History of Physics NEWSLETTER

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From the March Meeting:

Session Report: "The Author in Dialogue: Steven Weinberg's *To Explain the World*

by Robert P. Crease

Steven Weinberg, photo courtesy of Tushna Commissariat

Well over 500 people attended the March meeting session "The Author in Dialogue: Steven Weinberg's To *Explain the World*, with over 100 people standing along the back and side walls of the Baltimore Convention Center's ballroom. The session raised issues of genuine historical substance. The Nobel Laureate in Physics Steven Weinberg spoke first, then commented after each talk. A line of people formed behind the audience microphone after each speaker finished, though only a few questions could be accommodated.

Joseph Martin introduced the event by pointing out that the FHP organized the session because Weinberg's book is not only an important book in the history of physics, but has raised a conversation among historians about how the history of science should be done.

Weinberg's talk was entitled "Reflections of a Whig Physicist." He spoke concisely, forcefully, and bluntly, kicking up a twitterstorm from among the historians in the audience. Some years ago, he began, he decided he wanted to know more about history of science. He did what professors often do when they need to learn a new subject and taught a course on it, and his notes for the course led to the book. "I knew from the beginning that I was being naughty." The reason, he said, was that according to traditional historical practice the historian should set aside the history that he or she knows, and "I really couldn't." It would be great if we could go back and somehow get into the heads of early scientists, but that's not possible. However, he continued, "we have a great clue—the planets in the Hellenistic era move the same way that they do now." Knowing that that helps to understand what the ancient astronomers were thinking. Weinberg also said that he refused to avoid comparing our scientific practices with theirs as if ours were better: "They *are* better!"

Weinberg then explained his title. The term "Whig history" was coined by the British historian Herbert Butterfield in a book of 1931 to refer to approaches that conceive history as an inexorable march towards the enlightened present. Butterfield warned against "Whig history," Weinberg said, out of a fear of imposing an "ahistorical moral judgment," and ever since historians have taken "Whiggish" as a term of abuse, like "racist," "sexist" or "Orientalist." But, Weinberg continued, ahistorical moral judgment is not a problem for the history of science. The point of history of science is to learn about how people learned about the world, and there are good and bad ways of learning about the world. Sometimes scientists get hooked on the wrong problem because they are premature, sometimes because they are bad problems. Questions such as "What is the natural place of fire" and "What is the purpose of the stars?" are bad questions because they assume an ontology of the real that's just wrong. The real story that history of science considers is not what immediate

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influences acted on particular scientists; that's not interesting! "The real story is the progress of science from an earlier day when the most intelligent people in the world did not know how to address the mysteries of nature.... It's a great story, it's not at an end, but we have learned some things. If we don't use the things we know [to understand history of science], then the story has no point."

The first questioner asked if we can turn physics to the study of history. "I thought that's what I was doing!" he joked, then said that what the questioner probably meant was whether physics could be imitated by history as an intellectual discipline. "I think not," and great harm can be done by scientism.

Another questioner asked about the role of aesthetics in science, and Weinberg referred to a point he had made in *Dreams of a Final Theory*. When a scientist describes a theory as beautiful, it's similar to the way a horse trainer might describe a horse as beautiful. Based on the experience of hundreds of horses, the trainer is picking up on subtle cues that can't be explained that the horse is a winner.

Someone pointed out that our current theories might be wrong, and that our picture of the universe might be no closer to the truth than that of Plato or Aristotle. Weinberg disagreed. It's not that Einstein replaces Newton, he said; Einstein's theory explains why the conceptual foundations of Newton's theory work. "I see that as progress. Our theories are never wrong, just right for a different reason." History of science is about that progress. "Things that concern us on human level, and the theories of the nature of the world – these are two very different things. We have learned not to put human values into our physical theories."

The last questioner able to be accommodated asked Weinberg what ideas might be inhibiting current science. "Not our ideas; our lack of funds."

The second speaker was David Wootton, the Anniversary Professor of History at the University of York. Wootton is the author of the recent book, *The Invention of Science*, and a winner of the Beller Lectureship, designed to bring distinguished physicists from abroad to present invited talks at APS meetings. Wootton's talk was entitled, "Is Understanding the Past in Its Own Terms Understanding?" Wootton said that in the first half of his talk he would say where he agreed with Weinberg, and in the second half where he disagreed. Wootton said he agreed with Weinberg on six points. The first is that progress in history of science is real, historians need to write about it, and that can be done without claiming cultural superiority. The second is that the past must be studied not only on its own terms. The third is that it is not always wrong to write history from the point of view of the victors; historical actors sometimes made bad choices and we can't rescue losers from the condescension of posterity. The fourth is that one of the reasons that historians study science is to understand its success; science is a special and more rational sort of activity. The fifth (which Wootton did not have time to address) is the shortcomings of the Duhem-Quine thesis that theory choice is always underdetermined. The sixth is that theory change is not always contingent and non-rational, and that one can distinguish between

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Weinberg and his wife with a questioner, photo courtesy of Tushna Commissariat

History *of* Physics NEWSLETTER

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Session Report: "Peer Review: History and Issues"

by Daniel Ucko

Dan Ucko, Melinda Baldwin, Jamie Hutchins and Alex Csiszar in discussion after the peer review session

Report on session A14 at the APS March meeting in Baltimore, MD, on March 14, 2016.

For the second year running, the Forum on the History of Physics organized a session on Peer Review at the American Physical Society March Meeting. The session followed a similar event at the March Meeting in San Antonio, TX, in 2015. The title of this session was "Peer Review: History and Issues", and featured four speakers, all talking about journal publications from different perspectives.

The first speaker was Jamie Hutchins, Publishing Director of the Institute of Physics Publishing (IOPP), who presented results from an extensive survey of 6000 physicists performed in October 2015. The survey was aimed at elucidating the respondents' means of sharing scientific results and information. While the means of sharing information varies by discipline, there are some common themes. For instance, one finding was that journals still represent the "gold standard" for disseminating scientific results, even though the arXiv is also strong. Perceived journal quality is a strong determinant for where researchers will publish data, as well as these journals' ability for dissemination of results. Surprisingly, the popularity of reference managers such as Mendeley, ResearchGate, or Sci Val, was lower than expected, which is in conflict with the reported number of articles actually deposited on these sites.

The survey also broke down data by seniority of researchers, who have different priorities for journal choices. Researchers later in their careers were more likely to make decisions based on previous experiences with a journal, including as a reviewer, value personal relationships with editors and editorial boards, and the absence of page or color charges. By contrast, researchers earlier in their careers were more often guided by their supervisors or collaborators as to journal choice, but also were favorably influenced by the existence of open access and supplemental material options.

The next talk was by Alex Csiszar of Harvard University, who focused on the origins of referee systems in 19th-Century Britain. The actual history of peer review is complex, for not only is the invention of referee systems more recent than is often believed, but their imagined functions have changed over time. Csiszar locates these changes in periods of broader political change, when the role of science in society was being renegotiated.

It is in the early 19th Century that scientific societies began to consult systematically experts to make decisions about what to publish. The Royal Society of London's first attempt to set up a system of referee reports began with something that resembled open peer review, in which recognized authorities would publish their reports themselves as a form of publicity. But the system shifted toward anonymous specialists, in part because of the culture of criticism then dominant in England. Just as it is today, the legitimacy of anonymous judgment was the subject of lively debate throughout the period.

Next to talk was Melinda Baldwin, also of Harvard University, whose talk concerned refereeing for the National Institutes of Health (NIH) and the National Science Foundation (NSF). Peer review for grant organizations such as these exists in an atmosphere of tension between research autonomy and a governmental desire for oversight. Dr. Baldwin noted that early in NIH's history, grant proposals were decided on by the directors, and there was no requirement to have them reviewed externally. By contrast, the NSF did consult external referees, but the reports obtained were not sent to the applicants, and directors still had significant say in which proposals received funding.

