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## Obituary Wolfgang Rothenstein 1923–2003



Dr. Wolfgang Rothenstein, Professor of Nuclear Engineering at the Technion, Israel Institute of Technology and nuclear reactor physicist, died in Haifa, Israel on Wednesday, 19 March 2003.

Dr. Rothenstein was born in Amsterdam on 2 June 1923. In May 1940 the Rothenstein family was evacuated to England as British subjects, narrowly escaping the Nazi occupation of Holland. Dr. Rothenstein received his higher education in London. He received his BSc in physics in 1948, an MSc in mathematics in 1950 and a PhD in theoretical physics in 1956, all from the University of London. Dr. Rothenstein served as Instructor and Lecturer at Battersea Polytechnic Institute from 1948 to 1957.

Dr. Rothenstein's career as nuclear reactor physicist began with his appointment in 1958 (through 1959) as a Post-Doctoral Research Associate in the Reactor Physics Division at Brookhaven National Laboratory (BNL). During his career Dr. Rothenstein returned to BNL many times, as a visiting scientist with the National Nuclear Data Center during sabbatical years and, later, as a guest scientist in the Department of Nuclear Energy. The research activities that he participated in, and the relationships he established during his 3-year post-doctoral appointment at BNL, laid the foundation for a 45-year career as a nuclear reactor physicist and as an educator.

As a participant in the program in theoretical reactor physics and computations in the BNL Reactor Safety Division led by Dr. Jack Chernick, Dr. Rothenstein's post-doctoral research activities included reactor physics calculations for the BNL High Flux Beam Reactor, Monte Carlo physics calculations, and development of methods

for collision probabilities and resonance integral calculations. He performed reloading calculation analysis for the Brookhaven Graphite Research Reactor and developed methods for resonance capture of neutrons in reactor materials. Dr. Rothenstein continued to make contributions to many of these areas of nuclear reactor physics during his entire subsequent career.

Immigrating to Israel in 1960, Dr. Rothenstein joined the Technion-Israel Institute of Technology, where he became Full Professor of Nuclear Engineering in 1971. He served as Chairman of the Nuclear Engineering Department from 1972 to 1974, and retired in 1991. From 1991 to 2003 he was Professor Emeritus at the Technion, and was guest scientist at BNL from 1992 to 2003.

In collaboration with his students, with colleagues at laboratories and universities in many countries, and with colleagues at the Israel Electric Company and the Electric Power Research Institute (EPRI), Dr. Rothenstein pursued his long-term interest in analysis of resonance interactions of neutrons in nuclear reactors. This interest led him in the direction of methods development for resonance absorption and scattering in lattice geometries,<sup>1</sup> to involvement in benchmark calculations<sup>2</sup> and nuclear data testing and use, and to integrated reactor physics calculations using Monte Carlo computer codes. Since his retirement, Dr. Rothenstein pursued his interest in neutron resonance interactions, and developed a mathematical method to characterize the temperature-dependence of neutron scattering, including the effects of upscattering, in ideal gas media.<sup>3</sup>

During his last return visit to BNL in 2002, Dr. Rothenstein began to extend his research to characterize neutron scattering in crystal lattices, and to incorporate quantum-mechanical effects into the mathematical model.<sup>4</sup> As always he used this visit to BNL to consult with colleagues on technical matters, and to maintain friendships he and his wife, Miryam, established over a period of 45 years.

Dr. Rothenstein is survived by his wife, Miryam, three children—Edna Wigderson, Arnon Regev and Daniel Rothenstein, and eight grandchildren. All reside in Israel.

Theodore Ginsberg  
*Brookhaven National Laboratory, Long Island, USA*

## **From the Editor**

Wolfie Rothenstein made many friends over the years. He was admired for his contributions to reactor physics and much liked for his gentleness and kindness. We

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<sup>1</sup> Rothenstein, W. 1980. Resonance absorption calculations in thermal reactors. *Progress in Nuclear Energy*, 5, 95–144.

