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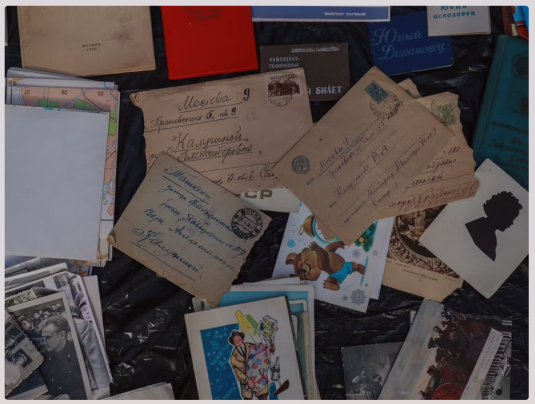
A Journey Beyond Borders

My Memoir of the 1975 Summer Institute in Quantum Chemistry, Solid State Physics, and Quantum Biology

Zahid H Khan

In 1975, shortly after submitting my Ph.D. thesis in Physics at Aligarh Muslim University, I found myself at a meaningful crossroads. With curiosity in my heart and time at my disposal, I came across an advertisement in a scientific magazine in the departmental seminar library about an "International Summer Institute in Quantum Chemistry, Solid State Physics, and Quantum Biology," to be held in Sweden and Norway.I applied by postal mail—an era when Air Mail envelopes and weeks of waiting defined global communication. Several weeks later, I received an acceptance letter from the organizers of the Summer School, awarding me a SIDA Fellowship. The fellowship covered all my travel expenses within Scandinavia. I only had to initially arrange funds for my air ticket, which would be reimbursed later. With support from my father, I arranged the funds and acquired a passport, an arduous task at the time, made possible through the help of a relative in Lucknow, whom I luckily met at the airport.

My confirmed ticket from Delhi to Stockholm had multiple layovers: Delhi – Kuwait – Cairo – Copenhagen – Stockholm. The return journey was rerouted as Oslo – Copenhagen – Delhi by the Summer Institute's official travel agent to make it more efficient. I applied by postal mail—an era when Air Mail envelopes and weeks of waiting defined global communication. Several weeks later, I received an acceptance letter from the organizers of the Summer School, awarding me a SIDA Fellowship. The fellowship covered all my travel expenses within Scandinavia. I only had to initially arrange funds for my air ticket, which would be reimbursed later. With support from my father, I arranged the funds and acquired a passport, an arduous task at the time, made possible through the help of a relative in Lucknow, whom I luckily met at the airport.



Communication in the 1970s required patience and physical mail -- a stark contrast to today's instant connectivity.

Application

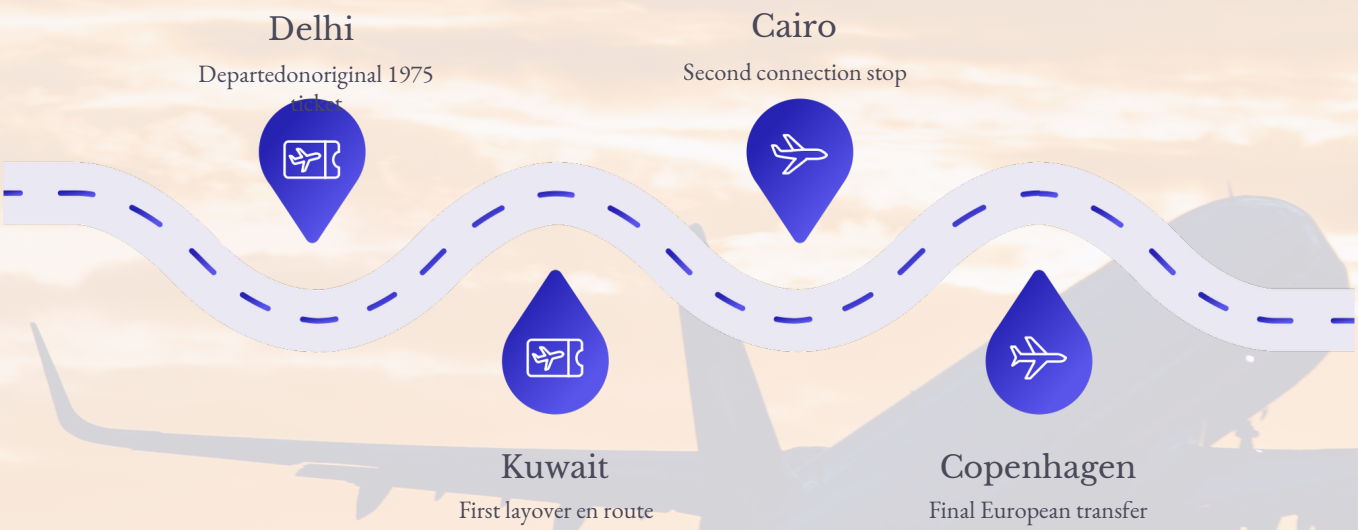
Applied via postal mail for the International Summer Institute.