Dr. Baldwin presented a number of instances in which the procedures of grant review in both NIH and NSF had come under political scrutiny, and the timing of these instances echoed Dr. Csiszar's contention that changes to peer review coincide with periods of historical upheaval. In the 1960's, following controversy over the exact spending of NIH grants, the NIH introduced stricter internal accounting rules.

In 1975, following hearings on its peer review process, it was decided that

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Session Report: "The History of Electrical Science"

by Amy Fisher

In the eighteenth and nineteenth centuries, spectacular electrical effects—from lightning strikes to electrically produced chemical changes and muscular contractions—encouraged multifaceted studies of electricity and its action-at-a-distance effects. Electricians attempted to mimic natural electrical systems—e.g. Alessandro Volta (1745-1827) argued that the voltaic pile (battery) should be called the "artificial electrical organ" because of its similarity in form and function to the electric eel's anatomy—and considered more broadly the application of electricity to technological development, especially long-range communication devices. Focusing on the period between 1750 and 1850, the five presentations in this well-attended session explored different aspects of this history, examining the ways in which electricians investigated and explained diverse electrical phenomena and interacted with specialists from different countries and other fields of study, such as chemistry and engineering.

In the first talk, Victor Boantza, an assistant professor in the History of Science, Technology, and Medicine Program at the University of Minnesota, focused on the life and science of Joseph Priestley (1733-1804). Priestley—best known for his contributions to chemistry, especially gas behavior and composition—wrote two popular and influential texts on electrical science: *History and Present State of Electricity* (1767) and *A Familiar Introduction to the Study of Electricity* (1768). Boantza argued that Priestley's electrical works were emblematic of both Priestley's scientific methodology and his commitment to Enlightenment ideals, such as a belief in egalitarianism, the promotion of intellectual freedom, and the rejection of dogma.

Amy Fisher, organizer and speaker of "The History of Electrical Science"

In the second presentation, Robert Crease, a professor in philosophy at Stony Brook University, spoke about the Russian natural philosopher and chemist: Mikhail Lomonosov (1711-1765). Lomonosov's interests in electricity, like Priestley's, reflected the broader eighteenth-century fascination with electrical demonstrations and experiments. Working with Vladimir Shiltsev, Director of the Accelerator Physics Center at Fermi National Accelerator Laboratory, to illuminate Lomonosov's electrical studies, Crease discussed the state of eighteenth-century Russian science. Founded in 1724, the St. Petersburg's Academy of Sciences was initially staffed by Western European natural philosophers, such as Leonhard Euler and Georg Richmann. Trained abroad in Prussia in chemistry, Lomonosov turned to electrical studies upon moving to St. Petersburg. Tutored by Richmann, Lomonosov strove to disentangle the facts of electrical action from fiction—e.g. did the motion of cannon balls through the air affect atmospheric electricity? —and his numerous contributions to chemical and electrical research helped to establish science in Russia.

Building on Boantza and Crease's presentations, which elucidated the characteristics of Enlightenment electrical science through Priestley and Lomonosov's studies, the third talk traced the roots of an eighteenth-century scientific problem into the nineteenth century: were electricity and heat related? If so, how? Amy Fisher, an assistant professor in the Science, Technology, and Society Program at the University of Puget Sound, spoke about Priestley's commitment to a theory of thermodynamics that included electrical effects because heat and electricity produced similar phenomena. For example, exposing air to a spark or flame caused analogous changes in its composition, volume, and toxicity. Considering the success of Antoine Lavoisier's (1743-1794) caloric theory of heat and the invention of the voltaic pile in 1799, she then examined how early nineteenth-century scientists approached the study of heat and electricity, focusing specifically on the work of Humphry Davy (1778-1829) in England and Robert Hare (1781-1859) in America.

In the fourth presentation, Iain Watts, a visiting assistant professor in the History Department and Science, Technology, and Society Program at the University of Puget Sound, asked how scientists, like Hare and Davy, learned about Volta's invention, especially during the Napoleonic Wars. He carefully traced how news of the voltaic pile spread from an anonymously written article in the May 30, 1800 edition of the *Morning Chronicle* across Europe and overseas. Much to the chagrin of Sir Joseph Banks (1743-1820) who famously controlled (or at least attempted to control) to whom science news from Royal-Society members was conveyed, the unauthorized article on the voltaic pile raised questions of authorship, ownership, and intellectual property rights.

Continuing on the theme of communications, in the last talk of the session, Bruce Hunt, an associate professor in the Department of History at the University of Texas at Austin, spoke about the development of cable telegraphy. He asked: why did British electricians approach the study of electromagnetism differently than German physicists? He argued that the development of long-range telegraphy raised awareness of "field" thinking as undersea

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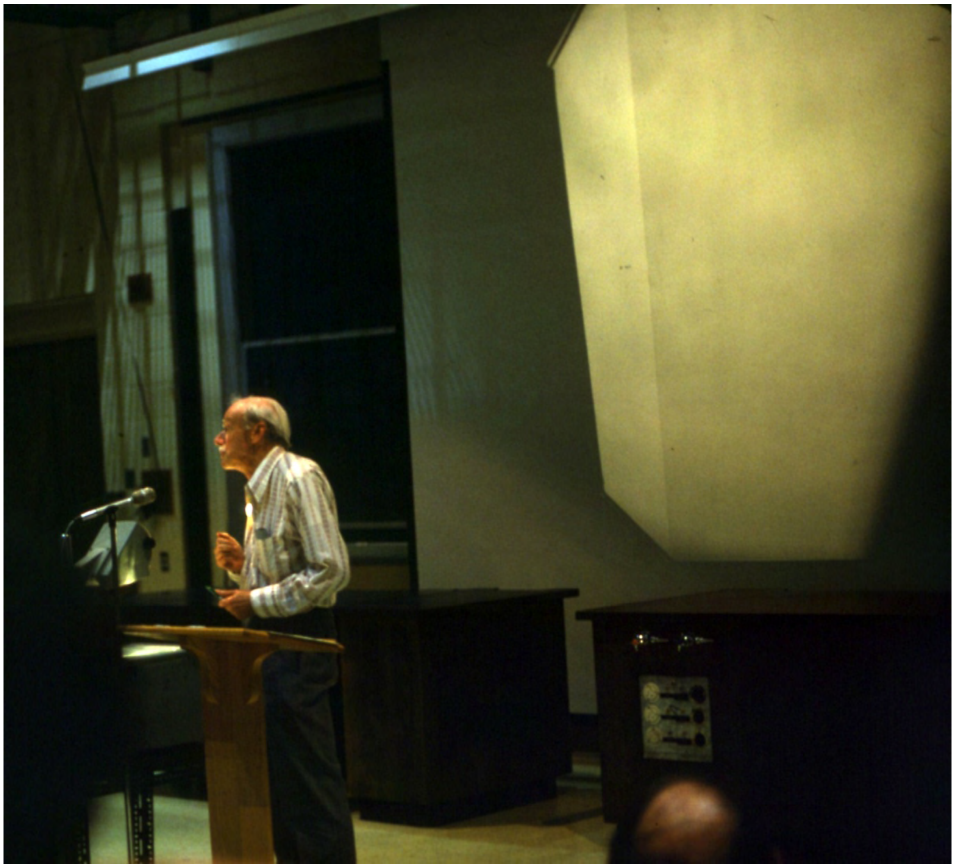
Adventures with Alligators, Sharks and Dirac

by Cherrill M. Spencer



Dirac lecturing at a 1978 symposium held in his honor at Florida State University. Photo by the author.

The author, an experimental physicist, is retired from the SLAC National Accelerator Laboratory, Stanford University.

