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RU lab part of collaborative success in international search for top quark

by Susan Blum

Using the most powerful "time machine" currently in existence, more than 400 collaborating physicists—13 Rockefeller researchers among them—have edged close to the moment of the creation of the universe to capture a long-sought-for treasure. Their prize: the first direct evidence for the elusive "top," the last of a six-member set of subatomic particles called quarks. The findings were reported last week in a 150-page article submitted to *The Physical Review*.

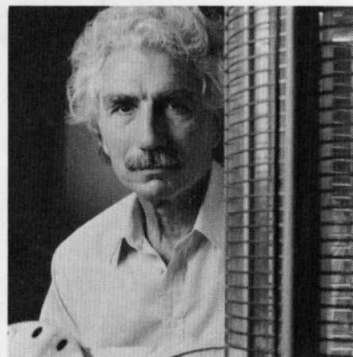
The evidence for the top quark provides strong support for the Standard Model, the prevailing theory of the particles and forces that determine the fundamental nature of matter. First formulated in the 1960s, the Standard Model has consistently been bolstered by ever-accumulating theoretical and experimental proof. But until last week's announcement, the top quark remained elusive. Had evidence for its existence never been found, "Our current understanding of the Standard Model would have had to be completely revised," said Professor Konstantin Goulianos, who headed the group from Rockefeller that is participating in the collaboration.

According to the Standard Model, matter is composed of six quarks and six leptons, arranged in three "families" and interacting through four forces. The up and down quarks and the electron, which together with the electron neutrino are the members of the first family, make up the matter of

the world around us. The other quarks and leptons are part of the infrastructure necessary for the universe to have been shaped into its present form. Having played its early "creative" role, the top quark is believed to have vanished after a billionth of a second following the cataclysm known as The Big Bang, in which the universe was born.

Top's partner, the bottom quark, was found seventeen years ago. But evidence for the top quark has been much harder to come by, because the top quark is so much heavier than its partner. The recent paper calculates its mass at about 174 billion electron volts, making it almost as heavy as a gold atom.

The evidence for the top quark was found in experiments performed at the Tevatron particle accelerator at Fermilab in Batavia, Illinois. Physicists create subatomic particles by crashing protons and anti-protons into one another at speeds close to the speed of light, resulting in energy concentrations that approach levels that existed



Professor Konstantin Goulianos heads RU physics lab and one of 34 groups hunting for top quark.

in the universe when it was born. In the collisions, the energy of the protons and anti-protons is transformed into fireworks of particles that fly off in all directions. As explained by Einstein's findings on the interchangeability of matter and energy, some of the bits that fly off are heavier than the proton and anti-proton combined; very rarely, massive top quarks are produced. "It's as if you collided two Volkswagen 'bugs' and got two Cadillacs and about 100 other cars as a result," Goulianos said. With

See Rockefeller, page 3

Faithful restoration of Caspary dome to begin in summer

If all goes as planned, the Caspary Auditorium dome will sport a glittering new surface by next fall.

"We want the new exterior to be as faithful as possible to the dome's original appearance," said Bob Francis, director of Plant Operations. "However, unlike the original, it will be made out of materials that will last for many, many years."

When the dome was first built in 1958, it was covered with one-inch-square tiles that were hues of blue with green and white highlights. Unfortunately, within eight months of its completion, the tiles started to drop off from the effects of winter freezing and thawing. The new surface will attempt to recreate the original color pattern using either glass beads or marble chips embedded in a final coat of roofing material. Also imitating the first surface, the new design will expose the underlying metal ribs of the structure, giving the dome a

geometric effect.

Last month, workers from Plant Operations removed 30 cubic yards of the current, water-logged exterior from the northwest side of the building so that contractors could evaluate the structure before placing bids for the project. The entire



Up on the roof: Resurfacing of Caspary Auditorium dome, originally covered with blue tiles in 1958, is slated to begin this June.

Friday symposium on DNA to cap Avery celebration

Lectures by members of a new generation of DNA researchers at the university will be presented today in a symposium entitled: "Fifty Years After Avery: DNA Research at Rockefeller."

Chaired by Frederick Henry Leonhardt Professor and senior physician Jan Breslow, the symposium will feature three lectures: "Envisioning How Genes are Turned On" by Professor Stephen Burley, "Progress on Cell Cycle Research" by Associate Professor Frederick Cross, and "Positional Cloning of Obesity Genes" by Associate Professor Jeffrey Friedman. This symposium is the last event in the year-long commemoration of the discovery that genes are made of DNA, the breakthrough finding made 50 years ago by Rockefeller researchers Oswald Avery, Colin MacLeod, and Maclyn McCarty.

