The Boice Report #54

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Chernobyl at 30 and the Beebe Symposium at 12

I'm still on pain medications after extensive back surgery (including three permanent rods that will forever set off airport metal detectors), but I wanted to write about the legacy of Gilbert W. Beebe and the November 2016 National Academy of Sciences 12th Beebe Symposium on Chernobyl at 30.

Gil Beebe and I both joined the National Cancer Institute (NCI) in 1978 and became good friends. Gil was 65 years old with an illustrious career behind him and mine was nascent. He encouraged me to continue studies of radiation-induced breast cancer. An inspiration and mentor to so many, Gil was active and in the office the weekend before he died just short of his 91st birthday in 2003. I believe his most lasting legacy will be in strengthening the Atomic Bomb Casualty Commission that morphed into the Radiation Effects Research Foundation and the Lifespan Study that continues to be so valuable today.

Gil published extensively on the psychological effects and mental disturbances associated with war and related traumatic experiences. At NCI we worked together on studies of high background radiation in China, radon in China, radar exposure among Korean War veterans, and summarizing knowledge of radiation-induced thyroid cancer. His second lasting legacy was motivating and mentoring the "best/most informative" Chernobyl studies of thyroid cancer following childhood exposure to radioactive iodine. His first study in Belarus provided convincing evidence that childhood exposure to radioactive iodines caused thyroid cancer and the increase could not be entirely linked to screening biases, endemic goiter, or other potentially confounding factors. This is not saying that the risk coefficients were not without uncertainty, but they did provide evidence for an effect. Subsequently, he continued with the Ukraine-American study of childhood exposures, which I consider to be the very best and most informative study. It is thus appropriate that the 12th Beebe Symposium was held in November 2016 on Chernobyl at 30 years with an emphasis on Gil's contribution.

Ruth and Gilbert Beebe at the 1st Beebe Symposium, 2002
Photo courtesy of John Boice

The 1st Gilbert W. Beebe Symposium was held in 2002 and Gil and his wife Ruth were able to attend. Every few years, a Beebe Symposium is held at the National Academy of Sciences. The agenda and abstracts of this year's symposium are online as well as the excellent presentations featuring renowned scientists from all over the world. I recommend to all those interested in radiation accidents, emergency response, late effects, community resilience, psychosocial effects, acute radiation syndrome, and more to glance over the information in the abstracts as well as the presentations.

The chair of the organizing committee, Jonathan Samet, provided an excellent summary of the research conducted after Chernobyl and what lessons have been and could still be learned. Below I summarize my take on the Chernobyl symposium and future directions (these are my own opinions and not a consensus).

- Fukushima is not Chernobyl, neither in terms of population or worker dose, acute radiation syndrome effects, radiation-related deaths, nor the scientific need for continued follow-up of the children exposed to radioactive nuclides.
- The World Health Organization's definition of health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."
- High doses (several grays) have acute consequences, such as radiation sickness.
- Moderate doses (on the order of 0.1 to 1 Gy) can result in detectable long-term consequences, such as increased thyroid cancer risk following childhood exposures.

- Psychological stress, such as depression and anxiety, can occur regardless of dose—there is no threshold for fear.
- Samet, with apologies to Donald Rumsfeld, mentioned several reasons for conducting studies:
  - Refining risk estimates (known knowns).
  - Hazard identification (new outcomes) and completing the understanding of dose response (known unknowns).
  - Overturning strong priors, finding surprises (unknown unknowns).
- Studies, however, should not be conducted just for the sake of conducting studies. There are certain criteria that should be satisfied before embarking on or continuing noninformative (or minimally informative) studies. These criteria have been summarized in many of the reports from the United Nations Scientific Committee on the Effects of Atomic Radiation (pages 19–40). The key scientific question is whether the incremental gain in knowledge is worth the expenditure of limited resources.
- There is a need for caution in interpreting studies where the outcome can be influenced by substantial uncertainties in dose reconstruction and substantial bias in the ascertainment of outcomes (both screening and diagnostic equality) and when the findings are diametrically opposed to scientific literature that goes back nearly 100 years of high-quality studies with good methodology, dose reconstruction, and outcome ascertainment.
- What is my understanding of what we have learned after the past 30 years, i.e., what is new?
  - The only convincing evidence for cancer effects following Chernobyl exposures has been the epidemic of thyroid cancer among the children (but not adults) who drank milk contaminated with radioactive iodines.
  - Cataracts occur at lower doses than previously expected, but the quantification of dose is associated with a high uncertainty.
  - There appear to be lasting neuropsychological consequences associated with radiation exposure, regardless of dose, and this is especially noticeable among mothers.
  - An increase in chronic lymphocytic leukemia (CLL) in some liquidators was reported. I am not entirely convinced that this is a causal association since an extensive literature search of studies with good methodologies, excellent dosimetry, and complete and unbiased outcome ascertainment, both mortality and incidence, continue to find no association between CLL and radiation dose, e.g., U.S. worker studies, U.K. worker studies, international worker studies, international studies of cervical cancer patients, and others, as well as some combined liquidator studies and Techa River studies.
  - There is a need to improve analytical methods dealing with uncertainty, but this is not straightforward.
  - Future research should include new approaches for dose-response modeling, integrating biological features with epidemiologic observations.

Beebe Symposium November 2016—A Few Attendees

Left to right: Vadim Chumak and Dimitry Bazyka (Academy of Medical Sciences of Ukraine), Geraldine Thomas (Imperial College, London), Mykola Tronko (Ukraine-U.S. Thyroid Project, Kiev), and Viktor Shpak (Academy of Medical Sciences of Ukraine)

Left to right: Mikhail Balonov (Institute of Radiation Hygiene, Russia), Ilya Veyalkin (The Republican Research Centre for Radiation Medicine and Human Ecology, Belarus), and Fred Mettler (University of New Mexico School of Medicine)

Photos courtesy of John Boice