

## Zippora Gromet-Elhanan (1931–2007), a passionate and a fiercely dedicated scientist

Richard E. McCarty

Published online: 12 February 2008  
© Springer Science+Business Media B.V. 2008

Zippora Gromet-Elhanan died December 2, 2007, 5 days after a heart attack, while attending a scientific conference in Israel. According to her husband Shmuel Elhanan, Zippy, as she is known by her colleagues, was happy because she had seen so many of her friends at the conference. She was to chair a session of the conference and left the lunch table to prepare her opening remarks. Shortly thereafter, she apparently had an unspecified heart failure and lapsed into a coma. Zippy never regained consciousness. Zippy loved science and it is fitting that she was an active participant to the very end of her productive life.

Zippy was born in Poland and came to Palestine when she was five. She received both of her graduate degrees from the Hebrew University of Jerusalem. Her M.Sc. and Ph.D. degrees were in Microbial Chemistry. As a doctoral student, Zippy worked in the laboratory of the late Shlomo Hestrin on the synthesis of cellulose by the bacterium, *Acectobacter xylinum* (Gromet et al. 1957). In the extensive analysis of the aerobic formation of cellulose from glucose, Zippy and her colleagues used a number of reagents that she would use in a different system in the years to come. These included: 2,6-dichlorophenolindophenol, dinitrophenol, and phenazine methochloride (Schramm et al. 1957). Zippy developed an interest in bioenergetics early in her career.

The same year (1958) when Zippy received her Ph.D., Mordecai (also written as Mordhay) Avron (1931–1991), the founder of research in Israel on the coupling of ATP synthesis to photoelectron transport in chloroplasts, assumed a research position at the Weizmann Institute, in



Zippora Gromet-Elhanan (1931–2007)

Rehovot. Avron (see his obituary by Malkin and Gromet-Elhanan 1992) had done outstanding work on this coupling, while he was a postdoctoral associate in André Jagendorf's laboratory, then at the Johns Hopkins University, Baltimore. Zippy wisely chose to be a postdoctoral associate in Avron's lab.

One of the enigmas earlier in research on ATP formation and electron transport by what we now call thylakoid membranes was that the photoreduction of 2,6-dichlorophenol was not coupled to ATP synthesis, but the reduction

---

R. E. McCarty (✉)  
Department of Biology, Johns Hopkins University, Baltimore,  
MD 21218, USA  
e-mail: rem1@jhu.edu

of other electron acceptors like ferricyanide was. Zippy and Avron showed very clearly that the dye is an uncoupler at higher concentrations (Gromet-Elhanan<sup>1</sup> and Avron 1963). Using MnO<sub>2</sub> to reoxidize the dye present at a low concentration, high rates of ATP synthesis by illuminated thylakoids were obtained (Gromet-Elhanan and Avron 1964).

From 1964 to 1965, Zippy was a postdoctoral associate in Daniel Arnon's lab at the University of California, Berkeley. She then returned to the Weizmann Institute rising in rank from Research Associate to Full Professor. From 1985 to 1997, she was the Marte R. Gomez Chair of Photosynthesis. She was the Chairperson of the Department of Biochemistry from 1987 to 1990. In 1974–1975, Zippy was a sabbatical visitor in the lab of Howard Gest, of the University of Indiana, Bloomington and she was a productive Visiting Professor in my lab, first at Cornell University (1985) and more recently at Johns Hopkins University (1992 and 1996). Zippy was the author and coauthor of nearly 100 articles, most of which appeared in leading journals.

Zippy carried out research on many aspects of photosynthetic phosphorylation, both in higher plants and in the photosynthetic bacterium *Rhodospirillum rubrum*. Among her many accomplishments were the purification of the “catalytic core” of the F1 part of the ATP synthase from chloroplasts and the characterization of its activities (Avital and Gromet-Elhanan 1991). Zippy exploited the *R. rubrum* ATP synthase with remarkable success. She and her colleagues were able to deplete specific subunits from the complex (Gromet-Elhanan and Khananshvili 1986) and were able to reconstitute ATP synthesis to chromatophores deficient in the  $\beta$  subunit by the addition of the  $\beta$  subunits purified from the ATP synthase of either *Escherichia coli* (Gromet-Elhanan et al. 1985) or chloroplasts (Richter et al. 1986). The  $\alpha$  and  $\beta$  subunits of the *R. rubrum* ATP synthase were over expressed in *E. coli* and were obtained in active form (Du and Gromet-Elhanan 1999).

