Journal of Aerosol Science 122 (2018) 59–62

Contents lists available at ScienceDirect

Journal of Aerosol Science

journal homepage: www.elsevier.com/locate/jaerosci

Obituary: Michel Benarie, a Pioneer of Aerosol Science (1917 – 2017)

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Michel Benarie

18 Mai 1917 – 13 June 2017

Founding member of GAeF
Member of first GAeF board

Picture taken on Sept. 10, 2016, at his home in Suresnes, suburban Paris in his 99th year

Michel Benarie was born on May 28, 1917 in Tovis, then a small town near Temesvar/Timisoara at the southeastern edge of the Austro-Hungarian monarchy close to the Border between Hungary and Romania. The region, also called Banat, was absorbed into the Habsburg empire in 1717 and almost deserted, thereafter populated by Germans, Romanians, Serbs, Spaniards, Frenchmen, Italians, Czechs, Slovaks, Croats, Bulgarians, Hungarians, Jews, Romani, and other peoples. Michel's mother tongue was Hungarian, though.

Despite the collapse of the Austro-Hungarian monarchy in 1918, Michel Benarie was able to get a solid education. From 1924 to 1935 he attended primary and secondary school in Szeged, Hungary, and studied chemical engineering at the University of Paris, graduating in 1939. He always obtained top grades. After the Nazi-German occupation of Czechia in 1939, he went underground for a while; in Prague he got in contact with like-minded people like Kvetoslav Spurny, later also an aerosol pioneer (see e.g. Gentry, 2000), and Ján Ludvík Hoch alias Robert Maxwell, who would later go on to found the science publishing house Pergamon Press. From 1942 onward Michel pursued studies at the University of Szeged, Hungary, obtaining in 1944 an M.Sc. degree in chemistry with a thesis on extraction, physical and chemical properties of the Element 93 (the name Neptunium was not yet coined). His doctoral

https://doi.org/10.1016/j.jaerosci.2018.05.007

0021-8502

thesis is on spectroscopic investigations on Rhodanine complexes of pentavalent Molybdenum was completed in 1945. For the following two years he was a lecturer at Szeged University, and from 1947 to 1951 he headed the material testing laboratory of the Hungarian Railways. From 1952 to 1959 he was with the scientific department of the Israel ministry of defense, and in 1959 he joined the Israel Institute of Biological Research.

From the 1960s on, he began work at the INSTITUT NATIONAL DE RECHERCHE EN CHIMIQUE APPLIQUÉE (IRCHA), located at first in Paris and later in Vert le Petit, in the southern outskirts of the city. This institute emerged from the CENTRE DE RECHERCHE DE LA SOCIÉTÉ NATIONALE DES POUDRES ET EXPLOSIFS (S.N.P.E.), but engaged in research on environmental issues and fine chemicals. It is not surprising that he was brought there by Alban A. Avy, a senior researcher who came from military aerosol research in Le Bouchet. (With regard to this career path, there are remarkable similarities between Avy and Norman Davies, who had also worked in Porton Down on military applications of aerosol technology and later turned to questions of industrial hygiene and basic aerosol science.) Through Avy, Michel Benarie became involved in fundamental and applied aerosol problems, with a remarkably broad and visionary sounding list of topics, some of which are (in no particular order) *slip correction, isokinetic sampling and sampling from turbulent flows, determination of the specific surface area of aerosols, generation of ultrafine aerosols, acoustic detection of aerosols, a low-pressure elutriator,* a *micro-dynamometer, a simple, portable sampler for particles and trace gases, extraction by supercritical CO2, the calculation of dose and "nuisance" of pollutants, comparison of indoor and outdoor pollutants, long-range pollution transport and its modelling.*

Michel Benarie became a well-published man with a broad range of interests and innovative ideas that actually went far beyond aerosol science. As an example, he submitted a proposal to measure the dry rubber content in latex (Benarie, 1982). As a scientist he always looked beyond the issue at hand, beyond solving just one particular problem. Notably in air pollution, he had the entire atmospheric system in perspective and became interested in the dispersion of pollutants, their transformation and removal. This knowledge he laid down in a book on air pollution modelling that was first published in 1980 and reprinted in 2003. Being a lateral thinker he wrote quite a few letters to the editor of Nature, among others in 1977, wherein he pointed out that impact factors are not an objective criterion.

