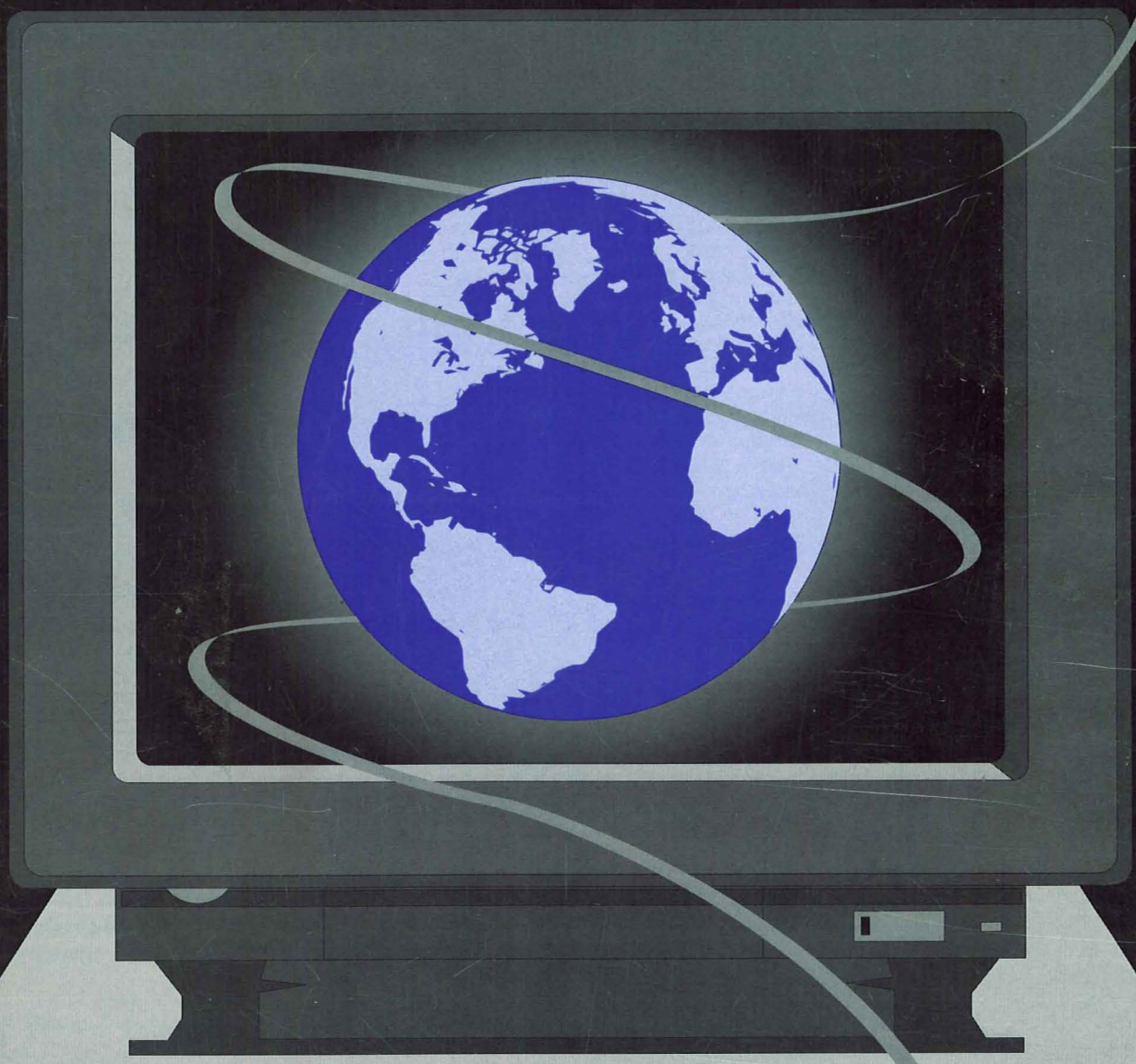
MINNESOTA
technolog
NOVEMBER/DECEMBER 1998

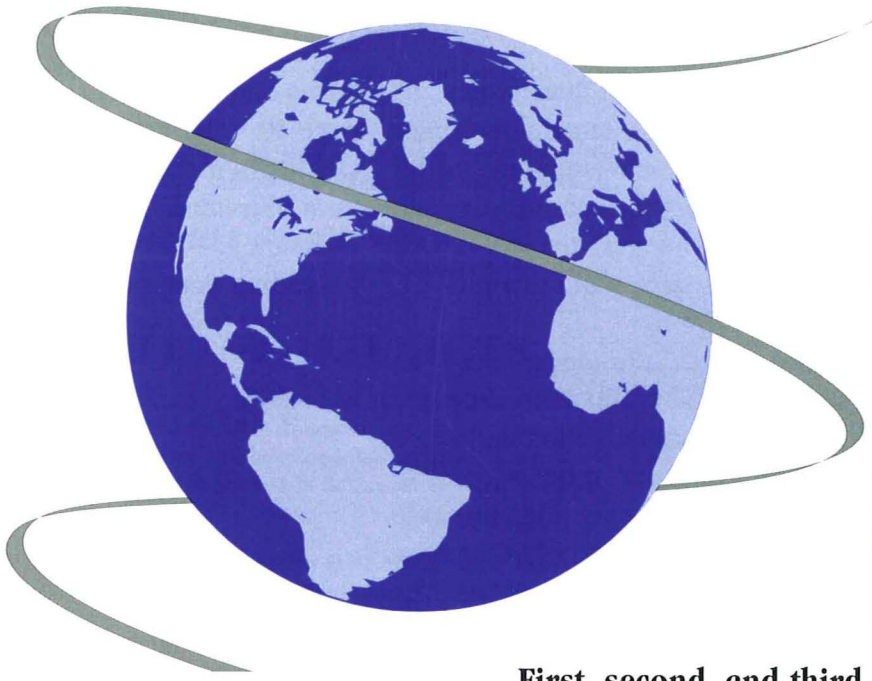


Technology Enhanced Learning at the U

1998 Sci-Fi Winners

November/December 1998

"Beyond the Classroom" Distance learning technologies that affect the presentation of technical information. (Page 6)



First, second, and third place winners of the Minnesota Technolog's Fiction Contest. (Page 10)

Cover design by Kristie Stiles

University of Minnesota
Institute of Technology
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MINNESOTA technolog

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Notes

From the Editor

As new editor-in-chief, I am dedicated to continuing this long tradition in excellence, a commitment shared by the editorial and writing staffs.

Welcome to the Minnesota Technolog — that is, the award winning Minnesota Technolog.

Once again recognised for excellence, the Technolog took home nine awards from the 1998 Engineering College Magazines Association (ECMA) Conference held last April in Madison, Wisconsin. Among them were three first place awards — two for excellence in editorials and the other for Best Article in General Science — and second place recognition for Most Improved Magazine and for Best All-Around Magazine. The Technolog also received two third place awards and two honorable mentions.

As new editor-in-chief, I am dedicated to continuing this long tradition in excellence, a commitment shared by the editorial and writing staffs. In an effort to raise the standard of quality even higher, between Fall 1998 and Spring 1999 we will publish three issues of the Technolog instead of the usual five.

In bringing you just three issues, we beleieve that we can give our topics more in-depth coverage and better illustrate how technology and research is changing the world. Our focus, as always, will remain on IT.

In this issue, our cover story on streaming video illustrates how the Internet and other technologies are making education more accessible and how IT is taking a leading role in the deveolpment of streaming video not only here at the University but across the nation as well. Please take time to read last year's winning science fiction stories. Entry information for this year's contest can be found on page 10. The 1999 Science Fiction Contest winners will be published in the Spring 1999 issue of the Technolog. We are looking forward to reading your submissions.