When I was a mere postdoc at the Florida State University back in 1977-79 I had the privilege of spending a couple of days out with Dirac. Yes, that Dirac who formulated the Dirac equation in 1928 and won the Nobel Prize with Schrödinger in 1933 for "the discovery of new productive forms of atomic theory." Who would have thought he was alive and well and living in Tallahassee, Florida in March 1977? But there he was, sitting in the front row of the audience for my colloquium on the particle physics experiment I had worked on during my previous post-doctoral job (the "Iron Ball" at SPEAR). And when Professor Dirac, the founder of quantum electrodynamics, told me in question time he didn't believe in the Feynman diagram I had used to explain how we had collided an electron and a positron and made a muon and anti-muon, I was completely flustered and had to appeal to the other theoretical physicists in the auditorium for help[1]. Nevertheless Dirac sought me out at the reception that followed and praised me for my youthful enthusiasm for physics. Then he told me he'd be joining me the next Saturday in a tour by car of northern Florida with the head of the Physics Department at Florida State University (FSU), Professor Joe Lannutti, and Assistant Professor of Physics, Ron Diamond.

So that's how I came to be sitting in the back of a car for a day out with arguably the most famous physicist of the twentieth century. But no-one had told me that Dirac was also famous for being very precise, quite shy and bordering on autistic in his social interactions. As we drove to Wakulla Springs to take a boat ride to see some alligators I was ready to pepper him with questions about his life at Cambridge University, how he came up with his equation that describes the behaviour of electrons and predicted the existence of anti-matter, and why he'd come to work at Florida State University when he'd had the choice of any university in the world for where to go after his mandated retirement from Cambridge. When he didn't answer my first question right away I asked him a different one and after three un-answered questions I took a break to wonder what was wrong with them. Then after what felt like an age Dirac answered my first question in a carefully-thought out way; to start with I was a bit confused because I supposed he was answering my most recent question, but then I realised what he had answered was my first question, asked over 5 minutes before! Having learnt how to converse with Professor Dirac I spread out my questions and waited patiently for his short but precise answers as we sped in the car towards the Gulf of Mexico to go for a swim after our boat ride.

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The tide was out at the deserted beach and one had to wade from shore over 50 meters to reach water deep enough to swim in. But first Professor Dirac had to check the water temperature, which he did by throwing a thermometer on a string into the water and dragging it back after a minute or two to read it. It was 73^{0}F and Dirac declared that the water was warm enough to swim in, so we four took off our outer clothes, having put on our swimming costumes before we set out, and waded into the calm Gulf water with no-one else in sight. Dirac was further out than me and swimming slowly parallel to the shore when I saw what I thought was a shark's fin gliding above the water a few meters beyond him. Oh dear, I thought, I'm going to have to save the most famous physicist in the world, who established the general theory of

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George Gamow, famous Russian-American physicist, honored by GWU, scientific diaspora and diplomats in Washington

by Vladimir Shiltsev

2015 RASA Gamow Award ceremony (left to right): Prof. Vladimir Shiltsev (RASA President, Fermilab), Prof. Roald Sagdeev (UMD, physics), Dr. Nikolay Vasiliev (President RASA-USA, Harvard), Prof. Lyudmila Ogorodova (Deputy Minister of Education and Science of the Russian Federation), Prof. Vladimir Zelman (2015 Gamow Laureate, USC), Prof. Igor Gamow (Colorado), Prof. Igor Efimov (2015 Gamow Laureate, GWU), and Ambassador Sergey Kislyak.

George Gamow commemorating plaque on the GWU Physics Department's Corcoran Hall.

The author is Director of the Accelerator Physics Center at Fermilab.

George – or Georgy Antonovich in Russian - Gamow was an outstanding theoretical physicist. He was born in the Russian Empire in 1904, received his education in the Soviet Union, and became a corresponding member of the USSR Academy of Sciences as one of the brightest representatives of the "new generation" of physicists. Gamow spent several years among a brilliant assemblage of physicists of the in-between-the-wars Europe and after immigration to the US in 1934, established a new school of physics in the United States. His career in the US spans for more than three decades, including 22 years at the George Washington University (GWU) in Washington, DC, and 12 years at the University of Colorado, until his death in 1968. The list of Gamow accomplishments includes several "Nobel-caliber" works - the theory of radioactive decay and nuclear transformations, the Big Bang theory, nuclear fusion and cosmic microwave radiation, insights on the mechanism of the DNA double helix work, and others. But for general public of up to our days his name is widely recognized due to his brilliant popular books which influenced several generations of students, graduate students and people interested in science. Of particular recognition are a book series on a hypothetical Mr. Tompkins, a clerk trying to understand the science behind various phenomena, a stunning book *"One, Two, Three ... Infinity"* explaining "how things work" to laymen and his sci-pop articles in magazines and newspapers. George Gamow's legacy has been commemorated by a plaque on the GWU Physics Department's Corcoran hall, by Gamow's Tower in the University of Colorado, in the book *"Genes, Girls and Gamow after the Double Helix"* by the Nobelist James Watson, in his biographies published by the National Academies and in the *Physics in Perspective* magazine.

George Gamow's 111th birthday was recently celebrated at GWU by the Russian scientific diaspora during the 6th annual conference of Russian American Science Association (RASA, http://www.rasa-usa.org/), November 7-8, 2015. RASA is a nonprofit organization working to consolidate the Russian-speaking scientific community abroad, to advance the career development and qualifications of its members, and to provide opportunities for social and cultural exchanges. RASA represents about 300 members, including scientists, engineers and hi-tech entrepreneurs in academia, national laboratories and

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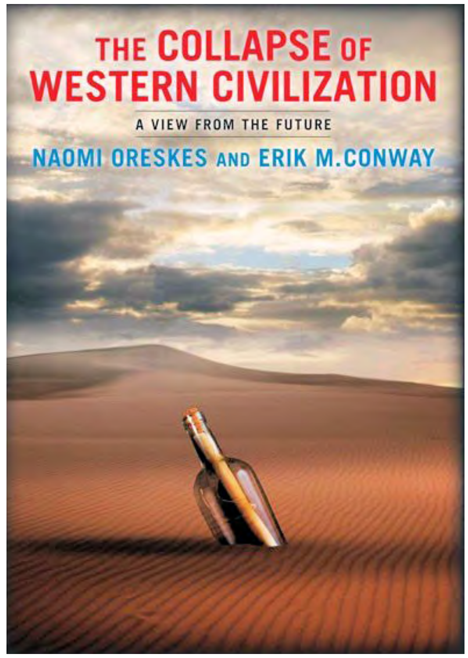
The Collapse of Western Civilization - a view from the future

By Naomi Oreskes and Erik M Conway | *New York, Columbia University Press, 2014*

Reviewed by Alvin M. Saperstein

Historians usually write in the present about the past. In this somewhat unusual small (81 small pages) "science-fiction" book, supposed historians of the distant future are looking back on today's world and its subsequent collapse due to global warming. The emphasis is on established science; the supposedly fictional decline in the Earth's livable land area and population is a straightforward extrapolation from existing trends. Oreskes and Conway, authors of the superb and still valuable 2010 account of contemporary attacks on the application of science to society – "Merchants of Doubt", focus on two basic concepts: "Baconianism" and "Market Fundamentalism". Baconianism is the general scientific outlook that experience, observation, and experiment leads to reliable knowledge, upon which power over the natural world can be based. The authors emphasize both the reliability of the existing knowledge and the powerlessness of



contemporary scientists to shape public policy based on that knowledge. "Market fundamentalism" is described as a quasi-religious dogma, "promoting unregulated markets over all other forms of human socioeconomic organizations". This extreme "neo-liberalism" leads to the failure of a supportive terrestrial environment, the subsequent collapse of democratic civilization, and the triumph of the centralized despotic governmental power that was the locus of the neo-liberalists loathing. The thrust of the book can be summarized in two phrases: "The invisible hand" (of the market) "never picks up the check", and "the neoliberal worship of deregulation leads directly to the poisoning of ourselves and the rest of the world". The story, based on these thrusts, as told by a "future historian living in the Second People's Republic of China", about the "Great Collapse and Mass Migration (2073-2093)", is a good one, and challenges all, scientist and non-scientist, to action based upon our abundant knowledge. It may take a short time to read but should result in much thinking and conversation. ■

