort of buggy. And, she sent us out to the farms of the people that we'd known in Cronton.

We would go there and knock on the door. And, farmers, nobody knew, you know, how many eggs the hens had laid and so on. So, it was a bit of a loose arrangement. They didn't get any ration books for eggs. They were told they could get chickens. So, we would go there, and I was 10, my sister Betty was 18 months – no, I was probably 11, [Betty] 18 months or so sitting in this buggy, looking a beautiful little smiling child –, and we'd say, "Do you have any eggs or bacon or butter that you could let us buy?" And, we'd go from one farm to the other, all the way around. When we came back, we'd probably have a dozen and a half eggs, a pound of butter, and so on. My mother would then say, "Look at this; we're all right."

But she loved tea, and she couldn't get enough tea. So, she would trade butter for tea with other people who didn't like it. So, it was quite a way because we knew the farmers, you know. But, at the same time, because my father was working in the mines, every month – this was a union, I think, had organized this; that every miner was given, free of charge, one ton of coal because all the houses were heated by coal and so on. And so, once a month, I would come home from school, and outside the front of the house was a big pile of coal. They just came and dumped it right on the side. And, my father had given me instructions: if ever you see that, you know your job is to get a wheelbarrow and take it and put it in the place at the back. So, my mother, however – we didn't need a ton of coal every month – she traded coal for tea, and it was amazing.

It was not exactly – I remember my father got it because my mother loved tea, he got a big pack of tea. A box about this big by this big. He was going on the bus to bring it home, and it was up about this high, so he was sitting on it. A policeman was riding back past him, and he just shouted, "It's obvious those are not eggs." Because you know, you wouldn't sit on the eggs, and my father said, "No, no, they're not eggs." I don't where he got the tea from, but anyway, those were the sorts of things that went on.
But my sister, Betty, was instrumental in getting us a large amount of those things. And then, as I say, my brothers and my father worked the rescue brigade. My mother also had to go and work. She did work at a big munitions factory, just down, three miles or so, filling shells with explosives. So, she would go, and my job was to stay home and watch the kids. I was always the one who had to help make dinner for her. I know she loved rice pudding, so I had to make rice. I became quite a cook. So, those are some of the things that happened during the war.

Maggie:

So, Betty rounded your family out to five there, five children then.

Charles:

Yes, but Betty was, as I say, 10 years younger than I was. She's still the same smiling person, as you know.

0:55:30 University of Sheffield – Exploring Departments to Replace Dull Courses

Charles Edward:

So, Dad, can you tell us about your time at University?

Charles:

Yes, as I told you, I was accepted to the University of Sheffield because it had a mining program. This high school that I came from felt that scientists, we should be going to Cambridge and the arts people, Oxford, [that] was where they should be directing [their] attention. But, Cambridge did not have a mining program. So Sheffield was the nearest, and I applied, recognizing that I had the year in the mines to do. I had a very interesting exchange with the professor, Professor Statham because he said that, at the university, they insisted that all entrances to the mining program have to spend one year in mines before they would be allowed to be admitted so that they knew what mining was about. So, to that extent, I fitted the bill. And, when I got to Sheffield, it was really my first time away from home. It was very different and very exciting. You are meeting students from all over the world, and it was very stimulating. But, when it came to the mining program, I had some excellent colleagues there. Some very good students.

So, I was a little disappointed with the undergraduate courses. They did not seem to build on the preparation we'd had in high school. At one point, I went to the head of the department and said, “You know, some of this is a little dull,” and we had an interesting chat. I said, “Would you mind if I looked around and took some courses, maybe in other departments?” Particularly I was interested in electrical engineering, and I managed to find a course which was dealing with heavy electrical equipment. And, I said, “Mines have hoisting equipment, you know, for bringing, going from the surface of the underground, and it was a special design, so-called “Ward Leonard sets,” and so on. And so, he said, “Oh, okay,” and they allowed me to take some courses in other departments in place of what I felt were quite dull courses.

In the end, I did very well in the other courses, too, and I ended up with a first-class honors degree. Graduated on time, and, at that point, there was a professor in the mining department named Dr. Robert Shepherd who just joined there. He was one of the few people who had a PhD in the department. He asked me if I would be [staying]; they were just starting to do graduate work.

Remember now that the National Coal Board had taken over, and the National Coal Board really had a very different national perspective compared to the miners, who were always production. Production was their thing for private owners. They had, were in the process of establishing research facilities and so on and so forth around the country. I could see myself, perhaps, joining one of those, but that's not what the courses were preparing me for.

0:59:45 Early Stages of Mining Research – Pursuing My PhD on Rock Drilling

Charles:

At any rate, I ended up, I did, well, I got a first-class honors program degree. And Dr. Shepherd said, “Would you be willing to keep going for a PhD? And, the National Coal Board will extend your fellowship for the length of time it takes you to go to get the PhD.” Because he said that they were looking at ideas

that they found out in Germany, and they wanted to develop them in England. So, they asked me to look at drilling at very hard rock. So, I entered into that program, but once again, there were problems. It was a different kind of problem, and that problem was that they had no funds for research, and I was pretty much left on my own. If I was going to study the breakage of hard rocks, I wanted to look at the breaking process, and I needed a high-speed camera.

I had to walk around and find another department that had one, and they were willing to loan me one. And then, I had to get what [tools I needed] to measure the forces that were acting on the cutting tools in what they call a three-component dynamometer. I found out that the Royal Aircraft establishment down in the South of England were willing to loan me one, and I was going around all the time trying to find things so that I could do the research. I remember once I was trying to drill some hard rock, but I'd put gauges on the drill, and since it was rotating and I wanted to take an electrical signal off, I had what they call slip rings running on the rod in a bath of mercury. The mercury is what allowed you to rotate and still take an electrical signal off.

So, I designed and built my slip ring assembly, but I needed mercury, and it was expensive. So, I said, "You know," to the lab technician, "there's mercury in a lot of things around here. We've got barometers," and for mine ventilation, they had very precise, inclined gauges to measure pressure differences and things. I said, "Why can't I use some of that?" And the lab technician said to me, "Go and talk to the head of the department. He should buy you some mercury. I don't want to empty all this stuff out of these instruments and then put it back again later."

And so, I went in, and the head of the department professor said, "Tell Harry Barker, I want to see him. I want you to bring him in." And so, he said, "Why don't you let him use that mercury from the instruments?" And Harry said, "Why do we have to keep robbing Peter to pay Paul all the time?" And he said, "I understand, but Peter's not using it right now. So, you [Charles] go out and use it."

