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## ISRAEL

### Developed Science, developing Science Communication

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#### 1. Introduction

Israel is a relatively young, small country, with highly developed innovative science and high-tech sectors (Getz, Buchnik and Zatzovetsky, 2020). The Israeli public takes great pride in Israeli science, technology and innovation and is convinced of their importance for national security, prosperity and quality of life (Yaar and Alkalai, 2010). In contrast to the public interest, trust and positive attitude towards science (Israeli Ministry of Science, 2018), the science communication landscape is far from ideal: the Israeli media are rather reserved towards science stories (Barel et al., 2015), infrastructure is slim and based on a few committed individuals, norms within academia do not necessarily support engagement with the public, a culture of public involvement in science-related policymaking is lacking, and government interest in science communication is faint at best. Indeed, a pan-European comparison classified Israel in 2012 as possessing a 'fragile' science communication culture, with weak infrastructure and a lack of science journalists (Mejlgaard et al., 2012).

However, we believe this is changing. In this chapter, we review the history and evolution of science communication in Israel as well as documenting some of the individuals and institutions who are orienting it in exciting new directions. We start with four of the figures who helped shape science communication in Israel in the 20th century; continue with dissemination efforts in print and broadcast media in the 20th century and new media in

the 21st; review the historical roots of our science museums and their major role in establishing public engagement with science; introduce the budding participation and citizen science scene; and conclude with the relatively new phenomenon of science communication as a field of research.

## 2. The founding fathers

Many individuals have shaped the early history of science communication in Israel. Four who played a leading role are Zvi Yanai and Nathan Sharon (popularising science in the media); Peter Hillman (founding science museums); and Azaria Alon (laying the groundwork for environmental mobilisation).

Zvi Yanai (1935–2013) was a unique figure in Israeli science media. After surviving the Holocaust in Italy, he immigrated to Israel, dropped out of high school, volunteered as a paratrooper for his army duty and, after several jobs, became the spokesperson for the Israeli branch of IBM computers in 1970. Yanai was an autodidact and an avid science reader. He transformed IBM's customer magazine into an intellectual science and culture magazine entitled *Machshavot* [Thoughts]. Although it was never sold commercially, the magazine gained popularity and issues were passed from IBM clients to other eager readers. Later Yanai hosted public events, gave talks on scientific issues and published popular science books. In 1993, he was appointed director-general of the Ministry of Science,<sup>1</sup> despite his lack of formal education. He was a popular interviewee on TV and radio and a leading science figure in Israel.

Yanai never practised science, in contrast to Professor Nathan Sharon (1925–2011). Sharon was a highly acclaimed biochemist and biophysicist and was awarded the prestigious Israel Prize in 1994. He immigrated from Poland in 1934 and studied chemistry at the Hebrew University. He was a researcher in the military science corps before earning a PhD from the Weizmann Institute. Sharon was devoted to the public communication of science, as scientific editor of the popular science magazine *Mada* [Science], editor of science features on public radio and science editor for the newspaper *Ha'aretz*.

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1 The Ministry of Science has been through 13 changes of name since 1982 (including 'Science and Development', 'Science and the Arts', and most recently 'Science, Technology and Space'). We have used the term 'The Ministry of Science' when referring to any ministry incorporating the word 'science'.

Professor Peter Hillman (1928–2013) immigrated from South Africa to Israel in 1960 after earning his PhD in nuclear physics at Harvard University. In 1964 he was appointed head of the Nuclear Physics Department at the Weizmann Institute of Science in Rehovot and, in 1967, he changed his scientific focus to neurobiology and brain research.

The idea for the Jerusalem Science Museum germinated in Hillman's laboratory in the Hebrew University (HU) in 1980, and it was supported by the Hebrew University and the Mayor of Jerusalem, Teddy Kollek. Subsequently, Hillman tested new approaches and ideas in a pilot museum at the HU science campus. Through donations raised by the Jerusalem Foundation, the first wing of the Bloomfield Science Museum Jerusalem was inaugurated in 1992. Hillman acted as the museum's first director in a voluntary capacity for three years; and after his retirement in 1995 he continued to act as the museum's scientific director until his death. Professor Hillman was acclaimed for making science accessible to the public. In 2002 he was awarded the science minister's prize for his work promoting and advancing science in the community. Hillman was the first and only recipient of this prize.

Azaria Alon (1918–2014) was among the leaders of the nature conservation movement in Israel. Born in the Ukraine, Alon lived his entire adult life in a kibbutz (a collective community). He was a co-founder of the Society for the Protection of Nature in Israel with Amotz Zahavi and awarded the Israel Prize in 2012. In the 1950s Alon started broadcasting about nature and the environment on public radio, which led to a weekly radio program called *Encounters with Animals and Plants*. He continued weekly broadcasts on Kol Israel public radio for more than 50 years. Alon wrote popular books about Israeli nature and wildlife and led campaigns to preserve the environment. His efforts raised generations of nature lovers in Israel, as well as increasing awareness of the importance of public engagement with science and the environment.

### 3. Disseminating science

#### 3.1. A brief history of science in the Israeli media

Modern Hebrew is a language revived in the 19th century that has had to invent its modern scientific vocabulary. This process involves adapting foreign words and inventing new ones. So 'meiosis', for example, either becomes '*miyosa*' or '*halokat haf-hata*', which means 'divide which decrease'. An example of a new word is '*galai*' for 'detector' (for science glossaries, see the Hebrew Academy site: [en.hebrew-academy.org.il/](http://en.hebrew-academy.org.il/)).

