Interview with Abraham (Avi) Domb – Chief Scientist of the Israel Ministry of Innovation, Science and Technology

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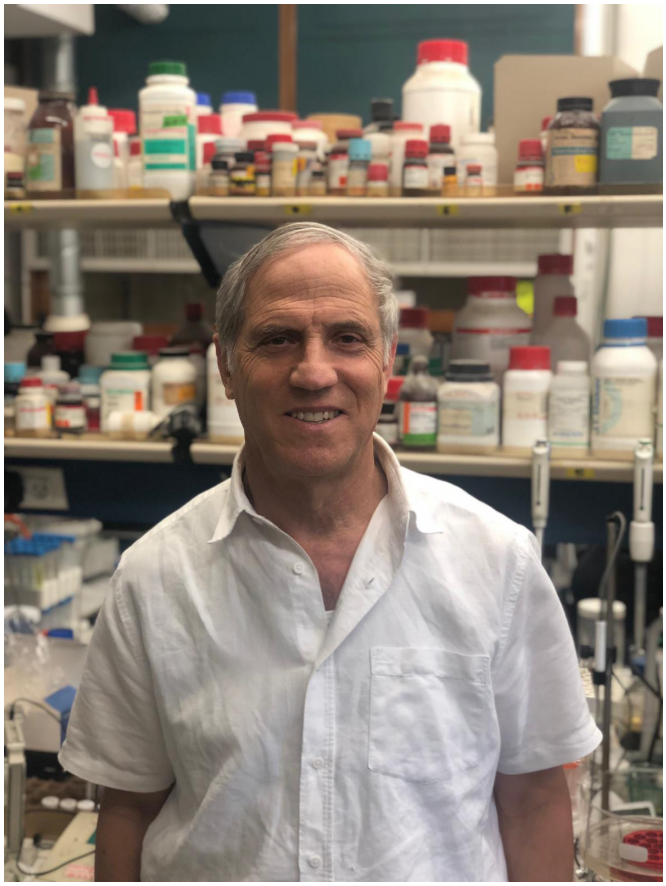

Q: Where were you born and where did your parents come from?

A: I was born in Ganei Zvi, now part of Hod Hasharon. Both of my parents came from Poland.

Q: What inspired you to study chemistry?

A: I went to high school in Kfar Haroe Yeshiva, where I had a great chemistry teacher, the late Prof. Moshe Adad. He instilled in me a love for chemistry. By the way, Prof. Adad was later a Prof. of Criminology at Bar-Ilan Univ. Later, when approaching university studies, my twin brother Menahem and I decided to go in different directions. He studied mathematics and computer science. I chose chemistry.

Q: Why did you choose your particular field of chemistry?

A: When looking for a field in chemistry to focus on, I was fascinated by the diversity of polymer chemistry and applications. I started MSc studies at the Casali Institute at the Hebrew University on Polymers and Textiles, a joint program with the Fiber Institute in Jerusalem. After one year, I was introduced to Prof. Yair Avni and Prof. Zilcha from the chemistry department and decided to move to Yair's lab to proceed to a direct PhD on "Functional Polymers". Within

Arlene Wilson-Gordon was born in Glasgow, Scotland. She completed her BSc (Hons) at Glasgow University and her DPhil at Oxford University under the supervision of Peter Atkins. After a postdoc at the Hebrew University withRaphy Levine, she joined the faculty at the Department of Chemistry, Bar-Ilan University, where she rose to the rank of Professor and in 2015, Professor Emerita. Her research interests lie in the field of theoretical quantum and nonlinear optics. She is the editor of the Israel Chemist and Engineer, an online magazine for all who are interested in chemistry and chemical engineering.

polymers, the field of biopolymers for implants and drug delivery had just started, so I decided to study pharmacy to better understand the medical needs. While doing my PhD, I studied pharmacy at the School of Pharmacy as an undergraduate student and completed both in 1984. I moved to Syntex Co., California for postdoctoral training, working on a hydrogel implant for a one-year delivery of the hormone LHRH for treating prostate cancer. After one year, I moved to Langer's lab at MIT and Folkman's lab at Children's Hospital, Harvard Medical School, working on the design and synthesis of biodegradable polymers for tissue engineering and carriers for controlled drug delivery.