So, that was the sort of environment – they didn't understand that you had to have money, and maybe assistance, once in a while. One time, I was lucky, I nearly broke my leg by a ram that got out of control, and [it] almost hit my leg, but you know. So, it was a very early stage they were doing [research].

1:03:44 A Letter from Pfleider – Going to the University of Minnesota for A Post-doc on Taconite ore

Charles:

At any rate, I ended up getting my degree, PhD, and I now left the university and went back to continue my obligation for the time in the mines. I'd been there just about, well, from July to about April, and I received a letter in the mail. It was from the University of Minnesota, and it was Professor Pfleider asking if I would be interested in coming to the University of Minnesota to start a two-year post-doctoral program to develop the work I'd been doing in rock drilling.

Because I found out later that the iron mines of Northern Minnesota were moving from what they called natural ore to taconite ore, and the taconite ore was much harder. There were no commercial drills that were able to cut it. The Hughes Tool Company had roller cone bits, but the bearings were failing. And so, they developed what they called a jet piercer, and it was, essentially, doing what you do when you let the pan run dry on a stove. It was all flame, and then behind the flame, a jet actually was settling the flame behind it; they put steam, and that cooled it. The rock was heated and then cold rapidly; it broke. Anyway, so they wanted me to start to look at how to deal with that and get a different process.

Maggie:

So, how did Pfleider know about you and your research?

Charles:

Well, I later learned that because of the concern for drilling of the rock, Professor Pfleider had been organizing conferences in Northern Minnesota to discuss the challenges of changing from natural iron ore to taconite ore, and he organized conferences on drilling and on blasting because it was very hard rock. I think he was actually a man before his time because he was really doing a lot of very, you know, communicating to the companies, helping them, and so on. Apparently, Professor, my Professor Shepherd, attended to give a talk at one of the drilling courses, and Pfleider said to him, "I want to develop a research program here, Minnesota, and do you know anybody that might be able to help me?"

Well, he told of two people; first of all, he mentioned a Dr. Inett, who was working with the research department of the [National] Coal Board. He already had finished his PhD and was at work. And then, he mentioned me as having just graduated and that I had worked on that topic. Well, apparently, they first approached Inett, and Inett decided he wanted to stay where he was working in England. So, Pfleider then wrote a letter to me saying they'd be interested if I would take this position.

1:07:38 Staying in the US – Meeting My Wife & Repaying the National Coal Board

Charles:

Now, this caused me a bit of a problem because the [National] Coal Board, I was still under obligation to them because they wanted me to work one year in the industry for every year that they supported me. So, I said, "How do I go and talk to them?" Because I still had about two years left. I'd worked overall for four years. So, I went and talked to them and said, "Look, this could be a valuable aid to my education. I'll go and spend two years in the United States helping solve the problems, and then I'll come back, and I'll continue."

Well, they were not very enthusiastic about that, but, nevertheless, they eventually said, "Okay, you go for two years and come back." Well, that's how I came here. And, as you know, I had not been here more than about nine months, and I met your mother and decided we were going to get married.

It was kind of funny because they, I mentioned Pots before, Pots was at the University of Arts here, and Pfleider was saying to him, "Try to, if you're here, why don't you take the two of them out to dinner? We'd like to encourage this, to make sure that he maybe is interested in staying." So then, I had to write to the National Coal Board and tell them they want me to stay and move forward. And, I actually, I think I'm one of the only few that did, asked the [National] Coal Board, could I repay them for the unexpired time that I was obligated to work for them.

They were very, very nice. They said they understood it. They said a lot of students, several of those students, had decided to go and work in South Africa in the mines there because they were better paid, and so on, and had not even talked to them. They ended up asking me for a very nominal amount, which I then paid. I was free to stay in the United States.

1:08:48 Starting UMN's PhD Program in Rock Mechanics

Charles:

I had only been going on the drilling for a little while, Professor Pfleider was a mover and shaker. He had been a prime mover in the establishment of the rock mechanics symposium at the Colorado School of Mines because it was a joint venture of the Colorado School of Mines and the University of Minnesota. And there was another person, Hartman, who was working, just got his PhD at Minnesota; he is listed as one of those working jointly on the first two symposia. But, he finished a PhD and got offered a job as the Head of Mining at Penn State University, and so he left.

That's when they asked me, would you mind teaching a couple of courses, one on ventilation and one on mine plant – it was called design, that was the hoists and all that sort of thing. So, what I'd done in England came in handy, and he said, "Just do that for a year or so." So, I did it, and then he came to me again. He said, "Look, I really would like to start a PhD program in rock mechanics. I've looked everywhere, and I can't find anybody to do it. I think I can find somebody to teach the other courses. Would you be willing?" And I didn't let him finish the sentence.

I said, "Absolutely. Yes, I'll do it." Because I saw it was the opportunity for me to use the maths and so on and build on it. So, I started on rock mechanics, and all of the things I told you before about serendipity, all those things started to happen at that time. Because I was asked to do that in, what was it, 1957, and other places started to get interested. The people in South Africa started the rock mechanics program. Then, some at Imperial College in London started [it], Evert Hoek. I still had one of the few in the United States that was pushing it, and so we developed that network of people, and it just blossomed from there on.

1:12:56 The Minnesota Mafia – An International Coalition of Rock Mechanics Students

Charles:

As I told you, my first job was to try to get students for the PhD program. So, I sent the note, I sent an announcement of what we're going to teach, and I was emphasizing that they were going to have to take courses, rigorous courses, in mechanics and a lot of applied math if you like, that had to be used. The response I got from students around the United States was very poor. I said, "Well, what am I going to do now?" And I said, "Well, we put all this work in; why not just send it out internationally?" And that produced a very interesting result. Because I got applications – the first PhD I accepted was from Egypt. They had some from Israel, Australia, well, just all over Germany and France, and so on, and a number from the United States.

We put that group together, and I said, "But they need this background in mechanics." Well, we had a very good mechanics department at the university. So, I went to talk to the professors there. I said, "Would you be willing to let me have these students take your courses for a while?"

They said, "Well, you know, typically mining students, and so on, don't have the background that we need for our students."

I said, "Yeah, but these are a special group. They're from Europe, not all from the United States. Some of

them have very high preparation."

Well, finally, they agreed; and so I was allowed to, and I taught them the applications of what they learned there. Some of them had the background, others needed more, but they bonded as a group. At the end, some of the professors in mechanics said to me, "We have never seen a group of students work so hard." Well, the rest is history.