Written science communication in Hebrew is rooted in the Haskalah, or Jewish Enlightenment movement. During the 19th century, scientific books using almost biblical terminology were published in central and eastern Europe, mainly with the aim of preparing youngsters for the modern era. A new scientific vocabulary had to be invented.

Science communication in the Hebrew media existed before the establishment of the State of Israel in 1948. Several Hebrew daily and weekly newspapers were published in Palestine under the British mandate (1922–48), and some covered science. For example, the daily *Davar* published a translation in 1935 by British entomologist Evelyn Cheesman about her research voyage to Papua, under the headline ‘Large Insects and Small People in the Land of Giant Worms’.

In subsequent decades, although Israeli newspapers reported regularly about science (Golan, 1998), coverage was small compared to newspapers in many other countries. The exception is the quality daily *Ha’aretz*, which still covers more science than any other Israeli newspaper (Barel et al., 2015). None of the major dailies publishes a regular science section, and almost none employs a full-time science reporter. Their online presence usually includes a ‘science channel’ that relies heavily on external sources (universities’ public relations, non-government organisations) for content.

Israeli public radio also came into existence before the State of Israel. Kol Yerushalayim [Voice of Jerusalem] started broadcasting in the 1930s. By 1948 it had changed its name to Kol Israel [Voice of Israel] and had longer broadcast hours (although 24-hour broadcasting only started in 1991). During the 1950s Kol Israel aired brief science features in news programs such as *What’s New in Science and Technology?* (Mann, 2008). The first regular science program was *Encounters with Animals and Plants*, aired weekly from 1959 to 1963.

In 1950 the Israeli army (IDF) set up a military radio station Galei Zahal [IDF Waves]. It was popular with the general public and became another public station, although still operated by the army. In 1977, the Israeli military broadcasting service joined Tel Aviv University to broadcast *University on Air*, a daily slot of academic courses running over three months. Many courses were complemented by popular science books (Boas and Baram-Tsbari, 2016). The program is still aired in a different format today and has contributed to the interest and education of many people in Israel. Dozens of lectures were printed in accessible language and gained wide audiences during the last quarter of the 20th century.

Israel public television started in 1968, shortly after educational television (1966). In 1968 public television began broadcasting a monthly prime-time science magazine program, *Mada va'Daat* [Science and Knowledge]. This was followed by a prime-time weekly science magazine, *Tazpit* [Observation] and a science magazine aired by Israeli television in Arabic called *Innovations and Inventions* that ran from 1977 to 1996 (Katz-Kimchi, 2012). All were very popular, but science coverage has been considerably reduced since the introduction of commercial television in Israel in the 1990s. In recent decades, science magazines are confined to educational TV and designed for children and adolescents. One exception is *Science News*, a science magazine put to air over five years (2003–08) on a private cable channel focused on culture, nature and science. In addition, there is generally little science coverage in news programs. An exception was *London et Kirschenbaum*, a daily show on commercial Channel 10, which topped the list of science items per show on Israeli television during its lifetime 2003 to 2019 (Armon et al., 2017; Armon and Baram-Tsabari, 2017; Barel et al., 2015). A bright corner in televised science is the new Israeli Public Broadcasting Corporation (on air since 2017), which puts more emphasis on science and academic knowledge than its commercial counterparts.

Over the years there have been several attempts to publish printed science magazines for adults. The most successful was Nathan Sharon's *Mada*, published six or 12 times a year between 1965 and 1991 by the Weizmann Institute, with many senior science professors contributing. Several other magazines were also published in Hebrew, including *Galileo*, which was published for 20 years starting in 1993. *Galileo's* science editor was Zvi Atzmon (born 1948), a neurobiologist and a poet who was the former editor of *Mada* and *Ladaat* as well as literary magazines. During the 1990s, *Galileo* was the most successful popular-science magazine in Israel but ceased publication in 2016 as a result of the print media crisis. Another victim of the media crisis was *Odyssey – A journey between ideas*, inspired by Zvi Yanai's *Machshavot*, which was published four times a year 2008–15. Since the 1990s, international science magazines have been published in Hebrew. *Popular Science* (1994) and *National Geographic* are still published but *Scientific American Israel* (2002–17), a bimonthly offering a selection of translated and original Israeli articles, has moved online.

Educational magazines for children and teenagers were popular in the second half of the 20th century, including *The Young Technician* (1945–65), *Ladaat* [To Know] for teenagers (1970–91), the environmental children's magazine *Pashosh* [Warbler] (1976–2004), and *Kimat Alpaim* [Almost 2000] (1994–2000). *Young Galileo*, *Galileo's* companion magazine for children is published to this day. A new addition is *Frontiers for Young Minds* in Hebrew, an open-

access online scientific journal written by scientists and reviewed by a board of adolescents. This was the first time this online magazine has been published in a language other than English.

In the 1950s and 1960s, encyclopedias played an important role in communicating science to the Hebrew reader. Most popular science books published in Israel are translations of bestsellers in English. There were very few popular science Hebrew titles during the first decades of Israel, but this began to change in the 1980s, when a translation by Emanuel Lottem of Stephen Hawking's *A Brief History of Time* was the first popular science book in Hebrew to have commercial success. Other successful books followed, but today the field is weakening and only a handful of new books are published each year. An outstanding exception is historian Professor Yuval Noah Harari's *Sapiens: A Brief History of Humankind* (2011, 2014), based on an academic course at Hebrew University. It became a worldwide bestseller, as did its sequels.

