Undergraduate Research: Cory Tamler

By: Bruce Steele

***Physics Today*'s "10 Most Beautiful Experiments" list inspires this Pitt student to write a play about science and reason**

This is the sixth in a series of *Pitt Chronicle* articles profiling outstanding University of Pittsburgh undergraduate researchers

Driving his car through a thunderstorm, talking distractedly on his cell phone to a detective who is investigating the alleged Murder of Reason (prime suspect: quantum science), Galileo Galilei—yes, that Galileo—bemoans 21st-century scientific illiteracy:

"*The rational mind, pah!" he scoffs. "I've no faith in it anymore. Science has become so popularized nowadays that any fool thinks he can discourse adequately on it.… When* [during the 17th century] *you looked into a man's eyes and explained to him the Copernican system, when you dragged him by the hand to your telescope and showed him the Medicean stars, he denied your proofs, he denounced the idea of a heliocentric system in spite of all reason, but there was a spark in his eyes that said, 'I know you're right, I'm just too terrified to believe you.'*

"Not anymore. Everyone knows the Earth revolves around the Sun now, but they know it in the same way our 17th-century theologians 'knew' the Earth was the center of the…no, it's not rational, it's what they've been told…it was once a triumph of reason, now it's blind lazy habit.… "

That Galilean screed appears in *Not Eureka,* a new play by Pitt undergraduate Corinne "Cory" Tamler that she hopes will help to bridge the gap in understanding ("if only a little," she modestly says) between science and art. The first public performance—a staged reading—of *Not Eureka* was held March 29 in the Pittsburgh Playwrights Theatre downtown at 542 Penn Ave.

The play's title refers to a quotation by Isaac Asimov: "The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka' but 'That's funny… .'"

A junior triple-majoring in the history and philosophy of science, physics and astronomy, and English writing, Tamler began work on *Not Eureka* last summer as a Brackenridge Fellow. (The summer fellowship program, named for Pitt founder Hugh Henry Brackenridge, awards Pitt undergraduate researchers stipends of $3,000 each, freeing them to pursue research projects rather than having to work traditional paying jobs.) Tamler fine-tuned her play this spring in the Playwriting 2 class taught by Pitt Professor of Theatre Arts Kathleen E. George.

Tamler was inspired to write *Not Eureka* by a list, published in the September 2002 issue of *Physics Today*, of the "10 Most Beautiful Scientific Experiments of All Time" as selected by a poll of physicists. The 10 winners "were largely solo performances, involving at most a few assistants," *The New York Times* noted in its report on the *Physics Today* list. "Most of the experiments…took place on tabletops and none required more computational power than that of a slide rule or calculator."

"As someone who is deeply interested in science," Tamler says, "it's easy for me to see how an experiment can be beautiful. However, as an artist, I also understand how it can be difficult for someone who doesn't find the sciences inherently fascinating to see the beauty inherent in a scientific experiment.

“I hope my play will help people who appreciate the beauty of theater to connect also to the beauty of scientific experimentation.”

In writing *Not Eureka*, Tamler was inspired by such popular science-based dramas as Michael Frayn’s Copenhagen (about a 1941 meeting between the Danish physicist Neils Bohr and his German protégé, Werner Heisenberg) and two plays by Tom Stoppard, *Hapgood* (which combines themes of espionage and quantum physics) and *Arcadia* (in which the overhaul of a garden symbolizes the transition from a neat Newtonian universe to a disordered one).

Stoppard, with his characteristic mix of philosophy, wordplay, and physical humor, is a particular favorite of Tamler’s. In February, she directed a Pitt Rep Laboratory production of his *The Real Inspector Hound* in the Cathedral of Learning’s Studio Theatre.

Rather than write a traditional play with historical characters conducting the experiments described in *Physics Today*, Tamler created characters who embody three of the experiments.

They include:

• The Magician, who represents “Foucault’s pendulum,” a celebrated experiment demonstrating the Earth’s rotation. It was named after French physicist Jean-Bernard-Léon Foucault, who in 1851 gave the most famous public demonstration of the experiment by setting in motion an iron ball suspended on a wire from the dome of the Pantheon in Paris. As an invited audience watched in amazement, the direction along which the ball-pendulum swung rotated over time, proving that the Earth was revolving on its axis;

• The Detective, a.k.a. “Millikan’s oil-drop experiment.” American scientist Robert Millikan devised the experiment in 1909 to measure the electrical charge of the electron. He did so by measuring the force on electrically charged droplets of oil suspended against gravity between two metal electrodes; and

• The Criminal, who embodies “Thomas Young’s double-slit experiment applied to the interference of single electrons”—not a catchy title, maybe, but a dizzying illustration of quantum mechanics.

And a dangerous one, according to the Detective, whom Tamler describes in her stage directions as being “older, rigid.”

While searching the Magician’s dressing room for the Criminal, the Detective warns that the latter has murdered reason by “shamelessly renouncing the virtues of logic” and “breaking the laws of physics.”