You can go through their names and see what they did. You know, eventually somebody like Mark Board, who's recognized as perhaps the best consulting mining engineer in the world, in the English-speaking world certainly. You know, he's just retired now from, he was Director of Innovation at Hecla Mining Company. And he's developed a new mining method for them that's saving the company 50% on their costs. He's just published a paper for it in "Mining Engineering." So, anyway, they were that caliber of people. The other thing is that they all became close friends, and, you know, this one person coined the term the Minnesota Mafia because they spread out. Anyway, that's how I started at Minnesota.

PART 2

00:00:33 Sweden's Underground Caverns – Doing What the UCRC Only Talked About

Charles Edward:

So then, from about 1957 onwards, you often talk about a number of different events that happened from there on up to around 1990. Can we just talk a bit about those events or –

Charles:

What sort of events –

Charles Edward:

Well, you mentioned something about Sweden.

Charles:

Oh, oh yes. I was trying to think of how to cover what influenced me. I remember the years were passing, and people asking me to take on being the head of the mining department. And then, a long time later, we combined the departments, and they said, "Would you be head of the civil department?" I think I told you, maybe I've said it already, soon after I arrived here, and I set up my drilling research thing, a professor from Sweden, the mining professor from the Royal Institute in Stockholm, just visited the department, and he looked at my setup, and he said, "You know, I really think you should go and see, go and talk with Dr. Hans-Christian Fischer. He's a professor of physics at [Chalmers] University." He said, "I can't say anything about it because his work is classified. He's doing it for Atlas Copco."

So, I said, "Oh, okay." So, I didn't think much more about it. But, later on, I can't go into all the details, I went to Sweden. I went to see Hans-Christian, and it was true. He was doing a little more analytical work, but we were doing very similar things. We became very good friends because we exchanged ideas later. He came back over, and he actually stayed up at the cabin, got along with us fine. While I was there, I got to know of this man called Sten Bergman, and Sten was THE top applied rock mechanics

person in Sweden. And, as I've said before, the Stockholm region is – a lot of Scandinavia is -- built on really high-quality granite. They were neutral, but they were concerned about the potential for nuclear warfare between the United States.

It was the Cold War Era, and yet Sweden here, I mean Russia here, the US here, and if you draw a line between them, it goes right through Scandinavia. They thought we'd get involved either with fallout or something. So, they developed all kinds of preparation to avoid any consequences from nuclear weapons. They built all of their oil reserves, they had a 14-month supply, I think it was, of oil reserves in deep underground caverns. They built the metros, expanded the metros. They built concert halls, and later in Norway, in Lillehammer, the ice, the Winter Olympics was in the world's largest cavern: 60 meters, 200 feet free span across in rock. They were doing all of that, and it was just showing what I'd said about the AIME earlier and developing the Underground Construction Research Council. They were doing what we were talking about could be done and could save money, and it just blew me away. So, I got very involved with them later on. So, that's Sweden. For a variety of reasons, later on, Magnus Bergman, the son of the first Bergman, came to help ITASCA.

00:04:22 Is Underground Containment the Solution to Disposing Radioactive Waste?

Margaret:

Tell us a little bit about how the US influenced your career. For example, in 1957, the US National Academy of Sciences published the report “The Disposal of Radioactive Waste on Land.” Can you talk a bit about that?

Charles:

Yes. As you know, one of the developments of World War II was the atomic bomb. But then, also one got to peaceful uses of nuclear energy, and nuclear power was considered to be a very major development. But, one of the problems was, what do you do with this radioactive waste? Because it remained dangerously radioactive for thousands and, in many cases, over a hundred thousand years. So, how do you avoid it having a negative influence, the waste from those power plants having a negative influence on the population? Well, again, the underground was considered the best option to separate these things that decay from the biosphere, the living. So, the academy recommended that, and that led to a number of experiments. The nuclear power plant in Savannah River, Georgia, there was a notion to put the waste in, actually liquid form, down under the nuclear power plant there.

At the time, Jimmy Carter was the Governor of Georgia, and he was an engineer. He said, “Ah, ah,” because he said there could be a mistake, and some of that waste could get into the groundwater and contaminate it, and so on. But, the argument he did use to get it stopped said, “Well, what if there was an earthquake while you were pumping it down?” We said, “The chances of that, we can isolate a pipe thing.” You are just getting round to blasting engineers, blasting astronauts off in a capsule. So, you can shock isolate very wisely. So, they were looking at ways to stop it, and they did stop it.

00:06:45 Board of Radioactive Waste Management – Answering the How, Where, & What

Charles:

But, that led to the National Academy of Sciences research group to establish what they call the Board

of Radioactive Waste Management, and that started to look at every option: as well as putting it underground, on land, shooting the waste up into a solar orbit, so it would go back to where it came from, I mean the sun, putting [it] on an island where the wind is never below 120 miles an hour, and so nobody would – all kinds of things and eventually came back to put it underground.

So, there was a lot of reactors in the US. They said, "Where do we do it?" So, there was a national search, and I was actually – Minnesota was considered to be a good group because you had granite up around St. Cloud. So, every state was looked at to see where should it go, which were candidates. And, it's kind of funny to look at how every group developed a mentality; how do we make sure that it doesn't come here? Minnesotans went very big on the fact that this radioactive waste would be right next to the biggest freshwater repository in the world, Lake Superior so that you don't put it in Minnesota; it's too close to Lake [Superior].

So, every state fought to avoid having it, and eventually, it came down to Yucca Mountain in Nevada. I was involved very much with the Board of Radioactive Waste Management. Then, we had another set of radioactive waste from Los Alamos Lab. It was the kind of low-level waste people who had gloves that they'd thrown in. You know, you wear a glove to protect yourself and then throw it out. All of that low-level contaminated stuff. Where to put that? So there was a proposal to put that in Carlsbad, New Mexico. What they call the waste isolation pilot plant. So, I got to be involved chairing various groups, and we went from the US sometimes – after the Chernobyl accident, a group of us went to Russia to check with Russian colleagues whether there was any possibility of similar accidents since the same nuclear plants that were in Chernobyl were, for example, right outside what was called Leningrad then.

They were doing some fascinating things. They were putting the nuclear plants right next to big cities because the waste heat that you see going up; they were using that to heat the homes around Leningrad. So, there was a lot of discussions. What should we learn from that disaster and so on. So, the Board of Radioactive Waste occupied a lot of my time. I was still trying to do drilling, the rock mechanics research, people asking me to be head of department or whatever. Fortunately, as time was moving forward, I was able to add one or two people to the rock mechanic staff, so I wasn't the only one teaching the courses. Tony Starfield came along. So, that was how I tried to move forward. And then, I got involved with the National Academy of Sciences. I got elected to the Academy, and there were similar things there.

