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ATG Interviews Dr. Avram Bar-Cohen

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University of Maryland, College Park, MD

by John Long (Senior Library Sales Manager, World Scientific Publishing Co., Inc.; Phone: 401 785-0129)
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ATG: I happened to notice that you got your PhD at MIT, which led me to think about sauntering MIT's historic halls as a visitor and how one is in awe of the many great individuals who have strolled these halls. When you were a graduate student was there a particular MIT faculty member/mentor who greatly impressed you, and can you tell us about him/her?

ABC: I actually got all three of my engineering degrees at MIT, having come as an UG in 1963, continuing on to the Honors program in Mechanical Engineering — leading to combined Bachelor's and Master's degrees in 1968 — and completing the PhD, with support from Raytheon, where I had started working in 1968, in January 1971. An early mentor was Prof. August Ludwig Heselcherwerdt III, who was my UG advisor and taught HVAC courses. Despite my reluctance at the time, he helped me see that graduate education and ultimately a PhD in Mechanical Engineering could help me realize, rather than undermine, my dreams of harnessing technology to desert development and to harnessing the world's resources for the betterment of mankind.

As I continued my UG education, I got to know Prof. Warren Rohsenow, who led the Heat Transfer Laboratory and served as the Graduate Advisor for the Mechanical Engineering Department. Warren — recently passed away — was a giant of the Heat Transfer world and inspired my life-long interest in boiling heat transfer and two-phase flow. But his fascination with everything thermal, his patience in engaging in hour-long conversations with a confused UG and later Master's student, and the breadth of his thermal science and engineering interests helped to chart the path I have followed for my entire career.

I found these same characteristics in Prof. Arthur E. Bergles, a young Assistant Professor at the time, who had completed his PhD with Warren Rohsenow, and was my Fluid Mechanics and Heat Transfer instructor. Numerous after-class conversations and office visits led to Art Bergles agreeing to serve as my SM/SB Thesis on direct contact heat transfer and setting the stage for a close advising and mentoring relationship that has extended over nearly fifty years. An entry-level position at Raytheon in 1968 opened before me the world of electronic cooling and led me to the recognition that Art Bergles was one of the pioneers and acknowledged leaders of this emerging technical community. So, when exposure to the thermal management challenges of RF components motivated me to consider PhD studies, Art Bergles was the natural choice for advisor. We have been partners and companions on my "journey of discovery" ever since.



ATG: Please tell us a something about how you became fascinated by mechanical engineering? Was it the "hands on" aspect or "problem solving" features of engineering that attracted you?

ABC: I spent my formative years (1950s) in what was then a small town in Israel, called Holon, and is now part of the greater Tel Aviv area. We lived in a poor community of immigrants who had survived the Nazi atrocities or fled persecution in the Arab countries after Israel's declaration of independence and were desperate to build new lives and create a viable future for their children. One of my heroes, David Ben Gurion, Israel's first Prime Minister, would often speak about how in the absence of natural resources, limited water and arable land, and continuing hostility from its neighbors, rebuilding a Jewish national homeland in Israel would require extraordinary perseverance, technological prowess, and harnessing that technology to innovative development of the desert. So, as a kid in elementary school, I was often daydreaming about ways of harnessing solar energy, finding new water resources, and desalination and water purification. It also helped that my father was a plumber and worked with water and heating-cooling system. These interests led me to MIT as an UG in the 1960s and motivated my MS Thesis on direct-contact (oil-water) heat exchangers for desalination systems. In the 1970s I was among the first faculty to join the Mechanical Engineering Department at the Ben Gurion University in Beer Sheva, Israel to help bring engineering education to this region and pursue desert development. I spent

fifteen years on the campus helping BGUN to emerge as one of Israel's leading Universities.

ATG: Your research at College Park [not to mention your important work at the Defense Advanced Research Projects Agency (or DARPA) with responsibilities for thermal packaging programs] blindsided me at first. Thermal management is critical, and at the heart of the electronic revolution, yet most of us rarely focus our attention on it until one of our electronic devices fails. To a non-scientist like me it seems like a "perfect storm" in light of the importance of thermal management & design, and thermal phenomena as it coincides with boundless, unprecedented complexity with regard to a multitude of the electronic revolution's devices.

ABC: The inherent, and at times rather appalling, inefficiency of electronic devices means that operating any of the handheld, desktop, or backroom electronic devices that we are so dependent on these days results in relatively high rates of heat generation. The generated heat, coupled with the need to prevent large temperature increases in these electronic devices, makes electronic cooling the central — and often forgotten — handmaiden of the electronic revolution. The consistent and predictable performance, high reliability, and miniaturization we associate with micro- and nanoelectronic systems would not be possible without the thermal packaging techniques and modeling tools developed over the past fifty years. Inadvertently, thermal packaging has also emerged as a driver for advanced heat transfer techniques that can then be applied to a broad range of other applications in energy engineering.

ATG: I've also been struck by the innumerable disciplines encompassing your research including the template of international scientific collaboration (lots of prestigious universities, plus a who's who of corporate clients, and top national government labs); and that becomes a salient factor in the major reference work you edit, "Encyclopedia of Thermal Packaging," Sets 1 & 2, published by World Scientific Publishing, 2012, 2013, & forthcoming in 2014 available in e & print. Could you provide us with a snapshot of how ideas are exchanged on a daily basis?