Q: You have held a variety of positions from University Professor to College President to Head of Forensic Science in the Israel Police and now Chief Scientist at the Ministry of Science and Technology. Can you describe these roles and what attracted you to them?

A: After three years of postdoctoral training in the US, I worked for one year at the Biological Institute in Ness Ziona and then moved back to the US to become director of R&D at Nova Pharmaceuticals Co. in Baltimore. After about three years, I was looking for a job in Israel. An academic position was a distinct possibility. I received an offer to join the School of Pharmacy of The Hebrew University at the Hadassah Hospital in Ein Karem, a perfect place to carry out applied medical research. In 1997, I completed a diploma in Business Administration and in 2007 Law studies, both from Hebrew University. Coincidently, I was approached by the police with an offer to head the Division of Identification and Forensic Sciences (MAZAP), in charge of 15 forensic labs and 450 employees. I thought that this would be an interesting opportunity, took a leave of absent from the university, and joined the Israel Police with the rank of Brigadier General. After about five intensive years during which time I learned a tremendous amount about forensic science, management, and public service, I moved back to the university. During my years in the Israel Police I kept my lab active, thanks to my graduate students, Boaz Mizrahi and Shady Farah (both now professors in the Technion). In 2014, I was approached by Uzi Wexler, founder and president of Azrieli College of Engineering, to become president, which I did in parallel to my university duties. This was an opportunity to understand the importance of engineering and its role in translating science into practice. In 2018, I was elected head of the School of Pharmacy with the objective to increase the number of pharmacists in light of the shortage of pharmacists in Israel. The position Chief Scientist came up with no intention on my part. This position is an opportunity to promote applied academic research to achieve important national needs and increase academic involvement in government programs and industry.

Q: Which role gave you the greatest satisfaction?

A: The position at the Israel Police. The forensic division is responsible for the national forensic activities, serving not only the police but also security and government agencies. The position requires operation of forensic laboratories with a staff of about 200 scientists, most with MSc in addition to 20 PhDs and about 250 field investigators. The labs are equipped with up-to-date instrumentation and technologies in diverse scientific fields: biology, chemistry, physics, engineering, and computer science. Most important for me was the opportunity to meet policemen of different ranks and positions. These policemen work hard and in harmony towards the wellbeing of all of our citizens.

Q: Do you enjoy teaching and interacting with students?

A: I very much enjoy teaching and interacting with students. I teach in two faculties, the Faculty of Medicine – School of Pharmacy where I teach medicinal and organic chemistry, biopolymers, and pharmaceutics, and the Faculty of Law where I head the MSc Program in Forensic Sciences. I have graduate students in both faculties studying biopolymers, medicinal chemistry, pharmaceutical sciences, and forensic science.

Q: What do you consider to be your greatest scientific achievement so far?

A: Synthesis and applications of biodegradable polymers, particularly the polymers that are in use in Gliadel, Inspace, and Bioprotect products and in Intragel and Gentagel-LR products that are under development.

Q: What do you consider to be your greatest contribution to Israeli society?

A: My contribution to professional education, teaching and supervising hundreds of undergraduate and graduate students who today hold positions as pharmacists, industrial R&D staff, and academic positions.

Q: Would you recommend a career in academia to young scientists?

A: Absolutely – to individuals who see science as part of their life, are willing to spend long hours reading, writing, and researching in a lab. An academic position provides the freedom to perform research in various fields, associate with the international community of scientists, collaborate with industry, and even establish companies and enjoy royalties.

Q: What are the main challenges facing Israeli science?