00:10:46 Growing My Relationship with France – From High School French to Sabbaticals Abroad

Charles Edward:

So, tell us, talk a bit about the longstanding, very close relationship with France throughout your career.

Charles:

Oh, yeah. Well, as I said, when I was a high school student, I developed an appreciation for learning French, and I had a very tough French teacher. I could actually pull it out of a drawer here somewhere and show it to you; three times a year, we got a report card. It was a book, and it listed where you stood in the class. And, another one was what was your standing in the class, were you top of the class, second, third. And, the other one was this teacher's evaluation. Did she give you an A, B, C, D, or what? The French teacher, one time, the class was about 35 students, and I got the report card. I had to take it home. My parents had to sign it before it could go back to show that they'd seen it.

And, it said for French, ranking in the class, one. I was the top of 35 students, and the grade at that time was called VF. Very fair. That was like a D. And, I said, “I'm the top of the class, and you give me a D?” She said, “Look, everybody will know from the first one that you were the top of the class. The second one is my evaluation of how much effort you put in compared to your potential. That's why we have two ratings.” She said, “I don't think you worked very hard for that, and you didn't deserve anything higher.” So, that was [that], and I actually, eventually, got to really appreciate her because she was tough, but she cared. That's why I took French all the time. So, I always had this pleasant – and secondly, the French, ever since Napoleon, had a high commitment to higher education and very top-quality education.

What I said about students coming from other places, the French students that came to Minnesota always were prepared very, very well from places like what they call grande école, École Polytechnique, the civil engineering lab, Ponts et Chaussées, and others.

00:13:34 France – At the Forefront of Rock Mechanics & A Worldwide Uproar on Nuclear Testing

Charles:

And so, since we could speak a bit of French, we went over there a while. We took sabbaticals there, and I got to know the top rock mechanics people, Pierre Londe. And, you know, eventually, you spent a year with them and learned French, and he referred to you as my other daughter. So, I had a very pleasant relationship with them.

I liked to have a dialogue and discussions with them because they were at the forefront of some of the questions [about] this Malpasset Dam fail, and they always felt it was a blot on the, you know, engineers. It was a while later that they – going back to the various nuclear powers: the US, China, Britain, France, and who I left out -- anyway, the ones that had nuclear weapons – all agreed to a comprehensive test ban treaty, which meant no more testing of nuclear weapons. And, the US – no, anyway, all of the countries except France, signed it.

The French said they wished to conduct an additional series of tests in the South Pacific and that they would like the time to do that, and once they've finished that, it would be the end of their testing. Well, that provoked a major uproar around the world, and that's when, you know, the Congress said they weren't going to eat French fries anymore. They were going to call them freedom fries and stuff like that. The Australians said that if they conducted a test, any radionuclides that sneak into the water would go past Australia and maybe New Zealand and down there. So, they were up in arms and protesting. That was going on for about two weeks, three weeks, and I got a telephone call. I think it was in this house, and it was from Pierre Bérest, he was one of the younger ones.

00:16:10 Forming an International Research Enterprise on Behalf of the President of France

Charles:

Pierre Bérest, on the side, was also a big rugby fan, and he liked to travel around the British Isles and France to follow the rugby. And I got this call; he said, "Charles, I have to tell you. I'm in the middle of Ireland, I'm in a coin box, and I'm running out of, you know, coins. I want to talk to you. Will you be willing to lead, form and lead an international group on behalf of the President of France?" It was a

request from, I'm trying to think of the president's name at the time, Jacques Chirac. He said, "Would you be willing to do that? Because we want to have you go to the place they're doing the test down in the South Pacific and evaluate it, when we've completed the tests." And, he said, "What we'll do, we'll give you a million dollars," which was a bit of money at the time, "and then we won't have any more involvement. You will form your own international committee, and we will" -- it was the French army, really with control, you know, military control -- "We will help you go down there." And, he said, "I need an answer quickly because I'm running out of coins." And, he said, "There's a few people knocking on it saying there's not many coins." So, I said, "Well, yes, I'll do it, but you'll have to come and get more details." Well, that started a three-year study which was the finest, you know, research enterprise we'd done because we were able to get Frenchmen, Australians, English, Russian, the top people around the world. What was nice about the French is that they insist that when you do a job like that, that you travel first class. None of this economy class.

And so, he said, "But, it's up to you." And so, I said, "Well," to all of the people I invited, "Look, you have one first-class ticket, but if you make the choice to take and bring your wife or girlfriend or whatever, as long as you don't go over the price of the first-class ticket, we'll pay for it. Because the French said, it's –" So a colleague from Cambridge, he brought his wife. We were in Tahiti, and we then flew down - the men flew down to the testing grounds, and the women stayed back and had a lot of fun in Tahiti for a while. So, it was a wonderful meeting.

00:19:29 Officer de Légion d'Honneur – A Tribute to My Scientifically Rigorous Work with France

Charles:

The first meeting was in King's College Cambridge, and it was held in the house, which was a bigger house than this, of the English person on the committee, Anthony Pearson. We paid them for being able to stay for two or three days. I was walking down the street after we'd listened to a recital by the King's College choir at night. And, Pierre, no, Ghislain de Marsily – who was a leading French hydrologist and a world hydrologist – he went there down the street, and he came alongside me. He'd had polio, but he'd recovered mostly, but he was still a little limp. And, he said, "Charles, would you mind if the next meeting is held in France? I'd like to –" And, he said he had a somewhat rundown château that he'd inherited from his family in the South of France. He said, "We can have the meeting there." Well, we did, and it was a remarkable meeting, but it developed this little bit of national pride. Where's the next one going to be? Anyway, then we had – so, then we did a report, and it was in English and French.

It took us three years, and we submitted it to the French. Then, I was working on another group with the French to look at their radioactive waste facility, which was up near the champagne fields. There was a big concern that with all the champagne sales in the world – anyway, all that was going on in France. And, of course, as you know, that eventually led to, well, one of the biggest surprises of my life. When a few years later, I got the note to say that I'd been elected to the French Légion d'Honneur. It was interesting because two or three of the French people I knew were in the Légion d'Honneur, but they were at the level of Chevalier, which is the first one. They nominated me for a higher level, which was higher than they had.