Mark D. Stewart

Minnesota Technolog

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Beyond The Classroom

IT TAKES THE LEAD IN TECHNOLOGY ENHANCED LEARNING AT THE U

by Doreen Starke-Meyering

Over its 27 years in the business of distance learning, the University-Industry Television for Education Program (UNITE) of the Institute of Technology (IT) has earned an excellent reputation among companies and their employees in Minnesota and Western Wisconsin. From its five Interactive Television (ITV) classrooms, UNITE has been deliversing IT's highly acclaimed credit and non-credit courses in computer and information sciences, computer engineering, electrical engineering, mechanical engineering, and materials sciences to over 300 students each quarter.

Although IT already has a proven track record of technological innovations ranging from seat belts to black-box flight recorder systems this fall IT also took the lead in technology enhanced learning by launching its streaming video project. As Professor Doug Ernie, Director of IT's UNITE program, explains, "through this new technology, students now have access to online and on-demand multimedia classrooms that enable them to review the latest class notes, access course reading materials, and view lecture videos on the Web anytime, anywhere."

Streaming video is a new technology that allows video and audio data to be delivered to a computer regardless of its location, as long as the computer has a network connection. The technology delivers data in a continuous stream, so users don't have to wait for the entire video to download before viewing it. Instead, the process of streaming enables them to view the video as soon as the computer begins receiving the data. In addition to saving download time, this process does not require large data storage capabilities on the learner's computer, a critical issue when dealing with the large files generated by high-quality video.

The streaming video project has great advantages for everyone involved. On-campus students, for example, find it convenient to review the lectures at any time and as often as they like. Similarly, if students miss class, they can simply access the course Web site and watch the lecture at their own convenience. Before streaming video technology, these students would have had to copy another student's notes.

"It's good for the students to have access whenever they want to," says Professor David Lilja from Electrical and Computer Engineering, one of UNITE's streaming video pioneers. He admits, though, that "there is, of course, the fear that students might just think, 'oh, I'm going to skip the lecture today and catch it on the Internet tonight.'" But so far, Lilja says, "there haven't been any problems with students' attendance in class. They find it useful to attend the class and to participate in the live discussions."

But for some students attending the class on campus is not an option. If they work full-time at a distant location, they may not be able to attend classes at scheduled times. However, they might be able to view classes on their computers during breaks or after work.

Before streaming video, remote learners, working in broadcast accessible workplaces, watched the classes through two-way audio, one-way video technology in training rooms at scheduled times. When classes overlapped with short-term job-related commitments, students usually taped them for later viewing.

However, high-technology employees often have long-term assignments at distant locations. This situation makes it difficult for the students to arrange for the taping of missed courses, leading to a significant delay in their' viewing of the course and making it difficult for them to keep up. With streaming video technology, students can access the lecture on their laptops regardless of where they are.

But what do these benefits for the students mean for the professors? So far Professor Lilja has only found advantages. When students miss a class or need an assignment, he simply refers them to the course Web site. Asked about his role as an IT pioneer in technology enhanced learning, Lilja says, "I like to think of myself as a guinea pig—but it's actually quite painless!" Lilja adds, though, that much of the success of the streaming video project is due to UNITE's success in making the technology transparent for the faculty. "Doug Ernie and his team have arranged things so there really is no additional burden on the faculty to extend a course offered through UNITE to streaming video."

Streaming video also has some particular advantages for graduate engineering courses. First, many of these courses are primarily lectures, which often evolve spontaneously based on student questions. These courses frequently change, so developing extensive online course materials would not be worthwhile. Second, many online communication technologies, such as listservs, chats, or threaded discussion lists, are not appropriate for the mathematical formulas and graphics typical of engineering classes.

Lilja also finds that the streaming video project gives him a new opportunity to achieve one of his teaching goals. As he puts it, "I want to minimize the distinction between on-campus and remote students by giving them options: ITV, live participation, or streaming video."

He also takes pride in IT and in the U: "I'm glad to see the U of M experiment with many different types of distance learning technologies. No one today knows which ones are going to be successful and which are going to fall flat. We won't know until we try. This kind of experimentation is exactly the type of thing a major research university should be involved in. I'm glad to see that we are not going to be left behind."

Experimenting with new ways of learning is the goal of the recent Technology Enhanced Learning (TEL) Initiative at the U. The office of the Executive Vice President and Provost (EVPP) launched this initiative last fall to facilitate the development, implementation, and dissemination of the highest-quality technology enhanced learning environments. With its streaming video project, IT's UNITE program delivers learning environments that provide the flexibility learners need and also improve the quality of learning by offering additional review mechanisms. As Vice Provost Ann Hill-Duin, who heads up the TEL initiative, says, "The EVPP office is proud to fund projects such as

UNITE's streaming video project. This project improves the quality of teaching and learning for everyone involved, and it helps the U to use cutting-edge technology to deliver world-class teaching and learning."

The streaming video project not only confers prestige on IT as a whole, but, more importantly, allows IT's UNITE program to reach out beyond the borders of Minnesota and Wisconsin. Up to now, UNITE has been working mostly with companies in these two states. The coverage area has been limited because the live broadcasts, transmitted on four microwave channels from the IDS tower, can only reach Twin Cites area students within a 35-mile radius. Alternative delivery technologies are used for transmission to Rochester and Western Wisconsin, but cannot be economically employed to extend UNITE's reach to other parts of Minnesota and the upper Midwest.

UNITE has also been able to broadcast a selection of its courses through the National Technological University (NTU), a collaborative organization of about 50 major U.S. universities that offers distance education by satellite. Since the U is one of the seven founding members of NTU, UNITE has been able to expand its reach to over 1,300 sites in the United States.

Nevertheless, with streaming video technology, UNITE will be able to reach a much larger audience. Since all of IT's engineering programs rank in the top 20 nationally, demand for these courses is high. The flexibility of streaming video will allow learners to take these courses, regardless of location or time constraints.

Before streaming video, remote learners, working in broadcast accessible workplaces, watched the classes through two-way audio, one-way video technology in training rooms at scheduled times.

The streaming video project is also strategically important for the University at this particular time. As Ernie explains, the current phase of distance learning development is at the point "when those schools who are going to become major players in Internet delivery of lifelong learning are starting to develop their programs. Two or three years from now, the situation will be different: it will be more difficult to secure a significant market share." Launching the project now will allow the University to compete with other early players in technology enhanced distance learning, such as Stanford University and Michigan State University.

Within the University, Ernie hopes that the streaming video project will lead to applications outside of IT. He views IT's UNITE program as the test bed for streaming video technology at the U and is happy to share UNITE's experience with other faculty. "UNITE is helping to get the system up and running," Ernie says. "Other faculty are welcome to come in and work with the technology to try it out."

This spirit of institutional cross-disciplinary collaboration has been crucial for the development and implementation of the streaming video project. Ernie found that much of the expertise needed for the project already existed on campus, in such units as the Digital Media Center (DMC), Academic and Distributed Computing Services (ADCS), the libraries, and Network and Telecommunications Services.

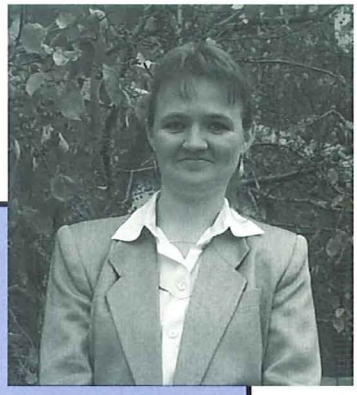
"These units are very much interested in helping," Ernie says. "They make it possible to implement the project without hiring additional staff." For example, the DMC is helping the UNITE team implement the required video server technology and develop a Web front door to the project, and the libraries are helping integrate research and information literacy into the Web-delivered courses. In short, the local cooperation on the institutional level has made it possible for IT's UNITE program to make the streaming video project a success and to reach out beyond the classroom — regionally, nationally, and internationally.

