PREFACE: OBITUARY FOR DR. ARIE PERETZ

Dr. Arie Peretz of Haifa, Israel passed away on November 16, 2019, at the age of 86.

Dr. Arie Peretz (Fig. 1) was born on Dec. 8, 1933, in Plovdiv, Bulgaria, and immigrated to Israel in 1949. Dr. Peretz graduated from the Department of Mechanical Engineering, Technion-Israel Institute of Technology, with his thesis "Generation of Gas for a Hydro-Pneumatic System by Burning of Solid Propellant" and was employed by Scientific Department (later RAFAEL-Armament Development Authority; ADA) of the Israel Ministry of Defense as a research engineer in 1956. He received a MSc degree from the Department of Mechanical Engineering, Technion-Israel Institute of Technology, with his thesis "Problems in the Design of a Solid Propellant Grain of High Length/Diameter Ratio for a Rocket Motor with Two Thrust Levels" in 1965, and was promoted to project head of Design and Development of Solid Propellant Rocket Motors, Propulsion Section, RAFAEL-ADA. In 1970, he attended the PhD program at the Department of Aerospace and Mechanical Sciences, Princeton University, under the guidance of Prof. Martin Summerfield. During his studies there, he was involved in research of erosive burning with ignition transients of high-loading density solid rocket motors, and received a PhD in 1973 with his thesis "The Starting Transient of Solid Propellant Rocket Motors with High Internal Gas Velocities" and was raised to the head of the Rocket Motor Design Section, Propulsion Department, RAFAEL-ADA. Dr. Peretz was hosted at the High Pressure Combustion Laboratory (HPCL) of Pennsylvania State University, presided by Prof. Kenneth K. Kuo (his lifetime friend from the PhD program at Princeton University) during 1988–1989, and during 1997–1998

FIG. 1: At 7-ISICP, Kyoto, 2007 (provided by Dr. Pein)

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as a visiting professor. Since 1989, Dr. Peretz held the position of research project lead engineer at the Weapon Systems Division of RAFAEL, and he contributed to RAFAEL significantly as an excellent researcher in the rocket propulsion area throughout his life.

Dr. Peretz's contribution to the rocket research society was outstanding. He published approximately 80 peer-reviewed papers in the areas of solid, hybrid, ducted, and ramjet rockets; served as a member of the editorial board of IJEMCP and the international executive committee of ISICP from their beginnings; was a lifetime member of AIAA since its establishment in 1963, and was a member of the Solid and Hybrid Rocket technical committees of AIAA since 1978, the IAS (Israel Astronautical Society) since 1958, the Israeli Section of the International Combustion Institute since 1965, and the International Pyrotechnics Society since 1980.

Dr. Peretz enjoyed reading, with a deep interest in linguistics, history, geography, and geopolitics. He was a kindhearted, true gentleman who never cared much about himself. He loved rocket science and supported all the scientists and engineers around him, being an ideal mentor for young researchers. He was loved and will be missed by many friends and all who knew him all over the world.

A funeral service was held by his close friends on November 17, 2019, at Tel Regev Cemetery near Haifa, where he rests in peace.

CONDOLENCES

Len Caveny (Princeton University, USA)

I am saddened to learn of Arie's death. He was a good friend and colleague. We stayed in touch on a range of topics. I will miss him.

I met Arie in 1969 (probably December; see Fig. 2), when he came to Martin Summerfield's Princeton University laboratory to begin his PhD studies. His industrial experience prepared him for the rigors of being one of Summerfield's students (Fig. 3). Thus, his preparations for the dissertation research were exceptional, as expected. A pleasant surprise was his preparations for his oral exams presented to the Mechanical and Aerospace Engineering faculty, which included prominent theoreticians. He expertly and confidently answered all their questions without hesitation. Of the oral exams I observed, Arie by far gave the best performance. His analytical grasp matched his hardware expertise.