That's the kind of people I was meeting. So, you remember you went to that meeting, and I was given the medal by the President of the French Physics Society in a really nice facility in Paris. And, he said, talked about the various things that I had done with France. I was on the scientific advisory committee for 10 years for finding their waste facility and so on. But, he said he examined that report, and he said it

was a more scientifically rigorous and high-level report, one of the few he'd seen. Now, I didn't put it together. Everybody did, but it was a very nice conclusion. And, the interesting thing is, then the French just quickly signed that thing and all of the controversy disappeared. So, that's my – and there's lots of others. As you know, you went for a year to school, you went over there and studied and got your PhD there. So, the relationship with France was very tight; and your mother taught French, of course.

00:23:34 Brazil – Developing Mines and a Distinguished PhD student

Margaret:

So, continuing around the world. Moving over to Brazil, and you have some experiences and stories from Brazil.

Charles:

I'll tell you. Yes, Brazil was a very interesting story. Well, to me, it's interesting. I was in my office one day, and there was a knock on the door. I had two offices because I was the department head– that's where I signed papers and stuff – and then I had another office where I could get some work and talk to students. And, this knock came on the door. The person who came in was a gentleman, he was about 15 years older than I was. And he told me that his name was Figueiredo and that he had taken a geology degree from the University of Minnesota. But he was from Brazil. He'd met and married his wife, who was a Minnesota nursing graduate, and he was coming back just to meet relatives and so on. I don't know why he came across me. Initially, I didn't know why. And so, he said that he was with the Petrobras, the big drilling company of Brazil – and he said, "During our drilling for oil, we've encountered this big potash deposit, and we were thinking it might be economic to mine."

He said, "Since you're a mining engineer, I was wondering if you might be interested to give us some advice." And, he was talking at a very low key all the time. And then, I said, "Well, yes." Well, it developed. I went down to Brazil and said, "Yes, I think that it looks like it could be a good economic proposition." And, I said, "So," I said, "It would be," it could have taken a while to do. So, I said, "What would be a good idea, since I'm at the university, is if I could put a student on it for a PhD thesis to help develop it." And he said, "Well, that would be okay. But, if you do, we would like it to be a Brazilian student, and we would like to choose them. We'll send them up here to work with you, but we would choose them." And, he said, "And, when he submits, finishes his thesis, he would have to submit it to the Catholic University of Rio de Janeiro." These were funny requirements, but that's okay, it's paying for it, and I don't have the responsibility to get the PhD. Well, anyway, it turned out to be a very interesting project, and I made many trips down there. And, as you know, I brought you back little gemstones and stuff.

So, at the end, this student, Alvaro Maia da Costa, he just got married. You remember, Charles? He was in the Jaguar outside. But his wife was with him, and she was a mathematics teacher. And, she taught mathematics at the, I think it was the Marine, essentially, West Point of Brazil, academy for military. I think it was Marines. And she said, "I'm the only woman teacher in the academy," she said, "and it's so nice to go in the morning to teach class, and they all stand up and salute me." She said, "There's only one woman teacher in there." But she was a lovely woman. Anyway, they came up and took the courses, I mean, he finished his PhD. A few years later, we had a meeting. There were several – there was one Brazilian man who was elected to the National Academy of Engineering for having discovered a major oil deposit off the coast of Brazil. I think it was called the Santos deposit or something. But, it was

a very difficult deposit because it had, I think it was over a thousand meters or 3000 feet or more of salt above it.

And, as you know, under pressure, salt flows and so on. So, this man, who was coming and he's getting, he's an international member of the academy. And, I said to him, "I wonder if you know Mr. Alvaro Maia da Costa." And, his face lit up, and he said, "Know him? His wife was my technical director, and if it hadn't been for him, we could not have got through, drilled through that salt." So, that's an end story to a student who went out. So, that was Brazil.

00:28:49 President of the International Society for Rock Mechanics – A Broadening Experience

Charles Edward:

You also have spent a time as the President of the International Society for Rock Mechanics. Can you talk a bit about that timeframe of your life?

Charles:

Yeah, that, of course, brought me into contact with people in many other countries that – I think one of the first places I went down to was Chile, and it was during the transition from a very repressive regime to something else, but we won't get into that. I learned about – because Chile is the biggest copper producer in the world – I got to know a bit about their expertise and so on. And then, I went to India. Had a lot of fascinating – [I went] a bit back to India. I even, I was also associated for a while with the, at the time it was East and West Germany, and East Germans had a parallel organization. So, I had to go through Checkpoint Charlie quite a few times in Berlin. I just learned an awful lot about the fact that there were first-rate people in just about every country in the world, and it taught me – the headquarters of the ISRM were in Lisbon, so I got to know a lot about Portugal, but it was a very broadening and widening experience.

00:30:35 The Challenge of Attracting Students to the Mining Program and Expanding Research

Charles Edward:

Maybe backing up a bit. Talk a bit about when you were the head of the School of Mineral Metallurgical Engineering earlier on.

Charles:

Do you want me to take into account when they closed the program?

Charles Edward:

Yeah. You did talk about that before.

Charles:

Yeah. Well, with the School of Mines and Metallurgy or Minerals and Metallurgy, it was given various titles from time to time, and we had a persistent problem. It was kind of interesting. The mining

companies up North – this gentleman, Professor Pfleider, I told you about, had graduated from the university, and many of the people who were in charge of the mines had graduated with him. And so, he would frequently go up there trying to get funding for them to help develop research programs and so on, but they would never give him anything for research. They would say we are paying so much in taxes. Go back to the Minnesota government and ask them for the research money. We're paying enough already. But, he was always able to get funding for scholarships for students. And so, we always had plenty of money to give to students, but for some reason, we could never attract enough students to come into the program. Even though everyone we told we'll pay your way through the whole thing, they went, no, no. We'd go on special bursts, and the enrollment would go up, but then it would go down.

A lot of things were going on. The state of the University of Minnesota was very anxious to develop graduate programs and be at the forefront of research. We had the mines and metallurgy, and metallurgy was process metallurgy, that's refining it, and the other one was really what they call physical metallurgy. That was really getting to the high alloy strengths and refining very carefully. They felt that they wanted to be closer to the chemical engineering people rather than attract to us, who were just digging it out of the ground.