Acceptance

Received a SIDA Fellowship covering all Scandinavian travel expenses.

Preparation

Arranged funds with father's support and acquired a passport.



At Copenhagen airport, I was the last passenger to board the connecting flight to Stockholm—my name echoed through the terminal. Unfortunately, my suitcase did not make it. After reporting the loss, I boarded the underground train and waited for a taxi. An elderly lady offered to share the ride, though it later turned out our destinations were different. The taxi driver, understanding my confusion, not only arranged another taxi for me but said words that still echo in my heart: *"Gentleman, since you are coming to this country for the first time, I will not charge you."*

The next morning, I boarded a train from Stockholm to Smedjebacken. The rail ticket had already been sent to me by post—another thoughtful gesture by the organizers.

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Smedjebacken: A Gentle Beginning

Our journey began with a warm welcome in Smedjebacken, a picturesque Swedish town. Participants had come from across Europe, South and West Asia, and the Asia-Pacific. Professor Per-Olov Löwdin and his trusted Ph.D. student, Dr. Michael Hehenberger, greeted us with genuine warmth.

At the formal welcome ceremony, the town's Mayor greeted each participant and presented with a red wooden horse—a traditional Swedish souvenir. A visit to a nearby farm gave us a taste of Swedish rural hospitality: fresh milk, bread, honey, and, unexpectedly, a personal library—leaving us to reflect on the cultural values often lacking in rural communities back home.

Professor Löwdin and his wife Karin hosted us at their riverside ancestral home. We marvelled at his horses, personal boat, and above all, his pride in winter horse-riding on frozen rivers—a passion he claimed made him the only quantum chemist in Sweden to do so! The evening was filled with joyful dancing, deep discussions, and unforgettable Swedish cuisine.

Dr. Michael Hehenberger was a model of care and efficiency. He ensured that each participant felt welcome and looked after. Both he and Professor Löwdin would personally visit our motel, checking if we had letters to send home. Their humility left an indelible mark on all of us.

Professor Per-Olov Löwdin: Architect of Global Quantum Discourse

Professor Löwdin was a towering figure in quantum science. He held dual appointments as professor—at Uppsala University in Sweden and as Head of the Quantum Theory Project at the University of Florida, Gainesville. He founded the International Journal of Quantum Chemistry and edited the prestigious series *Advances in Quantum Chemistry.* He also served on the Nobel Committee for Physics—a position of great influence.

Uppsala University: The Academic Heart of the Institute

The Summer Institute's academic programme began at Uppsala University. Professor Löwdin

Smedjebacken
(Credit: https://www.smedjebacken.se/)

opened with a chalk sketch of a tree—its roots were curiosity, its trunk science, and its branches the disciplines of physics, chemistry, and biology. At the canopy, he drew their convergence.

He explained the inclusion of Quantum Biology in the Summer Institute's scope with prophetic words: *"Man has explored the Earth and the sky but not yet understood himself. The 21st century will be the century of biological sciences."*

While discussing the organization of the International-level Summer Institute—held regularly over many years—Professor Löwdin spoke of the immense effort it required. He emphasized the need for strong connections with relevant ministries in the Swedish Government to ensure its continued success.