The symposium will begin at 3:15 P.M.—a half hour earlier than the usual Friday lecture—in Caspary Auditorium and will be preceded by tea at 2:45 P.M. Admission is free.

2 At home with the Rockefellers

2 Profile of a natural decoder

4 Winning secretary dines out

Historic Rockefeller estate in Tarrytown now on view

A home treasured by three generations of Rockefellers, the Kykuit mansion and grounds in North Tarrytown, New York has opened for public tours.

Bequeathed to the National Trust for Historic Preservation in 1979 by Nelson Rockefeller, Kykuit is a beaux arts villa set among formal, turn-of-the-century gardens and overlooking the Palisades. The grounds are studded with more than seventy 20th-century sculptures; major artists represented include Picasso, Brancusi, Moore, Smith, and Nevelson. During an afternoon's sojourn on the 86-acre estate, visitors can contemplate an eclectic melange of

heirlooms, including wicker carriages, Oriental porcelains, antique furniture and autos.

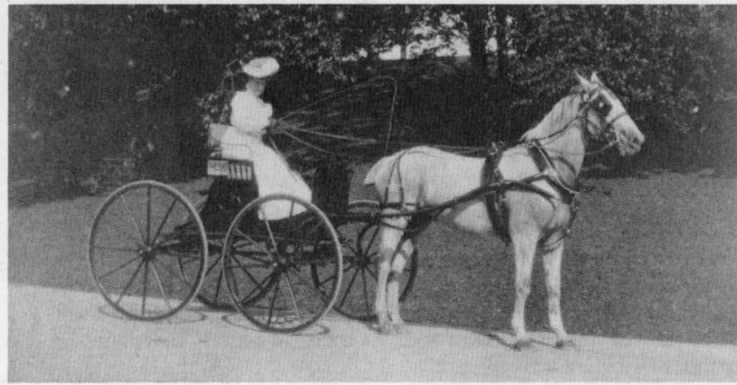
Named for the Dutch word meaning lookout, Kykuit was commissioned by John D. Rockefeller and was under construction for six years, between 1907 and 1913. More so than any other residence, Kykuit was a home for the family, and it is the only surviving Rockefeller residence to span three generations, dating back to the founder of The Rockefeller University and the Standard Oil Company. Both John D. Rockefeller and his son, John Jr., lavished attention on the landscape, decorating it with favorite flowers, terraces overlook-

ing the Palisades cliffs, grottoes, pavilions, and fountains. John D. Rockefeller, Jr. worked through philanthropy to preserve the Palisades. Inside the English neo-classical rooms, he showcased antiques from the 18th and 19th centuries and Oriental porcelains. Nelson Rockefeller expanded the collections with early Chinese ceramics and 20th-century paintings, sculptures, tapestries, and prints. His 1959 Chrysler limousine with the New York Governor's license plate reposes in the stone coach barn along with pony carts, carriages, and vintage cars, including an early electric car.

Among Kykuit's neighbors in the Westchester region, curiosity about the estate is such that the first three months of tours offered by Historic Hudson Valley are booked. However, tickets are available throughout the season, which runs from May 4 to Oct. 31, from NY Waterway (1-800-53-FERRY), which offers ferry excursions departing from Manhattan and New Jersey. For those who might wish to make the hour-long drive, some tickets are available from the Historic Hudson Valley ((914) 631-8200): for July 4, during the week before Labor Day, and on some weekdays in Sept. and Oct.



Liana Berkova (center), a postdoctoral associate in the Cohn-Steinman lab, shows her daughters, Teodora, age 11 (right) and Maria, age 15, how to look for cytokines in a sample of cerebrospinal fluid last Thursday. The demonstration was part of the university-wide participation in this year's national Take Our Daughters to Work Day, a program developed by the Ms. Foundation for Women.



Abby Aldrich Rockefeller, circa 1915, tours her estate at Kykuit.

RU programmer gives helping hand to the deaf and others

by Jennifer Horne King

Pat Dash is a natural decoder. At The Rockefeller University she programs computers; in her spare time, she works with the deaf using sign language. Recently, Dash volunteered as a wardrobe assistant for



Without words: Pat Dash demonstrates the sign language skills she uses to communicate with the deaf.

the New York Deaf Theatre's production of Elizabeth Egloff's "The Swan."