MT

To learn more about the UNITE streaming video project, call 612-624-2332, e-mail unite@cs.umn.edu, or visit UNITE's Web site at http://www.unite.umn.edu.

If you would like to learn more about the Technology Enhanced Learning Initiative at the U, contact Sue Engelmann at 612-624-3608 or sengelmann@extension.umn.edu, or visit the TEL Web site at http://www3.extension.umn.edu/tel.

About the Author



Doreen Starke-Meyering is involved with both Technology Enhanced Learning (TEL), an initiative of University of Minnesota, and Minnesota Virtual University (MnVU), an initiative of the state of Minnesota. A Ph.D. student in the Department of Rhetoric, Doreen holds an administrative fellowship in the Office of the Executive Vice President and Provost, University of Minnesota.

SCIENCE FICTION contest

Technolog Science Fiction Contest

Entry Deadline March 20, 1999

First Prize: $250
Second Prize: $150
Third Prize: $100

Entries must be typed and double-spaced, on 8 1/2 x 11 paper and be no longer than 3,500 words. Each entry must be accompanied by three photocopies of the manuscript and must bear an attached cover page with the story title, author name, home address, and phone number. DO NOT PUT AUTHOR'S NAME ANYWHERE ELSE ON THE MANUSCRIPT! Manuscripts will not be returned.

Deliver entries to the Technolog office at
Minnesota Technolog
Attn: Sci-Fi Contest
5 Lind Hall, 207 Church Street S.E.
University of Minnesota
Minneapolis, MN 55455
Illustrations relating to your story are welcome.
If you have any questions, call 624-9816.

MT

Science Fiction Contest

1998 Winners

1st Place - Partly Cloudy

by Daniel Raasch

2nd Place - After the Interview

by Christopher Whurr

3rd Place - Gunny Green

by Alan Davis

4th Place - Experiencing a Nexus

(Published in the March/April 1998 issue of the Minnesota Technolog)

by Jason F. Wetter

Partly Cloudy

by Daniel Raasch

7:13 p.m. — Somewhere, thunder is echoing off of big red barns and rattly glass windows, and that means another late night for this TV weatherman. I'm on again at 10, and I might happily give up a kidney if I could just go out and get a nice dinner with Judy instead of cuddling up the NexRad3, barely keeping ahead of the storms tonight. But there's a lot of trust inherent in being a meteorologist.

"Any evidence of funnel cloud activity in Northern Heights yet?"

That's Jim. He could handle it nicely if I wasn't here and a tornado touched down in Awachahee County, but his Hawaiian shirt couldn't. "No, I haven't seen anything yet, but I'll let you know."

Jim's a good guy. He's been my right hand man since I started at WTGN. He's skilled enough to be chief meteorologist anywhere, but he's got a personality like a bee trapped in a jar, which is why he's in the lab and not on TV.

"You get so much as a blip, and you holler, okay Richie?"

"Will do."

As I was saying, there's a lot of trust inherent in being a meteorologist, and that's why I love the job. I considered being a lawyer or a mechanical engineer, but I wanted an honest job in a world where the honesty and philanthropy departments seem to have been eliminated due to lack of funding. It's a lawyer's job to lie sometimes; a mechanical engineer has to design something cheap and shabby if he wants to keep his job. It's that way for nearly anything. And it used to be so for weathermen, too.

Hmmm.

"Jim, come take a look at this." I point out a jagged, multicolored bullseye shape the size of a quarter on the computer screen.

"Riot dot," says Jim through a mouthful of Subway.

"When did you go out for food? And where's mine?"

"This is lunch. I never got a chance to eat it. You want half a 7-hour old sub? Mighty temptin'!" He grins like the damned.

"I take it back. So what about the dot? I was running a microscan of the last Beaumont pass to check on that possible funnel cloud activity we saw earlier, and I got this. Can't be a funnel cloud; color's all wrong. Can't be aircraft because it's stationary."

Jim takes it in like a jeweler. "I'd say it's a Hadley system, ionized particles from a lightning strike held in place by heat and humidity. Nothing big. We should probably focus on Northern Heights."

"A Hadley system? You've got to be kidding. The winds up there are 30 to 40 miles per hour right now."

"Must be in the eye of a cyclonic air mass, I guess. Why ask me if you don't want my opinion?"

"Jim . . ."

"If I'm right, it couldn't last for very long. Take a look now. Is it still there?"

The new wipe swept around the circle, and sure enough, it swept over the dot like a magic wand, and suddenly it was gone.

7:55 p.m. — For most of TV history, the weatherman's been a clown. In the 50's, there wasn't much science to meteorology; the technology to make accurate long-term predictions simply wasn't there. Today we make literally millions of measurements of every sort: air pressure, temperature, humidity, and wind speed, across every continent, every minute of the day. These are fed into sophisticated multi-layer computer models, and each day that goes by, we actually get a tiny bit better at predicting the weather. But in the 50's, you could flip a coin and be as right as your 72-hour forecast.

So meteorology has changed a lot. And in that time, there have been those few diligent folks who were agile enough to make the switch from clown to scientist. It's an incredibly difficult feat, and those who have done it are deservedly legends. One of the best happens to be my main competitor, Donald Fraunshue at WORD, Channel 6.

Donald is a tall, lanky son-of-a-gun, 68 years old. I met him at a charity function a couple years ago, and he regaled me with anecdotes about his term in the Navy. We hit it off well, despite the competitive edge, or maybe even because of it. Now, every so often, we get together and try to outbrag each other. He's a colleague I trust.

Which is why I need to call him. Because the spot came back.

And now there's three of them.

8:23 p.m. — Donald was silent.

"There's no aircraft in existence that could do that, Donald. 37 miles in 30 seconds — from a dead stop? Forget wind shear, the forces involved in acceleration alone would snap your neck."

"There's no aircraft in existence that could do that, Donald. 37 miles in 30 seconds — from a dead stop? Forget wind shear, the forces involved in acceleration alone would snap your neck."

"And you think these weather anomalies are . . . ?" His words came out in a quiet drawl.

"I can't say what they are, only what they aren't: They aren't clouds, or any sort of precipitation. They don't seem to be an atmospheric phenomenon and the don't behave like any aircraft I know of. I had Jim check with our local military liaisons, and they all deny having any exercises or any planes in the air — experimental or otherwise. Which leads me to this phone call, Donald. You've been in this business a long time, and I want to know if you've seen anything like this before. Help me out here. I've got to report on this, somehow."

There was a pause, and when he next spoke his voice had dropped to a hoarse whisper.

"Richard, what I'm going to say to you may sound very brusque and unreal, but I want you to put that out of your mind and I want you to listen very carefully to the next three words I'm going to say to you: LEAVE THIS ALONE. Crumple up this thought and throw it away. Do you understand, Richard?"

"Donald?"

"You don't know what you're getting into, but I'm going to tell you. I'm going to tell you so no one else gets hurt."

8:39 p.m. — "In 1959, I was hired to do the 6 p.m. forecast here. I'd just been discharged, and the combination of my military service and goofy smile, with some serious work in weather for the Navy, made me by far the best choice for the job. I was young, handsome, and a new family man, which made for great PR. Very much like yourself.

"Now, WORD's ratings had gone up substantially in that first year I was on, and I don't deny that I felt a little heady. I was putting a new level of professionalism and discipline into the job, and it was paying off. I'd often stay up late and try and make predictions for tomorrow. Nothing I had to do, I just wanted to increase my accuracy, become more in tune with the tiny cues that Nature gives. And one night, at about 11, someone called the station.

"'Strange lights in the sky!' he said. 'I live right outside Marillion, and it's like Judgment Day out here!' I had to tell him I didn't know anything about it, and ask him to describe them to me. 'Red flashes in the clouds,' he said, 'like Hell itself.' I didn't ask how he knew.