In an informal conversation, Professor Löwdin also confided that initially certain scientists had deliberately avoided citing his research in their publications. To counter this, he assembled a team of scholars who would refer his work in their own publications, helping to establish its visibility within the international scientific community. At the time, we were too young to fully grasp the implications, but as we matured, we began to recognize similar type of professional jealousy and disregard among scientists in our own countries as well.

Löwdin's lectures—delivered without notes, using only chalk and a blackboard—were intellectually profound and conceptually seamless. In the span of an hour, he would cover multiple blackboards with intricate derivations. From elegant treatments of Schrödinger's equation to the complexities of many-body theory and

Group Photograph of Participants in the1975 Summer Institute, University of Uppsala, Sweden. (Credit: Uppsala Quantum Chemistry Group)

Teaching Excellence

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Advanced Topics

From elegant treatments of Schrödinger's equation to the complexities of many-body theory and quantum coherence, the clarity and sophistication of his thinking were truly captivating.

Innovative Approaches

A memorable highlight was his original derivation of Schrödinger's equation based purely on algebraic principles4 an innovative and intellectually stimulating approach that left a lasting impression on the audience.

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In his sessions, Professor Löwdin explored advanced topics such as orthogonalization techniques, extended Hartree-Fock theory, and density matrix methods. A memorable highlight was his original derivation of Schrödinger's equation based purely on algebraic principles—an innovative and intellectually stimulating approach that left a lasting impression on the audience. He also ventured into philosophical reflections, addressing the nature of objectivity and the foundational concepts underpinning quantum theory.

Distinguished Faculty and Inspiring Lectures

Prof. Löwdin maintained high standards when selecting lecturers for the Summer Institute. He explicitly stated that applicants should consider applying only if they were proficient in both mountaineering and soccer.

Thus the Summer Institute featured the following extraordinary lineup of scientists:

Prof. Jean-Louis Calais

Associate Director of the Institute and Professor of Quantum Chemistry at Uppsala. His lectures offered a clear exposition of molecular orbital theory and group symmetry, illustrating how symmetry principles streamline the analysis of electronic structure.

Prof. Ruben Pauncz

A theoretical chemist from the Technion, Israel, Pauncz was well-known for his group-theoretical insights. His lectures focused on the construction of spin eigenfunctions and the use of unitary group methods in configuration interaction (CI), essential for handling electron correlation efficiently.

Prof. Osvaldo Goscinski

A key figure at Uppsala, Goscinski delivered incisive lectures on Green's function methods, electron correlation, and relativistic quantum chemistry, emphasizing their relevance to accurate electronic structure calculations.

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Prof. Yngve Öhrn

Then at Uppsala (later at the University of Florida), Öhrn lectured on molecular collisions and time-dependent quantum mechanics. He demonstrated how propagator techniques capture many-body dynamics and underpin scattering theory.

Prof. Herbert Jehle

A distinguished theoretical physicist from George Washington University, Jehle's lectures at Dalseter focused on **quantum biology,** where he explored the application of quantum principles to biological systems. His talks uniquely combined scientific depth with a philosophical perspective, offering a broader context to the Institute's themes.

Rhythms of Uppsala: Where Science Met Sport

While the lectures at the Summer Institute were intellectually demanding and deeply enriching, the daily routine at Uppsala also reflected Professor Löwdin's holistic vision of learning—one that embraced physical activity, nature, and informal interaction as essential elements of the scientific life.

Each afternoon, after lunch, Professor Löwdin himself would enthusiastically invite both participants and lecturers to play soccer. His energy and openness erased all formal boundaries. Scientists from different countries and disciplines could be seen chasing the ball with equal zeal under the afternoon sun. It was as if quantum chemists, theoretical physicists, and biologists found a common "field"—literally—to bond and relax.

