B to *B*′, is problematic, because *B*′ does not belong to the event algebra of the sample space used previously, as is obvious from the fact that it does not commute with *C*′. Consequently, either the step from *B* to *B*′ is not allowed, or else one has to adopt a new sample space in which both *B* and *B*′ make sense. But in the latter case it is necessary to abandon the earlier (*B* and not *C*′), as it cannot be a part of the new sample space. In either case, the argument cannot be completed. Chaining together arguments using mutually incompatible sample spaces is a common mistake in quantum reasoning, leading to a variety of quantum paradoxes. Readers may find it useful to consult reference 3 for detailed discussion of a similar example.

A possible way out of this conclusion might be the distinction that Faris makes in his letter, which is not very clear to us, between a quantum event and a physical event. He refers to *X*, *Y*, and *Z* as physical events, and it may be that Faris believes that one can sensibly speak of them occurring simultaneously despite the fact that the corresponding quantum projectors do not commute. One must certainly distinguish between physical events occurring in a laboratory and the mathematical objects, such as projectors, that represent them in the theorist's notebook. Still, insofar as quantum theory is a correct description of the world, it is unlikely that there are real events in the laboratory whose counterparts in the theory lack any meaning. To be sure, Faris has the right to develop his own theory using definitions and rules that are different from those we have developed for the consistent-histories approach. But then the contradiction that he has derived has to do with his own alternative proposal, and not with consistent-histories quantum theory as that has been defined up till now.

We do not think that the rules of consistent-histories quantum theory are at all obscure. Instead, confusion arises from importing classical ideas into quantum theory in a manner that is incompatible with the mathematics of Hilbert space. The consistent-histories rules, when they are taken seriously, prevent this sort of thing, and keep one from falling into the sort of contradiction that Faris is concerned about.

References

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Echegaray—Fiscal Scientist and More

This letter is in response to Lloyd Kannenberg's delightful article "Fiscal Physicists" (PHYSICS TODAY, December 1998, page 38; Letters, April 1999, page 15). I would like to add to Kannenberg's collection the name of the Spanish scientist José Echegaray Izaguirre (1832–1916), to whom the Bank of Spain dedicated the 1000-peseta banknote (approximately $6) issued in 1971. The banknote, whose dimensions were 93 mm 153 mm, was in circulation until the beginning of the 1980s.

Although Echegaray may not have made any fundamental contribution to the advancement of physics worldwide, he played an essential role in the development of physics in Spain. Professor of mathematical physics at the University of Madrid, and now recognized as one of the best national mathematicians of the late 19th century, he introduced in Spain many of the ideas about physics and mathematics that were circulating in Europe. He also founded the Royal Spanish Society of Physics in 1903, and was its first president.

But his activities were not limited to this. Educated as a civil engineer, he was also an eminent economist and a supporter of free trade. His talent and knowledge enabled him to serve several terms as minister of finance; he was also elected to the House of Commons several times and later to the Senate. Echegaray improved the country's economy, and founded the Bank of Spain, which was—and is today—the national institution that oversees the economy and the national currency. The reverse of the banknote shows an illustration of the central building of the Bank of Spain, built while Echegaray was minister of finance.

Echegaray also was a writer; his works were an excellent expression of romanticism. In 1904 he was corecipient, with Frederic Mistral, of the Nobel Prize in Literature.

This extraordinary confluence of abilities would have been enough to gain him recognition, but his renown came at one of the most difficult times in Spain's history. In 1898 Spain had lost the war against the US and, as a consequence, had also lost the last of its former empire (Cuba, the Philippines, and smaller territories in the Pacific Ocean). These losses generated a feeling of frustration among the Spanish people, and the sense of being weaker than their neighboring European colonial powers. In this atmosphere, Echegaray became a focal point for Spanish nationalism.

I do not know of many cases like José Echegaray Izaguirre: outstanding mathematician, engineer, physicist, economist, politician, and writer. It would be nice if PHYSICS TODAY collected similar cases of physicists with expertise in such diverse intellectual pursuits.

In summary, Echegaray was a

gifted man who definitely deserved a place in Kannenberg's article, considering that he was truly a "fiscal physicist."