The Most Wanted Man in China, My Journey from Scientist to Enemy of the State[1]

By Fang Lizhi | *New York, Holt, 2016*

Reviewed by Irving A. Lerch

> *"The intellectuals will accomplish nothing if they fail to integrate themselves with the workers and peasants. In the final analysis, the dividing line between revolutionary intellectuals and non-revolutionary or counter-revolutionary intellectuals is whether or not they are willing to integrate themselves with the workers and peasants and actually do so." —Mao Zedong*[2]

> *"By three methods we may learn wisdom: First, by reflection, which is noblest; second, by imitation, which is easiest; and third by experience, which is the bitterest." —Confucius, The Analects*[3]

Four years after his death, one of the most important figures of the Chinese scientific establishment, Fang Lizhi, has given us a first-person account of growing to maturity and eminence in revolutionary China. *The Most Wanted Man in China* is the memoir and personal testament of a remarkable man, written during his internment in the US Beijing embassy after his flight from the authorities at the time of the Tiananmen Square massacre, June 3-4, 1989. He remained confined in the embassy until his expulsion, June 25, 1990. A renowned scientist, humane scholar, political activist, intractable enemy of authoritarian government and courageous advocate of human rights, this journal, written in the interior rooms of the American embassy as his world vanished outside, tells a grim tale with humor as well as deep introspection. Inevitably this memoir will be compared to Andrei Sakharov's published in 1990[4] since Fang often has been called the Chinese Sakharov. But there are important differences which we must explore to overcome our Eurocentric predilections.

There are two ways to experience the emotional substratum of history. One way is to immerse a fictional character in the miasma of events in order to invoke a human dimension of the past. The other is for participants to bear witness. Among the many authors of both historical fiction and memoir, Aleksandr Solzhenitsyn opened a deep psychic wound in the Soviet body politic to indict a decrepit political system in, *One Day in the Life of Ivan Denisovich*.[5] A decade later, Solzhenitsyn would follow this "fictional" work with *The Gulag Archipelago*—a vast collection of factual reports that created an indelible image of political repression.[6] To understand, to *feel* history, we must have truth—whether it be scribed in fiction or recounted in a ledger.

We have not had an equivalent body of writing to emerge from China with the exception of a few "rags-to-riches" memoirs of officials once denounced and pushed to the margins who later emerged as political heavyweights and a few dissidents who have heroically escaped and stepped forward to tell their personal stories of survival. Fang's memoir now fills an important deficit in our understanding of the monumental events that convulsed 20th century China.

One theme that pervades all accounts of the arduous journey from child of the revolution to enemy of the state is that early on, the individual becomes a true believer, a dedicated follower. Alternatively, a survival reflex conditions the person to "lay low" and follow a path of least resistance. In Fang's case, and that of his wife, Li Shuxian, whose childhoods were spent during World War II under Japanese occupation, they were made acutely aware of foreign—Japanese and Western—imperialist designs on China. It was ordained that nationalism and the struggle for independence would bring them into the Communist fold. This was not widely different from the experiences of Sakharov who, as a young student and weapons scientist, was in thrall of Stalin's Communism at a time of great trauma during the war.

Dictators like Stalin and Mao seek to construct a regime enclosed in ideology that forces every actor into a niche within a political infrastructure. Behavior inside the infrastructure must comport with an absolute set of rules. The Mao quotation at the beginning of this review was selected to emphasize this as the starting point for Fang's story.

Fang's recollection of his parents, especially of his mother, is telling:

> *She went to high school—a bold move for a woman in her day—and told me that during the Northern Expedition in 1926,[7] she and some female classmates took to the streets chanting slogans like "Down with the foreign powers and out with the warlords!" If the guiding principle of my father's philosophy was "Stay the same no matter what happens to you," my mother's principle was "Watch what happens and make a difference."*

Ultimately, he would adhere to both his parents' admonishments. Central Beijing, where Fang was born after his family relocated from Hangzhou (Zhejiang Province), remained relatively calm during the turbulence of the Japanese invasion and the post-war Chinese Civil War. As modern China began its spastic condensation into a modern state, the violence and turmoil of war and revolution did nothing to dislocate Fang and his elders and siblings from their nationalist sentiments.

Fang was free to attend school during the Japanese occupation—the only wrinkle being forced study of Japanese, relieved with the pranks and expressions of disrespect by children in quiet rebellion. Eventually the Japanese presence evaporated to be replaced by the Kuomintang (KMT) administration under Generalissimo Chiang Kai-shek. This era was essentially apolitical for Fang except for the resurgent nationalism that brought Chinese culture—suppressed by the Japanese occupiers—back to the classroom.

Fang's transmogrification to political awareness in the late 1940s coincided with the gradual political and military disintegration of the KMT and the rise of Mao's forces:

> *The tide turned toward the Communists on the ideological battlefield even before it did on the physical battlefields. Almost all the intellectuals and college students became sympathizers, supporters, or even worshippers of Communism …The energy in their sympathies came much less from the discovery of a new truth than from a wish to jettison a moribund regime.*

The increasing desperation of the KMT authorities to suppress this incipient rebellion in the schools and universities led to violence that further alienated students and the intellectual communities. By 1948, the young Fang had made the plunge and defying KMT authorities, secretly joined a Communist front, the Federation of Democratic Youth.

Fang's memoir is not a simple linear account with way-signs imprinted on a calendar. He moves between historical narrative to consequential incidents in his and Li's later life. This non-linear approach is powerful in that the extraordinary brutality of events intrudes into life in ways that make living itself a daring achievement.

For the young Fang and Li, the future blossomed with Li's elevation to the Communist Party and a position of leadership and Fang's appointment to research in nuclear physics—an elite specialty marked by the government for its military and energy implications. Yet within a few years of Fang's graduation from Peking University in 1956, he and Li would be expelled from their Eden in the wake of Mao's "Anti-Rightist" crusade (1957-59). Fang was sent to work in the agricultural fields of rural China. In fact, over the next two decades, Fang would be banished to the countryside and enforced labor on four different occasions (excluding assignments to factories and workshops). Why? Why would a gifted scientist, recruited into the most secret brotherhood of science to work on defense projects vital to the government, be exiled, his studies and work seriously, perhaps fatally, interrupted?

The immediate, superficial answer seems to have been a campaign by the authorities to punish Peking University students and faculty for giving haven to "rightist" sentiment. Fang may have been targeted for the simple act of collaborating with friends in drafting a letter to Party Central criticizing the

Communist Party—criticism invited by the Party to address shortcomings but which in reality was designed to identify potential dissidents.

However, the deeper answer to this question resides in history, the nature of governing, and in the bones and sinew of authoritarian dictatorship.

Early in his memoir, Fang provides an historical foreshadowing that would imperil the intellectual enterprises of China, and he reaches back 2,000 years to tell the tale:

> *In the first century B.C., Emperor Wu of the Han Dynasty founded an imperial academy …The school grew steadily until, a century later, its students numbered as many as thirty thousand and a number of mature scholars were emerging from it. The students grew more and more independent and offered ever more criticisms of the social order and the dynasty's rule until the emperor, unready to see ferment that might affect imperial power, repressed the students in what came to be known as the Calamity of the Proscription of Parties…No later dynasty ever tried to open another school of its kind.*

Thus, as ordained in millennia past, Fang and Li found themselves in the maw of an intellectual enterprise that Mao and his minions were committed to controlling.

For 2500 years, the intellectual life of China was increasingly dominated by Confucian thought which steadily developed from a scholarly cult into a kind of state theology that subsumed the education of bureaucrats and government officials. Yet in his lifetime, Confucius was never elevated to a position of authority despite the tributes of princes and emperors.[8] Each succeeding governmental epoch was faced with a conundrum: how to train and employ the specialists and technocrats needed to run the state without fomenting critical dissent and independent thinking—the ineluctable outcome of education and creativity? Mao's solution was to discredit Confucius but he was never able to root out Confucianism.