00:33:01 Merging Civil and Mining Engineering – Becoming Head of the Conjoined Department

Anyway, it ended up with separating the School of Mines into an affiliation with civil engineering, and it was renamed the Civil and Mineral Engineering Department. We kept the degree programs, but they moved around, and they affiliated with the chemical engineering and became chemical engineering and materials science. Well, that went on for a while, and I was head of the mining department. And, when they combined the two departments, I was no longer – civil engineering was a bigger department. Oh, I'm sorry. I jumped the gun a little bit. We were operating as the School of Civil, School of Mineral, and – some other name. Anyway, and then they decided to put us together with civil and the other people, as I said, with chemical engineering. And when it merged, I felt very happy because they had a civil engineering department head, and it was a much bigger department than mine. So, I felt I could get back into dealing with students and research, and then I went on leave for a while. When I came back, I found out that they had, the head of the civil engineering department had been invited to step down. He was an excellent engineer but didn't have [the] apparent administrative skills they wanted. And then, they came to me and asked me to take over the group. I was very upset at the time because I said I just finished doing a lot, and I want to get more involved in the research.

00:35:15 Losing the Twin Cities Mining Program to Duluth's Economic Engineering Propositions

Charles:

But, anyway, I finally conceded, and so we had – I was head of the civil and mineral department, and just after we had merged those two, there were some, what they call, coordinate campuses around Minnesota. One of them was in Duluth, and they had a geology department; and the head of the geology department was the chief geologist for US Steel, before he came to the university. He was a mining geologist, in other words. And, the provost of the university – that's like the president of that campus – was also a geologist, Bob [Robert] Heller, a very distinguished one. There was another third person who was the dean of the geology group, I think, and it was, they gave him the nickname, Rip, Rip Rap, and he was an archeological geologist. They three came down to the university and said, "Look, you're having all this trouble with getting students for the mining program.

Why don't you think about transferring the mining undergraduate degree? You can keep the graduate programs to the University of Minnesota Duluth." They said, "We're close to the iron range and so on, and we think that we're a smaller college; we'll have a better chance of attracting students into the mining program than you have." Well, Pfleider was in there with me and others, and, eventually, we agreed, with some reluctance, but said, "Okay, and while you're getting going, we were going to go up twice a week and teach courses until they got their own people."

Then they said, "So, we'll have to apply to the Board of Regents for permission to give engineering degrees." Because at the time, nobody else but the big campus could give professional degrees. You couldn't have a medical school. You couldn't have a law school. You couldn't have engineering. So we said, "Okay, we'll wait until you make an application to the Board of Regents." And so, they applied for permission to grant engineering degrees up there, and the Board of Regents said, "Yes, okay." So, they said, "Great, we're all set." And then, the Chamber of Commerce for the University of Minnesota Duluth went to the University of Duluth and said, "Hey, if you want to influence, to improve the economy of Duluth, absolutely engineering degrees will help. But mining is not the one that's going to do it for us. We want computer science. We want mechanical. We want electrical." We had agreed to terminate the program here, Twin Cities, and suddenly they had been told that you're better off to get degrees in these other programs. And, right now, that was in, what was it, 1983, '82, or '83. There's the Swanson College of Engineering up in Duluth, and it has degrees in about every engineering discipline you can think of except mining. And so, we lost mining here, and I would go to SME meetings, and they said, "We alumni," they would say, "we feel betrayed." I said, "What do you mean?" They said, "Well, we were alumni of the School of Mines at the University of Minnesota, and we felt proud of it." They said, "Now, when you go to SME meetings, there is no booth. There's nothing for us." It's called, as you know now, Friends of Minnesota. So, I got sort of blamed for depriving them of a part of their existence.

00:39:43 Starting ITASCA – Emphasizing Applied R&D for Mining and Civil Engineering

Margaret:

So, in 1981 then, you started ITASCA Consulting Group emphasizing applied R&D for mining and civil engineering. Today, it is now recognized internationally in mining and civil engineering consulting, not the action of someone abandoning mining.

Charles:

No, I'm glad you made that point because that was it. We had been developing for, what was it? Anyway, since I came from 1956 to 1981 because I was finding it frustrating there was nobody pushing what I consider was essential R&D for mining, we put together the consulting company. I mentioned this Peter Cundall, who I'd met as a graduate student in London and managed to get him to come over here, and he was going gangbusters. I mean, his developments were really showing that they were paying off, and I had Magnus Bergman and everything they'd done with underground space there. I thought that between us, we could put a good consulting company together. As I think you know, it's on that separate tape that you have, the whole story of how we did it, how we got it going.

By 1981, we just graduated the 20th PhD. Right now, if you look in the records, although they changed the term now to geological, something engineering, but it's all rock mechanics in there. We have got just about 120 PhDs that could work in the mining industry. You know, they don't all work in the mining

industry; they work other places; but I'm saying we have made a contribution to where I think mining engineering should be going, having real R&D, competent people. One of them that I have mentioned to many, and I shouldn't mention one because there's so many, but as you know, Mark Board, what he's done. It took me 17 years to convince him to finish a PhD, but he did it. He's probably, he's just a great, great guy, top-flight engineer, practical engineer.

00:42:23 Critical Minerals & The Kissinger Report – A Crucial Player for National Security

Charles Edward:

You talked a bit about the US and minerals, critical minerals et cetera, in the US. You made the comment that it's been neglected for almost 60 years. Do you want to share some thoughts about that?

Charles:

Yeah, I could go back. I think there's, if you look on Wikipedia, you'll find a thing called the, I think, Kissinger Report, and I think it was in 1972 or so. Henry Kissinger was behind a report which was talking about threats to the United States. And, you'll see on there, the number one in the listing is, it just says, the US will be heavily dependent on minerals from developing countries, which will grow, you know, continuing to go into the future we need to do something about this. I could go into more, there's more details to that report, but that was what I thought was the first indication of that. Then, I could give you chat from verse, but 1980 something, was the first report of the National Academies on Critical Minerals [and Materials]. The term was defined then, saying what is a critical mineral, something that is essential to the wellbeing, for example, manufacturing – economic wellbeing of the United States and national security. Now, what's national security?

The US was always priding itself on being in the forefront of military technology, but they were beginning to realize that a number of the minerals that were required, like rare earths and other things, were coming from other countries. That has just grown and grown and grown, and right now, I think the 2022 report of the US Geological Survey lists, like, what is it? It was 35, about 40 years, no, it's more than that. Anyway, a huge host of minerals, and you can see the list; and, for something like 20 odd of them, it's a hundred percent imported. The others, it's 50% or so imported. Various administrations, the Trump administration passed some legislation, the Biden administration, but then recently, the Biden administration says, "No, we're not too…," They didn't quite say we're not too worried, but they said, "We are going to try to talk to our friends of Canada and Australia to help us."