Profile

A: Excellence in science requires a talented work force – faculty and students, a proper scientific infrastructure, up-to-date instrumentation, and lab resources. To remain relevant in today's fast growing and highly competitive international academic environment, support from government is essential. Beside excellence in basic science, academia should contribute more to functional science that leads to science-driven industrial development, while training the best graduate students who should proceed to applied research. As Chief Scientist, my intention is to promote applied research of national preference, leading to more start-up companies and licensing technologies that originate in universities and research institutes.

Q: If you had a magic wand, what would you change in a) in academic life, b) in Israeli society?

A: Academic research must continue to be competitive, excellent, and innovative at an international level. The universities and colleges have a role is training the science-driven workforce, thus, the academic ecosystem should promote applied research as a continuation or part of basic research. Efforts should be made to encourage all communities in Israel to be part of the science and technology revolution.

Q: Do you have any advice for young people embarking on their career?

A: Any individual who proceeds into the scientific community should choose what they would like to do for life but remain open to new opportunities. Diversification in education and job opportunities should always be considered at any time point during a scientific career.

Q: How do you enjoy your free time?

A: These days my free time is used for exercise and enjoying my family and grandchildren.

Women in science

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Abstract

Women continue to represent a small proportion of faculty members in science and technology programs, especially in more prestigious research institutions. They still need to cope with discrimination, with an **unconscious bias,** as well as with the demands of their families. According to UNESCO institution of Statistics, fewer than 30% researchers all over the world are women. The analysis of *"A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences, How to measure it? How to reduce it?"* survey, contributed to the understanding of this phenomenon and to the identification of the various factors causing it**.** The recommendations address a variety of groups: instructors and parents of girls in primary, secondary, and higher education; educational organizations; Scientific Unions and other worldwide organizations. This paper will deal with the situation of women scientists in Israel, with examples of women chemists in academia.

1. Introduction

At a symposium on women in science, conducted at the Israeli Academy of Sciences and Humanities on April 23rd, 2003, Professor Ruth Arnon, a biochemist and co-developer of the multiple sclerosis drug Copaxone, from the Weizmann Institute of Science, Israel, claimed [1]:

> *After all, scientific research is an occupation that relies on personal skills (talent, perseverance, executive ability, etc.) and does not depend on the gender of the practitioner. And therefore, why dedicate the discussion to women scientists only? But it turns out that what is true in theory is not always true in reality. For ages, female scientists were not given the right of an equal among their fellow male scientists. Therefore, we thought that there was room to discuss the issue of women in science in Israel, and precisely within the walls of the Israeli National Academy of Sciences.*

At the same symposium, Dr. Pnina Abir-Am from Rockefeller University [2] gave a *historical* overview about the participation of women in science, since the Scientific Revolution in the 17th Century. Women only participated as collectors, illustrators, translators, or assistants of scientist family members. The establishment of women's colleges in the last third of the 19th Century enabled science education for women (e.g. Marie Curie). Even today, despite various improvements and a rise in the number of women students of science, women are still a minority in many fields of science – underrepresented in positions of leadership in universities, scientific societies, or industries.

Dr. Rachel Mamlok-Naaman was the head of the National Center of Chemistry Teachers at the Weizmann Institute of Science (until 2020), and the coordinator of the chemistry group at the Department of Science Teaching (until June 2016). In addition, she serves as the chair of DivCED EuChemS, a titular member of the IUPAC committee on chemical education (CCE), and an executive member of the IUPAC gender gap committee. Her publications focus on the topics which are related to students' learning (cognitive and affective aspects of learning), and on teachers' professional development. She received several awards, among them - two from the Weizmann Institute: the 1990 Bar-Ner award for teaching, and 2006 Maxine Singer award for professional development of science teachers. In 2018, she received the ACS award for incorporation of sustainability into the chemistry curriculum, and in 2020 the IUPAC award for distinguished women in chemistry or chemical engineering.

Blickenstaff [3] claims that women are not represented enough in science technology, engineering, and mathematics (STEM) disciplines in not only the United States, but also in most other countries around the world, despite the advancements in science and technology. Women continue to represent a small proportion of faculty members in science and technology programs, especially in more prestigious research institutions. For STEM women faculty, for example, academic tenure often coincides with their child-bearing years. With decreased lab space, inadequate resources, lower salaries, and fewer prestigious opportunities, early stages of an academic career are particularly difficult for women. They still need to cope also with discrimination, an **unconscious bias,** and the demands of their families.