The daily soccer match became a beloved ritual, remembered not just for its playfulness but for the easy camaraderie it fostered. It gave younger participants a chance to connect with world-renowned faculty on equal footing (sometimes quite literally), and added a joyful rhythm to the academic schedule.

Per-Olov Löwdin leading a soccer team including lecturers: (L-R) Osvaldo Goscinski, Sam Trickey, Piet Phariseau, Jean-Louis Calais, and Ruben Pauncz. (Credit: Michael Hehenberger)

Cultural Encounters in Stockholm: Science, History, and Heritage

Beyond the academic rigor of the Summer Institute, the organizers ensured that participants were also given a taste of Sweden's rich cultural and historical heritage. One of the most memorable excursions during our time in Sweden was a visit to the Stockholm Concert Hall, the iconic venue where the Nobel Prize ceremonies are held each year on December 10th. Standing in that grand and solemn hall—where some of the greatest scientific minds in history had received the world's most prestigious honour—was an emotional moment. It felt symbolic: a quiet reminder of the ideals of excellence, perseverance, and global recognition that every young researcher aspires toward. For many of us, it was not just a building, but a temple of inspiration.

Another unforgettable visit was to the Vasa Museum, where we saw the legendary Swedish warship Vasa. Built between 1626 and 1628, the warship tragically sank just 1,300 meters into her maiden voyage on 10 August 1628. For centuries, the wreck lay forgotten beneath the waters of Stockholm harbour until it was miraculously rediscovered in the late 1950s and raised in 1961, with much of its original structure preserved.

We were deeply moved by the story of the Vasa—its ambitious engineering, tragic fate, and eventual resurrection. Seeing the massive, ornately decorated hull—now housed in the remarkable Vasa Museum in the Royal National City Park—was like stepping into a portal through time. The ship's story, much like the unfolding story of science itself, spoke of human ambition, fallibility, loss, and redemption.

Swedish Warship "WASA" – sank in 1628; raised in 1961. (Source: Printed Postcard; personal collection)

These visits were not simply sightseeing—they were reflections on human achievement and humility, intertwined with the scientific and philosophical discussions we were immersed in during the Institute. They offered perspective: that while we explore the laws of nature, we also carry the responsibility of learning from history.

Dalseter: Where Ideas Climbed Mountains

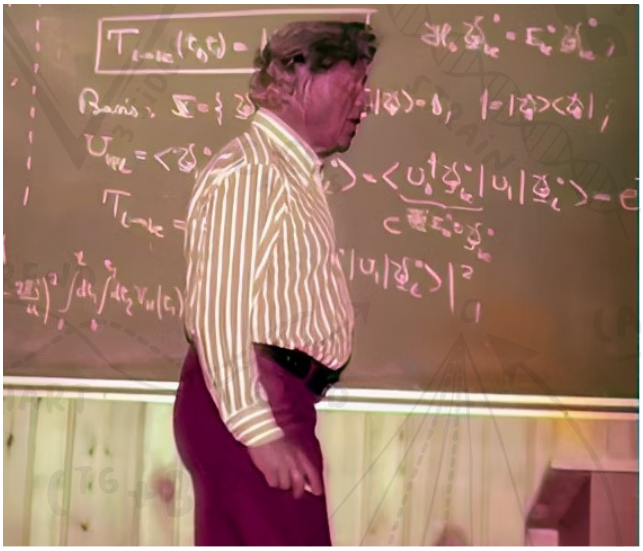
Our journey into Norway was smooth and scenic. Crossing the border by bus, we encountered no visa formalities—a relief that mirrored the serene Nordic landscape. Our destination was the picturesque Dalseter Høyfjellshotell, nestled high in the mountains.

Each morning, the lectures began sharp at 8:00 AM, in keeping with Professor Löwdin's unfailing punctuality. His sessions were followed by a series of enriching talks from other distinguished professors, running until around 4 PM, with a break for lunch. The academic atmosphere was intense, yet deeply stimulating.