Modern dictatorships—wholly dependent on science, technology, and the professions—have answered this overarching question by instituting an executive, extra-judicial structure of intimidation and force. Representative democracies have also sought to reduce, even eliminate, criticisms from their intellectual establishments—but with little lasting effect.

Mao and his henchmen instituted a system, at the beginning of their rule, of marginalizing intellectuals and their institutions to prevent them emerging as alternative centers of thought and leadership. The systemic intimidation of teachers and students counted on early conditioning that promoted their acquiescence and support—coming as it did after the Japanese occupation and ultimate collapse of Kuomintang governance. The Korean War was used as a maul against workers and intellectuals alike to consolidate Communist power at a critical time, much as anti-Communist witch hunts convulsed the industrial democracies. The enlisting of Chinese intellectuals in their own suppression was so successful that none could emerge as heroic figures capable of capturing public sentiment or leadership.

While at Peking University, the students were harangued by the university's Party Secretary. Fang recorded this worthy's more pithy remarks during a meeting:

> *He said that the question "What kind of people should our education produce?" needed no further discussion because the Party's policy on education had already answered it with perfect clarity. There was no need for "independent thinking" because Marx, Lenin, Mao and the Communist Party had already thought so well on behalf of the people that there was no possible way to do any better.*

Had it stopped at this, little would have come of it since the absurdity of such a declaration was evident on its face. But Fang would soon learn that party proscriptions would extend into the kinds of science that were permitted.

The USSR under first Lenin then Stalin did not have the luxury of this approach although it was exploited before and during WWII with disastrous results. Stalin's embrace of the charlatan Trofim Lysenko who had promoted the crackpot theory that environmental manipulation controls heritable biological function—an attractive theory to a political system that was convinced that ultimately the worlds of men and nature could be controlled by political will—led to the destruction of Soviet biology and agronomy along with a generation of biologists and agronomists. It wasn't until the decades after the war that Lysenkoism was quietly discredited.[9]

As a more advanced industrial society with a mature political apparatus, the USSR's institutions and intellectual/scientific communities played an active role in Soviet society. Whereas before the war, Stalin could and did brutally suppress all potential dissent, reaching into the universities and the academy, his focus was on the military and government apparatchiks whom he culled with mindless efficiency. The Soviet effort to discourage the study of modern physics, chemistry and biology in adherence with Marxist principles; foundered on the shoals of reality. After the war, with the rapid enlistment of the quantitative sciences in the defense establishment, Stalin lost his opportunity. He had to promote talent in his effort to catch up to the West and this allowed physicists like Sakharov, Kurchatov, Tamm and others to become, quite literally, "heroes of the revolution." Mao, on the other hand, knew that all he needed were faceless technicians to build his bomb and defense establishment. And whereas the USSR could throw dissidents like the physicist Yuri Orlov into the Gulag for daring to promote the Helsinki Accords, they did not dare to do more than banish Sakharov to internal exile.

In his forward, Professor Perry Link observes that Fang is not so much a Chinese Sakharov as a Chinese Galileo. But it is important to recall that pope Urban VIII, a former friend of Galileo, was enraged by Galileo's portrayal of him as a kind of simpleton in the *Dialogues*.[10] In this sense, Fang was very much a Galileo to Mao and his successor Chinese communist "popes." Fang's use of humor in his public pronouncements indeed makes him Galileo's legatee.

Perry also reports on Fang's sense that there was a "double standard" in US policy when dealing with human rights issues in China and the Soviet Union. I don't see this as a criticism on Fang's part, merely a truthful observation. The social/historical/cultural association of US and USSR society made this inevitable. Many leaders of the US intellectual community—especially

Jews—had a fierce attachment to the dissidents and "refusenicks" in Russia. Upon the collapse of the Soviet Union, there was a danger of loss of scientific and engineering institutional integrity throughout the emerging republics. The insolvency of government funded programs threatened the financial and physical well-being of the entire scientific enterprise and the very real prospect arose that weapons scientists and technicians might be forced to market their expertise abroad. Senators Nunn and Lugar had sponsored legislation to develop programs to meet this threat but the House was slow to react and provide funding. It was up to the scientific community to find the means, through private donations, foundations and existing government programs to develop support for scientists in the former Soviet republics—primarily Russia and Ukraine. These programs were ultimately successful but the US scientific community was totally consumed in this effort.[11]

Nonetheless, after the dispersion of the Chinese intelligentsia during the Cultural Revolution, the US physics community in partnership with institutions around the country embarked on a program to salvage Chinese scientific talent by bringing them to US laboratories and universities to engage in modern research (Chinese-American Cooperative Research Program).[12] This program was in effect from 1983 to 1991, when it was suspended in the wake of the Tiananmen massacre.

Pre-dating the physics community initiative the eminent Chinese-American Nobel laureate, Tsung-Dao Lee, conceived and promoted the China-U.S. Physics Examination and Application program (CUSPEA) to bring Chinese graduate students to the US. This program was initiated in 1979 and suspended in 1989.[13] Nonetheless, these programs had enormous impact on the course of Chinese science and Chinese-American scientific relations.

Despite repeated banishments to the countryside for hard labor in the fields, somehow Fang maintained his equilibrium and managed to pursue physics studies. One reason for his extraordinary balance was undoubtedly his ability to frame his experiences and see the humor in what most of us would consider a personal disaster. In the 1980s, after being permitted to travel to attend scientific conferences, he recounts how he was telling friends of his numerous excursions to work in the fields. One colleague said, "You mean *field* theory right? *Field* theory."

But more important, was his determination to turn every trial into a positive experience, every experience into a reflection on his own humanity. During his reeducation assignment working the Xiesan coal mines on Bagong Mountain, he noted the response of miners to banners demanding greater productivity:

> *Down below they still worked their three hours and then sat down to wait for quitting time. …As I sat there in the darkness with the miners, musing on all this, one of them said quietly, "Sixty cents of pay buys sixty cents of work."*

Fang's stuttered schedule of science-reeducation-science-reeducation (sometimes in the fields, sometimes in factories or mines) his mind gradually turned to the heavens and astrophysics. He had been forced to abandoned nuclear physics and then lasers. But now the core of his scientific personality was stirred by the vast precincts of space and relativity physics.

He faced intractable obstacles. There was a scarcity of current literature in the academic libraries and the authorities insisted on defining appropriate fields of inquiry. If Marx or Engels did not declare a discipline as appropriate, it was proscribed. Cosmology was one such banned area as were many important texts on relativity and quantum theory.

In addition to these problems, Li and Fang were raising a family from which Fang was often removed.

Chinese physics journals were abandoned in 1966 as the Cultural Revolution devastated science and did not resume publication until 1972. By then, Fang was entering a productive period and had been able to submit an article on cosmology for publication.[14] Unfortunately the authorities took notice and hastened to slam the door so importunely opened. Among the criticisms levied against the subject, one is redolent with unintended humor:

> *The model of an expanding universe "seeks to establish that the capitalist system not only cannot be overcome but will continue indefinitely to expand."*

In 1958, Fang had been assigned to a new institution, the University of Science and Technology of China (USTC) where he remained until the beginning of 1987—28 years. But after the convulsion and dislocations of the "Anti-Rightist" campaigns of the late 1950s and early 1960s, the authorities ordered the removal of USTC to Hefei, evidently to "purify" Beijing of its "rightist" elements. This forced the faculty to rebuild an institution afresh, with meager resources. By 1973, USTC was growing rapidly into a premier institution and Fang, despite official displeasure, was able to help found a small research group in cosmology (with the help of officials unwilling to look too deeply into the hearts and minds of the faculty).

By 1979, Fang was restored to full membership in the Communist Party and in 1984 he was elevated to Vice President of USTC. He was elected to the Academy of Sciences and received invitations and permission to travel to address scientific meetings in Europe and the US. Fang was moving to the front of the queue. So it seemed.