(Continued on page 18)

After the Interview

by Christopher Whurr

Great, you're hired. Welcome to the Faronic Foods, Sinus Medii team. We'll train you in on Monday. For now, though, I would like to give you a tour of our store; follow me. Have you ever shopped here before?

Oh, you've only been here a few days. Well you will find that this store is state of the art. It was built seven months ago, a prototype for other Faronic Foods soon to come on line — making us the biggest chain of stores to be situated on the moon. The staff here are very friendly. Some people you'll see more than others; it just depends on when you're scheduled.

Everything will be explained in excruciating detail when you are trained in with the other new applicants. This quick tour is just to give you an idea of what's what. Here we are, the ground floor, the epidermis of our trade if you will. This is Exit-side, the most elaborate area of the store. Its appearance is important because after all this is the last thing the customer sees before leaving our fine establishment, or for the rare few, it's just the last thing they see.

Those doors lead to tunnels for the outer airlock and also the car port. These are the checkout points. The customer slots their cart of groceries into this side, the computer reads the EPC of each item and totals the bill. Your job will be to take the customer's money and push the button that sends the cart through this side where the groceries are packaged. People generally use their purchase cards, but there are some (usually the older generation) that prefer to use currency. All problems, like people with bad credit, get sent to customer service, but you'll learn all about that on your first day.

The express lanes are strictly enforced. If a customer uses an express lane illegally, as in, if they have more than ten different items, the computer randomly chooses items to return to the store. It removes products until the total is brought down to ten. Generally the items chosen are the least expensive or the most important, whichever is most inconvenient to the customer, and an additional ten percent is added to their bill. All this compensates for any inconvenience caused to other people waiting in line.

Our store does not accept coupons; they are gradually being phased out. When was that . . . May '35, almost a year ago, someone discovered that coupons were part of a practical joke that had been started decades ago and hadn't been stopped. It had become a way of life to some until the truth was unearthed. Did you know people would spend hours cutting out little pieces of paper in order to save themselves money? It turns out that not only did they unnecessarily waste time, but ended up spending more money than normal just by buying products that had a coupon. Oh, you remember seeing that story on the news — fascinating, wasn't it?

This is customer service; all product requests, refunds, returns, and customer complaints are handled here. This is Sheila, she's on duty this afternoon. Oh! Step back please! That three by two metre area on the floor in front of the desk is actually an Arinthian plate. It is used for extremely rude customers or those with completely unjustified problems with our store or products herein. It was even used in our one and only holdup as well. The customer service employee pushes a button behind the desk and twenty thousand Akrons are pulsed through the plate — POOF — the customer is instantly vaporised. There's no more, "Liquid clean-up at customer service;" that was back in the late '20's. The county of Lunar-one believes that any person deemed by customer service to be "annoying for no good reason" has the right to be put out of their misery as it would be doing said person a favour and would obviously be doing something kind for the rest of humanity. The whole incident is recorded on disc and reviewed by the county to ensure that the vaporisation was justified. This new technology doesn't repulse any of the other customers as it used to; there is no bad smell left behind, and it oxygenates the air supply.

Just be careful when you are near this desk. Last month we had one customer complaining that her teanoodle was bad. Remember that one, Sheila? It was obvious that she hadn't even bothered to refrigerate it and, as with all perishable products, if you don't take care of it of course it will go bad. Anyway, Sheila here deemed that the lady's complaint was totally unjustified

due to a lack of intelligence, and vaporised the woman and her bad teanoodle right there and then. Unfortunately, at that time there was a new employee that had been running errands for the C.S.E. and had forgotten about the plate. Took his leg right off.

No, he doesn't work here anymore; our store's appearance requires perfection. In losing a leg he became defective, therefore spoiling the look of the store. I think he moved back to Earth. So again, be careful, because when you're wearing your uniform, a perfect appearance is of the utmost importance. You must look presentable at all times, you know, no messy hair or anything like that. If you have bad eyesight, don't wear glasses; get implants. Skin imperfections, use makeup. A crooked tooth, get it straightened; you get the picture. If a customer looks as if they haven't washed in four decades and have just come back from climbing Olympus Mons, then that's just fine; it's the employees that concern me. No imperfections, got it? Good.

Over there are the restrooms. Watch out for the third stall down: there's an Idaen water snake living inside the pipes of that one and the exterminators haven't been able to catch it yet. So far the score is snake, four children, Zap-It pest control, zip.

This is the main floor, the heart of the business. Without it customers would walk around aimlessly pushing carts for no apparent reason. Fifty-six aisles of provisional wonderment. If there's a product you don't see in our store, more than likely you haven't looked hard enough. Although, if a customer is having difficulty finding a certain item, customer service can help; they have the ability to hazard a guess at where it might be. But it is necessary to know what the product is called. "I don't know the name of it, but it comes in a yellow box about so big," is the kind of statement that will get you vaporised.

Everything is stocked daily: each by category, then alphabetically by type, not brand name. The only thing not stocked is bread. Our bread wall is located by the entrance. As the shopper comes into the store they select the bread they require from our extensive menus on the touch-screens. The bread is then baked while they shop; it's delivered to the checkout point when the customer arrives. This way the bread is fresher and it cuts down on shelf mites — those annoying little creatures that have a fondness for bread and tend to inhabit any areas used to store great quantities of it.

Shoplifting has been eliminated. We installed the patented Faronic Compuscan Laser. As you can see, the devices are strategically placed all over the ceiling. These gadgets continually track the Electronic Product Chip of each and every item. Anything that is read as being concealed within fabric is used as a targeting point for the laser. The laser efficiently changes the target item and the suspected shoplifter into a particle cloud that eventually gets removed by the store's air filtration system.

Back over there, behind the large red metal doors, is our storage area. All products are kept there until they are needed for restocking the shelves. The storage area is run by Ivor, a New-breed. He looks as if he'll eat you alive, but he's quite friendly really. You have no need to know about how things run back in the warehouse. It is very rare that you'll ever need to go back there.

Now let's see, did I forget anything? You'll become familiar with the rest of the staff as you work here. I think I already mentioned that. Um, oh yes. On a work day, you punch in when you enter the store and punch out upon leaving the store at the end of your shift. If you are planning on walking home please remember to suit up before going out the door. The last newcomer to the moon we had working here was back when we first opened. It had been a busy day. She worked hard yet was still quite happy by the end of her shift. I should remember, I was by the exit doors thanking customers for shopping during our grand opening. She walked by singing to herself, said a cheerful good-bye, and proceeded down the short corridor to the exit. She must have forgotten that she wasn't on Earth anymore . . . walked straight out of the airlock and practically turned herself inside out. Ooo, makes me shudder just thinking about it.

Well that's about it. Everything else you'll be taught during training. If you have any questions or concerns, please don't hesitate to ask. We do try to care about our employees here at Faronic Foods. It was nice to meet you. I guess we'll see you on Monday.

MT

Gunny Green

by Alan Davis

"Oh god, not another one," thought Gunnery Sergeant Green as he saw the corporal rush screaming from the dense, high grass.

"A hand! A giant hand just picked him up and. . . ." Corporal Plastik stopped his ranting when the Gunnery Sergeant (they called him Gunny Green) came into view.

Gunny Green's presence was enough to instill bravery in the biggest cowards. He had seen more combat than all of the other men in the unit combined, had been wounded countless times, and had saved all of their lives dozens of times.

"Shut the hell up!" his gravelly voice barked as he strode over to the now shaking corporal. "You'll give up our position! What happened to your weapon? Where's Molded?" At the mention of the name the barely composed corporal relapsed into hysterics.

"Oh, God! Oh, God! Molded, he's gone! Just gone!" Slap! Gunny Green's meaty hand collided with Corporal Plastick's soft pink face, and the corporal was spun to the ground. The corporal came around after a minute in the dirt.