At Dalseter, we were joined by the esteemed Professor Herbert Jehle, whose reflective lectures on quantum biology and the symmetry inherent in living systems added a philosophical depth to the program. His calm demeanour and profound insights left a lasting impression on many of us.

A particularly engaging session involved cultural presentations by the participants. Some spoke eloquently about their homelands, while others enhanced their talks with photographs or slide projections. It was a vibrant celebration of global diversity and scientific camaraderie.

Wednesdays were reserved for hiking in the surrounding mountains. Participants could borrow hiking kits, while others opted for leisurely walks to absorb the beauty of the local scenery—verdant trails, fresh alpine air, and panoramic views that seemed to mirror the heights of intellectual discourse we experienced indoors.



Per-Olov Löwdin delivering a lecture in a Dalseter Hotel Lecture Hall. (Credit: RK Hosur)

Dr. Michael Hehenberger: A Lifelong Bond Forged in Science and Kindness

Among the treasured recollections from Dalseter, one remains especially vivid—an enduring symbol of warmth and quiet generosity. Acting on the advice of a mentor from home, I found myself needing a *portable typewriter* and a dependable *travel suitcase.* To my profound gratitude, Dr. Michael Hehenberger graciously offered to drive me to a distant shopping centre, ensuring I secured what I needed. That humble typewriter went on to serve me faithfully for nearly two decades, becoming an indispensable companion in my academic journey.

His act of kindness transcended mere professional courtesy. It reflected a rare spirit of empathy and human connection, leaving an imprint that I carry to this day.

To my great joy, nearly half a century later, I reconnected with him. In a gesture as generous as it was meaningful, he shared several heartfelt articles written in memory of Professor Per-Olov Löwdin, with whom he had been closely associated for ten years, affectionately referring to him as his *'lost father'*. I remain truly indebted to him for allowing me to include the evocative photographs he captured during the Summer Institute—images that now lend visual life to these recollections.

This story would remain incomplete without mentioning Dr. Hehenberger's personal impressions about Professor Löwdin (POL), under whose supervision he completed his Ph.D. at Uppsala University in 1975. In his article, *"Per-Olov Löwdin's Impact on a Lost Son"* published in *Advances in Quantum Chemistry, Volume 77, 2018,* Dr. Hehenberger has noted that:

- POL prepared his students for competitive life, both inside and outside academia.
- He trained them to present topics of great complexity succinctly, insisting: *"You must be able to explain something in 10 minutes—and do it convincingly."*
- He gave assignments and spent his valuable time checking their progress.
- He attracted first-rate scientists to his seminars and symposia.
- He encouraged students to be bold and tackle difficult problems, while reminding them that *"bread and butter"* work was also essential.
- He emphasized an *"economy of thinking"*, valuing "fat symbols" and linear algebra for their conceptual power.

The profound influence of POL shaped Dr. Hehenberger's remarkable career trajectory. After completing his Ph.D., he spent two years (1975–77) at the University of Florida, first as a Postdoc and then as Visiting Associate Professor. Following research roles in materials science at Sandvik Hard Materials, Stockholm, he joined IBM Sweden in 1985, pioneering academic partnerships in computational chemistry, biology, structural engineering, computer networks, and supercomputing.

In 2000, IBM recognized Life Sciences and later Information-Based Medicine as strategic growth areas, with Dr. Hehenberger leading initiatives in these fields globally. His 23-year tenure at IBM took him to Paris (IBM Europe), California (Almaden Research, San Jose), and New York, where he led collaborations with academic and industrial life sciences organizations worldwide. He authored around 50 publications and book chapters, and his first book, *"Nanomedicine: Science, Business, and Impact,"* was published by Jenny Stanford Publishing in 2015.

Michael Hehenberger – Uppsala, Sweden (1975). (Credit: Michael Hehenberger)

After retiring from IBM in 2013, Dr. Hehenberger founded HM NanoMed LLC, a biotechnology company focused on advancing healthcare through nanotechnology, including writing, organizing conferences, and research in nanomedicine and genomics.

