HIGH-ENERGY PHYSICS

Researchers Quell Quark Rumor: The Top Is Still at Large

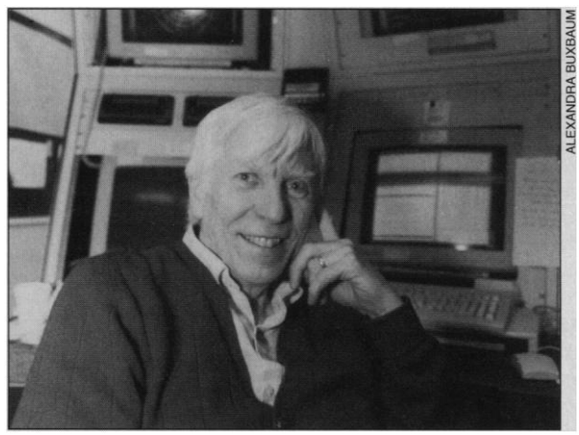
Equipped with electronic mail, scientists can send news of discoveries whizzing around the world at thousands of miles per second, without worrying about the traditional barriers of peer review. This new freedom has its advantages—and its risks—as the physics community discovered earlier this summer when there charged across the connecting circuits a real zinger. It certainly looked like big news: A group of scientists had allegedly found the top quark. That would qualify as one of those "holy grail" achievements that come about once a decade. The particle, the one missing piece in the predicted pack of 12 building blocks of matter, has been the object of years of intensive search. Eureka!

Except that the rumor, even according to the particle's "discoverers," just wasn't true. That didn't stop it from flashing "all around Europe," according to Fermilab's Melvyn Shochet, and showing up in two British magazines, *New Scientist* and a trade publication called *The Engineer*. There, readers learned that Oxford theorist Richard Dalitz and his colleagues had not only "discovered" the particle but had sifted it out of old data gathered 3 years before by Fermilab scientists in the CDF (Collider Detector at Fermilab) collaboration. The suggestion that the CDF scientists had overlooked their own quarry was galling enough, but one report went even further, asserting that the finding was somehow "being suppressed" by Fermilab scientists anxious to avoid losing out to outsiders.

The physicists who supposedly saw signs of the top quark in Fermilab's data, Dalitz and his collaborator Gary Goldstein of Tufts University, say they are embarrassed by the rumor and by the press's version of events. It's a case of the scientific rumor mill spinning out of control, Goldstein now says: "Had these rumors not gotten out, no one would have complained." Shochet and his cospokesman at the CDF, Alvin Tollestrup, are just as upset. But that's where agreement ends between the two camps. They disagree both about the significance of the discovery and the extent to which outsiders like Goldstein and Dalitz should have access to their colleagues' unpublished data.

Dalitz and Goldstein believe they have made a real discovery, if not the one that stirred the rumor mill. They think the patterns they found look suspiciously, though not unambiguously, like the top quark and deserve further analysis. The CDF group isn't impressed. That might be a simple scientific disagreement, but it has been sharpened by a deeper dispute about whether the two outsiders had any right to be looking at CDF data in the first place. Like most large scientific collaborations, the CDF group maintains tight control over data and its interpretation; Dalitz and Goldstein gained access to unpublished, partially analyzed CDF data only when Krys Sliwa, a member of the group, shared it without telling his colleagues. To Shochet and Tollestrup, the recent overheated rumors simply show the dangers of such data-sharing. Goldstein, much as he regrets the rumors, thinks outsiders should have more access to data.

The roots of the current flap, says Goldstein, go back to a paper he and Dalitz published a year ago in *Physical Review*. There, they described a new method for finding the top quark in the thicket of particle tracks that spray out from high-energy collisions in accelerators like Fermilab's Tevatron. The method, like others developed by CDF members, relies on the principles of conservation of energy and momentum to identify exotic and short-lived particles amidst a shower of decay products. But Dalitz and Goldstein thought their variation had a better chance of sorting out real top quarks from the many other events that can mimic their signature. In their paper, Dalitz and Goldstein illustrated their method with an event that the CDF collaboration had published as a possible top quark candidate.



ALEXANDRA BUXBAUM

Still on the trail of the top. Fermilab's Alvin Tollestrup.