### **3.2. Various forms of science in the Hebrew new media**

New media, including podcasting, Facebook, blogs, YouTube and sites providing science content for media outlets have been a major force in science communication in Israel over the last decade.

In the early 2000s, Israel's science journalism was written by a handful of in-house science journalists, and published by a few popular science magazines and two to three popular science websites such as *Hayadan* [The Erudite]. *Hayadan* was founded in 1997 by reporter Avi Blizovsky and was a milestone in Israel's online popular science publishing. It serves as a database of popular science articles, news items, interviews and reviews over the last 20 years, containing over 20,000 items on 550 subjects in science and technology. Entries are written by Blizovsky and hundreds of contributors, and it is still updated daily.

The rise of Web 2.0 has increased the number of science blogs authored by graduate students, scientists or science enthusiasts on topics such as space, diseases and insects. One example is Roey Tzezana's blog, *Ha Madrich La'Atid* [Guide for the Future]. Figures such as Yaron Assa and Gilad Diamant operate forums and blogs criticising pseudoscience, media scares and inaccurate science reporting in news media. These bloggers and informal science communicators set the stage for more formal online science communication.

In Israel, the main social network for science communication is Facebook, although there is some activity on Twitter, YouTube and Instagram. One Facebook page is run by PhD biology student Yomiran Nissan, *Mada Gadol Baktana* [Little Big Science], the largest popular science Facebook page to date. This page was started in 2013 by Ofer Sadan as a 'jokes and anecdotes' page and began to attract followers when it published longer posts about studies and the science behind everyday life. Today the page has more than 125,000 followers. Their most popular posts are 'debunking posts' about misleading articles on news websites or about health scares. One of *Mada Gadol Baktana's* posts that had a great impact was a long response to a supposedly investigative report on the side effects of various drugs. The report, broadcast on one of Israel's commercial TV networks, conducted little or no fact-checking and did not consult a science advisor. After scathing criticism on the Facebook page (and other similar Facebook pages), some media outlets started to seek advice from scientists and physicians for their shows. *Mada Gadol Baktana* is today an NGO with 45 scientist volunteers promoting science mostly through digital media.

Another recent online science communication model is the NGO *Midaat* [Informed]. In the summer of 2013, Israel experienced a silent polio outbreak. The Ministry of Health decided to re-vaccinate children, triggering virulent debates in the media and social networks. Science communicators started advocating and answering questions from concerned parents (Orr et al., 2016; Orr and Baram-Tsabari, 2018). Most activity was on Facebook, where long discussions and debunking of anti-vax claims were led by Dr Keren Landsman and Adva Lotan. Along with others, they subsequently founded *Midaat* to deal with responsible communication of medical information, especially concerning vaccinations. *Midaat's* activity is mostly on digital platforms (Facebook, YouTube and Twitter) and the organisation offers accessible medical information and free advice to journalists. *Midaat* also has a column on other health issues published on the website of *Ha'aretz*.

Science podcasts are relatively new in Israel. The first was in 2007, a science and technology history podcast called *Osim Hisotia* [Making History] produced by Ran Levi, an electronics engineer. This amateur podcast has grown to a company producing 11 podcasts on different topics, with roughly 750,000 episode downloads each month. Since 2017, the broadcasting corporation and the former educational TV channel have reached out to hire podcasters in many fields including science.

**Box 19.1: Organised science communication effort**

A telling example of the importance of organised science communication took place on 27 June 2018. One of Israel's commercial TV networks published an anti-vaccine video filled with misinformation on their Facebook page. About 24 hours later, the TV network took it down, mostly due to the efforts of *Midaat*, which refuted every part of the video on Twitter and Facebook and contacted the TV network to warn them of the dangers of spreading anti-vaccination propaganda. At first, the producers of the video asked *Midaat* and other science communicators to help create a counter-video to 'show both sides' of the vaccine debate, but *Midaat* refused, explaining that this would only create a 'deceptive balance'. *Midaat* worked with other organisations to make sure that there would be no debate and no new videos showing 'the other side' on that TV network. On other networks, news websites and social networks there were many posts and articles criticising this video. As a result, the TV network published a retraction stating that they had no knowledge or expertise about vaccines and retracting it was the ethical thing to do to protect the public. In addition, *Midaat* recently aided in forming a bill, stating that information on measles should be made accessible to the public, resources should be allocated to public health infrastructure and incentives should be offered to promote vaccination rates against measles.

In the last decade, scientific institutions and projects are slowly associating themselves with individual online actions, and there are growing numbers of collaborations between science communicators and the media. In 2006, the Davidson Institute of Science Education (the educational arm of the Weizmann Institute of Science) established the Davidson Online website for popular science. This website employs and trains dozens of graduate students as popular science writers and has published thousands of articles achieving millions of views each year. This was the first organised online initiative of science journalism based on scientist-writers in Israel, and had 3.65 million unique views in 2018.

In 2014 the Israel Society of Ecology and Environmental Sciences created *Zavit* [Angle], a science news agency offering popular science items in the field of ecology and environment. The aim of *Zavit* is to provide media with accurate, up-to-date stories about environmental issues in Israel, using environmental scientists from all Israeli universities and research institutions in public outreach. *Zavit's* editorial staff supplies journalists with new stories every day, and journalists can choose stories independently. Following a similar rationale, in 2015 the Davidson Institute opened the Department for Science Communications to promote scientific items to the media based on content published by Davidson Online.