<sup>2</sup> Barhen, J., Rothenstein, W. 1979. Thermal reactor benchmark calculations using resonance profiles. *Symposium on Nuclear Data Problems for Thermal Reactor Applications*, EPRI-NP-1098, 20, 1-13, Electric Power Research Institute.

<sup>3</sup> Rothenstein, W., Dagan, R. 1995. Two-body kinetics treatment for neutron scattering from a heavy Maxwellian gas. *Ann. Nucl. Energy*, 22(11), 723-730.

<sup>4</sup> Naberejnev, D. G. Argonne National Laboratory, Personal Communication (May 2003).

could have filled this issue of the journal with personal tributes but have settled for the five below which cover various phases of Wolfie's life. We are indebted to Miryam, Wolfie's wife of nearly 50 years, for providing background information about Wolfie. We extend to her and her children our deepest sympathy and we all grieve with them on the passing of a fine man.

M.M.R Williams

### **Reminiscences of Wolfie from a few of his friends and colleagues**

From Noel Corngold  
Pasadena, USA

Brookhaven Township, Eastern Long Island, late 1950's. Ducks and deer, cabbages and potatoes, poor pines and curious roads. Dominating the township is Brookhaven National Laboratory, born as Camp Upton, (Civil War Major General Emory Upton) the camp having been built to train soldiers for the two World Wars. To this backwater, in 1957, came Wolfgang and Miryam Rothenstein, Wolfie from London, from wartime adventures in India, from a Continental childhood, Miryam from the new state of Israel. What an invigorating addition to BNL and its Reactor Theory Group (the Yaphank Philosophical Society)! Indeed, Wolfie remarked once that he was related, distantly, to Sir John Rothenstein, author of "Modern English Painters" and sometime director of London's Tate Gallery. Since Sir John was a friend of T.E. Lawrence, think of an imaginary meeting over drinks ... Lawrence, Miryam, Wolfie and Sir John.

Wolfie's London doctoral thesis research, under the auspices of the distinguished theorist HSW Massey, was concerned with the scattering of electrons from molecules, treated via the second Born Approximation. I've often wondered whether the burden of calculation to get his results was responsible for the phrase "soul-destroying algebra" he introduced into our coffee-discussions. Perhaps his aversion to that sort of grinding led him to embrace new, computer-based techniques as they appeared. And he did, for Wolfie *loved* Monte-Carlo.

At Brookhaven Wolfie quickly became interested in resonance capture in reactors, a topic rich in physics, and central to the group's activities at the time. Close interaction with Jack Chernick and John Sampson yielded several research papers, and the subject of resonance integrals in reactor lattices remained a favorite throughout his career. Throughout, his work was characterized by concern that one was doing the physics right. One of our last discussions concerned the incorporation of the full, temperature-dependent scattering kernel into a program designed to calculate Doppler effects very well indeed.

The Rothensteins' first stay at Brookhaven was brief, but merely the beginning of a life-long and loyal connexion. Wolfie and Miryam returned to the US many times, for shorter visits, as he assumed the role of consultant. We, in California, knew they had returned when a late night 'phone call in summer would bring Wolfie's distinctive and elegant voice. As we both became increas-

ingly deaf our conversations became increasingly bizarre—but that was beside the point. Throughout, we traded family news, from the distant past when our first-born daughters crawled together to present celebration of grand-children. Occasionally, the Rothensteins, being determined and fearless travelers, would visit California. Not too long ago they were in Long Beach for a conference and agreed to meet in Pasadena for dinner. At about 11 am of the designated day we answered a knock at our door to find Wolfie and Miryam, smiling and happy. Oh they knew that they were 7 h early; they had merely made the complicated, 25 mile journey “for practice”. They had succeeded. After a few minutes’ chat they departed, to return at the appointed time. Their friendship was a treasure.