FIG. 2: With Prof. Summerfield at Summerfield's house, 1969

FIG. 3: (from left to right) Ms. Plett, Arie, Dr. and Ms. Ohlemiller, Dr. Kubota, and Ms. Crosby at Prof. Summerfield's house, 1971

Arie was very much part the 2011 AIAA paper that described Martin Summerfield's history.[1] His name appears 19 times; for example, see page 41 of the paper:

"Most graduate students developed a unique apparatus for their research. Routinely, research required rocket motor-type experiments. The apparatus Arie Peretz PhD '73 designed for his dissertation research on ignition transients in solid propellant rockets with high internal velocities exemplified some of the benefits and capability of Summerfield's laboratory (Fig. 4). Peretz studied the previous windowed combustors and motors used in ignition research and then designed a windowed rocket motor with several 'first-ever' features, including windowed length of $\sim$ 50 cm, special window to maintain optical transparency, opposing propellant surfaces to reduce heat loss, probes for pressure wave tracking, Mach number control, operation at real rocket pressures, etc. He specified a spark activation and controllable gaseous ignition system, known to be difficult by the experiences of Chris Felsheim, Lead Technician, on less demanding systems. The rather complex machining and multiple sets of propellant fixtures, casting fixtures, etc. were concerns with respect to practicality and cost. During the design review, Peretz expertly explained and defended his ambitious and bold approach with respect to safety, function, cost, and schedule. The fabrications were accomplished by Peretz interacting with the machinists in the University's shop. Peretz, with the assistance of Chris Felsheim, proceeded as planned to set up, check out, and implement the apparatus for his dissertation. After the pre-print of the Peretz AIAA paper [and eventual AIAA Journal article] appeared, the unique capabilities were

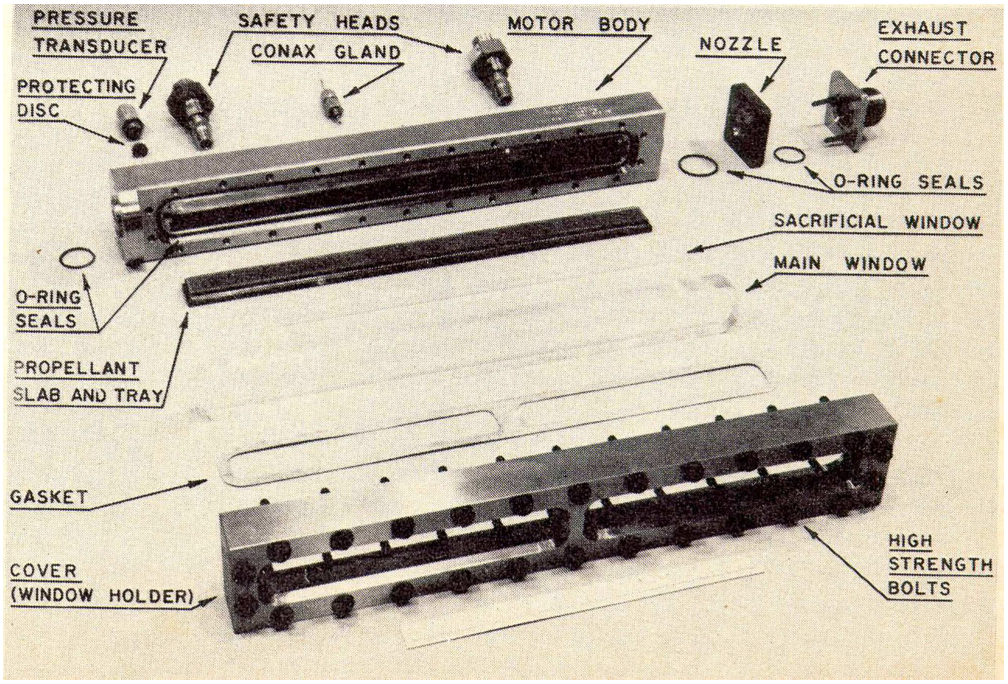

FIG. 4: Window motor designed by Arie Peretz for his PhD thesis in 1973 for his high velocity ignition and flow transition research

recognized. The Peretz apparatus remained in place for five years and was extended to conduct ignition, erosive burning, and aluminized propellant research programs (using forefront propellants) funded by propulsion companies, NASA, and Department of Defense laboratories."