His remarkable achievements reveal the enduring influence of his most valued mentor, Professor Per-Olov Löwdin, whose guidance shaped his intellectual rigor, professional leadership, and unyielding commitment to advancing science for human benefit.

The Summit of Dedication: Galdhøpiggen and Bygdin Lake

When in Norway, Professor Löwdin was not only teaching quantum chemistry but also leading mountain climbs. Michael assisted him in guiding Summer Institute participants to the summits of several mountains, including Galdhøpiggen, the highest peak in Scandinavia.

Left Photo: *Per-Olov Löwdin (POL) immersed in the group of students at the Galdhøpiggen Peak, Norway in the summer of 1975.*
Upper Photo: *POL posing alone at the Galdhøpiggen Peak.*
(Credit: Michael Hehenberger)

Boat ride across the Lake Bygdin, Norway (Credit: RK Hosur)

During the last phase of the Summer Institute, the most exciting and symbolic moment came when Professor Löwdin led a group of enthusiastic participants to climb the snow-clad peak of Galdhøpiggen. The mountaineering team had a long and challenging trip but ultimately reached the summit.

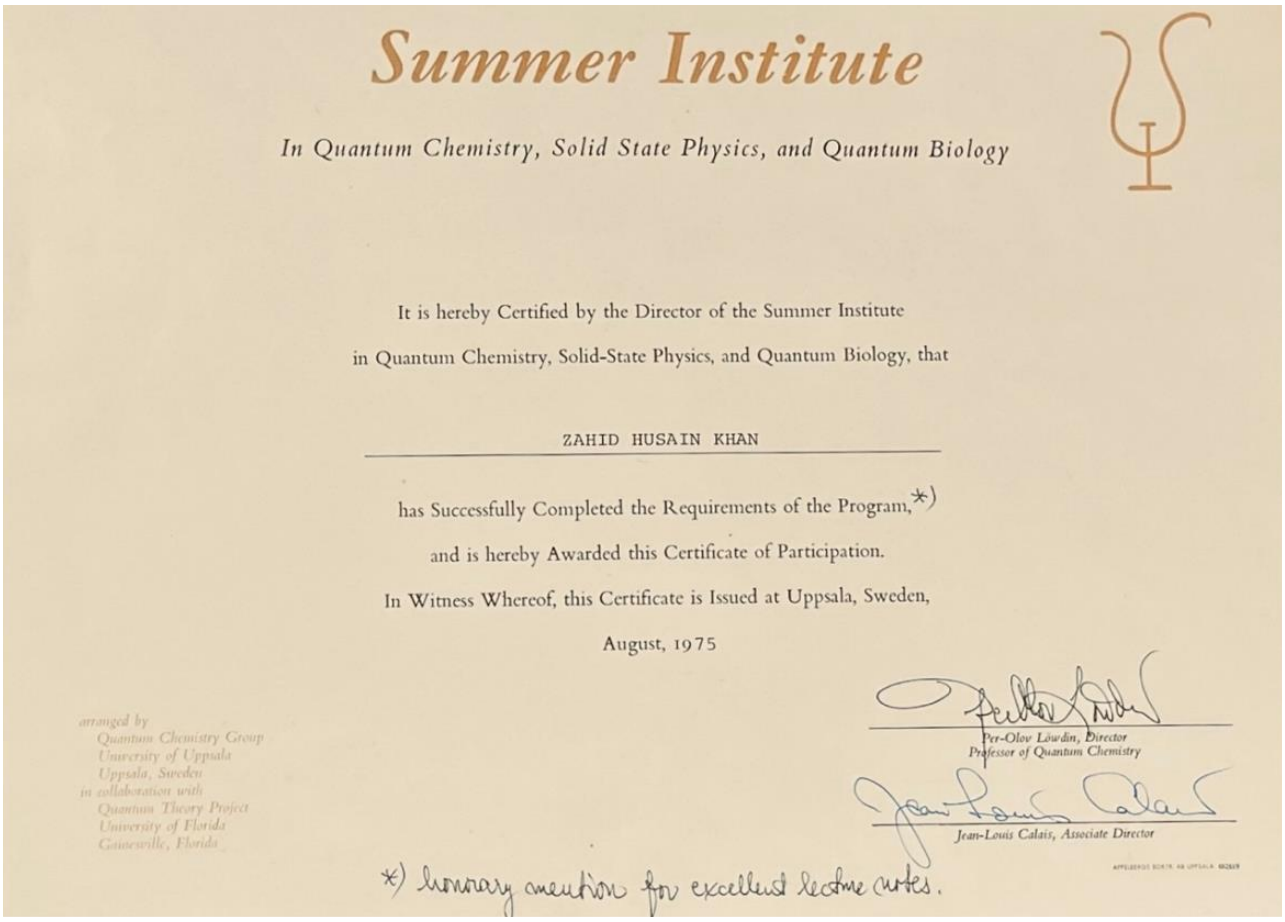
We learned the next morning that the entire team had returned to Dalseter Hotel after 2:00 AM. Incredibly, Professor Löwdin was in the lecture hall at 8:00 AM, as energetic as ever, ready to continue his teaching with undiminished dedication.