Goldstein says he and Dalitz never claimed their technique could turn a single event like that into a clear sighting of the top quark. No method could do that, explains Tollestrup. "The top isn't going to turn up with someone finding one event," he says. The real discovery will take the form of a statistical argument based on many candidate events, he says. And that superior statistical logic is exactly what Goldstein and Dalitz thought their method could provide.

In working out a practical test, Goldstein says, he started discussing the new method last February with CDF member Sliwa. Goldstein says Sliwa shared unpublished data from experimental runs of 3 years before to help them try out the method. And by April, Goldstein claims, he, Sliwa, and Dalitz were "beginning to show that this method could select out top quark candidates"—ones the CDF group had missed. At several points in March and April, says Goldstein, he and Sliwa told the CDF group about their results.

Thumbs down. CDF leaders Shochet and Tollestrup, in turn, did what they do with any new results generated within the CDF group: They put the top-quark claims through an internal peer-review procedure. This meant appointing a "godfather committee" of other team members to evaluate the new top quark candidates. And the initial review, Tollestrup says, was negative: The CDF researchers demonstrated that all but one of the various events Dalitz's group presented as possible top quarks came from other "background" effects. One remains ambiguous, but Tollestrup says the CDF people already knew about that event.

Goldstein rejects the criticisms. "It is highly unlikely that the background they have invoked could explain all the events we think are top quark candidates." But Goldstein says he and Dalitz haven't been given any opportunity to respond to the CDF criticisms. In late April, he says, the CDF people suddenly told him and Dalitz that they could no longer take part in the collaboration. "It was decided that [we] should be excluded from the process," he says. "We were not to sit in on meetings, give talks, or take part in the CDF communications."

Tollestrup says the group excluded Dalitz and Goldstein from their meetings because the two are not part of the collaboration: "They haven't put in the effort and commitment that others have." Shochet adds that there was a deeper issue arguing against Goldstein and Dalitz's participation. Although the CDF group examined the claims out of scientific interest—they wanted to know if the results, however obtained, could help lead them to the top quark—the group felt Dalitz and Goldstein should never have had the opportunity to analyze unpublished CDF data in the first place. Shochet says CDF member Sliwa violated an unwritten code of ethics by sharing data with out-

siders. "We have strict rules that, until data is analyzed and we make sure it is sensible and correct, we don't pass data to people outside the groups."

This concept is by no means unique to Fermilab: Many other large collaborations consider the rule essential for getting anything done, says Jean-Pierre Revol, who worked on particle searches at the European laboratory CERN. Tollestrup cites the example of the NASA collaboration that recently came forward with evidence for the first seeds of structure in the universe, based on observations by the Cosmic Background Explorer (COBE) satellite. The COBE team had worked in airtight secrecy for more than a year, he notes, as they checked and rechecked their observations. Imagine the chaos that would have resulted, Tollestrup says, if the investigators had just thrown out the data, saying, "There's a great discovery here, go make it."

Warty data. Nor would such open access advance science, he and Shochet say, because outsiders are incapable of drawing trustworthy conclusions from the raw data gathered in a complex experiment. Even with Sliwa's help, Goldstein and Dalitz were prey to the pitfalls in the CDF data, says Tollestrup. "There is an enormous correction process. You have to understand all the quirks of the detector to go from the 10,000 words on a magnetic tape to the reconstruction of a burst of particles." Adds Shochet: "When we present data to convince people of something, that data has been corrected for all subtle systematic effects and statistical uncertainties involved in detection and analysis. Raw data has all these warts."

Sliwa chose not to comment to *Science* about his decision to share the data. But Goldstein says he sees no problem with working on someone else's unpublished data. He argues that these 3-year-old runs aren't "hot data"; the CDF group has had ample time to analyze it—though Tollestrup responds that people in the group are far from through with it. Besides, Goldstein adds, he and Dalitz never planned to make claims without first appealing to the Fermilab group for approval. But he's for opening the whole process of data analysis to the community at large. "If CDF decides our work is not significant enough, the fair thing would be for that data to be published" for the rest of the community to evaluate. "It would be nice if everyone could have a chance to look at this."