As a protégé of von Kármán, Prof. Summerfield recognized the benefits of international scientific exchanges as a precursor to better world relationships. For example, the ties he helped maintain with the Russians in the 1960s and 1970s are the basis for the present-day interactions by his students and staff. Prof. Summerfield took charge of assigning offices to visiting scientists. My concerns about him assigning Vadim B. Librovich (visiting scientist) from Moscow's Institute of Problems in Mechanics to be the officemate of PhD candidate Arie Peretz from Israel's RAFAEL Advanced Defense Systems, Ltd. were soon overcome by the respect the two men gained for each other as they became friends, just as the professor planned.

Arie's dissertation and the associated AIAA Journal publication[2] are among the most widely referenced publications from Summerfield's laboratory (Fig. 5). Arie's high velocity transient computer program invoked the best of Robert Vichnevetsky's challenging forefront techniques for coupled differential equations and required Princeton's (then) supercomputer. Arie's computer program served as the starting point for the computer program that predicted the ignition transients and troublesome wave forms of the space shuttle solid rocket motor boosters.

Arie was probably the most demanding of Summerfield's students with whom I worked. Arie pressed the laboratory's world-class systems to achieve excellence from his research. As the senior person on Summerfield's staff, he directed his demands at me. (He had the good judgment not to be direct with his professor.) On several occasions the business-as-usual raised voices caused concerns, but then became part of an expected event. Everything worked out to Arie's

FIG. 5: Working on AIAA paper with Dr. Caveny, 1972

satisfaction. I was among the first to give him credit for the excellence of his accomplishments (see Fig. 6).

As noted, Arie's window motor was put to good use after he graduated. To achieve high quality data the complex test preparations had to be exact. Arie prepared a detailed test procedure. He and Chris Felsheim were a good team. As I recall, all of Arie's motor tests produced useful data. Others who used Arie's window motor were not as exacting; their mistakes caused about half of the subsequent motor tests to be redone. This is a sample and measure of Arie's engineering skills.

Arie will be remembered. He will be missed.

1. "Martin Summerfield and His Princeton University Propulsion and Combustion Laboratory," AIAA Paper 2011-5711, August 2011, 70 pp., L.H. Caveny.

2. "Starting Transients of Solid Propellant Motors with High Internal Gas Velocities," *AIAA Journal*, vol. 11, no. 12, December 1973, pp. 1719–1727, A. Peretz, K.K. Kuo, L.H. Caveny, and M. Summerfield.

Roland Pein (DLR, Germany)

When I heard that Dr. Arie Peretz passed away I felt very sad. I first came into close contact with him many years ago at a conference in Munich. He invited me to give a lecture at the Israel National Aerospace Conference. This was the beginning of many visits to Israel.

FIG. 6: (from left to right) Peretz, Prof. Kuo, Dr. Caveny, Ms. Summerfield, Prof. DeLuca at AIAA JPC, San Diego, 2011

Later, I met him again in the United States at an AIAA conference where he introduced me to Prof. Ken Kuo, who was looking for a local organizer for the 2nd ISICP in Lampoldshausen, Germany. The conference was a great success and the beginning of much cooperation with Ken Kuo and Arie Peretz in steering committees of many ISICPs. After an ISICP conference in Stresa, Italy, Arie joined my wife Barbara and me on a trip across Tuscany, which we enjoyed.

I very much remember the very extensive scientific and nonscientific discussions with him. I think we all have lost an excellent scientist and a good friend. We will miss him very much.