Her collaboration with Mark Richter was wonderfully successful (see for example Tucker et al. 2004). Mark writes:

Zippy and I first met and worked together while I was a Postdoc with Dick McCarty at Cornell in 1985 and Zippy visited Dick's lab. Our task was to assemble a hybrid ATP synthase by swapping beta subunits of the chloroplast F1 and *Rhodospirillum rubrum* F1 enzymes for one another. This was very successful and we were able to demonstrate the remarkable conservation of structure and function that exists

among the different ATP synthases. At that time Zippy and I developed a close working relationship and a wonderful friendship that lasted for more than two decades. She opened her home to my family and was always interested in our whereabouts and doings. We shared joint grants, traveled between our respective institutions on several occasions, jointly mentored graduate students, had lively dinners together at meetings all over the world and shared the same joy in our science. Zippy was a fiercely dedicated scientist. Her passion for her science was inexhaustible and her contributions have helped to shape our understanding of one of the most amazing molecular machines to be found in living systems. We will all miss her endless scientific insight. I will always cherish our close friendship.

I share all of Mark's impressions of Zippy. She was not only a scientist, but also with Shmuel, a gracious host. A visit to Jerusalem with Zippy and Shmuel was the highlight of my visits to Israel. It is hard to think of Zippy without thinking of Shmuel. He is known to many in the photosynthetic community since he attended many conferences on photosynthesis, especially Gordon Research Conferences with her. I have known Shmuel for more than 35 years. My heart goes out to him, their daughter, Ofra (Ofrit), son Binyamin (Bini) and their children. We have lost a friend and a keen scientist; they have lost a loving wife, mother and grandmother.

**Acknowledgement** This obituary was invited and edited by Govindjee.

## References

- Avital S, Gromet-Elhanan Z (1991) Extraction and purification of the beta-subunit and an active alpha-beta-core complex from the spinach chloroplast CFoCF1-ATP synthase. *J Biol Chem* 266:7067–7072
- Du ZY, Gromet-Elhanan Z (1999) Refolding of recombinant alpha and beta subunits of the *Rhodospirillum rubrum* FoF1 ATP synthase into functional monomers that reconstitute an active alpha(1)beta(1)-dimer. *Eur J Biochem* 263:430–437
- Gromet Z, Schramm M, Hestrin S (1957) Synthesis of cellulose by *Acetobacter xylinum*. 4. Enzyme systems present in a crude extract of glucose-grown cells. *Biochem J* 67:679–689
- Gromet-Elhanan Z, Avron M (1963) Photophosphorylation coupled to reduction of indophenol dyes. *Biochem Biophys Res Commun* 10:215–220
- Gromet-Elhanan Z, Avron M (1964) Role of indophenol dyes in photoreactions of chloroplasts. *Biochemistry* 3(3):365–373
- Gromet-Elhanan Z, Khananshvili D (1986) Selective extraction and reconstitution of F1-subunits from *Rhodospirillum rubrum* chromatophores. *Methods Enzymol* 126:528–538
- Gromet-Elhanan Z, Khananshvili D, Weiss S, Kanazawa H, Futai M (1985) ATP synthesis and hydrolysis by a hybrid system reconstituted from the beta-subunit of *Escherichia coli* F1-

<sup>1</sup> In the literature, the last name of Zippy has been written as “GrometElhanan” or “Gromet-Elhanan”; we have used Gromet-Elhanan throughout this article; her maiden name was “Gromet”.

- ATPase and beta-less chromatophores of *Rhodospirillum rubrum*. J Biol Chem 260:12635–12640
- Malkin S, Gromet-Elhanan Z (1992) Obituary of Mordhay Avron (1931–1991). Photosynth Res 31:71–73
- Richter ML, Gromet-Elhanan Z, McCarty RE (1986) Reconstitution of the H<sup>+</sup>ATPase of *Rhodospirillum rubrum* by the  $\beta$  subunit of chloroplast coupling factor 1. J Biol Chem 261:12109–12113
- Schramm M, Gromet Z, Hestrin S (1957) Synthesis of cellulose by *Acetobacter xylinum*. 3. Substrates and inhibitors. Biochem J 67:669–679
- Tucker WC, Schwartz A, Levine T et al (2004) Observation of calcium-dependent unidirectional rotational motion in recombinant photosynthetic F1-ATPase molecules. J Biol Chem 279:2411–2418