The *Zavit* and Davidson projects aim to promote science in the media, but they differ in the way they address journalists and the topics they cover: *Zavit* covers mainly environmental topics, while Davidson covers all science disciplines. Both initiatives reach print, online, TV and radio in Israel, and interest readers outside the circle of science and environment enthusiasts with stories on sport, the economy, tourism and food. In 2018 the Davidson Institute published 728 science items, 305 of which were re-published on general news websites, on TV (70 items) and radio (150 items).

The year 2018 saw two new popular science websites in Arabic: Davidson aired an Arabic version of their popular science website aiming to reach science teachers and students; and Arab life and exact science professors collaborated to air a new popular science site with original content in Arabic called *Al-Maram*.

In both the Davidson Institute and *Zavit*, articles by scientists are edited by science writers and published in the media. A long trust-building process taught editors and reporters from the mass media that stories from Israel's science and environment news agencies are scientifically accurate and written in a language their readers understand (with similar engagement outcomes to those of items by organic reporters (Barel-Ben David et al., 2018)). But this is a double-edged sword. On the one hand, more high-quality science items are being published in the media and reach a broader public that would not actively seek them. On the other hand, 'feeding the media' with science items at no cost may act as a disincentive to media organisations to employ in-house science reporters.

#### **Box 19.2: Impact on policy**

There are many examples of scientific items promoted by the media to influence the public agenda and promote data-based decision-making in health, education and the environment. A striking example is an item published by *Zavit* reporting a study linking drinking of desalinated water and an increased risk of heart attacks. The study was originally presented at a small professional conference and was not meant to be published in the media at all. It caught the attention of *Zavit's* reporter who attended the conference and understood its significance. A story was written that same day and sent to the health correspondent of Israel's leading news program. The item opened the leading evening news show that day, created a public outcry and eventually attracted the attention of Prime Minister Benjamin Netanyahu, who ordered a special committee to look into these findings and the funding of a pilot program to try solving the problem. This example shows how the work of an independent, science-based news agency can affect the country's environmental agenda and make a real impact on its people's lives.

## 4. Public engagement activities

### 4.1. The history of science centres and museums in Israel

The history of interactive science museums in Israel starts with researchers who considered that increasing the numbers of those interested in science was a national priority and one of the duties of academic institutions. Professor Amos de Shalit and Professor Gabi Goldring from the Weizmann Institute of Science started the *Science Camp for Science-Oriented Youth* in 1964, on the grounds that the research community had an obligation to encourage the scientific education of the younger generation.

When Professor Peter Hillman, the founding director of the Bloomfield Science Museum in Jerusalem, visited the San Francisco Exploratorium he heard Exploratorium founder Frank Oppenheimer's statement: 'The whole point is to make it possible for people to believe they can understand the world around them'.<sup>2</sup> In 1981 with a group of scientists, Hillman began the construction of exhibits based on the principles of the Exploratorium. The 'Simply Science' centre was established in a hall allocated by the Hebrew University in the National Library building on the Givat Ram campus. Ten years later, this initiative led to the building of the Bloomfield Science Museum Jerusalem on the National Museums Mall in 1992.

In 1983, Professors Yitzhak Oref and Tzvi Dori<sup>3</sup> from Technion's Chemistry Department began dreaming of a science museum in Haifa. They built interactive exhibits like those in the Exploratorium and in 1983 displayed their efforts in a hall provided by the Technion. The Haifa museum moved to the historical Technion building in 1986 as the MadaTech—National Museum of Science and Technology, Daniel and Matilde Recanati Center (originally called the Technoda).

At the Weizmann Institute in Rehovot, as part of the programs of the Youth Activities Department operating since the mid-1960s, the department's director Dr Moshe Rishpon<sup>4</sup> developed interactive exhibits displayed in the institute's outdoor areas. The Garden of Science, which later became the Clore Garden of Science, opened in 1998. The Science Garden has twice

2 Discussions held by Maya Halevy with Professor Peter Hillman.

3 An interview held by Dr Ronen Mir with Professor Tzvi Dori and Professor Rivka HaShimshoni.

4 Comments by Dr Moshe Rishpon on the origins of the Science Garden, July 2018.

been awarded a prize for innovation from America's Association of Science and Technology Centers (ASTC). The first prize was awarded in 1999 for the concept and the second in 2013 for the Ecosphere in the park.

In 2013, Israel's fourth science museum, the Carasso Science Park, opened in Beer Sheva under the auspices of Ben Gurion University, the Beer Sheva city council and the Rashi Foundation. They saw a science museum as a crucial step for the development of science education in southern Israel. In 1990, all this activity led the Israeli branch of the International Council of Museums (ICOM) to initiate a conference with the museum department of the Ministry of Education and Culture.<sup>5</sup> Complementary areas of activity were presented: Professor Hillman from Bloomfield said the most important goal was establishing a scientific culture in Israel. It should be open to the public and encourage curiosity and inquiry into scientific principles and natural phenomena to connect science to daily life. Professor Tsvi Dori of Haifa noted that the main goal of the Haifa Science Museum was to operate as an educational and learning centre for the formal education system. Dr Neta Maoz from the Weizmann Institute focused on the strongest students to expose them to the latest research and support those the education system had failed.

Thirty years later, these issues continue to challenge the world of science museums and to define their activities. The specific foci of each museum still reflect these early distinctions, although goals and audiences have widened substantially for all.<sup>6</sup>

There are also nature and natural history museums in Israel. The newest is the Steinhardt museum in Tel Aviv, which opened to the public in 2018. Smaller nature museums can be found in Jerusalem, Maayan Baruch, Ein Harod and Kibbutz Dan.