From Mike Milgram  
Deep River, Canada

There is an old Yiddish expression: “Er darf vissen fon vannen die fiess vachsen” which, though losing much, loosely translates as “He’s got to know how it works”. It is usually applied to an inquisitive child, but, in the case of “Wolfi” Rothenstein, it is the most succinct, yet accurate description I can conceive of. For Wolfi was curious; like a child he always wanted, needed, to understand thoroughly the details of whatever phenomenon had caught his fancy. His child-like enthusiasm was infectious, his smile contagious, and his resolve unwavering. I always admired that resolve; on his many visits to North America, he would crisscross the continent in order to consult with the one expert who might be able to shed light on whatever piece of the physics puzzle had captured his interest. Every 2 or 3 years he would make the trek to Chalk River to commune with Don Craig, and present a seminar that was always a model of clarity. At his home in Haifa, he positively glowed with enthusiasm for his city, his country and his beloved Miryam. His emailed communications always abounded with details of his family, children and grand-children, his latest battles with the computer and the latest report about his research. He and I shared a common birthday, and, although separated by quite a few years, he faithfully, and gleefully, sent me annual greetings, with a note describing his celebratory plans. This coming June would have seen Wolfi’s 80th birthday, a day which he had long anticipated, and a day which he was never destined to enjoy. He will be missed, for his science, for his enthusiasm and for his smile.

From Mike Williams  
London, UK

W. Rothenstein was a name that arose time and time again when, in the period 1958–1961 as research student at Queen Mary College, London University, I was working on my PhD and studying a number of topics in reactor theory. One such was resonance absorption and the name Rothenstein was linked with those of Chernick, Sampson, Vernon, Dresner and Corngold. I was

particularly taken with the work on collision probabilities which as a young man had always fascinated me and indeed still does. Rothenstein was in the forefront of the development of practical methods for obtaining these and deploying them in resonance escape probability calculations. So by 1960 I was very conversant with the work of W. Rothenstein although I had never met him. I came closer to the man when I was a Research Associate at Brookhaven National Laboratory in 1962 where Wolfie had done some of his seminal work, but it took another 23 years before I actually met him. This came about because in 1985 Wolfie had a sabbatical and was exploring the possibility of taking it in London at Queen Mary College to which, after many adventures, I had returned. He and Miryam arranged to visit the College to meet me and presumably see if I would be suitable company for Wolfie. They came to lunch and stayed for tea. We immediately struck up a rapport and it was soon arranged that Wolfie should spend his sabbatical with us. I was very fortunate, indeed my Department was very fortunate because Wolfie entered into the spirit of the College wholeheartedly. Of course looking back at his career this was not surprising because before going to Brookhaven and then to Israel, Wolfie had been a lecturer in physics at Battersea Polytechnic which was later to become the University of Surrey. He left there in 1957 so was familiar with the British University tradition of a senior common room where academics from all disciplines; law, science, engineering, arts, history, etc all met and exchanged views. I think he enjoyed it immensely, we certainly enjoyed having him there. In fact the senior common room provided Wolfie with some very useful advice via the law faculty. To explain why this advice was useful let me take the reader back to May 1940 when Wolfie escaped from Nazi occupied Holland, literally by the skin of his teeth. He came to London, but at the age of 17 was too young for military service although he was a British citizen. While waiting for his call-up he worked in a chemical factory and eventually joined the army in 1943 and was sent to India. Unfortunately, I do not have Wolfie's raconteur style but his description of his flight from Holland and his subsequent early career were worthy of 'Casablanca'. My own children, teenagers in 1985, were captivated by Wolfie when he visited us at home. Their comment 'he's not like the usual boring scientists who usually visit is he dad', will remain with me forever. I should add that Wolfie studied under H.S.W. Massey at University College, London for his PhD on a part-time basis. He was awarded the degree in 1956 on matters connected with the Born approximation. But I digress. I was talking about the senior common room and its company. Wolfie had always thought that he was ineligible for a British university teacher's pension because he had only spent 9 years in that job and 10 years were needed. Well, the law department at Queen Mary College specialised in employment law and offered advice (gratis, unusual for lawyers) to staff members, of which Wolfie was now one. They gave Wolfie excellent advice and pointed out that his war service could be counted as pensionable years. So the sabbatical year was doubly productive. That year led to a close friendship between us and every year after that Wolfie and Miryam would come to London for a week and we would meet for a meal. We eventually found a perfect venue at the Royal Society of Arts. We shall miss him.