Makarova, Aeschlimann, and Herzog [4] conducted a study in which they investigated the impact of the masculine image of three school subjects – chemistry, mathematics, and physics – on secondary students' career aspirations in STEM fields. The data was collected from a cross-sectional study among 1364 Swiss secondary school students who were close to obtaining their matriculation diploma. The findings suggest that gender-science stereotypes of math and natural sciences may influence young women's and men's aspirations to enroll in a STEM major at university.

According to UNESCO Institution of Statistics [5], fewer than 30% researchers all over the world are women. A three years' global project (2017-2019): "*A Global Approach to the Gender Gap in Mathematical, Computing, and Natural Sciences, How to measure it? How to reduce it?*" was funded by the International Science Council and involved eleven scientific partner organizations [6] . The main goal of the project was to investigate the gender gap in STEM disciplines from different angles, globally and across disciplines. The project consisted of (i) a global survey of scientists with more than 32,000 responses; (ii) an investigation of the effect of gender in millions of scientific gap in Mathematical, Computing, and Natural Sciences at various levels.

Chiu and Ceca [7] analyzed the results of the global survey disseminated to 32,000 scientists, of which 50% were male and 50% female. They showed how it contributed to the understanding of the gender gap, and to the identification of the various factors which cause it**.** Its results confirm that the Gender Gap in Science is very real: it exists across all regions, disciplines, and development levels. Women's experiences in both educational and employment settings are consistently less positive than men's. Recommendations for improving the situation were based on the survey's findings. The recommendations address a variety of groups: (1) instructors and parents of girls in primary, secondary, and higher education, e.g., to avoid books and social media that reinforce the gender gap in science; (2) educational organizations, e.g., to avoid books and social media that reinforce the gender gap in science; (3) scientific unions and other worldwide organizations, e.g., to encourage the presence of women in editorial boards in their disciplines and publish reports on the proportion of papers published by women.

Discrimination can be also found in the publication data [8]. A Survey of Doctorate Recipients [9], and the National Study of Postsecondary Faculty [10] deal with questions about career progression, such as self-reports of faculty persons and the number of their publications, a measure of productivity. The findings show that women are less likely to be promoted with tenure, even after controlling for number of publications [10].

Weisshaar [11] claimed that publication measures show gender bias, expressed through work on self-citations. Publication data were retrieved from Google Scholar using a Python script. She created multiple variables to measure both the quantity and quality of research productivity – number of journal articles, books by type (research monographs, textbooks, and edited volumes), book chapters, and (for Computer Science) conference presentations. She measured the quality/visibility of research productivity with three measures: (1) a binary variable that is coded as 1 if the professor has published in the highest-prestige journals in their discipline, (2) a variable that reflects the cumulative percentage of first-authored and single-authored publications. Each of the above productivity variables were measured at three time periods: 1) the five years prior to beginning an assistant professorship; 2) the years in which the person served as an assistant professor; and 3) the year after a tenure decision is made.

2. Science and women chemists in Israel

Prof. Hagit Messer-Yaron, an electrical engineer from Tel Aviv University, chairperson of the Council for the Advancement of Women in Science and Technology, established by a government decision in 2000 [12] , and Prof. Hadassah Degani from the faculty of biology at the Weizmann Institute of Science [13], who participated in the symposium mentioned above focused on interesting aspects of women in science in Israel. Messer-Yaron [12] presented the percentage of women engaged in science and technology in Israel. She said that it does not exceed ,25% while women are about 45% of the labor force in Israel, and about 55% of university graduates. Women who choose to work in scientific fields encounter a glass ceiling, in academia as well as in industry, so that the percentage of women decreases. In the highest ranks (full professor) it is slightly less than 10%. In order to improve the situation, The Council for the Advancement of Women

in Science and Technology coordinates national activities on this issue in coordination and cooperation with the European Community. It should be noted that the chemistry field is less "masculine". There are more than 60% female students studying for BSc and MSc degrees, and more than 50% for PhD but, still, faculty women are ~ 10%.