Along with the original development of exhibits and exhibitions and supplementary educational activities, Israeli science museums have gone beyond the 'walls' of museums. The Clore Science Garden initiated science festivals, the Bloomfield Science Museum promotes and develops the Science Theater in Israel, MadaTech opened the first 3D movie theatre in Israel,

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5 *Science and Technology Museums*, summary of a one-day seminar, Israeli Association of Museums and the Museums Department of the Cultural Administration of the Ministry of Education and Culture, Tefen Industrial Park, 13–14 March 1990.

6 Israel's first science museum was actually built in Tel Aviv in 1958 in one of the pavilions of the Ha'aretz Museum (today the Eretz Israel Museum). The science museum operated under the management of Ivan Moskovitch who, along with Shabtai Levy, developed and built the first interactive exhibits in Israel. The museum closed in the mid-1960s and parts of its collection moved to the MadaTech archive in Haifa.

and the museum produces and screens unique scientific films. Science cafés and ‘Science in Movies’ encounters are initiated by the Bloomfield Science Museum and held at public locations. The Maker Faire is a yearly event at the Bloomfield Science Museum, exposing the public to the ‘makers’ culture; and the Carasso Science Park runs a scientific youth movement. Israeli science museums now operate as a national network, promoting the National Science Day and National Space Day in collaboration with the Ministry of Science. They also develop special programs with the Ministry of Education to provide pedagogical support for STEM in the formal education system.

In addition to their work in Israel, Israeli science museums have helped set up science museums in developing countries. The Bloomfield Science Museum Jerusalem collaborated with the Città della Scienza in Naples to build the first Palestinian Science Museum on the Abu Dis campus of Al-Quds University, funded by the European Union. For several years, the MadaTech in Haifa has helped establish a network of science museums in Ethiopia.

The special connection between Israeli science museums, research and institutions of higher education continues to be one of the outstanding characteristics of the science museum network in Israel. Institutional oversight provides these museums with advice and assistance from active researchers and serves as a basis for exhibitions and public programs. The proximity to research institutions makes it possible to employ science and engineering students as instructors/guides. This has several benefits: they serve as role models for the museum’s young visitors, while being trained in science communication and acquiring skills in science-based professions of value in their future professions.

The science museums were established with philanthropic funds and their development depends on philanthropy. They receive some funding from the Ministry of Culture and Sport, like other Israeli museums. The government provides funding for specific educational programs through contracts and calls. Similarly, the Israel Society of Ecology and Environmental Sciences is funded mainly by philanthropic foundations, but also by joint ventures with government and government agencies. A survey in 2011 showed that there were no national funding programs that specifically target science in society issues (Mejlgaard et al., 2012).

## **4.2. Public engagement and outreach initiatives**

From 1949 to 1998 no major institution dealt with public engagement with science or science communication. This included the Israel Academy of Science, the Council for Higher Education, the Ministry of Education, the universities, the Israel Science Foundation (established in 1992) and even

the Ministry of Science (only created in 1982). Instead, their efforts regarding public understanding of science were targeted towards science education. But in 1999 senior faculty members from various universities established the Bash'ar [At the Gate] association, with the aim of increasing the involvement of Israeli academia in public discourse and society. The organisation operates in the geographic and social periphery of the State of Israel, and its activities include sending lecturers to schools and providing expert answers to teachers.

A few major figures (including some within official bodies) made pioneering individual efforts to reach out and engage wider publics, including Israel's first president Professor Chaim Weizmann and Professor Aharon Katzir, winner of the Israel Prize, who made social and political efforts to promote science at the national level. Professor Alex Keynan and his wife Malka joined Professor Joshua Jortner, President of the Institute for Advanced Studies in the Humanities (IASH) at the University of Edinburgh to initiate the Batsheva de Rothschild Fund, which hosted two seminars dedicated to encouraging public engagement activities (in 1982 and 2000).

The year 1998 was a turning point. Hemda, the Science Education Center of Tel Aviv-Yaffo funded by the Rothschild Foundation and the Tel Aviv municipality, initiated a season of public lectures. When Hemda turned to Tel Aviv municipality for support it was met with scepticism and doubts about the public interest. Nevertheless, Hemda went on to host hundreds of popular lecturers throughout the 2000s. In 2002, Hemda's director Dr Tehilla Ben Gai was invited by the British Council to visit science media centres in the UK. This led to the Science–Culture project, directed by Dr Eitan Krein. At the same time, the Davidson Institution of Science Education, led by Professor Haim Harari, started the Frontiers in Science meetings and workshops; and Professor Itzhak Parnas in the Hebrew University initiated the 'Why' monthly lecture series for young adults and the general public (2000–17).

Other public engagement events followed. These included Famelab, a contest 'imported' by the British Council Israel's science officer Sonia Feldman from the science festival in Cheltenham and ran in Israel from 2007–12 and in 2015; Researchers' Night, an event involving public activities in research centres and science museums and sponsored by the EU and the Israeli Ministry of Science (2007–present); the annual Science on Tap events led by Weizmann Institute President Professor Daniel Zaifman and PR director Yivsam Azgad (2009–14) (Rehovot), 2011–present (Tel Aviv); Einstein on Trains that later became Professors in Slippers organised by the Hebrew University (2009, 2012–15); the Wolf Prize Public Events initiated by the Wolf Foundation and led by its director Dr Liat Ben-David (2012–16); and the newest addition, Davidson's S-Factor science talent contest.