Fang did not have to wait long to be engulfed in another altercation with the regime. At the Fourth Marcel Grossmann[15] meeting held at the Vatican, the International Center for Relativistic Astrophysics (ICRA) was organized and Fang, as USTC's "financial vice president" lost no time in enlisting his institution. It was an important coup for Chinese science. Not only was USTC a founding member of a prestigious international program, but it would benefit further with the gift of a telescope.

A cloud of poisonous suspicion rose from Beijing that eventually enveloped the telescope and USTC membership in the ICRA and would eventually engulf Fang.

In his memoir, Fang notes: "Student movements can be seen as society's temperature regulators. If you solve the problem that is causing them, they will settle down on their own." Thus begins Fang's description of the events, beginning in 1985, that would lead four years later to the Tiananmen Massacre and his final exile.

Despite the regime's continuing hostility to modern cosmology, the proceedings of the 124th Symposium of the International Astronomical Union, was permitted to be organized in Beijing, August 25-30, 1986. The subject was observational cosmology. This would be Fang's final hurrah. By December, USTC students had taken to the streets, demanding democratic elections to the district council—essentially calling for an end to the Communist Party's diktat. The authorities yielded and opened the nominating process for elected seats in accordance with the law. This ignited new fervor and even wider agitation to expand democratic prerogatives.

Fang and a few of his colleagues tried to dampen the students' ardor and sought out gatherings in an attempt to counsel caution. It was to no avail. By the beginning of 1987, Premier Deng Xiaoping had ordered Fang's expulsion from the Party and both he and USTC President, Guan Weiyan, were fired. The remaining months before the explosive events of spring, 1989, were calm, if strained. Fang was permitted to function in his scientific duties but was pressured to conform and return to the fold.

In the winter of 1989, Fang wrote a letter to Deng noting that the year marked the fortieth anniversary of the founding of the PRC and the seventieth anniversary of the May Fourth Movement. He concluded:

> *In order to capture the spirit of these occasions in the best possible way, I sincerely propose that you announce a general amnesty specifically to include all political prisoners…*
>
> …
>
> *This year will also mark the two hundredth anniversary of the French Revolution, whose ideals of freedom, equality, fraternity, and human rights have been gaining ever more respect in the world. So I again express my earnest hope that you will consider my proposal, as a way to demonstrate ever greater concern for our future.*

This letter would be cited by the authorities as a principal cause of the student demonstrations ("riot" in the regime's official argot) leading to the massacre in Tiananmen Square, June 3-4.

Events moved quickly as the turmoil in Beijing spread. Friends helped spirit Fang and Li to the American Embassy where they would live for the next 13 months until the two governments worked out an exit from the impasse. It must be noted that the translator of this memoir, Professor Perry Link, played an important role in publicizing Fang's letter to Deng and later in assuring Fang's and Li's safe exit to the American Embassy. This gave him unique access to Fang and Li and to their thoughts at this historic time.

Fang continued his fight for human rights in the US and pursued his scientific interests as a professor and theoretical astrophysicist at the University of Arizona in Tucson. His death 4 years ago at the age of 76 deprived the world of an eloquent voice in the advocacy of human rights. His expulsion from China, allowed that voice to be heard around the world. ■

Endnotes

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12. APS China Program. American Coordinating Committee, American Physical Society, Chinese-American cooperative basic research program in atomic, molecular and condensed matter physics of the American Physical Society, 1983-1991 : final report of the American Coordinating Committee, [United States] : American Coordinating Committee, 1991.
13. http://scitation.aip.org/content/aip/magazine/physicstoday/article/41/6/10.1063/1.2811450 also New York University Archives, Series III: China-U.S. Physics Examination and Application (CUSPEA) Program, 1980-1987 and Richard B. Freeman, Daniel L. Goroff, eds, *Science and Engineering Careers in the United States: An Analysis of Markets and Employment*, The University of Chicago Press, 2009.
14. Fang had already amassed a distinguished bibliography of articles in other fields of physics despite his difficulties with the authorities—difficulties that led to efforts to expunge his name from publications or replace his name with a pseudonym.
15. Grossmann, Marcell, April 9, 1978 (September 7, 1936), Hungarian mathematician, friend of Einstein, innovator of non-Euclidian geometry essential to the modern formulation of Relativity Theory

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David Wootton, photo courtesy of Tushna Commissariat

"contingent preconditions and path-dependent developments." Because historians of science have neglected these six points, Wootton said, they have "got themselves into a terrible state of intellectual confusion."

How, then, should the history of science be written? Wootton's answer differed from that of Weinberg in three ways, all having to do with what Wootton considers Weinberg's underestimation of the difference between the past and the present. One example had to do with language. Copernicus never used the word "system," and the eventual application of that word to the world rather than to a model "encapsulates an intellectual revolution." Wootton therefore considered Weinberg's phrase "the solar system explained" as applied to Copernicus an anachronism. A second example had to do with the fact that science is not just a method of collecting facts, but involves a critical community that carries forth the work of its own members. A third example had to do with the key role of certain now-abandoned conceptions in theories, such as the role of the ether in early electromagnetism. Whig history, Wootton concluded, is not very good history and "leads to a misleading picture of science as straightforwardly accumulative rather than periodically revolutionary and destructive." Nevertheless, Weinberg's larger project "of understanding how modern science came into existence and how we became so much more effective than previous societies and previous generations in interpreting nature " is "a perfectly legitimate intellectual enterprise, and if that is Whig history then I too am a Whig historian."

Following Wootton's talk Weinberg remarked, "I thoroughly enjoyed the first half of Professor Wootton's talk." Faced with the second half, Weinberg said he initially felt a little anxiety, like when you are called before a magistrate, you have no idea why, and you fear you are about to be accused of a serious crime, "then you find you are accused of having a rear light on your car that's not working." He defended his phrase "the solar system solved" by saying that Wootton's critique "passes over the value of alliteration."

F. Jamil Ragep from McGill University followed Wootton with a talk entitled, "To Explain Copernicus: The Islamic Scientific and Religious Contexts." The people we historians of science study, Ragep said, are not necessarily aware of what is going to happen to their theories, making the context of discovery is different from the context of reception. He took Copernicus as a case study, pointing out that what motivated Copernicus was not aesthetics, as Weinberg had suggested, but something quite different: the desire to get rid of the equant, which had nothing to do with the heliocentric problem. Ragep also mentioned Islamic scientists who anticipated the idea that the Earth might be moving. He concluded by warning against a disease that a mentor of his called "precursoritis." Weinberg responded by saying that there's no question but that Copernicus was influenced by Islamic scientists and their concerns, but that he was interested in how progress happens. "Galileo is not worried about the equant," Weinberg said, "but about the superiority of the Copernican system."

The fourth speaker, Will Thomas from History Associates, gave what he called *"A Sympathetic Critique of To Explain the World."* Thomas offered two critiques. The first was of Weinberg's assumption that the Principia was the beginning of the end; that "Newton's achievements provided the paradigm for what has become modern." Thomas then offered examples of cases where scientists tried to emulate Newton and failed, such as in chemistry, where interactions were mechanical rather than involving action at a distance. "If anything," Thomas said, "chemistry and physiology had to break away from Newtonian principles." Thomas also criticized Weinberg's claim that, "following the example of Newton's work, if not of his personal opinions, by the late eighteenth century physical science had becomes thoroughly divorced from religion." That's not so, Thomas pointed out. Mainstream scientific opinion embraced a version of intelligent design into the mid-19th century. Such an opinion was even held by Whewell, who coined the word "scientist," and also by Maxwell. Darwin's work, Thomas argued, played a key role in breaking the hold religion had over physicists.

Weinberg responded that "the successful part of Newton's theory was completely naturalistic. It's not that it drove religion out of the scientists, but it drove religion out of the *science*." As to the idea that religion could have a good effect on scientific work, Weinberg said, "*Anything* can have a good effect on your work—even a good shower."