"I like to take something I don't understand and make it understandable, whether it's a new computer language, Greek—which I studied in college—or sign language," said Dash. But Dash believes computer languages are not technically "languages." "Languages are dynamic; they evolved out of a need to communicate," she explained. "Computers, on the other hand, just do what you tell them; they cannot talk back."

Dash, who once worked as the first train signal-woman for Amtrak, learned to sign when her son, who is now in college, was ready to leave the nest. "Once I was launched in computer programming at Rockefeller, I went about realizing a childhood fantasy that began when I was spellbound by people who communicated in sign language on the New York subway. Finally, after all these years, I could learn to fully appreciate this language."

After many night classes, special workshops and three intensive summer sessions, Dash has become

more confident with her new form of communication, but remembers well her first use of sign language in the "real" world.

"I was waiting in line in a candy store and saw a man ahead of me who was blocking another man's passage while filling out a lottery card. Several calls of 'excuse me' didn't seem to have any effect on the man, so I tapped him on the shoulder. He jumped back, motioning to his ear and shaking his head. I was skeptical that we could communicate successfully, but I signed 'Are you deaf?' and he responded—so enthusiastically that I had trouble understanding his signs! Knowing that we could communicate, even in a rudimentary manner, was such a kick."

Since this experience, Dash has volunteered as a buddy to several deaf persons with AIDS for the Gay Men's Health Crisis and backstage for the New York Deaf Theatre company. Some day, Dash hopes to become a legal interpreter.

Several of the plays produced by the New York Deaf Theatre company were written by deaf playwrights. An upcoming production, "Language of Love," written by

Drew Emery (a hearing playwright) and Lewis Merkin (a deaf playwright), will open this fall at the Vineyard Theatre. For more information on the New York Deaf Theatre company, call 924-9491 (924-9535 TTY).

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Rockefeller team helps uncover first evidence for elusive top quark

(continued from page 1)

its most recent upgrade, completed in 1990, the Tevatron's energy and intensity levels were high enough to produce a top quark about once every hundred billion collisions.

Although a top quark decays into other particles far too rapidly for its electronic "signature" to be recorded by a particle detector, the signatures of its decay products can be recorded. But the interpretation of these signatures is extraordinarily complicated. For one thing, the top quark has more than one possible decay pattern, and thus more than one possible signature. For another, processes other than a top quark event can mimic a top quark's decay, producing so-called "background" signatures. To present convincing evidence of a top quark, physicists must show conclusively that its signature appears statistically more often than would be expected from the background alone.

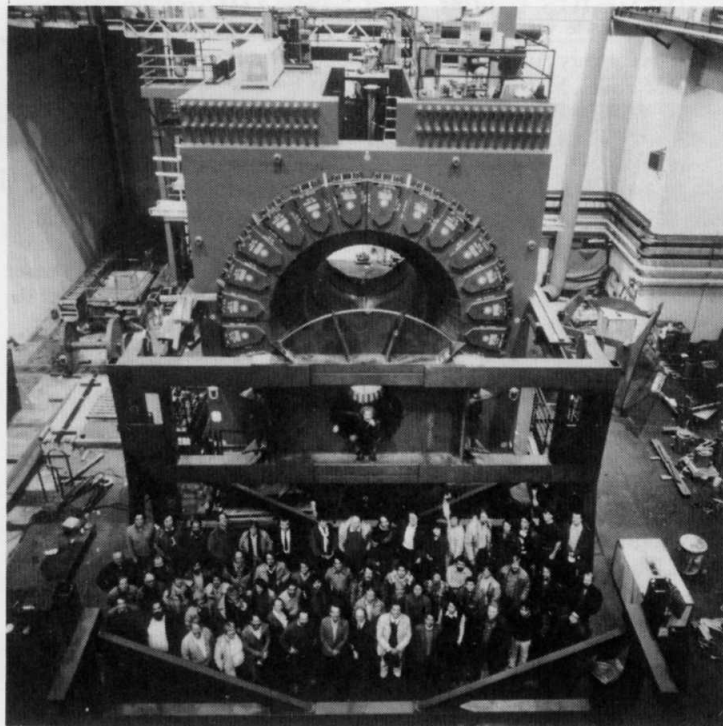
Out of a mind-boggling one trillion collisions in the recent round of experiments, Goulianos reported, "we found twelve candidate events, when statistically we would have expected about six. At this point, we don't know which of these events are evidence for the top quark, and which ones are background. The odds of all candidate events being due to background are estimated to be two in one thousand." The members of the collaboration are presenting their findings very conservatively. "We have good but not absolutely conclusive evidence" that the top quark has been found, Goulianos said.