"I asked where Molded was." Gunny Green said it calmly, as he pulled a cigarette out of the pack he had fished from Plastik's rucksack. He lit the Camel with his silvered "Semper Fi" lighter, and handed the pack back to the corporal. "Now, what happened? Go slow." Gunny Green blew a jet of smoke out his nostrils.

"I know this sounds crazy, Gunny. Molded and I were out on the north perimeter. It was real quiet, and we were thinking about opening our C-rations. I look behind us, 'cause I seen something out of the corner of my eye, and I seen it. I know it sounds crazy. Maybe all this shooting's got to me." Corporal Plastik's hands started to shake again.

"What did you see, Plastik?" Gunny Green's voice had grown soft, far softer than one would think possible from such a hard man.

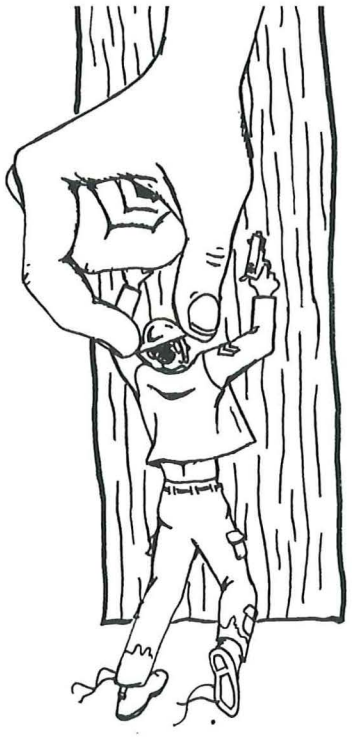
"A hand! A giant hand come out of the sky and grabbed Private Molded! I must be crazy. Am I nuts, Gunny?" Corporal Plastik was little more than a boy, just out of high school. All of the ones Gunny Green got lately were.

"Yeah," he growled as he grabbed the boy-soldier and pulled him upright. "Yeah, I guess you are."

Gunny Green would see to it that Corporal Plastik got admitted to the base infirmary. He would be going home soon, unless the base psychiatric vultures talked him into coming back out to the field. Right now he had bigger problems. Intel said that the Germans were planning a push through this sector any day now. Green's men were not ready to take on a major offensive like that.

"Jesus, now Germans." Gunny Green didn't understand the politics of this war. One week they were knee-deep in Russians, and the next week they were liberating a Korean POW camp. One time they had taken on a platoon of nutso Redcoat Brits, who seemed to walk straight out of the Revolutionary War. When Gunny Green asked Lieutenant Toye about that one, he was dismissed with a "need-to-know" answer and sent back to the field. Now he had Germans to worry about.

Gunny Green sat hunched on a



rock, and began composing a bunch of too-often written lies to Private Molded's parents. He told them how brave and how well liked he was. He wrote that their son had been killed by artillery, and that his body would not be shipped home. All lies. Gunny Green couldn't stand Private Molded, and neither could anyone else. His real cause of death would probably never be discovered. Too many men were disappearing now, and soon another enemy would engage them. This war had gone on too long, gotten too big. There were too many dead

men to waste resources tracking down some stupid private who probably just walked into a minefield. Gunny Green knew this attitude wasn't proper. He should care about the boys whose lives he had been charged with. He had just seen too many come and go to be emotionally involved.

The letter finished, Gunny Green lit one of his Lucky Strikes and opened a cold can of baked beans. He thought about Corporal Plastik being fitted for his straitjacket. Although Plastik was obviously off his rocker, what he said disturbed the Gunnery Sergeant. This was not the first time Gunny Green had heard such stories from his men. Before they locked up Private Kelly, he screamed about a giant booted foot wiping out the rest of his unit last winter. PFC Forest just trembled and mumbled the word "vacuum" over and over after the push against the Italians in that weird pink-colored scrub land a couple of months back. He also remembered that corporal over a year ago. What was his name? Oh, yeah, Corporal Grun. Gunny Green remembered the name because it sounded so much like his own. Corporal Grun had come in, staggering and bloody, screaming about a giant dachshund that had devoured his platoon. Gunny Green had laughed at the time, but he wasn't laughing anymore. When he approached Lt. Toye about these strange reports, he was given a short, clipped answer about "mass hallucinations" and "weak-minded men," and was assigned to picket duty on the north perimeter. Gunny Green decided to stop asking so many questions.

Gunny Green could see fairly well. The moon was full and bright, casting deep shadows on to the forest below. He was looking northward, scanning the treeline for advancing German scouts, when he saw something from behind casting a shadow onto him. He spun around in time to see the gigantic hand coming toward him. He stood stone still, and, oddly, made no sound when it hefted him into the sky.

"Timmy, put your toys away. It's time for bed," Timmy's mother called from the kitchen. "You've got plenty of time to play with your army men tomorrow."

"Okay, mama," he said as he scooped Gunny Green and the rest of his men into a big green bucket.

MT

(Partly Cloudy continued from page 13)
He said the lights were dashing back and forth between his house and the horizon.
I said I'd look into it, although I thought to myself that what the fellow was seeing were kids shooting off fireworks, and that maybe he'd had a couple of shots of something himself. Still, half an hour later, I went to the radarscope.

"We still used vacuum tubes then, so what I saw was a dull haze that grew brighter and sharper until it all coalesced into a picture. Do you know what that picture was? In an other wise clear black sky, there was a cluster of dots up by Marillion. Bright green, like a cat's eye. For a cluster like that to show up, there had to be 30 tons of metal in the sky. Standing still. Unbelievable.

"I slowly reached out and put my finger right on top of them.

"And then they moved. All of those whatever-they-were in the sky moved at once, like a flock of sparrows taking off from a tree.

"For hours, I watched. Fascinated. I tried to time their movements, figure out some sort of pattern from what I was seeing, when, at around 2 a.m., they vanished off the screen, and didn't come back.

"In the morning, I went straight to Louis DuPree, the station manager. I told him what I'd seen and what I wanted to do: report it on tonight's newscast. There was quiet in the room for what must have been a full minute. A minute of silence is a long, long time. When he finally spoke, he said softly, 'Donald, you do this and you'll never work again. Here, or anyplace else.'

"'Yes sir,' I intoned as I stood up and walked out.

"It was then that I did my stupid thing.

"It was such a small thing that I hardly thought anything of it.

> *"'Strange lights in the sky!' he said. 'I live right outside Marillion, and it's like Judgment Day out here!'. . . ."*

"I walked over to my desk, and began drafting a memo.
"In it, I described what I had seen that night, using my notes as reference, and included a paraphrase of the conversation I'd had with Louis. I concluded the memo with a statement to my co-workers: reporters, anchors, cameramen. 'A station with the public trust of broadcasting on such a vital resource as our airwaves should have a higher commitment to the truth. Now you know exactly how committed your station is.'

"I mimeographed it myself, 30 copies, and put one in each of the wooden staff mailboxes reserved for this sort of thing, and went smartly back to work.

"I didn't say anything about the experience for the rest of the day, and soon enough it was time for the 6 o'clock. I began to stroll down the hall to the studio when one of the secretaries shouted my name down the hall. She said there was a call for me. From my wife. Urgent. I should pick it up now.

"Hesitantly, I walked back to my desk and picked up the receiver.

"In 1959, my family lived in a small suburb, surrounded by other neighbors with young children. Ours had been playing in the front yard, with our dog, Royal. A smart dog. Springer Spaniel. My wife told me that she'd been making dinner when she heard a screech of tires outside, and then the children screaming. She ran to the door, only to see a sedan speeding away. Our youngest, Denice, lay crumpled by a tire track that veered up onto our lawn, and Royal lay in the driveway, whimpering and bleeding. Michael stood crying by the side of the house.

"The ambulance had just come moments before. They said Denice had only a broken arm and would be fine. Royal was injured internally, however, and would die before I could get home. I told my wife I would meet her at the hospital as soon as I could.