There are numerous public lectures, youth science festivals and shows initiated by universities, colleges and municipalities. In the last 20 years, Israeli versions of science projects from around the world such as Famelab, Scientific PechaKucha, Science-TED and others have been produced. The private initiative Think & Drink Different was started in 2012 by a former history teacher Tuval Rozenwasser. It offers popular science lectures, along other topics such as politics and art. This initiative has expanded from 16 locations across Israel to New York. The initiative WIZE was established in 2011 as a social entrepreneurship project. It is now an NGO promoting public interest in science, innovation and technology through bar lectures across the country. These lectures, also by other providers (e.g. TalkHouse), have become a popular way to spend a night out.

## 5. Public participation in science

Much of the early public engagement in Israel can be attributed to the activities of environmental movements active in Israel since the 1950s. The main movement is the Society of Protection of Nature in Israel (SPNI), founded in 1953 by Azaria Alon and Professor Amotz Zahavi, who responded to a deep public need to preserve Israel's flora and fauna (Tal, 2002).

The environmental movement in Israel can be broadly divided into three periods, in line with trends in Israeli civil society: the state-oriented period (until 1990), the civil society-oriented period (1990–2007); and the partnership-oriented period (2007–present) (Greenspan, 2016; Orenstein and Silverman, 2013). The two first stages corresponded to identification and then conflict with government agenda, whereas the third is characterised by coalitions and partnerships between NGOs, government agencies and businesses. The current partnership-oriented period sets the groundwork for increased public engagement and participation in promoting scientific, social and environmental agendas, still in its infancy in Israel (Greenspan et al., 2016).

Research shows that participation mechanisms are not well developed and have not influenced the decision-making structure in urban planning or health care systems (Alfasi, 2003; Efron and Davidovitch, 2011; Miron-Shatz et al., 2012). This is due in large part to the structure of public participation, which is generally based on objections and appeals rather than representation, consultation and deliberation (Alexander, 2008). In fact, public participation in these issues is generally passive in that citizens are typically informed rather than engaged (Efron and Davidovitch, 2011).

Changes in public involvement may come from the new *Strategic Planning for Israel Towards 2048*,<sup>7</sup> which includes public participation components, the increased consideration of social justice issues in local planning, partnerships and joint programs between local authorities and residents, and the emergence of citizen science (Sadan and Churchman 2012; Golumbic et al., 2015). An example of a public participation process revealing many of the underlying tensions is the participatory health impact assessment (HIA) report on the danger of living near a national hazardous industry site in southern Israel (Negev et al., 2013). The assessment helped uncover health issues known to the local community but not addressed by urban planning. It highlighted the difficulty of reaching diverse groups in society, the conflicting views of the stakeholders, the uncertainty and finally the challenge of making the results impact a society that predominantly acknowledges experts' knowledge (Negev et al., 2013).

Other recent public participation initiatives include the SPNI urban community projects for promoting quality of life by developing public spaces and involving residents in planning processes; and citizen science projects such as 'Sensing the Air' to facilitate air-quality research through public involvement in collecting and interpreting meaningful air-quality data (Golumbic et al., 2019). Together, these and similar activities constitute the basis for active and influential community participation, public awareness and public engagement (Greenspan et al., 2016).

## 6. Researching and teaching science communication

### 6.1. Terminology

Science communication is a nascent academic field in Israel, so new that until recently it did not have a name in Hebrew. The first and second Israeli conference in science communication in 2009 went under the name of Mada Batikshoret, which translates as 'science in the media'. Following advice by Uri Aviv, director of the Tel Aviv International Festival of Science Fiction and Fantastic Genre Films, Baram-Tsabari and Baer presented 'a translation challenge' to a forum of translators on Inga Michaeli's blog *Translating the Globe* in February 2011, asking them to suggest a Hebrew term for 'science communication'. Many suggestions were made, playing with words such as information, explanation, messages, popular science, science in culture, scientific communication and more. The suggestion that was chosen is *Tikshoret Hamada*, suggested by the

<sup>7</sup> *Israel 100: Planning now for 2048 multi-institutional panel* (israel100.org).

translator Ofra Hod and by the editor Ruth Almagor-Rimon. Verbatim it translates as ‘communication of science’. The main problem with the term is when using it as a verb and as an infinitive, *Le’taksher*. This unfortunately has been taken over already by the parapsychological sector, which uses it to describe communicating with aliens, the dead and other fantastic beasts. Therefore, the verb being normally used for communicating academic knowledge is *le’hangish*, a word that stems from the word ‘accessibility’.

## 6.2. Academic degrees and courses

Although science education, history, sociology and the philosophy of science are well-established disciplines in Israeli academia and there are many master’s and PhD theses carried out in related fields, to date there is only one science communication research group. The Applied Science Communication Research Group at the Technion – Israel Institute of Technology is led by Associate Professor Ayelet Baram-Tsabari and operates within the Faculty of Education in Science and Technology. There is still no specialised department for the field. The group focuses on empirical examinations of how non-scientists navigate science in their everyday lives and supports scientists in learning how to communicate effectively. The group is interested in bridging science education and science communication scholarship, and studies expressions of science literacy in online public engagement with science environments. Its alumni are the first science communication graduates in Israel.

The first academic course to teach STEM students to communicate science began in 2009 at the Technion. Professor Baram-Tsabari still leads the course today (for the syllabus see Baram-Tsabari and Lewenstein, 2017). Additional courses include a graduate seminar in science communication (since 2014) and a practicum course in science communication (since 2017).