Luigi Tonino DeLuca (Politecnico di Milano, Italy)

When I arrived at Princeton University directly from Italy many years ago to conduct my doctoral program under the supervision of Prof. Martin Summerfield, I was asked to share the office that Arie Peretz was already occupying. Arie was already in his third year of studies. He soon became my personal tutor in dealing with all the novelties (for me) of American life in general and in particular of Forrestal campus, where our SP lab was located. He was a quiet, diligent, and cheerful young man; soon we became good friends. We spent a lot of time together but his wise guidance in affording difficulties and discovering the little secrets of our common academic life never failed. He congratulated my achievements but was also patient enough to kindly point out my mistakes. Goodbye Arie, and thank you for your good mood, pleasant company, and everyday help!

Savely Khosid (RAFAEL, Israel)

While working on expendable mini-turbojet engines at RAFAEL, I hoped to improve their design by removing the external pressurized oxygen tank that was necessary for high altitude ignition. I thought that a small pyrotechnic starter enriched by oxygen could do the work. I needed the help of propulsion and chemical engineers to realize my idea, and somebody told me that Dr. Arie Peretz was both. We worked together on this topic for a few years after our first meeting in 2005 (as a result of this work we received two US patents). We also presented our research at the 7th ISICP in Kyoto and 8th ISICP in Cape Town, and published our results at the Conference on Advancements in Energetic Materials and Chemical Propulsion (2008), and in two papers in IJEMCP. Dr. Arie Peretz was so excited by the potential of our idea for conquering the whole APU concept for aircraft that he decided to buy the patent rights from RAFAEL to promote this starter worldwide. It was not easy to convince him to forfeit this heavy task. Maybe a younger Arie could have made it—who knows? Arie served as the presenter of our shared work at international conferences. One of these presentations was not as perfect as he envisioned.

"Tell me the truth," he demanded, "how was it?"

My response was somewhat blunt: "Not that good."

"You don't know how to encourage people without resentment," he said angrily. Only much later I recognized his level of perfectionism. In all of our meetings with Arie, his focus on the work was amazing. Throughout his work at RAFAEL for more than 60 years (1958–2019), he was ready to talk almost exclusively about rocket engines. Such dedication and professionalism are rare today.

Rest in peace, Arie. I will remember you.

Charles Kappenstein (Poitiers University, France)

I met Arie more than 20 years ago at different conferences and workshops, and we had a very nice discussion about propulsion, but also about science and general interests. I regret that he never come to Poitiers and I never went to Haifa. I remember the clean and quiet voice coming from a modest person who was able to convince you with great attention. I have tried to retrieve photos, but I did not succeed. Perhaps it is better so.

Grant Risha, Eric Boyer, Richard Yetter (The Kenneth K. Kuo High Pressure Combustion Laboratory, Pennsylvania State University, USA)

Dr. Arie Peretz was a collaborator and colleague of the Prof. Kenneth K. Kuo High Pressure Combustion Laboratory (HPCL) family for many years. Ken and Arie established a close friendship that began during their time spent together at Princeton University. Arie was a visiting scholar at the HPCL on several occasions during the 1990s and early 2000s, and contributed to more than ten technical papers focusing on subjects such as hybrid rocket combustion, boron-based solid propellants, transient burning in solid propellant rockets, and pyrolysis of solid fuels, just to name a few (Fig. 7). His technical expertise in these areas helped shape the research direction for many projects and provided a priceless source of knowledge for aspiring undergraduate and graduate students in the field of engineering. His meticulous attention to detail was an example for young scientists to observe the value of thoroughness in experimental research. During Arie's time at the HPCL, he often attended lectures discussing energetic materials, solid propellant combustion, and propulsion topics. Although his research reputation preceded him, he

FIG. 7: With Prof. Zarko, Prof. Kuo, Dr. Schoyer at 3-ISICP, 1993

humbly sat in the classroom next to graduate students, often further explaining the technical details of the lecture topic (even if occasionally in a "whispered" comment of a volume challenging that of the presenter). Anyone who interacted with Dr. Peretz immediately witnessed that he had a brilliant mind and also a great sense of humor. He would often tell Dr. Kuo's graduate students humorous stories of the times when he and Ken were in graduate school together. His willingness to contribute to young engineers' success, whether it be reviewing a technical paper, assisting in conducting experiments, or simply introducing them to potential collaborators, is among his most noble traits. Dr. Peretz is sorely missed. His experience, humor, sincerity, and humbleness impacted many young aspiring engineers and research scientists.

