

# LETTERS

## Let's Get Fiscal: More Noteworthy Physicists

Having read with great interest Lloyd Kannenberg's "Fiscal Physicists" in your December 1998 issue (page 38), I would like to offer an addition to his roster: Kristian Olaf Birkeland (1867–1917), a gifted and productive scientist—and long-time professor of physics at what is now the University of Oslo—who was given a place of honor on a 200-kroner banknote (now worth

evacuated box. When the terrella was subjected to an electron beam, a glowing halo would appear in a narrow region around its magnetic poles, simulating the auroral zones. Based on his experiments and field work, Birkeland correctly proposed that the aurora resulted from cathode rays carrying an electric charge into Earth's atmosphere.

The back of the banknote shows a map of the north polar regions, where Birkeland established a network of auroral observation stations. A ring encircling the magnetic dipole symbolizes the location of auroral phenomena, including the satellite-determined statistical location of Birkeland currents (an electric circuit along the magnetic field

of the ellipse, instead of at its focus as Newton had stated. The letter writer suggested that the bank withdraw the note both to restore its own reputation and "in consideration of the misleading effect this mistake could have upon school children and others."

That £1 note ceased to be issued in January 1985 and was replaced by a coin. In retrospect, it is ironic that Newton, who for nearly 30 years was master of the mint, should have had his time in a place of honor on a banknote so drastically curtailed by his own office.

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roughly US\$30) by the Norwegian government in 1994.

Birkeland's pioneering work underlies many of our present ideas concerning the three-dimensional nature of Earth's magnetosphere, the workings of polar geomagnetic activity, the aurora and the Sun's connection to the magnetosphere. He is also remembered for having discovered the plasma arc that resulted in the development of the first industrial method for nitrogen fixation.

It is his auroral work that is celebrated on the banknote. The front side (see the accompanying illustration, published by permission of the Norwegian Central Bank) portrays Birkeland against a stylized pattern of the aurora, as well as a large snowflake that symbolizes his interest in meteorology at polar latitudes. On the far left of the note is shown his terrella experiment, which consisted of a small magnetized sphere representing Earth and suspended in an

lines above the aurora). Also shown is Birkeland's original depiction of field-aligned currents as published in 1908.

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Banknotes bearing pictures of physicists customarily convey reliable information about their achievements. However, in the case of the £1 note honoring Isaac Newton that was issued by the Bank of England in 1978, the physics involved was more than questionable.

The reverse side of the note depicted Newton sitting beneath a flowering apple tree with his prism by his side and a copy of the *Philosophiae naturalis principia mathematica* on his lap. The book lay open at proposition 11, the section in which Newton proved that the planetary orbits must be elliptical. To the left of Newton was shown the ellipse, enlarged, and on it was superimposed a machine-engraved pattern to suggest the Solar System.

In the spring of 1983, some sharp-eyed individual in Stockholm sent a letter to the Bank of England pointing out that there was an error—and "not a little one"—on the banknote. The Sun was positioned at the center

Your readers should also know of the 50-tolars banknote that was issued in 1992 by the government of Slovenia in recognition of the accomplishments of a renowned mathematician and physicist named Jurij (Georg) Vega.

Vega was born of Slovene peasant stock in 1754. By the time he was 30, he had published a textbook on mathematics (said to be the most advanced textbook of that era) and a handbook of logarithmic and trigonometric tables to seven decimal places. Over time, the handbook ran through almost a hundred editions, the last being published in Berlin in the 1950s (as far as I know), and was translated into at least eight languages. Vega was so sure of the accuracy of his tables that he promised to pay one gold coin for each mistake found in them; in the course of his lifetime (he lived to be 48), his total outlay for those mistakes amounted to five gold coins. It is just as well that he did not make a comparable offer regarding a later handbook of his that provided tables to ten decimal places. Carl F. Gauss determined that Vega's methodology was flawed and estimated that there were almost 32 000 errors in the tables. On the other hand, Vega wrote the first comprehensive work on geometry, trigonometry and differential and integral calculus.

Vega also distinguished himself in the field of physics and published several works on such subjects as astronomy (in recognition of his accomplish-

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ments, his name was later given to a mountain on the Moon), hydraulics, hydromechanics and the movement of solid bodies.