"I replaced the receiver. I then walked over to the wooden staff mailboxes, and removed each of my memos, one by one. I tore them all. I placed them in my wastebasket. I took out a book of matches. Struck one. Lit the entire book, and dropped it in. I understood."

9:03 p.m. — I couldn't speak.

"Donald, what you're trying to

make me believe . . . what you're saying, it's — well I don't know what you saw, but it isn't rational, what you say. Agents placed on every two-bit weatherman in the States, just in case one of them uncovers, what, UFOs? Aliens? Secret government war machines? What exactly? You're implying a near-omniscient secret government of anti-Constitutional conspirators. Isn't it more likely that . . . that perhaps a drunk driver hit your kids and didn't wait for the consequences? That your boss was simply trying to exercise responsible journalism? I just can't see the evidence for your conclusion."

"I'm not trying to make you believe anything; I just don't want to have my conscience washed in the blood of your family. And I believe you can see the evidence. You're just afraid to. The first misconception you have is the notion of 'conspiracy.' Let me ask you this: What causes weather, Richard? What causes clouds? Is it a conspiracy between water molecules and dust? A totalitarian droplet of water that enlists others in some vast army? No. It's simply the result of their natural properties. A cloud is another way of describing the natural properties of the constituents of the atmosphere. Now tell me: What is the defining natural property of life?"

"To survive. Life exists to survive."

"Does life survive by giving up power? Does anyone or anything choose to be weak?"

"No."

"And do you become more powerful by fighting the strong, or by adapting to them?"

"Adapting."

"So, power becomes its own conspiracy. There's no mastermind planning it all, no evil genius behind the curtain. There is only one thing: self-interest. Certain choices provide advantage for more than one party, and those are the choices that become acts. There's no collusion, no coercion. Just people with similar, mutually reinforcing, dangerous interests."

"But that would take so much planning!"

"I'm not trying to make you believe anything; I just don't want to have my conscience washed in the blood of your family . . .".

"Have you ever been to a sale? You saw something in the Sunday paper you wanted. A great deal. You spent Sunday morning gardening, and when you got to the store, they were all out. Was that a conspiracy? How do you explain the co-operation it would take to implement such a scheme to deprive you of your refrigerator or toaster or shiny new bangle? It's all inherent in the system. There didn't need to be a leader of soldiers marching down the streets because there only needed to be a class of people with the same power as you that could benefit from it."

"And you think those things in the sky are?"

"They're precisely what you said, Richard. Unidentified Flying Objects. Are they aliens? Spy ships with corporate mind-control beams? How about ghosts? Science doesn't know everything, and I don't either. But I do know that it's important to the interests of the powerful that they stay unidentified. Louis understands the same truths that I do — that if you probe the status quo in certain sensitive areas, you will be silenced. It's always been that way in human society, from cavemen to Caesar. Power has never dissipated. Never! It has only changed hands. That's why I told you my story. I want you to be very, very careful in what you do next, because they're watching you now — they're aware of you. You're being listed to because it's in someone's interest to listen to you. And you've already started the trouble by asking questions tonight. I suspect something will happen. What and to whom will depend on what you do in the next . . . 40 minutes?"

9:20 p.m. — "If I go on the air, if I say that there are unexplained aircraft, non-commercial unknown aircraft, surveying Beaumont and the surrounding areas, and that the military denies their presence . . . what do you think will happen? You think they'll come after my wife? My kids?"

"They may anyway, Richard. You're going to have to choose between two values tonight: your family, or the truth. And do you know what I've learned in my 30 years of broadcasting? The truth isn't as important as you think. It's

bigger than you, and you can't change it. The truth will eat you alive. I chose family. Hah ha! You see, Richard? Am I part of the conspiracy now? Am I? You see how it spreads?"

I had to stop and think. "I've got to make a call."

"Call your wife, Richard. Call her. But be careful what you say. They're listening."

"Thank you Donald. I'll call you again when this whole thing blows over, and maybe then we can find a pub where we can really talk about conspiracies."

"I look forward to it. I mean that, Richard."

I hung up and speed dialed Judy with no idea what I would say.

9:27 p.m. — "Hello?"

"Judy, it's me. I'm at the station. How're the kids?"

"They're already asleep. How come? Is something wrong?"

"No, no. Nothing's wrong. I just thought I should call."

Think think think.

"Jude, are you gonna watch the broadcast tonight?"

"Sure, I thought I would. How come?"

"Well, I was just thinking of those times in college. I guess I just missed you a lot. You remember watching me train in front of the Chroma-Key for the first time? The blue screen?"

"I remember it perfectly."

"Well, remember it tonight. I miss you lots. I gotta run; we're on the air in less than 30 minutes, okay sweetie?"

"Okay. I love you, Rick."

"I love you too, Jude. Watch me tonight."

"So, power becomes its own conspiracy. There's no master-mind planning it all, no evil genius behind the curtain. There is only one thing: self-interest.."

9:38 p.m. — Jim's giving me the eye. I think maybe he's feeling stung that I went over his head.

"So what'd the old man say? 'Bout the dot. Hadley system, am I right?"

I trust Jim. And I've got to tell someone.

"Jim, it's my opinion that what we're seeing on NexRad3 are some sort of aircraft."

"Negatory, Ricardo. I already called on that, remember? And they don't move like planes."

"That may be. Which means something else is going on."

Jim stopped and licked his lips.

"What are you saying? You're seeing a UFO? Let me guess: the old man fed you that one. Have you forgotten he's your competition? He's probably just stringing you along, hoping you'll look stupid, and he can finish his career in a blaze of ratings. Come on, Rich, snap out of it. You know better."

"Well, I know something. The question is: who else should know?"

"You're on your own on this one, then. It's your funeral."

What a strange choice of words.

9:53 p.m. — This is where I make or break my career.

Donald was wrong. It's not a matter of truth versus family; how can I live with my family if I don't tell the truth? How can I tell my children it's wrong to lie when I've done it to half a million people? Truth and family aren't separable; they're just one thing. Which means there's only one thing to do.

10:00 p.m. — Voiceover: You're watching the state's fastest growing newscast! Channel 10 at 10! With Stephen Ridley . . . Keisha Williams . . . Don Bauer on sports! And Richard Stein's weather! Tonight's top story:

Keisha Williams: Heavy storms have knocked down trees and knocked out power to almost 10,000 people in northern Awachahee County. Stephen Ridley

will have more with a live report from Beaumont in just a moment.

Richard Stein: And I'll have an update of storm conditions and the damage it's left behind at 10:13.

Keisha Williams: But first out to Stephen, live in Beaumont, where the storm has hit the hardest.

Stephen Ridley: That's right, Keisha . . .

10:10 p.m. — Judy's smart; that's why I married her.

When I had some of my first college classes in broadcasting, I'd practice my mannerisms in front of the blue screen in the evenings, watch myself on tape, and then Judy and I would go out and get a bite. She got so bored watching me, she eventually suggested inviting some friends to watch and give me pointers — and, not coincidentally, to give her something more to do than listen to the same imaginary forecast two dozen times over. And so, while all her friends watched, I used to spell out secret messages to here in the gestures I made — the sort of things you might find on valentine hearts: I LUV U, U R SWEET, KISS ME. And she would laugh hysterically.

Her friends never caught on, and they were always telling her not to be so hard on me.

Funny times.

10:13 p.m. — ". . . Richard?"

It's time.

"Thanks, Stephen. Well, as you can see . . ." Make a G-shape over Beaumont.

". . . Beaumont's not the only town in the path of these fall storms." An E-shape for the path.

I walk outside into the rain, and start to get into my car when I look and see the Taurus parked on the other side of me. The kids are waving. Judy is giving me a look that says, "What's this all about?"

"A front of cold air from the north is colliding with" — make a T — "some unseasonably warm air from the south. The entire mass" — an O, then a U — "as you can see on NexRad3, is being swept" — a T-shape — "to the west . . ."
Look straight into the camera. "NOW . . ." C'mon, Jude. I'm gonna start stalling.