## 6.3. Conferences and workshops

### 6.3.1. National conferences

The first national science communication conference, ‘Science in the Israeli Media: from Apathy to Dialogue’, took place on 16 March 2009 at the Technion in Haifa. The event was organised by Professor Baram-Tsabari, and although the potential attendance was a complete unknown prior to the conference, it ultimately attracted 85 scientists, science journalists, formal and informal science educators and university spokespersons. This confirmed an assumption that many people are interested in this topic. An important institutional outcome was the collaboration between Technion’s researcher Baram-Tsabari and Avital Baer, (then) Director of Media and Public Relations for the Israel Academy of Sciences and Humanities.

In an effort to establish and consolidate the budding Israeli science communication community, Baram-Tsabari and Baer have organised five more national conferences with various academic collaborators. The second Israeli Science Communication Conference took place immediately after the first, on 24 December 2009 in Jerusalem. It was part of the National Academy's 50th anniversary events and the first conference to involve international speakers.

The third conference was the first to have an academic track where studies were presented as well hearing about science communication initiatives.

The fourth Israeli science communication conference was a two-day event and marked Technion's Cornerstone Centennial. It was the first to include master classes for scientists and science writers. The fifth conference entitled 'Mada, Yeda, o Dea' [Science, Knowledge or Opinion] in 2013 was at Tel Aviv University's Edmond J. Safra Center for Ethics. A dozen international science journalists attended it as part of the first science journalist mission to Israel sponsored by the National Academies and the Jerusalem Press Club.

In parallel, with support from Professor Ruth Arnon and Dr Meir Tzadok, Baram-Tsabari and Baer founded the Academic Forum for Science Communication in Israel at the National Academy of Sciences. This forum allowed key actors to meet and discuss critical science communication-related issues. It led to the sponsorship of a science communication workshop and educational tour in London in February 2015. Fifteen leaders from the science communication community in Israel participated and the meeting was sponsored by IASH and the British Council.

The sixth Israeli science communication conference at the Davidson Institute of Science Education in 2015 built on the success of earlier events, showcasing local science communication initiatives and a second day of master classes for journalists and scientists, and academic sessions presenting peer-reviewed research.

As the field has matured in Israel, specialised conferences have been organised by the Davidson Institute and the Israeli Young Academy. The Davidson Institute ran three events in 2016, 2017 and 2019 called 'How to Connect People with Science', designed to serve as a meaningful bridge between practitioners and the public. 'Pass it Forward' was organised by the Israeli Young Academy and the Davidson Institute in 2018, bringing together humanities, social sciences and STEM communicators to discuss mutual challenges.

### 6.3.2. International conferences

In 1982, Hillman organised the first international science communication seminar in Israel: the Batsheva Seminar was attended by an invited group of science museum directors from leading science museums in the United States and Europe and researchers from Israel's higher education institutions. It was held under the auspices of the National Academy of Sciences and was the first in a series of meetings that resulted in the construction of science centres in Israel.

In 1998, 10 international science museum directors attended an international seminar to promote the building of a new science museum in the south of Israel. Along with representatives of science museums in Israel, they discussed the challenges facing all the science museums and formulated recommendations. These became the guidelines for the Carasso Science Park, which opened in 2013.

A further meeting in 2000 at the Bloomfield Science Museum set up an Israeli umbrella organisation for all bodies and institutions to create a fruitful dialogue between the public, scientists and authorities around the issue of science and community. The seminar 'Understanding Science' adopted as their model the British Committee on the Public Understanding of Science (COPUS), founded in 1985 by the British Association for the Advancement of Science (BAAS), the Royal Institution and the Royal Society.

### 6.3.3. Science communication workshops

In 2011, Professor Bruce Lewenstein from Cornell University led the first science communication workshop for scientists in Israel at the Technion. Other international visitors followed. In 2012, Dr Neta Lipman of the Israel Society of Ecology and Environmental Sciences organised science communication workshops for members of Mimshak, a prestigious postdoctoral program training young scientists to apply science in government administrations. Since then, general workshops for environmental scientists focusing mainly on interactions with the media have been held regularly, attracting an audience of hundreds of scientists.

Since 2010 there has been a growing demand for science communication workshops, fuelled by the needs of individual scholars who wish to enrich their research groups, alongside funders, NGOs, the high-tech sector and research institutions. The Israel Young Academy, the Technion applied science communication group, the Alan Alda Center for Science Communication and the Zukerman foundation have all been involved in providing science communication training, as well as private providers.

## **6.4. National and governmental programs and funding schemes**

Currently, there is no funding scheme or program specifically earmarked for science communication research or practice in Israel. However, a 2018 grant call by the Ministry of Science addresses science policy, and specifically included a subsection on science communication funding. The Israel Science Fund (ISF) and the Israeli Ministry of Science fund science communication research under their general schemes. Recently, the Ministry of Science asked all grant recipients to dedicate a small sum of the grant to public outreach activities. Recipients of ISF grants are now asked to write a lay summary of their findings.

## **6.5. Public understanding of science and attitude surveys**

Since the year 2000, public attitudes toward science have been irregularly assessed by the Samuel Neaman Institute at the Technion, and usually compared to the extent of pride and trust in different institutions (Yaar, 2000, 2006; Yaar and Alkalai, 2010). The Samuel Neaman Institute also sponsored the only survey so far of science coverage in the Hebrew media (Barel et al., 2015).

