First, we underscore the broader need for research funding by pointing out that the topic of weather damage encompasses more than hurricanes developing from severe storms over water. Dawson's November article stated, "Politicians from the Dakotas and Montana 'don't think [research on hurricanes] is their problem.' " However, tornadoes spawned by severe storms over land are very much an increasing threat to people, infrastructure, and property in the US interior. Tolls associated with these devastating killers are staggering. On average, 800 tornadoes occur nationwide each year. The Environmental Protection Agency states that tornadoes annually cause approximately $1.1 billion in damages and around 80 fatalities. On 3 May 2003, for example, a series of tornadoes ripped through Oklahoma City and its environs, leaving 48 people dead and causing more than $1 billion in damage. The hurricane insurance losses for 2005 were $57 billion, the highest ever before Hurricane Katrina, whose costs are still being counted. And on 5 May 2007, a single tornado with winds up to 205 miles per hour struck and essentially destroyed the town of Greensburg, Kansas. Thus, whether over land or sea, there are more than enough concerns about personnel, infrastructure, and finances to warrant investing in research on severe storms.

Second, now appears to be an optimum time for bringing together the previously estranged communities of weather modification practitioners, who are mostly supported by insurance industries, and research academics, who have very limited funds. A considerable amount of data on practical weather modifications has accumulated, and significant advances have occurred in fundamental model descriptions of severe-weather-based instabilities; for example, two of us (Armstrong and Glenn) have reexamined the role of electrification forces in contributing to tornado formation.[1] With coordinated efforts, a new, stronger community can be formed to advance the art and science of weather modification.

In another case, Jürgen Michele, Vladimir Pudov, and one of us (Alamaro) have been discussing a concept inspired by a 1970s Soviet weather-modification program in the Baltics.[2] In that program, an array of jet engines was employed to form a vertical air flow that, it was hoped, would be sufficient to cause cloud formation. Even in a stable atmosphere, 9 out of 15 tests led to cloud formation. Alamaro and coworkers presented the hypothesis that the method may be used for such weather modification applications as frost prevention, fog dispersion, and, most ambitiously, hurricane modification. In the case of hurricane modification, a designed array of multiple jets would be used to create atmospheric perturbations that might turn a hurricane back to sea.

References

1. R. W. Armstrong, J. G. Glenn, *J. Weather Modif.* **38**, 77 (2006); available at http://alamaro.home.comcast.net/JWM_armstrong_glenn.pdf.
2. M. Alamaro, J. Michele, V. Pudov, *J. Weather Modif.* **38**, 82 (2006); available at http://alamaro.home.comcast.net/WMA_April_2006.pdf.

Ronald Armstrong
(rona@eng.umd.edu)
University of Maryland, College Park
J. Greg Glenn
(joseph.glenn@eglin.af.mil)
Eglin Air Force Base, Florida
Moshe Alamaro
(alamaro@mit.edu)
Massachusetts Institute of Technology
Cambridge

Stories and statistics of Bose

Kameshwar Wali's article on Satyendra Nath Bose (Physics Today, October 2006, page 46) prompts me to narrate a few incidents about the great physicist. My father, cardiologist Sunil Bose, was his contemporary at Presidency College in Kolkata, India (1909–11), and later his doctor and friend. My siblings and I were thus brought up on tales of his genius. Bose was omnivorous in his quest for knowledge, and even as a student of physics at Presidency College, he would often borrow and devour books on anatomy and physiology. Chemists would come to him to solve their problems and would leave wiser. Here is an example of his creativity: An "indelible" ink was used in the first Indian general election in 1952 to mark the fingers of voters. He playfully found a solution that could erase the ink mark.

It is fairly well known that Bose never bothered to submit a doctoral thesis. Of value to the physics community is the role he played as mentor to generations of students and researchers. I offer one example: In the early 1940s, his student Shyamadas Chatterjee had set up an experiment at the Bose Institute in Kolkata to study the newly reported fission of uranium when bombarded with neutrons. While setting up the experiment, Chatterjee found that distinct counts were recorded even without the neutron source. Puzzled, he reported the phenomenon to Bose, who at once came to the conclusion that it must be due to spontaneous fission. The half-life they calculated, which later proved to be correct, was way above that attributed to Edward Teller. As a result, by order of the institute's director, whose permission he had failed to obtain, Chatterjee had to withdraw the paper describing his findings. The phenomenon was discovered almost at the same time by Georgii Flerov and Konstantin Petrzhak in the Soviet Union. Chatterjee published his work later and was recognized by the Russian authors.

Chatterjee shared with me the story of a visit Paul Dirac made to Kolkata in the early 1950s to give a lecture at the Institute of Nuclear Physics. As Dirac spoke, Bose, sitting in the front row, appeared to doze off. Writing an equation on the blackboard, Dirac seemed to hesitate and looked toward the white-haired Bose for confirmation. Bose lumbered to his feet, scribbled the rest of the equation, and then resumed his earlier somnolent posture.

After the lecture, Dirac and his wife were ushered into the rear seats of a car, while Bose, Chatterjee, and one other person were about to occupy the front seats. Dirac demurred and requested that Bose join him in the back. Quick as a flash came the reply—"We follow Bose–Einstein statistics in front, you should follow Fermi–Dirac at the back!"

Wali mentions Bose's connection with the swadeshi movement and the names of Manabendranath Roy and Abani Mukherjee. Bose was also a close family friend of the nationalist leaders Sarat and Subhas Chandra Bose, who were students at Presidency College at almost the same time as S. N.