". . . winds over forty miles per hour have been clocked in the area, but have died down in the past hour, and the National Weather Service advises . . ."

10:18 p.m. — Five minutes ought to have been enough. Jim is watching me offstage like a border collie.

". . . and it looks like we've passed through the worst of it . . ."

Keep talking and they can't cut to a commercial. ". . . so I'd like to take a moment to talk to you about news of a different kind. As these radar images from NexRad3 show, unidentified aircraft have been tracked in the towns of Beaumont, Sweetwater, and surrounding areas tonight . . ."

Oh god. Jim just walked off the set.

10:25 p.m. — ". . . and you can be sure that Channel 10 will have more news on this story as it develops. Back to you, Keisha."

"Thanks, Richard, for that special report. We'll be right back."

Cut to a commercial. I whip my cellular phone out of my pocket and walk straight through the mob of stagehands, directors, and reporters from the newsroom who are suddenly gathering around me and shouting. I don't hear what they're saying. I hear the phone ringing at my house. What I don't hear is an answer. Where are you, Jude, what have I done? Someone answer the phone.

I walk outside into the rain, and start to get into my car when I look and see the Taurus parked on the other side of me. The kids are waving. Judy is giving me a look that says, "What's this all about?" As I get in the passenger's side, I reach over and kiss her on the ear, and before she can finish asking what's going on, I say: "Let's all sleep at a hotel tonight." Judy's smart. That's

why I married her.

9:30 a.m. — I'm lying in the largest bed in the city. Our 2-year-old Jodi and 3-year-old Henry are sandwiched around me, while Judy is getting me a cup of strong black coffee. The paper I'm reading says, "Army Denies Weatherman's Story, Other Sources Confirm." While the military still aren't talking, it seems that the airport and a couple other sources of meteorological data from the National Weather Service confirm my statement from last night with logs of their own. The general consensus is that some sort of man-made craft was in the air, and the AP tells me that the investigation is proceeding at the DOD's highest levels.

So far, it had been a good morning; I don't deny I was feeling a little heady. I'd done something no other meteorologist I knew of had ever done: I'd broken a news story. I'd busted a conspiracy. And lived to tell about it. Most of all, my family was safe, and I was letting the credits roll in my own private movie, when my cell phone rang.

It was Jim — "Congratulations, you son-of-a-gun! Well, I guess I should've listened to you, huh?"

"No big deal, Jim. You were just doing what you thought was right, and so was I."

"Well, I hope you remember who your friends are. You're going to the top. Big raise, I bet. And now that you're out of competition, you'll be number one here for a long time. That is, if the networks don't try and buy out your contract!"

"What do you mean, 'out of competition?'"

"I thought you read the paper. Didn't you hear? Look in the obits. Fraunshue died last night, at his desk. Didn't even make the evening forecast. A stroke or something."

I need that cup of black coffee.

Because I think I'm just starting to understand.

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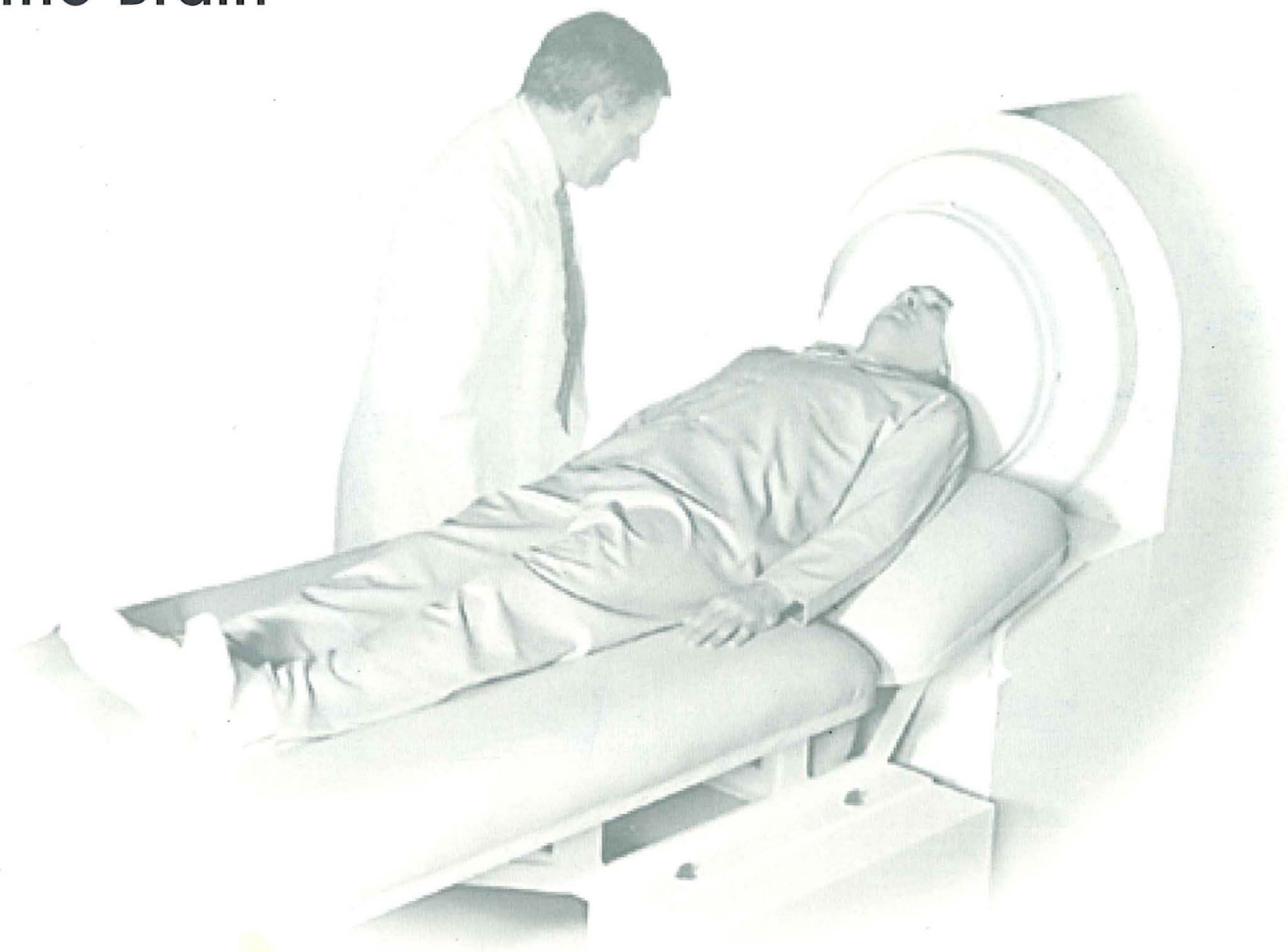
Professor John Broadhurst Investigates the Magnetic Physiology of the Brain



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Learning styles affect achievement

Preparing for the job hunt

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Physics Professor John Broadhurst investigates the magnetic physiology of the brain.

Time, Experience and Networking (Page 6)

Preparing for the job hunt.

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FEBRUARY/MARCH 1999

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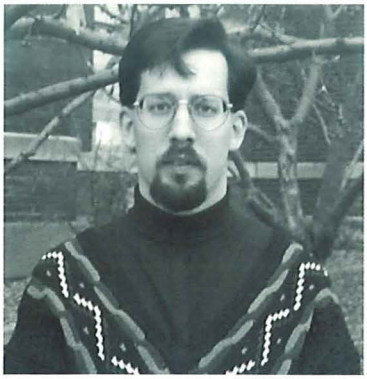

Notes From the Editor

Mark D. Stewart

IT students can only gain from what the Department of Rhetoric has to offer, including world-class scholars and instructors in the field of scientific and technical writing.