Degani [13] referred to the situation of women in science in Israel, and said that there is huge progress in women's science education but, still, women are not eager to be the chairs of science and biotechnology faculties in academia or in industry. Most women with a PhD are struggling with sharing their time between family and career, and in many cases they make career concessions on the professional level.

Arnon [14] said that, although among the students studying at universities and colleges for all three degrees, women make up more than half, in the faculty of universities in Israel, women make up only 29%! This figure is considered particularly low compared to Western countries where the percentage of faculty members is about 40%. Out of 31 countries examined, Israel is ranked 30th! The glass ceiling is a common phenomenon in Israel. Also, the higher the rank, the lower the percentage of women among the academic staff – the well-known scissors phenomenon. The glass ceiling is a common phenomenon in Israel. Women make up only 16% of full-time professors at universities, a lower-than-average rate in Western countries.

Regarding the physics discipline, Jona and Nir [15] claim that about one third of those who study physics at high school are girls. This drops down to about 16% of female students at the first, second, and third university degrees, and then drops further down to about 7% of academic staff. During the last few years, universities in Israel initiated a few programs, aimed to promote gender balance but, still, it is not possible to assess the success of these programs in improving gender balance.

2.1 Examples of programs of enhancing women scientists' career in two academic institutions in Israel

The examples of programs aiming to enhance women scientists' careers will refer to two academic institutions in Israel: The Weizmann Institute of Science, and the Israel Institute of Technology (Technion). These two institutions were chosen, since both of them are world-class multidisciplinary science and technology research institutions.

2.1.1 Enhancing women scientists' career at the Weizmann Institute of Science [16].

The Weizmann Institute of Science gave priority to the development of the careers of **women scientists.** Following are a few examples:

- Offering national postdoctoral award program for advancing women in science
- Offering comprehensive information on scholarships for Master's and PhD students, as well as postdocs, including travel scholarships, excellence scholarships, and scholarships for advancing women in science.
- Hosting a variety of activities for female students (MSc students, doctoral students and postdocs), including a mentoring program. Students are matched with female scientists who can provide support and encouragement in all matters concerning career advancement and direction.
- Celebrating women researchers by providing a snapshot of the research world through their eyes. In their essays, the authors tell some of their personal stories, and share the challenges and successes that were significant in their careers. One of the celebrations was dedicated to Ada Yonath, a distinguished woman chemist from the Weizmann Institute of Science. She was awarded the 2009 Nobel Prize for Chemistry, along with Indian-born American physicist and molecular biologist Venki Ramakrishnan and American biophysicist and biochemist Thomas Steitz, for her research into the atomic structure and function of cellular particles called ribosomes [17].

2.1.2 Enhancing women scientists' careers at the Israel Institute of Technology

In 2016, the Technion held the first conference for outstanding female high-school students from all over Israel "Tech Women 2016" [18]. Attended by 670 high-school students, the conference was designed to encourage female students to pursue higher education in science and engineering. This first conference was held in honor of International Women's Day in March. It was supported by the Rosalyn August Girls Empowerment (GEM) Mission, which was launched by Rosalyn August Girls Empowerment Mission (GEM) at the Technion in 2016. There are presently over 5,000 female students at Technion, and 32% of the master's students and 44% of doctoral students at the Technion are women.

TechWomen 2020: 6th TechWomen event - featuring "X-Men", and the Israel Security Award [19]

Three hundred outstanding female high school students in science and mathematics attended a virtual event which showcased an array of opportunities flowing from academic studies in science and engineering at the Technion. The event was held courtesy of the Rosalyn August Foundation for the Empowerment of Young Women. August, who lives in Florida, greeted the students from her home, telling them: "I have always felt that women could do whatever they want. I believe in you and your leadership to change the world. You have talent that many women long for, and you are an

inspiration for me. You are the future of the world. I salute you, and I will continue to support this important event."

