Ephraim Katchalski-Katzir. 16 May 1916 — 30 May 2009

Ruth Arnon, Michael Sela and Colin Shindler

originally published online June 15, 2016

---

**Email alerting service**

Receive free email alerts when new articles cite this article - sign up in the box at the top right-hand corner of the article or [click here](http://rsbm.royalsocietypublishing.org/subscriptions)
EPHRAIM KATCHALSKI-KATZIR
16 May 1916 — 30 May 2009
EPHRAIM KATCHALSKI-KATZIR

16 May 1916 — 30 May 2009

Elected ForMemRS 1977

BY RUTH ARNON1*, MICHAEL SELA1 AND COLIN SHINDLER2‡

1Department of Immunology, Weizmann Institute of Science, PO Box 26, Rehovot, Israel 76100
2SOAS, University of London, Thornhaugh Street, Russell Square, London WC1H 0XG, UK

Ephraim Katchalski-Katzir was a leading researcher in the development of polyamino acids, which allowed new insights into the reactions and behaviour of proteins. His work developed pathways into the exploration and investigation of antigenicity. He was a founder of the Israel Society for Biochemistry and a founding member of the European Molecular Biology Organization. He was also president of Israel between 1973 and 1978—an unusual distinction because this post was usually held by former politicians. As head of the Israeli Association of Science, he was prominent in promoting the cause of science both as president and outside his term of office. Ephraim Katchalski-Katzir passed away in May 2009.

PART I: SCIENTIFIC CAREER

By Ruth Arnon and Michael Sela

Ephraim Katchalski-Katzir dedicated his life to science and to the State of Israel, all within the frame of his belief in the progress of humanity through science. He was one of the most prominent Israeli biological chemists of his time.

He was born in Kiev, Ukraine, in 1916 and as a six-year-old immigrated with his family to Palestine. The family first settled in Tel Aviv, then a tiny coastal city, and then moved a year later to Jerusalem.

This memoir was written in two parts by separate authors.

* ruth.arnon@weizmann.ac.il
‡ colinshindler@googlemail.com

© 2016 The Author(s)

http://dx.doi.org/10.1098/rsbm.2016.0015 269 Published by the Royal Society
He enrolled at the Hebrew University of Jerusalem, where he studied botany, zoology and bacteriology before finally concentrating on biochemistry and organic chemistry. In 1941 he completed his PhD thesis on simple synthetic polymers of amino acids. After 1945 he continued his education at the Polytechnic Institute of Brooklyn, Columbia University and Harvard University.

Soon after receiving his PhD, while still at the university, Katzir prepared the first water-soluble polypeptide, poly-l-lysine, and showed that it is digested by trypsin. It was the first demonstration of a synthetic polymer serving as a substrate for an enzyme and emphasized the potential use of polyamino acids as protein models. This was an idea first developed by Ephraim Katzir and was widely seized upon by the biochemical community. This pioneering work of Katzir opened the way to a new approach to the study of proteins, and won him international recognition almost immediately.

Katzir remained associated with the Hebrew University until 1948, when Chaim Weizmann, Israel’s first president, a renowned chemist in his own right, invited Katzir and his eldest brother, Aharon, to join the fledgling Weizmann Institute. At this institution, Ephraim founded the Department of Biophysics, while Aharon, who was also a distinguished scientist, chaired the Department of Polymer Research. He held this position until his tragic death in the hands of a Japanese terrorist at the Ben-Gurion airport in 1972.

In the Department of Biophysics, Ephraim Katzir, together with his young associates, continued the research on polyamino acids (1)*. The discovery of polylysine, the first polymer of bifunctional amino acids, led to the synthesis of other polymers: polyarginine, polyproline, polyaspartic acid and many others. The investigation of their chemical, physical and biological properties led to most interesting results (2). For example, it was discovered that peptides of lysine helped penetration into cells. Poly-l-proline was discovered to exist in two completely different shapes, depending on whether the peptide bond is in trans or cis conformation, resulting in obligatory helices that are respectively right-handed or left-handed.

In addition, these synthetic polymers provided early evidence for the presence of helical structures and β-conformations in proteins. They were also useful in evaluating the role of various molecular forces, such as hydrogen bonding and hydrophobic interactions, in stabilizing the conformation of proteins. In addition they permitted a better understanding of protein denaturation. Katzir’s work on polyamino acids opened the way for the preparation for the first time, by Michael Sela and Ruth Arnon in the Department of Biophysics, of synthetic antigens and their extensive application in fundamental studies of the chemical basis of antigenicity (Sela et al. 1962). This led to the development of the drug Copaxone, a synthetic amino acid copolymer used worldwide for the treatment of multiple sclerosis. Thanks to these fundamental contributions, Katzir occupies a unique and distinguished position in the field of protein science.