**Shalom Wolfie**

From Paul Michael  
Brookhaven National Laboratory Upton,  
New York, USA

One of the great joys with which my family has been blessed is the close friendship with “Wolfie” Rothenstein and his wife Miryam. Our grief at Wolfie’s passing is tempered by the memories we have shared.

Friendships formed at critical points in ones life are often the strongest. We met in the early fall of 1958 when Wolfie and I took our first post-doctoral positions, in Jack Chernick’s Reactor Theory Group at Brookhaven National Laboratory. We collaborated on the core physics and analysis of the High Flux Beam Reactor. It was an exciting time as our computations complimented, and were tested by, critical experiments performed by Herb Kout’s experimental group. Our families were at the same stages of development (we each had young daughters when we met; sons were born within a year of our coming to BNL.) As important as this coincidence in time, status and place, was that we shared interests and values. Being together was always rewarding.

We remained close even though the Rothensteins moved to Israel (immigration for Wolfie, return for Miryam). On Wolfie’s frequent sabbaticals and professional trips to the United States we were able to take up as if we were never apart. A tourist visit we made to Israel in the 1973 allowed them to act as tour guides outshining the professional guides. Particularly memorable was a visit to the Meggido archeological site. We were free from our formal tour on a Saturday. Undeterred by the Sabbath closing, Wolfie lead us through a hole in the fence and we explored for hours. We frequently recommended that friends and relatives visiting Israel call on the Rothensteins, they always acted as gracious hosts and guides; though seldom breaching fences to reach sites.

After our daughter moved to Israel in 1983, we visited Israel regularly. Our friendship with Wolfie and Miryam became even closer than it had been before. They visited our daughter’s kibbutz; we had dinners and lunches at their home. Often on our first several visits, they would, unannounced, meet us at the airport to greet us and to be sure we could find our way. My wife Norma would ride with Wolfie. Miryam would accompany me in our rental car following Wolfie north to a road junction from where he was sure I could find my way.

Whether in the United States or in Haifa we had the most satisfying and wonderful exchange of ideas. We would discuss science, from “meaning of the universe” topics to the recalcitrance of computer systems to follow instructions. And, of course, we discussed his current research. Even though I had left the field of Reactor Physics, his descriptions of his current research were lucid enough for me to catch up.

We also had discussions on many and varied topics (sports being one notable omission!). We discussed the politics of the Middle East; how fervently he wanted peace in Israel! On religious matters he was dedicated to a pluralistic society. We discussed the great pride and love we had for our children and grand children.

And there were light hearted discussions also. On one occasion Wolfie questioned the proof that in the Monte Hall game<sup>5</sup> that the contestant should switch. The clumsy explanation that I tried did not satisfy him. The next day he came back to report that the result was clearly correct after all! I asked if my explanation invoking the “Principle of Restricted Choice” finally got through to him. He said, “No, I wrote and ran a Monte Carlo model. That convinced me!”

It is hard to believe that Wolfie isn’t going to pop into my office or home, or send an e-mail, to intelligently discuss a topic of importance, to relay news about mutual friends, to report on his family or to inquire about mine. He will be missed deeply.