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Correcting the Record on Jordan, Zermelo

The suggestion of Engelbert L. Schucking (Physics Today, October 1999, page 26) that Pascual Jordan is still widely unknown outside the physics community is quite correct. The 1997 edition of *Chambers Biographical Dictionary* contains a short paragraph on "(Ernst) Pascual Jordan (1902–) German theoretical physicist." Evidently, 17 years after Jordan's death, the editors of the dictionary were not aware of it. Several current popular biographical dictionaries of scientists contain no mention of Pascual Jordan at all. What is more striking is that for many years after World War II, even physics students were hardly aware of Jordan and his work. David Bohm's 1951 textbook *Quantum Theory* does not mention Jordan at all. The 1958 4th edition of Paul Dirac's *The Principles of Quantum Mechanics* makes no mention of Jordan. Nor is he mentioned anywhere in Richard Feynman's *Lectures on Physics* (1965). So for many years, he remained the mysterious third party in the Born–Heisenberg–Jordan genesis of matrix quantum mechanics, an unmentionable person even to students of quantum mechanics.

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I hate to spoil a good joke, especially one by Wolfgang Pauli, but the Felix Klein comment recounted by Engelbert Schucking is spoiled by the facts. Schucking reports having heard the joke when Pauli regaled him and Pascual Jordan with anecdotes about Ernst Zermelo's days as a *privatdozent* at the University of Göttingen, when the math department had been ruled by Klein. Schucking tells us that Zermelo's punch line, "Felix Klein isn't a mathematician," had then been topped by Pauli's laconic remark, "Zermelo was not offered a professorship at Göttingen."

In fact, Zermelo had been appointed professor at Göttingen in 1905, during Klein's tenure as top dog.

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Sticky Things Heat Up, Cool Quickly

The article entitled "On Stickiness" by Cyprien Gay and Ludwik Leibler (Physics Today, November 1999, page 48) is excellent in its coverage of most of the subject of stickiness, but it misses one important topic—the temperature changes involved in the stretching of an adhesive. It is well known that the temperature in adhesive tape increases rapidly and then falls just as rapidly after separation. For information on this topic, your readers can consult Robert J. Good's 1971 paper and my 1995 book.[1]

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1. R. J. Good, in *Aspects of Adhesion*, D. J. Alner, ed., U. of London P., London, England (1971). H. H. Hull, *Thermodynamics of Rheology*, Society of Plastic Engineers, Brookfield, Conn. (1995), especially chap. 7, p. 53.

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Physical Information Before Landauer

The article on the future of computing by Joel Birnbaum and R. Stanley Williams (Physics Today, January 2000, page 38) makes exciting reading. Their allocation of credits, however, leaves me a little unsure.

The authors say Shakespeare gave the lines "the fault, dear Brutus, . . ." to Julius Caesar. Actually, these are Cassius's lines.[1] The full quote is "The fault, dear Brutus, is not in our stars, but in ourselves, that we are underlings." Julius Caesar, who was not an underling, would not have made this remark.

Also, Birnbaum and Williams give the impression that Rolf Landauer was the first to understand that computation is physical and related to entropy. I learned this point from Léon Brillouin's 1956 book,[2] but it was pointed out to me that Edwin Jaynes had already published these results in 1957.[3]

I am not sure whether there was cross influence between him and Brillouin or not. Both discussed the physical nature of information quite independently of the electronically mechanized logic gate. This was at a time when digital computers still used vacuum tubes. (By the way, Jaynes's obituary appears in the same January 2000 issue of Physics Today, page 71.)

References

1. W. Shakespeare, *Julius Caesar*, Act I, Scene ii, lines 140–141.
2. L. Brillouin, *Science and Information Theory*, Academic Press, New York (1956).
3. E. T. Jaynes, Phys. Rev. **106**, 620 (1957).

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Correction

November 1999, page 25—The second part of the third sentence in the figure 1 caption should read: Foam wedges 1.2 m long on the walls of the room make the room strongly absorbing for wavelengths shorter than 5 m, or frequencies above 70 Hz. ■