Dwarka N. Bose
(tutubose@yahoo.co.in)
University of Calcutta
Kolkata, India

In his excellent article "The Man Behind Bose Statistics," Kameshwar Wali mentions that Albert Einstein proposed to Bose that he work on two problems: "first, whether the new statistics implied a novel type of interaction between light quanta; and second, how the statistics of light quanta and transition probabilities would look in the new quantum mechanics."

Apparently, Bose did not make progress with either of the two questions, nor is there any evidence that Einstein considered them further. Bose had formulated an interaction between radiation and matter,[1] which Einstein criticized because, according to Wali's article, "the coefficient of absorption is independent of the density of the radiation." It can be shown, without the need to appeal to the "new quantum theory," that it is Einstein's 1916 quantum theory for the interaction between matter and radiation[2] that leads directly to Bose statistics.[3] Surprisingly, this deduction escaped the attention of Einstein, who otherwise would have discovered Bose statistics.

References

1. S. N. Bose, *Z. Phys.* **27**, 383 (1924).
2. A. Einstein, in *Sources of Quantum Mechanics*, B. L. van der Waerden, ed., North-Holland, Amsterdam (1967), p. 63.
3. M. Nauenberg, *Am. J. Phys.* **72**, 313 (2004).

Michael Nauenberg
(michael@mike.ucsc.edu)
University of California, Santa Cruz

Of politics and preparation in Cuban physics

What has happened to the community of physicists in Cuba (PHYSICS TODAY, September 2006, page 42) is a good example of how scientific research and the lives of scientists can be manipulated by authoritarian and inept politicians.

The article shows very clearly how Ernesto "Che" Guevara, Fidel Castro, and a few others without any scientific background have determined the direction of physics research in the country. After so many years of arbitrary political decisions, as the article says, "an estimated 200 physicists left the country, and an undetermined number sought better economic conditions in fields other than science."

The same politicians have dictated the economic, financial, industrial, journalistic, artistic, and literary lives of Cubans. As a consequence, censorship, prohibitions, and repression have dominated Cuban political, economic, and cultural life during the past 47 years. It's difficult and demoralizing to live in a country where all people, scientists included, are under the control of a totalitarian regime.

Carlos Delgado
(carlos.delgado@ccsn.edu)
Community College of Southern Nevada
Las Vegas

Congratulations to PHYSICS TODAY on the very informative article about advanced physics education in Cuba during the late 20th century, from this former student of Ciencias Físico Químicas (chemical physics) at the University of Havana. The approximately two-century-old tradition of strong public science education has led to the success of their graduates at home and abroad. My contemporaries (1946–51) received instruction in various disciplines that physics depends on, particularly mathematics and chemistry. Many of us were prepared to obtain higher degrees abroad—for example, at the University of Minnesota and the University of California, Berkeley. The excellent, devoted professionals mentioned in the article gave us the foundations—such as the Gauss, Green, and Stokes theorems—that we would later use for solving real physics problems.

We were also exposed to lectures on street-wise topics. One noteworthy example was a presentation as the first lecture of organic chemistry. The instructor showed students how to build a firebomb using the important national product, sugar, plus a still readily available liquid that could be carried in a small test tube in a coat pocket. The purpose was not to train terrorists but to inform the students of possible threats in the world. This type of education is still needed everywhere.

I have made my academic career in the US because of family matters. But I received the important undergraduate foundations of my education in Cuba, from excellent teachers, at public institutions.

Juana V. Acrivos
(jacrivos@athens.sjsu.edu)
San José State University
San José, California

Rodríguez, Fajer, and Baracca reply: It is a pleasure to see that scientists continuing their academic careers abroad are grateful for the high-quality education they received at Cuban public universities. In the times Juana Acrivos remembers, the number of university students was very small and a degree in physics was not yet offered, but there were two mixed programs: in physico-chemical and physico-mathematical sciences. Extensive access to universities, degree programs in physics, postgraduate studies, research, connections to industry and the health system, and so forth came later, with the revolutionary transformations of the 1960s. The selection of research directions was, and still is, a highly participative process involving physicists, students, and colleagues from many different countries. The vision and stimulus of some government leaders also played a very important and encouraging role.

At the beginning of the 1990s, changes in the international arena interrupted a 30-year process of growth and development of Cuban physics, which has returned only in recent years. Looking for better economic conditions, some physicists left the field or the country: Cuba experienced the so-called brain drain that affected so many countries. It had been almost nonexistent in Cuba until the 1990s.

We hope our article has provided a vision of Cuban reality, an alternative to reiterated diatribes and disinformation. We invite bona fide scientists to engage in free academic exchange based on mutual respect, understanding, and scientific interest.

Carlos Rodríguez
(dir@imre.oc.uh.cu)
Institute of Materials and Reagents
Havana, Cuba
Víctor Fajer
(vfajer@ceaden.edu.cu)
Center of Technological Applications and Nuclear Development
Havana, Cuba
Angelo Baracca
(baracca@fi.infn.it)
University of Florence
Florence, Italy

Bicycle stability in no-hands riding

With great pleasure, I reread the article "The Stability of the Bicycle" (PHYSICS TODAY, September 2006, page 51, reprinted from 1970). As an enthusiast who has bicycled daily for approximately 40 years, I was in resonance with much of the article, especially the discussion of no-hands riding, which I recklessly persist in doing. I was in the middle of my undergraduate career when this article first appeared, and my overall understanding of it at the time was feeble, but this article is one of the few in PHYSICS TODAY that I remember clearly, even after 36 years.

Sid Redner
(redner@bu.edu)
Boston University
Boston, Massachusetts

The reprint of David E. H. Jones's article made me wonder how one can understand a bicycle's stability without