An area of applied physics in which he succeeded was the design and construction of military cannons. Not only did he teach at an artillery school in Vienna, but when the Austrians laid siege to Turkish-held Belgrade in 1789, Vega was there, commanding a heavy artillery unit equipped with his highly accurate cannons.

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**K**ANNENBERG REPLIES: My thanks to all who have sent comments or corrections both to PHYSICS TODAY and directly to me regarding "Fiscal Physicists." I regret that space limitations prohibit my including here the names of all those who have contacted me, but I would like your readers to know that I do answer each message as it reaches me.

The above three letters are only a tiny sample of the responses received.

Alv Egeland's comment is representative of a great many messages pointing out that I missed the banknote honoring Kristian Olaf Birke-land. Judging from the number of such messages, I seem to be almost the only person on Earth who didn't know about it.

Lars Falk's story is amusing, but the ellipse on the Newton banknote is actually the figure for proposition 11, problem 6 (in book 1 of the *Principia*), in which *S* denotes a focus of the ellipse and *C* denotes its center. Later in the same problem is a treatment of two mutually attracted bodies revolving about their common center of gravity, with the bodies being labeled *S* and *P*, which at least suggest *sol* and *planeta*, respectively; so maybe the Bank of England shouldn't be castigated too severely on this point.

As for Božidar Kanajet's letter, I did know about the Vega banknote—in fact, I have a copy. Like everyone else old enough to own Vega's *Seven-Place Logarithmic Tables*, I also knew a little about his mathematical work, but not about his research in physics. As a result, I did not include him in my list of fiscal physicists. Unfortunately, Vega does not rate a citation in the *Dictionary of Scientific Biography* (Birkeland does); perhaps Kanajet's letter will lead to Vega being included in a supplementary volume.

Some of my correspondents point out other omissions, such as the Iraqi 10-dinar note of 1980–82 that shows Arab cosmologist and mathematician Abulhasan ibn al-Haytham (or Al-hazan); the Colombian 20 000-peso note of 1998 honoring astronomer Julio Garavito (for whom a lunar crater is named); and three Australian notes—issued about a decade ago and no longer in circulation—that featured aerodynamics pioneer Edward Hargrave (\$20 note), radio astronomer Clunies Ross (\$50) and the country's first astronomer, Edward Tebbitt (\$100). And I have also been told that, in my article, I managed to misspell the first name of Volta; it properly is Alessandro.

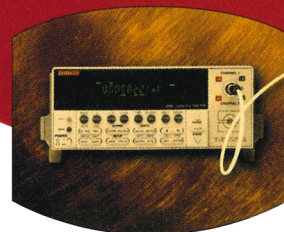
Following are a few brief comments about some of the other messages sent directly to me. Mike Lieber (University of Arkansas) points out the fine Web site (<http://www2.physics.umd.edu/~redish/Money>) maintained by Joe Redish (University of Maryland, College Park); the site has color images, not only of nearly all the notes listed in my article, but also of still others. Giancarlo Ghirardi (Abdus Salam International Centre for Theoretical Physics in Trieste, Italy) tells me that he has an extensive list of scientists (not just physicists) on banknotes, as well as a sizable collection of such notes. Anthony Michaelis (*Interdisciplinary Science Reviews*) writes that his large collection (over 1300 pieces) of "scientific banknotes," containing not only banknotes depicting scientists but also notes with scientific and technological themes, is presently housed at the Deutsches Technikmuseum Berlin. About 300 of his notes are now on display there, and he and the museum are preparing an annotated CD-ROM catalog of the full collection.

Several of my correspondents report that a few coins also have featured physicists, such as Max Planck on a West German 2 DM coin and, of course, Benjamin Franklin on an old US 50-cent piece. Germany has also issued a long series of commemorative 5 DM coins in honor of such physicists as Gottfried Leibniz and Carl Gauss. Yuval Ne'eman (Tel-Aviv University) adds two names to this short list: Copernicus, on a Polish 10-zloty coin, and Democritus, on a Greek 20-drachma coin.

Further comments are most welcome (please note my new e-mail address, given below).

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