Knowledge of the physical and chemical properties of synthetic polyamino acids played a role in the work that led, in 1961, to the deciphering of the genetic code. In their first publication on the subject, Marshall Nirenberg and Heinrich Mathaei identified the poly-l-phenylalanine produced enzymically in a cell-free system in the presence of polyuridylic acid as messenger, by comparing it with poly-l-leucine, first synthesized by Katzir.

Another major success of Ephraim Katzir was the work on immobilized enzymes. Katzir developed a method for binding enzymes, which speed up numerous chemical processes,

* Numbers in this form refer to the bibliography at the end of the text.
Ephraim Katchalski-Katzir
to a variety of surfaces and molecules. He was among the first to prepare, in 1960, a well-characterized derivative of trypsin coupled to a synthetic polyamino acid copolymer, with full catalytic activity and enhanced stability. This was followed by the preparation of other insoluble enzymes such as chymotrypsin, papain, urease and alkaline phosphatase, several of them also as synthetic membrane–enzyme conjugates (3). This method laid the foundations for what is now called enzyme engineering, which plays an important role in the food and pharmaceutical industries. For example, it is used to produce fructose-enriched corn syrup and semi-synthetic penicillins.

In the late 1950s Katzir was among the founders of the Israel Society for Biochemistry. It was through his activities that several Israeli scientists were invited to serve as founding members of the European Molecular Biology Organization (EMBO). He was also pivotal in the efforts to create international scientific links and collaborations that led to the acceptance of Israel as a full member of the Federation of European Biochemical Societies (FEBS).

In 1973 Katzir was elected as the fourth president of the State of Israel, a position he held until 1978. (It was upon becoming president that he changed his surname from Katchalski to Katzir.) Upon completion of his term as president he returned to research at the Weizmann Institute and was named Institute Professor, a prestigious title awarded by the Weizmann faculty and administration to outstanding scientists who had made significant and meaningful contributions to science or to the State of Israel. He also devoted himself to the promotion of biotechnological research in Israel and founded the Department of Biotechnology at Tel Aviv University. The creation of this department was a continuation of his previous efforts to establish science-based industries in Israel: he had helped create several companies based on the fruits of scientific research.

In the later years of his scientific career, Professor Katzir turned to new research areas. In one project he headed a team of Weizmann scientists who won an international contest on computer modelling of proteins. In another study he was part of an interdisciplinary Institute team that revealed an important aspect of the effects of snake venom on the body.

Katzir authored hundreds of scientific papers and served on the editorial and advisory boards of numerous scientific journals. International scientific symposia were held in Rehovot and Jerusalem to celebrate his 60th, 70th, 80th and 90th birthdays.

Professor Katzir was a member of the Israeli Academy of Sciences and Humanities and of numerous other learned bodies in Israel and abroad, including the Royal Institution of Great Britain, the Royal Society of London, the National Academy of Sciences of the USA, the Académie des Sciences in France, the Scientific Academy of Argentina and the World Academy of Arts and Sciences. He was a visiting professor at Harvard University, Rockefeller University, the University of California at Los Angeles, and Battelle Seattle Research Center.

Katzir won many prizes and awards, including the Rothschild Prize, the Israel Prize in Natural Sciences (which he shared with Michael Sela), the Weizmann Prize, the Linderstrom Lang Gold Medal, the Hans Krebs Medal, the Tchernikhovski Prize for scientific translations, the Alpha Omega Achievement Medal and the Engineering Foundation’s International Award in Enzyme Engineering. He was the first recipient of the Japan Prize and was appointed to France’s National Order of the Legion of Honour in the rank of Commander. He received honorary doctorates from more than a dozen institutions of higher learning in Israel and abroad, including Harvard University, Northwestern University, McGill University, the University of Oxford and the Technion-Israel Institute of Technology, as well as his own Weizmann Institute of Science.
Ephraim Katzir was an incredible teacher: friendly, inspiring, patient, thorough, and always stimulating! He had dozens of PhD students and at least as many postdoctoral fellows and visiting professors on sabbaticals. Many of his doctoral students eventually became professors, and their students did so as well, resulting in seven such scientific generations, in institutions of higher learning and in the Israeli biotech industry, besides the many who returned to their own countries and excelled there.

Ephraim Katzir was a legend in his lifetime. He passed away on 30 May 2009 in his home on the grounds of the Weizmann Institute. He will be greatly missed by his many colleagues and friends and will be remembered not only as a brilliant scientist and statesman, but also for his human warmth, integrity and high moral standards.