In 2012, the Israeli Ministry of Science began administering an annual survey of public attitudes toward science in a representative sample of Hebrew- and Arabic-speaking Israeli adults (Smith and Faniel, 2014). Beginning in 2014, the ministry's spokesperson Libi Oz consulted Baram-Tsabari on adding questions to the survey, resulting in a new module on public understanding of science based on questions reported by the US National Science Board's Science and Engineering Indicators (Israeli Ministry of Science, 2015, 2016, 2017, 2018). Attitudes and knowledge are analysed according to gender, age and education, but also regarding first language (Hebrew spoken by Jews or Arabic spoken by Muslims, Christians and Druze minorities). The results are also reported as a function of degree of religious observance among the Jewish population. The main findings are published as a press release and as a full report on national science day, Albert Einstein's birthday. Generally speaking, the Israeli public takes great pride in Israeli science, technology and innovation and is convinced of their importance for national security, prosperity and quality of life (Israeli Ministry of Science, 2015, 2016, 2017, 2018; Yaar and Alkalai, 2010). Overall, science content knowledge levels are comparable with US statistics (Table 19.1), with major disparities between secular and religious people as regards the origin of the universe and evolution (Israeli Ministry of Science, 2018).

**Table 19.1: Percentage of adult representative sample (n = 500) correctly answering true/false and other questions, by gender, religiosity and sector.**

	All		Gender		Religiosity (Jewish sector)			Sector	
			F	M	Secular	Traditional	Religious and Ultra-orthodox	Hebrew speakers	Arabic speakers
Horoscope is an exact science	89	87	92	92	92	90	91	91	79
The centre of the Earth is very hot (True)	84	84	84	84	89	84	76	85	78
The continents on which we live have been moving their locations for millions of years and will continue to move in the future (True)	82	84	81	89	89	85	61	83	80
All radioactivity is man-made (False)	73	67	80	77	77	73	77	76	59
It is the father's gene that decides whether the baby is a boy or a girl (True)	73	80	65	77	77	72	65	73	71
According to astronomers, the universe began with a big explosion (True)	70	66	74	81	81	70	54	73	54
Human beings, as we know them today, developed from earlier species of animals (True)	64	62	67	88	88	60	21	68	44
Electrons are smaller than atoms (True)	64	63	65	63	63	60	64	62	73
Lasers work by focusing sound waves (False)	60	55	65	61	61	62	62	61	53
The universe began with a huge explosion (True)	60	55	65	80	80	52	21	61	51
Antibiotics kill viruses as well as bacteria (False)	52	49	55	62	62	42	55	55	35
Does the Earth go around the Sun, or does the Sun go around the Earth? (Earth around Sun)	81	77	86	79	79	79	80	79	88
Do you agree with the statement 'Earth is getting warmer due to human activity'?					Secular	Traditional	Religious and Ultra-orthodox	Hebrew speakers	Arabic speakers
Yes, the Earth is getting warmer due to human activity (True)	78	NA	NA	84	84	78	63	78	78
No, the Earth is getting warmer but not due to human activity (False)	4	NA	NA	1	1	1	5	2	15
No, Earth does not get warmer (False)	12	NA	NA	10	16	23	14	14	3

Source: Israeli Ministry of Science (2018).

## 7. Concluding remarks

Science communication in Israel is thriving. Even though it lacks national funding and institutional infrastructure, it is spread widely across the country through various outlets. Science was not a priority in the main media outlets of the 20th century, and the media crisis of the 2010s further diminished the availability of quality science coverage in print newspapers, magazines and on television. However, individuals and institutions are successfully working today to fill in this void with dissemination, engagement and participation-based initiatives, alongside university-based research, research–practice partnerships and training opportunities for scientists. The four science museums in Israel today serve as hubs for science communication for people from all Israeli sectors and are spread from north to south. All operate under the academic auspices of one of the leading research institutions.

Alongside this exciting capacity-building among local science communicators, the next stage should be greater involvement and interest in science communication by funders and leaders of science in Israel, as a means to address social problems and to inform science policy (rather than marketing). These institutions have yet to play a major role in changing norms and practice among Israeli scientists.

There is still a long way to go, but while Israel's science communication culture was classified in 2012 as 'fragile' by Mejlgaard and others, judging today in 2020 by the same criteria we would classify it as 'alive and kicking'.

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## Timeline

Event	Name	Date	Comments
First interactive science centre founded.	Simply Science – Hebrew University Jerusalem	1982	1986: MadaTech, now Israel National Museum of Science, Technology and Space, Haifa
First national (or large regional) science festival.	Science and Music Festival at the Weizmann Institute	2000	
First university courses to train science communicators.	Technion – Israel Institute of Technology	2009	Taught by Professor Baram-Tsabari
First master's students in science communication to graduate.	Maya Kallir-Meyrav	2014	Topic: the learning of early career scientists in a science communication course
First PhD students in science communication to graduate.	Dr Ran Peleg	2013	Topic: Theater as a venue for science education and communication
First national conference in science communication.	'Science in the Israeli Media: From Apathy to Dialogue'	2009	

Event	Name	Date	Comments
First significant initiative or report on science communication.	'Towards evidence based policy in science communication in Israel'	2015	Report led by Yael Barel on science coverage in Hebrew language print, broadcast and online, 2013–14
National Science Week founded.	Occurs around Science Day on 14 March	2001	The National Science Day was announced by the Knesset (Israeli parliament)
First significant radio programs on science.	<i>Meetings with Animals and Plants</i>	1959	Hosted by Azaria Alon. Holds <i>Guinness Book of Records</i> as the longest-running host of a radio program
First significant TV programs on science.	<i>Mada va'Daat</i> [Science and Knowledge]	1968	
First awards to scientists or journalists or others for science communication.	Professor Peter Hillman (award from the Ministry of Science)	2002	This award was given only once

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