00:45:24 China Has the Driver's Seat in the Mineral Market – The Concern with Importing Minerals

Charles:

In the meantime, China has been all over the developing world agreeing to help develop their mines and so on with a proviso that they will allow them to be refined in China. So, even though they're not mined in China, China will have the minerals in the form that everybody else in the world will want. So, they're in the driver's seat. Well, there was an argument between Japan and China over a fishing boat, and it ended up with saying that the Chinese were going to deny sending rare earths to Japan. That created a panic for a while, and it's settled down, but that potential exists. You know, if the US and the Biden administration knows it, and right now, China's the biggest place we import from. The second most is Canada.

To me, Australia, if we try to get them to give us favored nations status, they will not send as many minerals to the Middle East – to the Far East, China will move in on there. So, it's not – getting the minerals from Australia to me doesn't make sense. Getting from China, but that's Canada's already doing that. Right now, people are making a lot about lithium and other things for electric vehicles. You know, when you get to a list that's as long as the list of the US, all mining needs to be a, you know, concern.

00:47:28 The US May Not Have the Minerals, But We Have the Technology

Charles:

Now, there was a friend of mine, he was the Home Secretary of the National Academy of Science, National Academy of Engineering. He's retired now, but he constantly said to me, "Remember, Charles, knowledge is power." His idea was, if the US stays in the front of technology, other countries will want to come to us because we'll be ahead of the game.

We may not have the minerals, but if we say we have the technology to develop those minerals in a way that is ahead of other countries, then we have a chance that they will be wanting to do business with us. So, I don't see any option really for competing with China on minerals, except on technology. I've been to the US, where we have trouble getting 10 or 15 students in a room. I've been to China, where it's a standing-room-only crowd of 200, 300 students. All mining students waiting to hear what you have to say. Yet, most of those Chinese students that got ahead were developed, and educated in this country. I think it's a good thing. I have nothing at all against China. I love the industrious and so on, but the question is, do we have to deal with the American economy and keeping Americans employed and so on. Now, as you know, the reality is that you're not going to employ many people in the mining industry. Currently, as you know, there's less than 0.1% of the US workforce [that] works in the mining industry.

Over half of that so-called mining industry is the construction, the construction materials industry, the quarries, and so on. So, the number right now, and if you look at what mining engineers advertise as the way that they work, they're showing your mines which have virtually no people in them. So, what's happening now is you're getting mines with almost nobody in them, but technology is running them. They're running from [technology], and I think that we sell ourselves short.

00:49:57 The Makings of a First Rate Graduate School is the Link Between Research and Industry

Charles:

The US graduate schools, research schools, are first-rate to graduate school. There's this bill that's just going before Senate now. The Manchin [Sen. Joe Manchin], somebody else bill. It's a Republican from, I think it's Barrasso [John Barrasso]. Barrasso-Manchin bill, and they're talking about giving money to get mining schools going back again. Well, you gotta be careful. Those are nearly all – there's the Colorado School of Mines. There's Penn State, West Virginia, and Arizona. There's three or four who are first PhD granting institutions and are very good. But, there are a lot of them that are small schools that never give anything above a master's degree. They're talking about, there were some early things in SME, some exchanges, "Oh, well, it's good to give some of that money – get the money and give it to the small schools". Be careful.

What is it you want to get out of that? What the National Science Foundation does is say, "We'll put $5 million a year into an engineering research center for five to 10 years, and, at the end of that 10 years, the group that's done that is able to go off and form their own company and lead the way." They have provisos in there that talk about how to bring along disadvantaged schools. Well, you can do that for the small schools as well. For example, it's not only R&D you need, it's professional master's programs that take in an engineer and say, "How do you get to know enough about research so that you can go and work at a mine and talk to the people about your problems, who are in research. Develop a linkage between those who speak the language of research. Pick two miners, those who do the research, and they can come from any discipline.

You know what we need now, like at ITASCA, I don't know how many mining engineers, very few. There are every grade of engineer, but they're all developing computer programs and so on. There needs to be a great deal of thought. I'm delighted that they're getting that money, but when I was looking back at some of the legislation to try to get policies for minerals in the United States, I couldn't believe my eyes when I saw that – this is a bit of a digression.

00:53:11 Establishing the RETC – How Government Policy and Funding Influence Mining R&D

Charles:

When the Cuban oil crisis, not Cuban oil, Cuban Missile Crisis came, they were concerned that missiles would be hitting Washington, D.C. A group of the Senate [sic], from the state department [US Department of State] said we've got to find a way to dig tunnels very much faster, 10 times faster than we can now to get the President and others into bunkers below Washington, D.C.

They have them now, but I'm talking about the 1960s. In 1964, the National Academy of Engineering was just being founded, and one of the standing committees that they established was the Standing Committee on Rapid Excavation. And, you wonder about that because it ended up leading to things like the RETC Conference, Rapid Excavation and Tunneling Conference, and it's gone on and on. But, the whole idea was to make a quantum jump in how fast you can excavate tunnels. That has not happened. Now, a lot of very good work - for example, you can go through tunnels now, have tunnels now that go through very bad ground where there's water seeping in and everything, and you get through it – you could never do that before. But, as far as speed is concerned, they haven't done it.

Now, there were, what's his name? I'm trying to think of Peterson, Carl Peterson. He was a mechanical engineer at MIT. The fellow who was in the AUA, now the American Rock Mechanics Association, together with Dick Robbins, we were all together in what we call NADET, the National Association for Drilling and Excavation Technology, and Carl Peterson was leading it. After about three or four years, RETC went out of business. We couldn't get a nickel from anybody in the industry to do R&D. That's why I've [been] saying that, and then I started looking at previous efforts; and, low and behold – and I've now copied it, and it's on the Fairhurst files – Pfleider was the first chairman. The man who hired me was the first chairman of the Rapid Excavation Committee for the National Academies, and he went before a minerals hearing committee and said that what they needed [was] over and above the money that was available – because that included the Bureau of Mines and others – an amount of money. Do you have the number there somewhere? It's amazing. Pfleider, how much he said, it was billions.

Charles Edward:

It was $150 million a year for 10 years.

Charles:

Right. That's what he said was needed.

Margaret:

1966.

Charles:

Now, think of how many years ago that is.

Margaret:

So, it was two, sorry Dad, just to correct. It was $200 million for 10 years and equivalent to one and a half billion, or 150 million a year for 10 years in 2022.