**PART II: POLITICAL CAREER**

*By Colin Shindler*

Ephraim Katzir was born in Kiev on 16 May 1916. His father, Yehuda Katchalski, was an accountant and an adherent of Zionism. Katchalski and his wife, Tsila, originally lived in Łódź, then in the Tsarist empire, now in Poland. Łódź was a centre of socialist politics and radical endeavour. During the 1905 revolution an uprising took place in Łódź in which many workers were killed. The city’s social awareness extended to the Jewish community of Łódź, which constituted approximately one-third of the population. The intense fighting between the Russians and the Germans on the Eastern Front during World War I persuaded the Katchalskis to move further eastwards to Kiev in the Ukraine.

After the end of the Great War, the Katchalskis moved to Białystok in an independent Poland. The economic crisis of the mid 1920s provided the impetus for the Polish Jewish middle class to leave Białystok for the Yishuv (Jewish settlement in Palestine) in 1925 as part of the fourth aliyah (emigration to Palestine). The family settled in Jerusalem.

Katchalski (later Katzir) attended the Rehavia Gymnasia in Jerusalem before enrolling in the newly established Hebrew University of Jerusalem.

Katzir was a member of Hanoar Haoved (the working youth), a youth group, established in 1925, which was an intrinsic part of the pioneering labour Zionist movement. Berl Katznelson, a central labour figure, was involved with the group from the outset and spoke at their gatherings.* He commented that Hanoar Haoved ‘turned to the most neglected and impoverished circles of young people, on whom all the educators and organisers had given up … it listened and understood the lives of young people who worked every day and opened up new vistas from the everyday life to a world of culture’.‡

Katzir’s devotion to the construction of a state of the Jews led to a cross-fertilization between his scientific interests and his national activism. In 1939 he graduated from the first non-commissioned officers’ course of the Haganah, the Yishuv’s self-defence force, and subsequently became commander of its student unit in the field. In view of growing military clashes between Palestinian Arabs and Zionist Jews—and the inevitability of a conflict with nationalists in the Arab world generally—Katzir contributed his scientific expertise to the defence of the Yishuv. Katzir felt that in the aftermath of the Shoah (Holocaust) the Jews

* *Davar*, 1 and 13 October 1926.
‡ http://noal.org.il.
would face terrible consequences if they lost the conflict. In May 1948, at the height of Israel’s war of independence, Katzir was appointed head of the Heyl Mada (HEMED)—the scientific research and development corps of the Israel Defence Forces. This in turn laid the basis for RAFAEL Advanced Defence Systems, which today is Israel’s second largest defence manufacturer, employing 7000 people and responsible for the development of the Iron Dome, an anti-missile system that has protected Israeli cities from short-range rockets in recent years. In the early 1960s Katzir headed a governmental committee for the formulation of a National Scientific Policy.

In a broader sense, Katzir believed that the pursuit of science would make a contribution to the region. He was certainly inspired by his mentor, Chaim Weizmann, a former chemistry lecturer at the University of Manchester and Israel’s first president. Sixty years later, Katzir reflected (4):

I would do what I could to help establish the State of Israel and contribute to its security and its social and economic development. In addition, I would attempt to do some original research while at the same time playing my part in raising a new generation of Israeli scientists and helping to create the physical and intellectual conditions in which science and technology could flourish in this region. Like Chaim Weizmann, whose life and work served as an inspiration to many young scientists, I believed with all my heart ‘that science will bring peace to this country, renew its youthful vigour and create the sources for new life, both spiritually and materially.’

His close association with Weizmann—they shared scientific interests as well as liberal values—led to a life in which he was honoured for his scientific research in Israel but also for his commitment to creating a modern state. He thus headed the Israeli Association for the Promotion of Science, but also served as Chief Scientist of the Ministry of Defence in the mid 1960s. He trained a generation of younger scientists and translated important material into Hebrew.

Katzir was heavily involved in the popularization of science from the outset. Even as a student, he organized a series of lectures on different aspects of scientific endeavour and investigation for the general public at the Hebrew University of Jerusalem and kibbutzim around the country. He often met with children to stoke their interest in science from an early age. He subsequently became the co-editor, with Shlomo Hestrin, of one of the very first Israeli popular science journals, Mada.

Katzir was elected the fourth president of Israel in 1973. The office of president was deemed to be above politics. Einstein was offered the presidency in succession to Weizmann in 1952, but preferred to remain at Princeton. Yet all his predecessors had previously been political figures—and like Katzir had all been members of the dominant Labour party. Since his term of office in the 1970s all successors have similarly been political figures. Katzir—while certainly a committed Labour man—was therefore unusual in that he never formally entered the bear-pit that is Israeli politics.

Katzir came into office at a crossroads in Israeli politics. The pioneering labour Left that had characterized and influenced his upbringing was in a state of disintegration, while Menahem Begin’s nationalist Likud was in its ascendency. Begin won office in 1977 at his ninth attempt. Katzir decided to leave office one year later, having served only one term.