“Because words cannot express my true feelings, let me just say, ‘shalom haver,’ goodbye friend.”<sup>6</sup>

From Ron Dagan  
Karlsruhe, Germany

I had the honour and luck to be Wolfgang’s last graduate student. Luck because Wolfgang was Professor Emeritus. He had more time and I got the opportunity to work closely with a unique person and educator. The first time I met Wolfgang was when I attended his basic course on Reactor Physics. I missed the first two lectures due to military reserves duties and when I came to the third one I could not follow him. Yet the way he lectured was very interesting and different. He wrote everything on the board so neatly and he did not need to erase anything as if the board was made only for his lectures. He used to start with mathematical definitions and it was fascinating how “somehow” they all got their physical meaning as if to put pieces of the puzzle together into a whole picture that presented the topic he was teaching. I was keen to continue studying with him, so in the next lecture I took my chances, stood up and said I had difficulties in understanding the tutorial material. His reaction was very surprising. He stopped teaching, let me and others clarify all the questions that we had in mind and from that time everybody knew one could ask him anything at any time and would get a comprehensive answer without fearing that the question is too simple or not proper to be asked.

Wolfgang’s lectures were known to be an unusual event, that his students still remember them years later. Astonishing was how Wolfgang who was known as the founder of nuclear science studies in Israel and world wide recognized scientist could sit sometimes on the table, closing his knees towards the chest, and thus totally concentrated he kept on lecturing. This contradiction or better to say the combination of outstanding scientist with modesty and informality was his “trade mark”.

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<sup>5</sup> In the “Monte Hall” game a the player chooses one out of three closed doors in an attempt to locate the prize that is behind one of the doors. Then the game host opens another one of the other doors, which he knows not to have the prize behind it. The host then offers the player the chance to switch doors. Is there an advantage to switching from the first selection to the other unopened door? Proving that switching doubles the contestant’s chance of winning is left as an exercise. The World Wide Web has many on line Monte Carlo calculations testing the result; Wolfie surely did it first.

<sup>6</sup> President Clinton’s remarks on the death of Prime Minister Yitzhak Rabin, 5 November 1995.

He was dealing with respect with every employee in the Technion ( Israel Institute of Technology) giving the impression that every job is at least as important as his. The following story is an example. Two years ago I met Wolfgang in London. We entered Marks & Spencer. He looked at the floor cleaner and said in his typical unique style: “You see, this was my first job in London but I was not so good at it, so I went to study in the University”.

Wolfgang had some amazing capabilities. Most likely, he was the only one in the Technion who could read fluently from the holes in the computer cards the FORTRAN statements. But for me most impressive was his ability to write page upon page with out needing to correct anything. I was already his sole student. We were sitting in his office and he just wrote down the whole material and its equations from his head.

For the last 2 years of my PhD. study I worked with Wolfgang at his home. I used to talk a lot with Miriam and him in their kitchen and I will always remember their warm hospitality. Like in other fields, Wolfgang’s ideas about politics and society looked at first so idealistic and impossible and some years after seem to be so realistic and logical. He believed strongly in peace in Israel and wondered why people are killing each other if at the end they must live together in peace. In the Technion Senate he was usually alone when he suggested solving economic problems by cutting part of the salaries instead of striking and fighting, and thus damaging the reputation of the Academic staff.

During the last phase of my PhD we had difficulties in developing the double differential scattering kernel and it was then that I understood the meaning of the unwritten law I have heard in our faculty: “When you start with Wolfgang as a graduate student, you will surely graduate.” Wolfgang helped me a lot. In some countries a PhD supervisor is called also Doctor father and that title suited him completely. On one side he was not ready to compromise on less than the exact and full assignments he had decided upon and on the other side he fully participated and worked shoulder to shoulder with me to solve the problems I was confronted with.

Among the e-mails that were circled announcing his sudden death one said: ‘No more Wolfgang Rothenstein’. Wolfgang was much more than a leading scientist he was the symbol and pride of the Israeli nuclear community although I am quite sure he never noticed it.

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