Others, myself included, chose a scenic boat ride across Lake Bygdin in Jotunheimen National Park—a tranquil experience amidst towering fjords. We took the last boat ride and reached the hotel in the evening.

Farewell from Dalseter: A Lasting Souvenir

After spending three weeks at the Summer Institute in Dalseter, the final day arrived. On the evening of 31 August 1975, we boarded the bus to Oslo International Airport, each departing to their respective countries. Among the mementos of this journey, the souvenir presented by Dalseter Høyfjellshotell remains with me even after fifty years, forever refreshing the sweet memories of Norway's majestic beauty and the warm, friendly environment of the Summer Institute.

Souvenir from Dalseter Høyfjellshotell



Summer Institute

In Quantum Chemistry, Solid State Physics, and Quantum Biology

It is hereby Certified by the Director of the Summer Institute
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ZAHID HUSAIN KHAN

has Successfully Completed the Requirements of the Program,*)
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In Witness Whereof, this Certificate is Issued at Uppsala, Sweden,
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Per-Olov Löwdin, Director
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Jean-Louis Calais, Associate Director

arranged by
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in collaboration with
Quantum Theory Project
University of Florida
Gainesville, Florida

*) honorary mention for excellent lecture notes.

Legacy and Gratitude: A Tribute to Löwdin

Years later, I fulfilled a quiet dream—to publish in *The International Journal of Quantum Chemistry.* My 1992 research paper, ***"A Theoretical Study of Electronic Spectra of Radical Cations of Some Dihydroxynaphthalenes,"*** found its place there and published in its Vol. 42, pp. 1717–1735, after careful expansion of the theoretical section, in true spirit of the journal, following the comments of the editor.

Looking back, I now wish I had dedicated it to Professor Löwdin. But as 2025 marks the **International Year of Quantum Science and Technology,** I take this opportunity to posthumously dedicate that work to him, with gratitude and admiration.

The most cherished souvenir of that journey is my **Certificate of Participation,** signed by Prof. Löwdin himself—with a handwritten note: *"honorary mention for excellent lecture notes."*

It is a personal treasure, preserved for five decades.

Epilogue: A Journey Etched in Time

As the world marks a century of quantum mechanics, I reflect on the Summer Institute of 1975 not merely as a scientific event, but as a defining chapter of my life. It shaped my intellectual perspective, sharpened my research aspirations, and broadened my global scientific connections.

To Professor Löwdin, whose visionary leadership made it all possible; to the distinguished faculty, for their illuminating insights; and to Dr. Hehenberger, for his enduring kindness—I extend my deepest gratitude. ◆

Dr Zahid H Khan *is an advisor at the Zaheer Science Foundation in New Delhi and a former Professor of Physics at Jamia Millia Islamia, a Central University in New Delhi. He can be reached via email at zhkhan1948@yahoo.com*