Katzir’s time in office was marked by both war and peace, by violence and calm. A year before his election, his brother and fellow scientist had been killed in the attack on passengers at Israel’s Lod airport by the far-Left Japanese Red Army—which was guided by the Popular
Front for the Liberation of Palestine (PFLP) with arms supplied by North Korea. In 1974—one year into Katzir’s presidency—the killings of high-school children took place in Kiriat Shemonah and Ma’alot in northern Israel.

However, the central events of Katzir’s presidency were the bookended occurrence of the Yom Kippur war in 1973 with Egypt and the visit of its president, Anwar Sadat, to Israel in 1977.

On taking office, the former president, Zalman Shazar, an admirer of the Lubavicher Rebbe, greeted him with the biblical invocation

Arise, arise chosen of the nation and blessed by God in a good and auspicious time. You should merit seeing with your very eyes … peace and righteousness reign in the land of our forefathers.*

Yet six months after his inauguration, Israel fought a bloody war with Egypt and Syria. Although the Yom Kippur war ended with the Israeli army near Cairo, the unexpected Egyptian assault and the crossing of the Suez Canal of its armed forces severely dented Israel’s self-image and its confidence in being able to defend itself. Israel suffered more than 2500 killed and 7000 injured.

Katzir visited the troops on the front line, talked to bereaved parents and spouses in their homes and went to hospitals to comfort the injured. Within four years the enemy had turned into a negotiating partner—and Katzir was the first to greet president Anwar Sadat on his totally unexpected visit to Israel at the end of 1977. He later recalled Sadat with mixed emotions (4):

[There was] the close personal relationship that I developed with President Sadat during his brief but momentous visit to Israel and until his untimely death. This was a valued friendship and one that I had hoped would help establish closer ties between our two countries. It was a bitter disappointment to find that zealots from both sides seemed to have ruined every chance for lasting peace. Sadat was murdered in Egypt by Muslim extremists, and [prime minister Yitzhak] Rabin, whom I greatly respected and admired, was assassinated by a Jewish extremist in Israel.

During his time in office, Katzir promoted a closing of the gap between the haves and the have-nots in Israel. He endorsed volunteerism and instituted the Presidential Award for Volunteerism, a prize granted annually in recognition of 12 individuals who had devoted themselves to volunteer work. Katzir also promoted the importance of science at all levels of the Israeli educational system. In the wider world, he strongly supported the expansion of Jewish studies in institutes of higher education.

Katzir carried out his duties, but he maintained his interest in scientific advances even while president. In one sense, it mollified an inevitable tedium of office. Katzir was clearly a political dove in his later years and remained an old-school Zionist pioneer. He strongly believed in a resolution of the Israel–Palestine problem through a fair settlement. In 2005 he wrote about his vision for the future (4):

I have always thought of Israel as a pilot plant state in which dedicated people can explore all kinds of imaginative and creative possibilities aimed at improving society and the state. I feel certain that in the years to come we will continue to operate as a testing ground, drawing on the fruits of science and technology to determine the best and most satisfying ways of living in a country geared to the future. The highest standards of health care, educational practice, and cultural and recreational facilities will flow from research and development in the natural

Ephraim Katchalski-Katzir

sciences, as well as in automation, computer science, information technology, communication, transportation, and biotechnology. I believe it is possible to create such a pilot plant state by encouraging the development of science-based high technology industry and agriculture. Once it gains momentum, this core of activity will contribute significantly to the economic growth and prosperity of the country. In this pilot plant state, I would like to see a free, pluralistic society, a democracy whose citizens live by the rule of law, and a welfare state in which public services are efficiently handled. Great emphasis will be laid on excellence in science and research, literature, and the arts, thus enriching the intellectual and cultural life of every citizen.

We Jews are eternal optimists. We have always believed, even in the depths of our despair, that the Messiah will come, even if he tarries a little. I am sure that ultimately we will create our model society geared for life in the twenty-first century and founded on the great moral and ethical tenets that we have held sacred since ancient times.

The fashion in the early years of the state of Israel was to hebraize one’s name. Gruen became Ben-Gurion and Persky became Peres. Katchalsky chose the surname Katzir. This means ‘harvest’ in Hebrew. It testified to his lifelong belief that hard work and intellectual commitment would bring its reward for the benefit of all.

ACKNOWLEDGEMENTS

Emeritus Professor Nathan Sharon, Weizmann Institute, initiated this account of Ephraim Katzir’s scientific career. He passed away in 2011.

This memoir is adapted in part from Sela (2011). We recommend Katzir’s autobiography A life’s tale (Carmel Publishing House, 2009) for more information.

The frontispiece was taken by Shlomo Ben-Zvi and is used courtesy of the Weizmann Institute of Science Archives. All rights reserved to the Weizmann Institute of Science.

REFERENCES TO OTHER AUTHORS


BIBLIOGRAPHY

The following publications are those referred to directly in the text.