DETECTIVE: *He has warped the human mind until it can no longer perceive the difference between a particle and a wave. According to everything that’s logical, a thing can’t be both a particle and a wave at the same time.*

MAGICIAN: *I should think not.*

DETECTIVE: *But this fellow’s got everyone in such a twist that they’ve stopped trusting their powers of reason. He takes a beam of electrons, you see, and passes it through two tiny little slits to let it make a pattern on the other side. Now, everyone knows that electrons are particles, but when he passes them through these slits he makes them appear to interfere with one another just like waves would. So the pattern on the other side, instead of being uniformly bright, like it should be with particles, is in bands. Bright bands where the crests of the waves meet up and reinforce one another. Dark bands where a crest meets a trough and they cancel one another out. As if the particles are waves. Do you see?*

MAGICIAN: *I think so. But if that's the case, isn't it possible.… .*

DETECTIVE: *Wait. You haven't heard the height of his treason. What he does next is the most depraved, bloodthirsty attack on reason that you could possibly imagine.*

And the Detective proceeds to describe how the Criminal (i.e., the double-slit experiment) apparently proves that an electron can, in effect, be in two places at the same time.

MAGICIAN: *How does he do it?*

DETECTIVE: *That I don't know. All that I know is this: It only works if you don't watch. You must set up the apparatus and let it run in blindness. If you watch an electron, it will only go through one of the slits and there will be no bright and dark bands. But if you don't watch, the trick works. It seems to go through both.*

MAGICIAN: *How do you know it's a trick?*

DETECTIVE: *What?*

MAGICIAN: *How do you know he isn't showing you the truth?*

When the Detective finally tracks down the Criminal, the latter insists he's innocent.

DETECTIVE: *If you're innocent, why are you running?*

CRIMINAL: *I live by the laws of quantum physics, not your outdated classical nonsense. Just because you never know where I am doesn't mean I'm running.*

To support his case, the Detective enlists an expert witness, Galileo. ("I introduced Galileo as a character because he's such an icon of reason in Western history," Tamler explains. "Also, I thought the image of Galileo driving a car and using a cell phone was pretty funny.")

But Galileo, arriving on the scene after having just attended the Magician's theatrical performance of Foucault's pendulum experiment, retracts his earlier judgment that reason is dead.

He tells the Detective, "If you'd asked anyone in that audience before the performance whether the Earth turns, they'd have told you yes, of course it does, but they wouldn't have understood what they were saying. It would be parroting. Deep down, they all still felt that the Earth is stationary—because, doesn't it seem to be?"

But then, Galileo watched the audience members' faces as it dawned on them that Foucault's pendulum was changing direction because the Earth itself was moving.

"If you had seen it, Detective, you would have known—that is a journey that no one could complete without reason," Galileo declares. "Reason is alive and well, if you ask me."

In applying for her summer 2006 Brackenridge fellowship, Tamler needed a faculty sponsor for her playwriting project. While theater isn't among her majors, she has plenty of contacts in the University's Department of Theatre Arts: In addition to taking department courses, Tamler is president and cofounder of the Redeye Theatre Project, a Pitt student club that writes, rehearses, and stages a series of one-act plays—all in 24 hours—each fall and spring.

But instead of seeking a Brackenridge sponsor among the theatre arts faculty, Tamler looked for one in the Department of the History and Philosophy of Science (HPS). “I’d written plays before and done research before, but not so much on straight science,” she says. “I thought that if I could find a sponsor in HPS, it would help me.”

Not knowing any HPS faculty members at the time, Tamler searched their individual Web sites and found the page of Assistant Professor Paolo Palmieri, whose research includes using new technology to uncover precisely how Galileo performed his experiments, and with what materials and equipment. (Before modern times, scientists rarely documented such details.) Palmieri also teaches a course, Galileo and the Creation of Modern Science, that makes use of Bertolt Brecht’s polemical drama, *The Life of Galileo*.

“I found Cory’s project to be interesting and highly original,” remembers Palmieri, who, like Galileo, was born in Italy. “The first thing I told her was, ‘I’m not a native speaker of English, so I can’t give you any advice in terms of style. But I can help with the science.’ I ended up marking a few passages in the first draft of her script that I wasn’t sure were clear. In the end, the experiments themselves were, I thought, simply but correctly represented in Cory’s play.”

Unlike Galileo, who studied medicine and mathematics at the University of Pisa (failing to complete an academic degree), Tamler did not set out to attend a big university. Her first choice was Oberlin College, her parents’ alma mater. But then Tamler discovered Pitt’s Honors College, where college dean G. Alec Stewart and others encouraged her to apply for a full-tuition Chancellor’s Scholarship.

“They were just awesome,” Tamler says of the Honors College staff. “After I completed my interview for the scholarship, they gave me all of these books that showed they had read the essays I’d submitted” as part of the application process. One of the books was Tom Stoppard’s *Arcadia*.

Tamler won the Chancellor’s Scholarship.

“I’ve never regretted my decision to come to Pitt at all,” says Tamler, whose family moved to Pittsburgh from California when she was seven. She graduated from Baldwin High School, having enrolled as a sophomore after being home-schooled up to that point. “I’ve found that I really like being at a big, urban university. One nice thing is that there are so many different niches here. Pitt’s theater community is where I’ve found a home, where I feel most comfortable and know lots of people, but there are plenty of other niches.

“Certainly, Pitt is not a cookie-cutter school. People don’t come here all from the same background, and they don’t come out with the same stamp on them. There’s tons of diversity here.”