More conclusive evidence—and more accurate calculations of the top quark's mass—must await the discovery of additional candidate events. Such discoveries may come fairly soon. Right now, a new round of experiments is being conducted at the Tevatron, which should triple the current number of candidate events by 1995. After that, a major upgrade of the Tevatron accelerator should result in "something like ten times more candidates" by 1998, Goulianos said.

Group sociology

The collaboration to which Goulianos and his Rockefeller colleagues belong is known as the Collider Detector at Fermilab, or the CDF. It is an international collaboration composed of participants from 34 universities from the US, Italy, Japan, Canada, and Taiwan. Like all other members of the collaboration, Goulianos and his colleagues at Rockefeller are involved both in service and analysis aspects

Courtesy of K. Goulianos



In 1985, members of the Collider Detector at Fermilab collaboration gathered before the core of the three-story particle detector, then under construction. Goulianos (center, above) is seated where—9 years later—the first top quark candidates were detected.

of the project. For example, as part of their service they contributed to the collaboration's detector—arrays of mechanical and electrical components that allow precise tracking of individual particles as they speed away from the collision point—and are currently designing a new component for the detector's upgrade. Service aspects of the project also include running and maintaining the detector at Fermilab. The analysis aspect of participation, which involves interpreting and analyzing the recorded data and writing papers on the findings, are "a luxury" for members of the collaboration. "Analysis is considered a kind of reward for all the service work," Goulianos explained.

Four hundred and thirty nine names appear on the paper reporting evidence of the top quark, but even these "aren't as many names as there should be," Goulianos said. For instance, some of the people who have left the collaboration are not listed, nor are those who designed, built, and operated the Tevatron accelerator.

How do so many participants produce one coherent paper? For each paper, the collaboration assigns a few people to act as "godparents." They review the analyses done by various small groups or individuals, and write reports that

are sent to every group in the collaboration. Two weeks after each report is sent, a meeting is held at Fermilab that is open to all in the collaboration. At the meeting, each analysis in the report is discussed to see whether it can be "blessed," or approved. "Every table, figure, and number has to be blessed. Otherwise, you can't tell anyone outside of the collaboration about it," Goulianos explained. After all the report's individual parts are blessed, which may take several "blessing cycles," the full paper is written and circulated to all collaborating groups for their comments. For the recent top quark paper, there were, in addition, two three-day meetings at Fermilab, attended by almost every CDF participant. At those meetings, "We went over the paper section by section and sometimes line by line," Goulianos reported.

Questions remain

Confirmation of the top quark's existence, though tremendously satisfying, will by no means end physicists' search to "understand how the world is made," as Goulianos terms it. For instance, one big question that will remain is why different quarks and leptons have different masses—or, for that matter, why they have mass at all. Moreover,

why do some of the particles that carry the fundamental forces also have mass, while others do not?

One explanation, posed by the Standard Model, is that the universe's original symmetry—in which particles would have had the same mass—was broken due to their interaction with a field called the "Higgs field." If this field exists, it should be associated with a "Higgs particle," whose discovery awaits accelerator energies far higher than any currently in existence.

According to Goulianos, the now-defunct Superconducting Supercollider (SSC) would have provided such energy. "The SSC was designed to be a 'no lose' situation," Goulianos said. "Either we would have found the Higgs particle or, if not, we would have found violations of the Standard Model that would have opened the curtain on some new and undoubtedly exciting kind of physics."

Search goes on

The search for the Higgs particle can still take place, but not in the SSC, parts of which are now buried under tons of dirt in Waxahachie, Texas. Today, hopes are focused on future experiments at the Large Hadron Collider (LHC) at the CERN laboratory in Geneva, a project in which the Goulianos lab is participating. Currently, members of his group, led by Associate Professor Nikos Giokaris, are working on designing a component for one of the LHC's collider detectors. "If we are lucky and the mass of the Higgs particle is light enough, we will find it with the LHC. If the Higgs is heavy, we will live to regret the loss of the SSC," he said.