Coming from a very multicultural region of Europe, Michel Benarie considered Hungarian his mother tongue – which he spoke at home with his wife – but was also fluent in French, German and English (in which he published mostly), Hebrew, Romanian and other languages. Michel also had an extremely broad cultural horizon, with a large personal library, a life-long interest especially in the visual arts, mostly of his contemporaries, and he was an avid visitor to museums wherever he traveled.

For such an international man, it seemed natural to participate in the formation of a post-war aerosol community in Europe, which aimed at improving the environment and was sponsored by the EUROPEAN COAL AND STEEL COMMUNITY, a predecessor organization of the EU. He attended numerous meetings of German, French, Austrian, Belgian, and Dutch scientists, who engaged in many a long discussion trying to solve scientific problems but also to relieve resentments left from to all the confrontations of war. In particular, he became a very active participant in the workshop of suspended particles (SCHWEBSTOFFTECHNISCHE ARBEITSTAGUNG, and thus somewhat similar to the AEROSOL TECHNOLOGY MEETINGS held regularly in the US), organized annually since 1952 by professor Klumb in Mainz. This workshop can be considered a precursor to the European Aerosol conferences. Since the continued organizations of these workshops was in danger due to Klumb's retirement, Benarie, together with other motivated scientists, co-founded the GESELLSCHAFT FÜR AEROSOLFOSCHUNG (GAeF, the Assocation for Aerosol Research) and became a member of its founding board. Visiting scientists from Europe were welcomed regularly to Benarie's group at IRCHA, and encouraged to use its infrastructure for their research. His work and frequent travel brought him in contact with prominent aerosol scientists outside France, including Preining, Stöber, Schikarski, Junge, and Whitby. Benarie organized numerous other conferences as well, such as the well-recognized International Colloquium on Atmospheric Pollution, held in the UNESCO building in Paris in 1978, 1980 and 1982. At these meetings, in case a speaker did not understand the questions asked during the discussion, he served the scientific community also by translating quasi-simultaneously between the many languages he spoke. And naturally, Michel Benarie became involved also in scientific publishing. Thus, he was the founding editor, co-editor or board member of journals such as *ATMOSPHERIC ENVIRONMENT, JOURNAL OF AEROSOL SCIENCE, WATER AIR AND SOIL POLLUTION, THE SCIENCE OF THE TOTAL ENVIRONMENT*.

Michel Benarie retired from IRCHA in 1982. But far from retired he went on to become the executive editor of the *EUROPEAN CULTURAL HERITAGE NEWSLETTER,* funded by Brussels and dedicated to cultural heritage and its preservation. When authors were difficult to find for a specific topic of interest, he himself wrote the article. During retirement he first moved to Grenoble which was less polluted, but soon returned to Paris because there were definitely more museums to visit. From the terrace of his suburban apartment in Suresnes, one could overlook the monumental buildings of Paris, a view he proudly showed to his visitors, but which he himself was also able to enjoy until shortly before his death. He passed away on June 13th, 2017 in the 100th year of his life.

The following overview of Michel Benarie's publications is far from complete, but definitely shows the many fields of his interest:

Benarie M. (1944) A rapid determination of Selenium. Bull.Acad. Roum. 27, 692-632

Benarie M. (1946) Estimation of the beginning of geological time through comparison of of the decay constant of ^{235}U and ^{238}U. Bull. Soc. Roum. Phys. 47, 29-32

Benarie M. and I.Amariglio (1958) A corrosion proof vacuum controller J. Sci. Instr.35, 385

Benarie M. (1961) Optimal encoding of the visual image. J. Opt. Soc. America 51(3) 371-372

Benarie M. (1961) Enrichment of the ^{6}Li in dekagram quantities by migration in molten lithium chloride. J. Inorg. Nucl. Chem. 18, 32-41

Benarie M. (1961) Rheology of granular material. II. A method for the determination of the inter-granular cohesion Brit. J. Appl. Phys. 12(9) 515-518

Avy A.P., Benarie M.M. (1962) Les poussières d'origine extra-terrestre dans l'atmosphère (Extraterrestrial particles in the atmosphere), Rev. Pollution Atmosphèrique 4(15) 342-354