The title of the talk of Jennifer Ouellette, from the science and technology blog Gizmodo, was "Getting Whiggy with Science History." She pointed out that a Whiggish approach to Shakespeare, measuring his plays by our standards, would be terrible; you would miss what was great about the plays. She used this as a preamble to say sympathetic things about the Whig perspective. "The practice of science is different," she said, and as a science journalist one must treat science differently from other areas of journalism. She proposed a thought experiment involving a Whiggish perspective from 500 years hence on the present, noting that such a perspective from 2516 would get, but also miss, much about the practice of today's science. She ended with a quote from Will Thomas's blog: "If we insist that people dare not open their mouths until they have located and mastered an obscure and disorganized body of scholarship, that is the exact same epistemological exclusivity that we tend, in other settings, to object to. We shut ourselves off from what is potentially our most receptive audience, as well as an often-legitimate, if somewhat unruly, source of historical information." Ouellette concluded by saying that that's the kind of observation that the session was designed to get across.

Weinberg responded by saying that the story of science is one of the most interesting stories of that of the human species. Who should tell that story—professional historians or professional scientists? "I answered in a recent article in the *New York Review of Books*: both!" ■

Session Report: "Peer Review: History and Issues

Continued from page 3

NSF should provide verbatim referee reports to grant applicants and give more weight to referee opinions in the decision-making process. As this was unfolding, NIH also quietly updated their own process, possibly anticipating similar congressional challenges to their procedures. It is clear that peer review in this area changed drastically during the 20th Century, in an attempt to find a compromise between scientific accountability and government oversight.

Last to speak was Daniel Ucko, a doctoral student in philosophy at Stony Brook University and Associate Editor of *Physical Review Letters* of the American Physical Society, who presented an attempt to localize trust in the procedures of peer review. Peer review, Ucko claims, mimics the usual definition of the scientific method, with the paper under review as a hypothesis evaluated by the experiment of peer review. It represents a reach towards objectivity by attempting to eliminate subjectivity, through various strategies, include single- or double-blind review.

Trust as a concept is most often studied when it becomes conspicuous by its absence, when a breakdown of trust occurs. Since science as well as peer review is built on empiricism and skepticism, one could say that science is built on distrust. However, as in all dealings between humans, some level of trust is required. It is Dr. Ucko's contention that what trust does exist in peer review as well as in science is built on a foundation of distrust. If all actors share the same level of epistemological skepticism, then a system of scrutiny emerges that allows for trusting to happen in spite of the skepticism that empirical science requires.

The session ended with a lively Q&A, with questions being asked of all the participants. It is clear that peer review continues to be a fascinating and controversial topic that draws a wide audience at this meeting. ■

Session Report: "The History of Electrical Science"

Continued from page 4

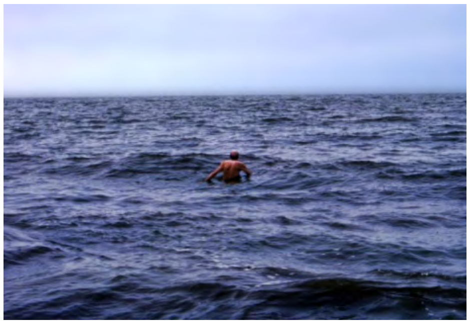
and underground cables brought about unique technological challenges and new physics. Focusing on the work of British electrical engineer Latimer Clark (1822-1898) and German scientist and industrialist Werner Siemens (1816-1892), Hunt described the difficulties in sending electrical signals long distances via high capacitance lines. He noted that British firms owned and operated almost all overseas telecommunications operations. Therefore, British electricians, like Clark, had a vested interested in using field theory to solve these kinds of technological problems. With the exception of Siemens' short-lived study of the physics of underground telegraph cables, German topography did not require the development of underwater or underground telegraph lines. Hunt concluded that German physicists did not pursue studies of Michael Faraday's "lines of force" not because they lacked access to British electrical science, but because they had no engineering need. ■

Adventures with Alligators, Sharks and Dirac

Continued from page 5

quantum mechanics about 45 years earlier, from a shark attack, so I shouted out "Professor Dirac, there's a shark over there!" He stood up (the water was not deep) and looked at where I was pointing, "Oh no," he said, "that's not a shark's fin, that's a dolphin's fin," and proceeded to explain the difference in their fin shapes, a subject he had apparently studied in preparation for swimming in Florida. You can imagine my great relief.

After a sea-food dinner at a restaurant Professor Lannutti drove us back to Professor Dirac's house in Tallahassee where his wife Margit (known as Manci) invited us in for a cup of coffee and to find out about our sight-seeing trip. While we chatted with her, Professor Dirac disappeared into the back of their house and eventually returned with a pile of presentation boxes which he opened up one by one to show me what was inside. They each contained



Dirac wading into the Gulf of Mexico. Photo by the author.

one of the many prizes and honors that Professor Dirac had received over his lifetime, for example, the Royal Medal, the Copley Medal, the Max Planck Medal, his Order of Merit and his Nobel Prize medal. What a treat it was to see all those medals and to read their accompanying citations; as we left Mrs. Dirac pulled me aside and told me Dirac had never before brought out his prizes to show anyone and I must have been a good influence on him. That was a marvelous remark to hear at the end of my first amazing day out with Dirac.

A year passed before I saw Dirac again because I was working on an experiment for FSU at the Stanford Linear Accelerator Center (BC67) and living in Palo Alto, California. I returned to Tallahassee in April 1978 to attend a symposium at FSU: "Current Trends in the Theory of Fields, A Symposium in Honor of P.A.M. Dirac." There was Dirac standing in the queue for coffee at the first break, also in the rather long and slow queue were other famous physicists (and Nobel Prize winners, past and future) who had come to pay homage to Dirac: Eugene Wigner (his brother-in-law), Murray Gell-Mann, Gerard 't Hooft, J.J. Sakurai, Kenneth Wilson, Frank Wilczek, Freeman Dyson, John Ellis (whom I knew from my graduate student days at CERN) and so on. But were any of them talking with Dirac? No! So I greeted Dirac and engaged him in some conversation; maybe the others knew it was difficult to have small talk with Dirac. He gave the last scientific talk of the symposium – on variations of Big G – and and I took a slide of him speaking.

One of Dirac's two daughters, Mary, lived in Tallahassee, and we became friends during my several stays there. Florida State University threw a dinner for Dirac and his family the day after the symposium finished, which I attended, and my diary (upon which I have depended for this article) reports that I spoke with Dirac about films and Shakespeare.

Dirac's theoretical physicist colleague at FSU, and close friend, Leopold Halpern, was also at the dinner and invited me to join him and Dirac on a canoe trip on the Wakulla River the next day, which I happily accepted. Mary Dirac drove her father and me (I never saw Dirac drive) to Wakulla Springs where we met Leopold and helped him launch his large canoe a little downstream of the Springs. We helped to paddle the canoe to a small island where we beached it and all went swimming in the refreshing but full of weeds river. I was relieved to see a water snake only after I got out of the water and a long alligator only later when we had paddled further downstream. We also saw osprey, a turtle, a blue heron and an enormous spider which turned up when we got stuck in a side channel and Leopold had to get out and push us off the mud. Many years later I read in Graham Farmelo's biography of Dirac[2] that he and Halpern took canoe trips on the Wakulla River most weekends and "occasionally, they would invite a visitor to join them – but it had to be someone who could be relied upon to stay silent most of the time." I don't think I fit that criteria but I recall we all had a lovely time on my second day out with Dirac. I gave a seminar a few days after the canoe trip on the experiment I was working on at SLAC with the FSU High Energy Physics (HEP) group, I was happy to see Dirac in the audience and he had no startling questions for me that time.