ABC: As the quintessential enabling technology for IT systems, thermal packaging attracts worldwide attention — with teams of researchers and developers pursuing enhancements of existing techniques and breakthrough ideas in laboratories and centers in nearly every country. The rapid pace of IT technology development, introduction, and replacement necessitates an equally rapid

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thermal packaging technology development process and an ongoing exploration and testing of new ideas whatever the source, followed by application, refinement, and standardization, when successful. In the 1990s I played a central role in creating international forums — in print, on-line, and face-to-face — for active information exchange in packaging and, specifically, thermal packaging. Today, in addition to the IEEE CPMT Transactions and ASME Journal of Electronic Packaging, I rely on the IEEE (ECTC, EPTC, ITherm), to name just a few) and ASME (InterPack) Conferences, as well as numerous Workshops, Symposia, and bi-national meetings and international research collaborations, to provide the required opportunities for dissemination and learning.

ATG: *I know that one of your many interests is micro/nano systems which I gather is yet another fast-moving, multi-disciplinary area of research. Is it safe to assume that micro-thermal management becomes a “game changer” as devices get smaller and are more efficient?*

ABC: While reducing the size of electronic devices — to the nanoscale — can improve the efficiency of certain functions, against the background of the continuing miniaturization, need for portability, and expectation of higher reliability, and required heat removal fluxes (W/cm^2) and densities (W/cm^3) often increase, making temperature control more and more problematic. Moreover, the thermal packaging measures must be implemented in the same locations as the devices themselves, necessitating unprecedented coordination in the design and development of the electronic and thermal management technologies.

ATG: *You have won so many awards and honors during your career, and my guess is that you are so busy with your research/teaching/mentoring that you don't have much time to think about these things. What are some of the activities that you and your family like to do when you can actually take a break from your full research/teaching calendar?*

ABC: In my younger days, I was a very serious soccer player — All-New England goalie for MIT and played for the semi-pro Boston Tigers in the American Soccer League. My playing these days is limited to running around the back yard with various combinations of my five grandchildren. Whenever possible — and it is not often enough — my wife and I also enjoy mountain biking, canoeing, and off-road ATV's.

ATG: *It has been delightful to talk with you and I'm certain that our ATG readers will be intrigued by the scope and applications of your research. Thank you so very much!* 🌸

Director of Library Services at
the London School of Economics

by Tom Gilson (Associate Editor, *Against the Grain*) <gilson@cofc.edu>

and Katina Strauch (Editor, *Against the Grain*) <kstrauch@comcast.net>

ATG: *Liz, can you tell us a little bit about what it's like to be the Director of Library Services at the prestigious London School of Economics? Which past career experiences best prepared you for the challenges of being Director of Library Services at LSE?*

EAC: It's pretty good being the Director of Library Services at the LSE. The School's full title is **The London School of Economics and Political Science** and the Library's full legal title is **The British Library of Political and Economic Science**. The LSE is a vibrant place to work with top-ranking faculty members in all social sciences, a truly international student body (many U.S. students) and a fantastic range of public lectures virtually every night of the week in term time. For me there is genuinely never a dull moment, and since we have a new Director of the LSE from last September, Professor **Craig Calhoun** from NYU, things are changing all around us, offering us all kinds of opportunities. Our Library building is one to be very proud of, designed by the architect **Norman Foster**.

Some years ago I was the Librarian of the **Institute of Economics and Statistics in Oxford University** and, as far as being in touch with academics goes, this was important background, not least because some post-Doc's then are Professors now at LSE, and one Professor there has become a Nobel Prize winner with LSE links. There is a strong link in Economics between **Oxford** and **LSE**, and in some ways **LSE** is like a very big **Oxford College**. While I was at **Oxford** I worked to bring together separate social science libraries so have some background in that area.

ATG: *Although the library was founded in 1896, your Website refers to the library as a 21st-century resource. What makes the library at LSE a 21st-century resource?*

EAC: The Library was founded by the **Fabians Sidney** and **Beatrice Webb** who were two of the four founders of **LSE**. The other two were **Graham Wallas** and **George Bernard Shaw**, the playwright and amateur photographer. Remaining true to our founders, the Library is open to any member of the pub-



lic who needs to use it, and while this can sometimes annoy **LSE** students as it is very busy all year round, it is good to provide such a wide and much appreciated service. But I think our founders might be surprised by our 24/7 opening hours for six months of the year, our self-service circulation, our huge array of eBooks and journals. In fact self-service in other areas like booking study rooms, reserving and renewing books and

more means we can serve our users even when they are not in the physical library. Since I have been at **LSE** we have launched a Digital Library, and to open it we set up a digitized version of **Beatrice Webb's** diary, both her illegible handwritten one and the typescript she sensibly had made in her lifetime. These can be searched together and bring a vivid picture of her life to the desktop. Our digital library team is also working on a great project called **PhoneBooth**. Based on the 19th-century **Booth Poverty maps** which are held in our Archives and which characterized the various parts of London depending on the poverty of the inhabitants, we have developed an app which students (and others) can take out into the streets of London and see what the place they are in was like in the 19th century. The team has overlaid this with current government poverty data too. This has been developed with the enthusiastic help of academics and students in the geography department. I think our academic liaison librarians provide another service that might surprise the **Webbs**, as might our roaming staff who walk around the five floors of our Library helping people at the place they need help and occasionally addressing behaviour issues. We provide one-to-one support for researchers helping them to find information for their research, and we have a Data Librarian whose job is to ensure we have the data our researchers and students need and to help them preserve any data they create for future re-use. Our Open Access Repository, **LSE Research Online**, runs from the Library, ensures that **LSE** research is fully open to the world and provides the full record for the **LSE** in its imminent submission to the national Research Excellence Framework, which determines future university funding.

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