Advancing Women in STEM at the Zuckerman STEM Program [20]

The Zuckerman STEM Program leads the way in advancing women in STEM in academic institutions. 64% of the 2020-2021 Zuckerman Scholars are women. Each Zuckerman female scholar is making an impact in her field, creating a larger group of her peers and making it easier for other women to be accepted as faculty members.

3. Personal perspective

My research can be described as a *spiral* procedure, referring to the diverse facets of chemistry education, which are largely integrated with one another. The findings on student learning and motivation guided (and guide) me in designing and revising curriculum materials and professional development (PD) programs for chemistry teachers, since they are the key to the success of their students, implementation of new curricular materials, and reforms in education. Therefore, I always put a lot of emphasis on research regarding chemistry teachers' professional development. I myself was a chemistry teacher for 26 years, part of them – parallel to my work at the Weizmann Institute.

My acquaintance with the education system helped me in planning and conducting professional development programs in cooperation with science educators in Israel and abroad. I felt the importance of stressing the point of education through science / chemistry, and not just teaching or learning chemistry. It gave me a huge satisfaction to work with teachers from all over the world, and to try to influence their attitudes towards the way in which chemistry should be taught, as well as their motivation to perform changes in their teaching strategies, e.g., planning lessons in which every individual student will be able to express themselves, and get the opportunity to understand chemistry.

My experience over the years convinced me that loving my profession, and believing in what I am doing, are the main components to success. The passion to research a domain in which I am involved with my mind and with my soul, kept me moving on even when I faced difficulties. Science education research in general, and chemistry education in particular, are composed of many different aspects: curriculum, teachers, students, policy makers, etc. It is always recommended to focus on not too many aspects. However, a researcher should be acquainted with the other components. The process may be full of handicaps! I myself faced quite a lot of challenges, including personal family constraints. However, I was persistent, loved my research and my practical work, developed self-efficacy, and believed in my ability to make a change.

4. Summary

Despite marked advances towards gender equality and empowerment of women, especially during the last century, progress has been slow and disparities persist around the world. Unfortunately, science is not immune to such inequalities, with women representing only a third of researchers globally and often facing gender-based discrimination and a lack of equal opportunities. In order to change the situation, it is necessary to act on both the educational and economic level [21].

Barnard et al. [22] suggest that women have to be able to adopt strategies of survival, and conform to their environment. Otherwise, they may be isolated, accept lower paying positions. They suggest creating social networking groups in order to support women with becoming accepted into the science community. In addition, women should promote themselves and their research on a broader spectrum, and enhance their collaboration and informal mentorship.

At the educational level, there should be a change in the belief that having a family clashes with making a career, as suggested by Wolfensberger [23]. There must also be a significant change in attitude regarding the responsibility for the family members. The educational process should begin from an early age in order to encourage women who decide to combine family life and a scientific career. Women who succeed in this process, and who get support from their families, may serve as a role model to other women. Moreover, supporting young women scientists in their career development is crucial at both professional, economic, and personal levels. The Nordic countries may serve as prime examples for family policy aimed at a gender-equal division of economic responsibility, and focusing on fathers' participation in childcare [24].

In summary, the gender gap is a problem of society (women and men). Reducing the gender gap is a major challenge for the whole scientific community, in developed as well as developing countries, and concerns everyone, men and women. The International Science Council (ISC) funded a unique three-year project in 2017–2019 called, "A Global Approach to the Gender Gap in Mathematical, Computing and Natural Sciences: How to measure it, how to reduce it?" that has provided a wide-ranging view of the issues women face in the sciences and how these issues may be overcome [25]. As mentioned above by Chiu and Ceca [7], the survey led to several recommendations, which may be summarized as: (1) We should actively promote gender balance at every

level of any organization, including its leadership, committees and also institutional events, and (2) We should raise the awareness of the gender gap and include specific actions that aim at reducing it, in all outreach and educational programs and products.

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