For now, the top quark flap seems to have revealed more about the uneasy relationship between large collaborations and outside scientists than about the particle itself. But Tollestrup says the CDF group may soon be capturing top-quark signatures that everyone can agree on. The Tevatron is starting a new series of runs, in which it will deliver five times as much data as before to CDF. It will also have a new detector called D0. With two detectors, investigators will be able to cross-check their results. And the CDF group has just equipped their experiment with a "silicon vertex detector" that will enable the investigators to detect bottom quarks in the collision debris. Bottom quarks, says Tollestrup, should distinguish the decay of a top quark from some of the most misleading background events.

Then again, the top quark may be too massive to form at the energies now attainable at Fermilab. In that case, it may take the extra boost from the proposed "main injector," a $185 million addition to the Tevatron that is slated for 1996, to dispel any doubts.

–Faye Flam

BIOMEDICAL RESEARCH

NIH Strategic Plan Nears Its Final Form

The strategic plan roadshow that began last February in San Antonio, Texas, is finally winding down. At a day-and-a-half retreat last week on the Bethesda campus of the National Institutes of Health, NIH Director Bernadine Healy unveiled the latest—and what must be the near-to-final—draft of her strategic plan, a blueprint for the future of her $9 billion agency. And while the scientists who depend on NIH for research support can take some satisfaction that their ideas have helped shape the plan, now dubbed "Advantage America," it was clear from last week's meeting that its final form will not please them all. Indeed, the scientific community appears to be losing one of its most cherished prerogatives: the plan makes it clear that individual-investigator grants, once the force driving budget requests and planning decisions, will take a back seat to the research priorities the NIH hierarchy thinks are necessary to foster the country's physical and economic health.

Not that NIH is abandoning investigator-initiated research: The draft plan states that such research "is at the heart of scientific inquiry in which discoveries arise in unexpected places, from improbable insights and through leaps of imagination." But at the same time the plan says that research grants are an important means to a broader end—"the achievement of scientific goals and programs." Healy's NIH, it is clear, won't make dispensing research grants a goal by itself.

But if grants are no longer the center of the NIH universe, Healy has at least invited scientists to participate in her new, priority-setting exercise: During the nearly 5 months the plan has been on tour, nearly 2000 scientists from around the country attended meetings to discuss the plan, including nearly 3 dozen at last week's retreat. Healy has also issued an open invitation to the scientific community to send her any additional ideas or comments they might have (*Science*, 17 July, p. 312). And even after the current plan is made final, NIH officials say, they will hold a meeting with extramural scientists in a year's time to review how the plan is working and make course adjustments as needed.

But for all the work that has gone into bringing the plan to its near-final state, scientists attending last week's retreat felt there was still a way to go. Although the NIH staff has done a fine job of analyzing their agency's needs, Upjohn chief executive officer Ted Cooper told the assembly, "your challenge is to convert [the analysis] into programs." That process has at least been started. Accompanying a slender, 9-page document sketching out the plan's outline were some 400 pages of supporting documents that spelled out specific programs. The whole package is expected to be whittled down to 100 pages by the end of the summer. With no more meetings scheduled, scientists will have to trust this critical task to NIH staffers.

As things now stand, the plan consists of four basic elements: a mission statement accompanied by four specific agency goals (see box); a two-and-a-half page statement of philosophy; a series of six "trans-NIH objectives"—topics that cut across the individual institutes' disease-oriented focuses—and a "statement of means" describing the role of the NIH director, the institute directors, and the scientific community in implementing the plan. But it is the trans-NIH objectives that form the meat of the plan, spelling out the science and policy areas that NIH intends to emphasize.

■ **Critical science and technology.** For the past 6 months, Healy has been persistently promoting critical technologies—techniques and methods that will make it easier for both academic and industrial researchers to capitalize on innovative scientific ideas—as the most important strategic emphasis for her agency. The plan originally identified four broad areas as deserving the most support: molecular medicine, biotechnology, molecular immunology and vaccine development, and structural biology. But scientists worried that research areas not included in this list will receive short shrift at budget time. In fact, that was a major topic in the hallways during the last stop on the strategic plan's tour, at a hotel near Dulles Airport outside Washington, D.C. from 24 to 26 June (*Science*, 3 July, p. 20). This fear was partly allayed, however, when NIH officials added cellular and integrative biology to the