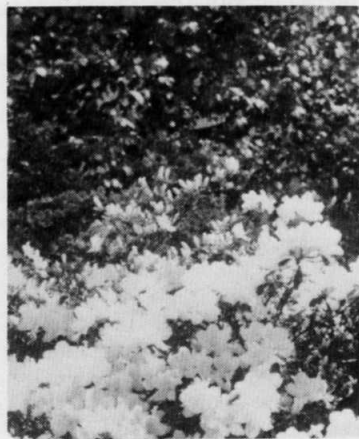
While decrying the loss of the "no-lose" SSC, Goulianos remains enthusiastic about the upcoming work at CERN. Many other current and future projects also occupy him and his colleagues in the Laboratory of Experimental Physics at Rockefeller. These projects include studies of top's partner, the bottom quark; investigations of the substructure of quarks; studies of a potential new phase of matter, called the "quark-gluon plasma"; and better definitions of the structure of the proton.

"Our group works like a miniature CDF collaboration. Each project is spearheaded by one or two individuals, including students, whose work is then discussed within the whole group," Goulianos said. "In such an environment, people really have fun searching for the top quark, or whatever else may lie beyond."

Potpourri

Azalea Festival

The Annual Azalea Festival will be held Sat., May 7 and Sun., May 8 at the university, from noon to 4:00 P.M. Guides from the New York Botanical Garden will give tours at 1:00, 2:00 and 3:00 P.M. each day. There will also be a lecture each day at 2:15 P.M. Admission is free and open to the public.



Flora to be seen at this weekend's Azalea Festival.

Bake sale

A bake sale to benefit The Rockefeller University Children's School will be held in the Tower lobby from 8:30 A.M. to 3:30 P.M. today (May 6).

Tri-Institutional Noon Recital

The Amelie Trio will perform works by Wolfgang Amadeus Mozart, Hans Werner Henze and Maurice Ravel at the Tri-Institutional Noon Recital today (May 6). The musicians include violinist Juliette Kang, pianist Melvin Chen and cellist Alexis Pia Gerlach. The concert, to be held in Caspary Auditorium at noon, is free and open to the public.

Cohn Forum

The date for the next Zanvil A. Cohn Forum on Health Affairs has been changed from May 11 to May 31. Robert Olby, visiting professor at the university, will speak on "The Rockefeller Centenary: A Historical Opportunity?" in the Faculty and Students Club at 5:30 P.M.; sherry will be served at 5:00 P.M. Admission is free, and all are welcome.

Clinical Research Seminar

Eric Schon, associate professor in the Genetics and Development Department of Neurology at Columbia University, will speak on "Molecular Biology of Human Mitochondrial Disease" at the Clinical Research Seminar, Wed., May 11, at noon, in Nurses Residence 110B.

Sunday film

The Thin Man (U.S.A., 1934), directed by W. S. Van Dyke, will be shown in Caspary Auditorium at 7:30 P.M., Sun., May 8. The film, starring William Powell as veteran detective Nick Charles and Myrna Loy as his sophisticated wife, Nora, is one of Hollywood's greatest screwball comedies. Admission is free.

Photo contest

Prizes for The Rockefeller University Children's School amateur photo contest will include: a Media photo shoot (\$400 value); a gift certificate for Fuji film; lunch for two at Angels Restaurant; two photo albums from First Photo; dinner for two at L'Auberge Restaurant; and lunch for four in Abby Aldrich Rockefeller Dining Room. The deadline for photo submissions is Fri., June 3. Drop off photos, which may be any size or format, at the Media Resource Service Center, Bronk 114 (attention Elle Starkman) or at the Children's School, first floor of Graduate Students Residence (attention Kathy Burke). A \$5 per photo entry fee will benefit the Children's School. For more information, contact Liz De Oliveira e Silva, x7676, Leslie Aitchison, x7425, or Elle Starkman, x8991.

Reading tutor wanted

A young adult patient in the university hospital wants to improve his reading and writing skills. If you are interested in tutoring (some background in education would be helpful), please call Lanie Fleischer, x8415. A tutor is needed for about four to six weeks, two to several hours weekly, afternoon or evening.

Honors

Professors Joel Cohen and Paul Greengard were elected to membership in the American Philosophical Society on Apr. 22.