Charles:

Because he was proposing a 10-year program, and you know what it was for? To make underground mining more efficient so that there'd be less need for surface mining engineering; and, as surface mining engineering got to the limit of what they could do, they would be ready with much better underground mining techniques. Now, that's 1966. If you look at the Manchin bill, they don't even say what they're going to do with the money. But, it's less than about, I don't know, a tenth of that. So, that was the thinking then.

00:57:52 What I Have Learned Over My 75-Year Career in Mining

Margaret:

Following on from what you've said, and you've probably already answered it, what's one key message you'd like to share about what you've learned over your 75-year career?

Charles:

You want me to talk about mining? I've learned a lot of things. I'd like to say it is about mining because I came from a mining background. As I've said, with all of the shortcomings, there's not a finer bunch of people in the world that I would ever like to have been associated with than miners, and I don't care whether they're Greek miners or Irish miners or whatever. They experience difficult underground, difficult conditions day by day, and they're rough-spoken, and so on. But, when the chips are down, you can rely on them to help. They face tough situations, and they do it without a need for applause or recognition. So, as far as that part of the career, I have always met first-rate people dealing with mining. What do you want to know? What would I want to do?

What I would love to see, and, as I think I said before, at the 2015 Denver SME Conference, the moderator – who was Peter Bryant, who then said, "Mining is broken. We need a new template." And,

he's formed the Development Partner Institute for mining together with the CEO of Anglo American, [plc] Mark Cutifani, who is saying that the industry absolutely needs R&D. But, we owe it to miners, there are a lot better ways to do things. And, the interesting thing is how are you going to justify to a place opening up a mine if you tell them, well no, there's not going to be many people working there. To be honest, there's not. How are you going to get them to process, to find out where you can make the money and make big for a community? It's going to be probably in the processing, it's going to be in the other – so we've got to think.

01:00:38 The Support of My Wonderful Wife – Building a Community & Bonding Students Together

Margaret:

The support you get around your career has largely, in the last 10 years or so, probably come from your children doing our best, and there's seven of us. Getting you to the airport, getting you things, dry cleaning, helping you out, wherever we can. But, before that point, there was our mother, and she's still alive but not as able to help. I wanted you – because at every talk I've ever seen you give, and I am certain Charles has seen the same thing -- you always mention mother.

Charles:

And you recognize her support.

Margaret:

You recognize her support, and I think I just wanted you to talk a bit about that.

Charles:

As you know, your mother is quite a wonderful woman.

Charles:

When we got married, she - first of all, she wanted to have a large family, but then she also saw things happening when, as we were students, as we said, from around the world. That these students and their families were coming sometimes – didn't have much money or whatever. They were married and had small children, but she took it on herself to get to know them, invited them to parties here, as you know, and find out what she could do to help.

Charles:

She had you alongside at the parties, and she built a community. That's what these students in this book, The Long Shadow you find that they're always talking about those parties and how it bonded everybody together. The thing that impressed me very much was when I heard a number of my former students giving a talk, like Jean Claude Roegiers in particular, he would say, "Before I conclude, I want to say thank you to some people who have influence me in my life, my graduate life, more than anyone." And, he always said, "Margaret and Charles Fairhurst," he never said my name first; she was there. You know, they were coming to a strange land. They didn't know things and so on, but without your mother, we wouldn't have had the people to write in The Long Shadow or what they write. If you read that book,

you'll see in it constant references to how – I remember another incident, was just a while ago.

01:03:24 The Brown Bread Story – An Anecdote of My Wife and Students

Charles:

I was thinking about the German student, and your mother wasn't trained to cook or anything. You know, first marriage, she just always had a housekeeper. But we were in the house when we were having a party with some of the students, and it was just after we were married. She made some brown bread, but when it came out of the oven, it hadn't risen. It was like a solid rock in my view, and she said, "What am I going to do? What am I going to do? I've got this bread, and it looks like this." So, I said, "You're all right. Just cut it as thin as you can, slice it, and leave it there. It'll be all right," and I said, "They'll eat it. They are grad – they're students. They won't say anything about it." Wolfgang Waversik came to me, came to Margaret after. As you know, Wolfgang was a very precise, gentlemanly person. But, he said, “Mrs. Fairhurst, I hope you don't mind me asking, please, but would you mind giving me the recipe for the brown bread? I have never tasted such excellent bread since I left Germany." So, she had to, we had to, cough up after a while. But there were so many incidents like that, and they became close personal friends. It was a wonderful experience, the career. You know that the thing I would love more than anything else right now is to be able to get up and go off in the car and drive mother somewhere and just have dinner together.

01:05:14 Final Words – Reminiscing My Remarkable Career & Excitement for the Future of Mining

Charles Edward:

So, Dad, thanks so much for sharing the stories about your career and everything with us. I think it'll be very useful for future generations to hear your stories and your career.

Margaret:

Yeah, Dad, I'd just like to say thank you. I mean, career-wise, it's just amazing to have this record, and for you to have taken that time and your recollection to me is always amazing. I don't know that I know anybody else that can pull out acronyms and just define them at any age, the way you can in your nineties. So career-wise, thank you. But, on a personal note, as your daughter, and I'm sure Charles [too], it's just great to have this opportunity. I don't think there's many families that get to do this kind of an interview of their father or mother, or parent. So, thank you very much.

Charles:

Well, thank you. Thank you both, and thank you, too, for taking the time. It's something I didn't have an idea of how it was going to go or what, and putting many different ideas, thinking about many. It made me reflect on a lot that I hadn't really given much thought to. And, even though I'm 93, I'm still going to write a paper and still hope that somebody might read it to say that mining is essential. It's a worthwhile endeavor, and it faces uphill battles just to tell the truth. I hope we will keep doing it and hope the young people will be influenced by that. It is, believe me, absolutely essential to the future civilization of the world. I remember listening to the astronauts that took the pictures of Earthrise. The first picture ever taken – seen of the Earth from outer space.

And they said, "We came up here to discover the moon, but we discovered more about Earth." So, that's where we all have to be. We're all on this planet together. So, our journey together has been wonderful, and you have both – you're the two who have been closest to it, although David being with petroleum, SPE, has also been in it. But I'm very proud of all of you. I think it's been a marvelous experience, and thank you both. Thank you to AIME. And, thank you also to Nic Trivedi, whom I learned, I'm not exactly sure by what route, but I learned that he was the one that proposed [it]. I look forward to seeing it. It's a very high honor. Thank you all very much. Thank you two.