Helmut Ciezki (DLR, Germany)

I am deeply saddened to hear of the death of Arie Peretz. He was an outstanding scientist and engineer (see Fig. 8).

He always had time for anyone's questions. I am very grateful to him for very intense and very fruitful discussions. We first met at the High Pressure Combustion Laboratory (HPCL) of Pennsylvania State University in 1997. I remember especially the discussion on metal combustion, which was extremely helpful for my work at DLR, and the comments he had regarding my presentation.

With him we lose a person who was indispensable for the development of the ISICP symposia to their current size and importance.

FIG. 8: With Prof. Timnat at 5-ISICP, Stresa, 2000

I am grateful that I had the opportunity to accompany him during a short part of his path of life.

I will always remember him as a scientist and excellent mentor for me and other young scientists.

Benny Natan (Technion, Israel)

Arie was a great scientist and a wonderful person. He had a sharp mind and he could clearly see the important things in every issue (see Fig. 9). He was my Master's and PhD candidacy examiner, and later he served as an examiner to my student's theses. His advice was always valuable.

He met my daughter, Irene, on a trip to Los Angeles when she was 12, and Arie revealed a character previously unknown; he was sweet and could talk to her like an equal. He came to her wedding in 2015 and was happy for us.

The most important thing in his life was his work and he volunteered until his last day. He had no family and siblings. I will certainly miss him. Blessed be his memory.

Levi Gottlieb (RAFAEL, Israel)

I first met Arie a few years after I joined RAFAEL. Although by that time Arie was already retired, I noticed his exceptional passion and devotion to advancement of novel ideas in all areas of chemical propulsion. Arie was a total professional—when I wrote something he liked (once hardcopy reports were fashionable!) he would call and congratulate me right away, but he would

FIG. 9: At AIAA JPC, Salt Lake City, 2001

not save his remark when something was not good enough. Whenever we met, he would ask—did you try what we discussed, or think about the problem? Shamefully, I would have to admit that I didn't have enough time for his flow of ideas. We also met at several conferences where he presented his work in addition to being heavily involved in organizing and chairing sessions with indisputable success.

In his last few years, he still continued to show up at work twice a week, relentlessly working and interacting with young people despite his deteriorating health. Arie was a true classic scholar, a great mentor, and a very pleasant person. He will be missed very much, may he rest in peace.

Alexander Vorozhtsov (Tomsk State University, Russia)

Arie's contributions to propulsion science was tremendous. It is a serious loss for our science and energetic materials community. Dr. Arie Peretz's research in gel propulsion is classic and very useful for our colleagues who work in gel propulsion technologies.

At Tomsk State University, all Russian experts will keep his name in mind, as well as his contribution in chemical propulsion and energetic materials research.

Keiichi Hori (ISAS/JAXA, Japan)

Our friendship started when my wife, Akiko, and I visited HPCL, PSU in 1998–1999 as a visiting scholar. Arie was also there as a visiting professor during his sabbatical. He very kindly taught us many "hows" at HPCL, PSU, State College, and America. After the visit, we met at ISICP, AIAA JPC, and other symposiums and had nice times together (see Fig. 10).

I was so impressed with his strong curiosity about everything. He was a scientist in his own right. He asked me many thought-provoking questions, and conversation with him was always just a pleasure for me (see Fig. 11).

FIG. 10: With Prof. Kuo at AIAA JPC, Denver, 2009

FIG. 11: In Kyoto, Japan, 2007

We had not met since 2013, and I planned to visit Haifa last November. We exchanged messages and I was excited to be able to meet with him again. However, a couple of days after his last message on Nov. 5th, he was hospitalized and passed away four days before my arrival to Israel. It was really heart-breaking for me, but with the help of Prof. Natan, I was able to visit his grave, offer prayers to him, and have some consolation.

Arie, thank you very much for many wonderful memories with you. I will never forget you.