Abby Aldrich Rockefeller Hall

The patio of the the Abby Aldrich Rockefeller Hall dining room is now open. Eight tables are available, with seating for about 36 people. For more information, contact Judd Newman, x8890.

New software

Entrez, a sequence retrieval system, is now available from Computing Services via a network software program called Nentrez. The software will enable RU network users to perform MEDLINE searches and retrieve protein or nucleotide sequence data from their computers (with System 7 and MacTCP 1.1 or later), or from one of three Macin-

toshes located in the Computing Services User Area and Classroom, TSH A21. Computing Services recommends using Nentrez with at least 6-8 MB. Macintosh files for Nentrez can be downloaded from the RUCS Mac Freebies Volume.

Nentrez users are requested to register with Computing Services upon installation of the program. For assistance in installation, configuration and software use, contact Anthony Popowicz at x8112, or via login=tony.

F-PROT 2.1.2 for PCs

A new version of F-PROT, a free antivirus software package for PCs, is now available from Computing Services. F-PROT 2.1.2 disinfects 58 new viruses and has improved detection for boot sector viruses. The program can be copied from the Freebies/Viruspro directory, which is on all PCs in the Users Area/Classroom, TSH A21, or it can be downloaded from the /mac+pc/pc software archives on rj, in the PublicFiles/VirusProtect directory. For more information, contact the consultant, x8940.

Appointments

Adjunct Faculty: Lindsey Grandison, Pfaff lab; Huw Hughes, Fischetti lab; David H. Live, Cowburn lab; Philippe Moreillon, Tomasz lab; Danny Schnell, Blobel lab; Basil Rigas, Hirsch lab; Karen Segal, Hirsch lab; Lisa Staiano-Coico, Carter lab; Makoto Watanabe, Blobel lab.

Visiting Professor: Nader G. Abraham, Kappas lab; Marina Siniaia, Wilson lab; Visiting Assistant Professor: Karen Bulloch, McEwen lab.

Research Associates: Gilberto Fisone, Greengard lab; Gang Lu,

T.P. King lab; Michael Rout, Blobel lab; Iddo Wernick, Ausubel lab. Postdoctoral Associates: Jonathan Goldberg, Kuriyan lab; Hideo Harigae, Sassa lab; Diane Harvey, Heintz lab; Carolina Malheiros, Desplan lab; Arun Malhotra, Darst lab; Dmitri Manin, Feigenbaum lab; Shusei Obata, Gilbert lab; Peter van Ophem, Manning lab; David B. Thomson, Wilson lab; Jonathan Wagg, Gadsby lab; Hongying Xie, Aderem lab.

Postdoctoral Fellows: Jahanara Ali and Fang Liao, Steinman lab; Laural S. Boone, Simon lab; Cordula Enenkel, Blobel lab; Jon Heinrichs, Fischetti lab; Luz Hermida-Matsumoto, Roeder lab; Harumi Hirai, Hall lab; Magdalena Hofer and James Millonig, Hatten lab; Sahng-June Kwak and Xin Ye, Hanafusa lab; Carole E. Lewis and Jian Wang, McEwen lab; Michiko Minami, Blobel lab; Miguel Navarro, G. Cross lab; Constance Scharff, Nottebohm lab; Izumi Sukegawa, Greengard lab; Hiroko Suzuki, Hall lab; Theresa Wizemann, Tuomanen lab; Unkyu Kim and Shwu-Yuan Wu, Roeder lab; Simon Barnes, Hiromasa Imaishi, Yan Wu and Jian-Kang Zhu, Chua lab.

Guest Investigators: Catherine Coffinier, Desplan lab; Jean-Louis Da Silva and Yan Lavrovsky, Kappas lab; Nozomu Eto, J. Young lab; Ricardo Gurtler and Clark Jeffries, J. Cohen lab; Yan Hong, Chua lab; Gang Lu, King lab; Francesco Melis, Asanuma lab; Katherine A. Neal, Desplan lab; Paula Paglia, Steinman lab; Faina Riftina, McEwen lab; Christiane Wolz, Fischetti lab; Chingwen Yang, R. Darnell lab; Zhongmin Zhou, Greengard lab; Jian Zuo, Heintz lab.



Fia Steiner (right), an administrative secretary at the Population Council, was the winner of a free lunch in the Abby Aldrich Rockefeller Hall dining room for Secretaries Day, Apr. 27. Steiner was joined by her mother, Delores Hutchins, a laboratory aide at the Population Council.