In September 1978 I spent three weeks in Tallahassee working on that experiment's data analysis, my office was in the same building as Dirac's and so sometimes I would see him in the corridor. One day he gave me some preprints of his more recent work and asked if I would sit in on an interview he was giving the next day. I agreed to, it was a young newspaper reporter who asked Dirac lots of questions about his latest theory (probably to do with the variation of the "Big G" gravitational constant, I don't recall) and I tried to help the interview process, having learnt how long it could take Dirac to answer a question. The next day Dirac flew off to Germany for a month, he often took trips away from Tallahassee to attend symposia. While I was back in Tallahassee working on our HEP experiment's data in the spring of 1979 I had dinner with Mary Dirac and her parents a couple of times. At the first dinner I heard about Dirac's March trip to Israel where he had addressed the Jerusalem Einstein Centennial Symposium and at the second dinner I heard about his May trip to Paris, where he had been guest of honour at UNESCO's Einstein celebration. On the 24th May 1979 I attended a colloquium at the FSU Physics Department given by Dirac- the talk he had given at the Einstein Centennial: "The Early Years of Relativity", quite a thrill to hear about that period from someone who was there. The next day I visited Dirac in his office to say goodbye, after much soul-searching and discussions with particle physics colleagues who had already left the field to work in industry, I had decided to leave particle physics and was flying back to Palo Alto to take up a staff scientist position at a large science consulting firm. When I explained this to Dirac he asked "Will you have to punch in and out?" I think this was a genuine question and indicates how little he knew about life outside academia, but I didn't hold it against him and have treasured the times I was privileged to spend with one of the greatest physicists of all times. ■

Endnotes

1. Dirac had invented quantum electrodynamics in the 1930s and using his mathematical equations one arrived at predictions that were - more often than not - infinite and therefore unacceptable. A workaround known as renormalization was developed, but Dirac never accepted this. "I must say that I am very dissatisfied with the situation," he said in 1975, "because this so-called 'good theory' does involve neglecting infinities which appear in its equations, neglecting them in an arbitrary way. This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it is small — not neglecting it just because it is infinitely great and you do not want it!" This 1975 quote comes from Helge S.Kragh, *Dirac: A Scientific Biography*, Cambridge University Press, p.184 (30 March 1990). I have since understood that any Feynman diagram has underlying mathematics for calculating

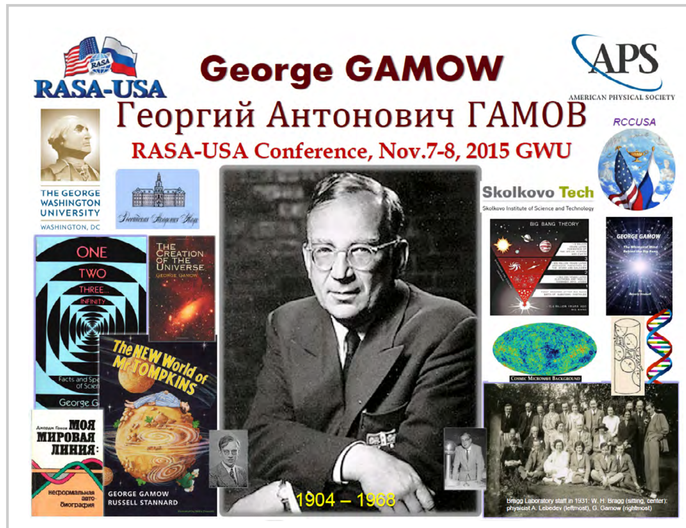
cross-sections that may need renormalizations to be carried out to match with the experimental data; so when Dirac saw my Feynman diagram, (which represented a first order reaction, not needing any renormalization) it brought to mind his many-decades long dissatisfaction with the renormalization process used in particle physics.

2. G. Farmelo, *The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom*, Basic Books, 2009.

George Gamow, famous Russian-American physicist, honored by GWU, scientific diaspora and diplomats in Washington

Continued from page 6

Prof. Igor Gamow, son of George Gamow (right), and Gamow's biographer Prof. Eamon Harper of GWU at the 2015 RASA-USA conference.



Conference poster of the 2015 RASA-USA "George Gamow" conference (November 7-8, 2015)

industry. It is part of an international Russian-speaking Academic Science Association (http://www.dumaem-po-ruisski.org/), which also unites the European and Asian branches. The objectives of RASA include the exchange of knowledge and experience, initiation of joint projects, coordination of research programs, organization of conferences, seminars, research schools, sharing knowledge of teaching programs and lecture materials. More on RASA and its goals can be found in the December 2012 issue of "APS News" and in the Fall 2013 issue of the "APS FIP Newsletters".

More than 160 scientists from the US and Russia attended the 2015 RASA conference which was sponsored by the "International Friends of APS Activity" grant. The APS sponsored a special session dedicated to George Gamow thus sending a strong message that RASA's initiative is very meaningful to the American, the Russian-proper and the Russian scientific diaspora communities and that the event helps to form "diplomatic links" and to strengthen communication and collaboration among our physics communities. Right after the conference Emily Conover of APS published a very nice article "Russian-American Scientists Honor George Gamow (1904-1968): Conference session celebrates physicist born 111 years ago" in the APS News: https://www.aps.org/publications/apsnews/updates/gamow.cfm and, later, the link to it (with George Gamow's photo) made it to the front page of the APS main website https://www.aps.org/

Amy Flatten, APS Director for International Affairs, opened Gamow's session with a short welcome message about how the United States will remember and appreciate the contribution of Gamow and with gratitude for organizing the memorial RASA Conference. Professor William Briscoe, Chair the GWU Physics Department, elaborated on the achievements of George Gamow - which he called the most outstanding scientist who has ever worked in the walls of his university - and on how GWU keeps up Gamow's scientific heritage: from a memorial plaque on the Physics Department building, to the commemorative meetings and support of the Gamow's studies, like, e.g., those conducted by Gamow's major scholar Prof. Eamon Harper of GWU.

The most entertaining part of the session was a presentation of George Gamow's son, Igor. Professor Igor Gamow, who flew to the conference from Colorado, gave a lively and interesting account of his father, showed several video clips about him and told a number of stories and anecdotes about George and his friends. The audience literally bombarded Igor with questions and did not want to let him go.

Scientific reports followed - first, Vladimir Shiltsev of the Fermi National Accelerator Laboratory (Batavia, IL) described several puzzling results of modern fundamental physics (from unexpected peaks in the data of the Large Hadron Collider, to the periodic variations of the measured gravitational constant, to the "Penrose rings" in measurements of cosmic microwave radiation of the universe as possible hints of previous reincarnations of the Universe before the Big Bang). Dr. Igor Moskalenko of Stanford University gave an overview of the modern astrophysics including recent studies of high-energy cosmic particles, the Sun, stars and galaxies.

The George Gamow session was the key scientific event of the 2015 RASA-USA conference. George Gamow's life and works are fully consonant with the aims and activities of the association, and so it seemed natural that RASA-USA established the award named after Gamow which goes to scientists of the Russian diaspora who have made outstanding contributions to science and contributed to the strengthened international reputation of Russian science. The first-ever RASA-USA Gamow Award ceremony celebrated two recipients - Professor Igor Efimov, a 1986 graduate of the Moscow Physical and Technical Institute, currently a Chair of the GWU's Department of Biomedical Engineering, for his work on the physics of the heart and contribution to the development of the Association (he was the first President of RASA-USA); and Professor Vladimir Zelman of the University of Southern California, a 1956 graduate of the Novosibirsk Medical Institute, for his contribution to the development of neurology and organization of medical research centers in Russia.

Ambassador of the Russian Federation to the US, Mr. Sergey Kislyak - himself a physicist, graduated from the Moscow Engineering Physics Institute - reminded the audience that at 28, George Gamow became the youngest member of the USSR Academy of Sciences, then - after his emigration - was excluded from the Academy, but then in 1990's was restored in the modern day Russian Academy of Sciences. Ambassador Kislyak remarked that George Gamow is the clearest representative of what he called "thinking in Russian" - the motto of the RASA Association.

The George Gamow session at the 2015 RASA Conference has been a remarkable commemoration of the remarkable Russian-American scientist. ■

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