I have it on good authority that the Dean's office is considering having IT students fulfill their writing requirements through the Department of Rhetoric. I think this is a splendid idea.

Presently, IT students receive writing instruction through the Composition and Communication Program sponsored by the English Department. Although Composition has done its job well, the Scientific and Technical Writing Program sponsored by the Department of Rhetoric specifically addresses issues of communication in a technological world. According to the Department of Rhetoric's Web site <http://rhetoric.agoff.umn.edu/>, successful technical communicators have the following skills: "strong writing and editing, oral communication, visual communication, and computer skills." In addition, technical communicators "need a sound knowledge and understanding of the goals, methods, and concepts involved in math and technology, as well as in a specific scientific area."

IT students can only gain from what the Department of Rhetoric has to offer, including world-class scholars and instructors in the field of scientific and technical writing. As the paradigms of communication shift, it is becoming imperative for all students in all fields, especially those in science and technology, to communicate effectively. The Department of Rhetoric provides instruction in:

- the techniques for written, oral, and visual communication, including gathering information, analyzing the audience, assessing conventional communicational formats and processes, and drafting and revising documents;
- organizational theory, with an emphasis on action research in scientific and/or technical settings;
- the principles and concepts of conducting experiments and analyzing qualitative and quantitative data;
- grant preparation and proposals for non-profits and/or research or business proposals;
- experimental and survey research techniques for both quantitative and qualitative methodologies in scientific and technical communication;
- ethics, experimental bias, and inferential statistical analysis;
- the theories and practice in international and inter cultural scientific, technical, and business communication.
- the principles of technical communication involving projects, scripts, and online support, and using a mark-up language; and

The Scientific and Technical Communication Program in the Department of Rhetoric is a combination of traditional lecture style learning and interactive classroom discussion.

- the criticism and practice to examine how science is "translated" for popular audiences.

These skills can give IT students an edge as they pursue careers in their fields.

Below is a small sampling of the undergraduate and graduate courses scheduled to be offered next Fall by the Department of Rhetoric. For a complete listing, please visit <http://www.semesters.umn.edu/tccat/template/courses.cfm>.

- RHET 3257. Scientific and Technical Presentations.
- RHET 3562. Technical and Professional Writing.
- RHET 4165. Managerial and Organizational Communication, Planning, and Change.
- RHET 4501. Usability and Human Factors in Technical Communication.
- RHET 4573. Writing and Managing Projects and Proposals.
- RHET 5511. Research in Scientific and Technical Communication.
- RHET 5534. Designing Technical Training for Intercultural Audiences.
- RHET 5562. Theory and Practice in International Business Communication.
- RHET 5662. Advanced Technical Communication.
- RHET 5664. Science Writing for Popular Audiences.

IT students should check out these and other technical communication courses offered by the Department of Rhetoric, or consider a minor in Scientific and Technical Communication. Under semesters, the Department of Rhetoric will offer three new minors, two of which encompass specific areas of scientific and technical communication.

For more information, contact either Dr. Laura Gurak, Undergraduate Major Coordinator, at (612) 624-3773 or gurakl@tc.umn.edu, or Cheryl Towler, Assistant Undergraduate Major Coordinator, at (612) 625-4710 or towl005@tc.umn.edu.

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Time, Experience, and Networking

Preparing for the Job Hunt

by Nathan Whalen

It's job hunting time, and what a mess to deal with. Not to mention the apprehension of the first job hunt, there's the avalanche of information to sort through.

There's job search books, career books, skill discernment books — many of which seem to get updated every year — company information, company videos, career magazines, employment newsletters, interview books, resume books, thousands of job listings in what seems to be an infinite number of other publications; the list goes on and on. Above all, you have to take the time to wade through all of the information and find the job or internship that interests you the most.

Taking the time to properly prepare for the job hunt can make the process a lot easier. The job search "process can be less scary if you start early," says Sharon Kurtt, director of IT Career Services. Students should start thinking about jobs when they start college by talking with advisors, upperclassmen, friends, student organizations, anyone that can provide information on the various careers that would be of interest. Several groups, such as the Society of Women's Engineers and Plumb Bob, sponsor job fairs.

To help identify skills and interests, take the various assessment tests, such as the Myers-Briggs Type Indicator, and the Strong Interest Inventory.

Another tool to help identify skills is IT 1312, Exploring and Managing Careers in Science and Engineering, which will help students identify which technical career they would find interesting. Then students should develop an academic plan that focuses on attaining a job goal. One of the best tools to help a job hunt is an internship, or any other practical experience. Kurtt says that many employers are looking for students with experience because they not only need students who are knowledgeable, but they also want students who are willing to work.

Starting the job search early is one of the keys to career success. For a head start, register with ITCareer Services, 50 Lind Hall.

IT Career Services, located in 50 Lind Hall, is one place to look for an internship. Of the 1,300 to 1,500 students that are registered in the office, Kurtt says that about 75 to 85 percent of those students receive internships. IT Career Services also provides help with resumes, has a wealth of company information, and information on companies that are inter-

viewing on campus.

Networking is yet another tool that helps locating an internship. Networking can be done through a professional group, contacts at school, a job fair, or even friends. Dorothea Czernik, a senior in aerospace engineering, heard through a friend that Boeing was having problems finding interns in their weight engineering department. Czernik, sent a resume and cover letter, and one month later had a telephone interview with a team leader of a project within the department.

"One thing that helped me get an interview was that I had previous experience," Czernik says, referring to her Undergraduate Research Opportunities project she had done. Using this experience, the team leader in the department she'd be working with could find a project that could use her experience and was related to her interests.

Sharon Kurtt, Director of IT Career Services, can help guide students in their job searches.

Another tool for networking is to conduct an informational interview with an employer. This is an opportunity to find out the demands, and requirements of a particular job field, and information about a company. It's important to note that this isn't a job interview, and that it isn't appropriate to ask about job openings when doing an informational interviews.

Now that Czernik is graduating in June, she finds herself looking for a job. Czernik says that she is trying to keep her options open. She has been researching companies that she would like to work for, checking into graduate schools, perusing job magazines relating to

engineers, such as "Job choices 1999 in Science, Engineering and Technology," and checking jobs on a local and national level. In short she is not rushing through the job hunt, but giving herself the time to find the best possible job.

Preparing for a job hunt is a process that should be thought about throughout college, and the best way to prepare for the job hunt, is to take time, obtain experience, and have a good system of networking available.

For more information on job and internship opportunities, contact IT Career Services at 612-624-4090 or visit 50 Lind Hall.

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Meet the other IT Students

Tuesday, April 6, 1999
4:30 p.m.

Formula for Success?

Gender and Ethnic Achievement Based on Learning Styles

by Elizabeth Pierce and T. A. Bennett

For many students, math is just another four letter word, but studies have shown that the issue of achievement in mathematics is much more complicated than that. Researchers at the University of Minnesota, in two separate studies, found that the types of tests given and high school courses taken may factor into gender and ethnic differences in mathematical achievement.

In "Gender Differences by Item Difficulty Interactions in Multiple-choice Mathematics Items," published in *The American Educational Research Journal*, University researchers John Bielinski and Mark Davison found that males are more variable than females in overall mathematical test scores, a variant that has existed since at least the 1970's.

"Mark Davison and I noticed the trend in math achievement tests and in other data," Bielinski said. Using data from several forms of the Minnesota Basic Standards Test, their study was based on this hypothesis, but the fact that it did occur was still surprising. "We found that item difficulty is the key to predicting gender performance."

In general, females tended to outperform males on the easiest questions, and males tended to outperform females on the hardest questions. While the mean score of the two genders was about equal, females scored consistently in the middle of the pack, while males were at both ends of the spectrum. This variability translates to males scoring highest on math tests: Studies cite a 3:1 ratio of males to females in the upper five percent of scores. As a result, more males than females tend to go into math and engineering fields, and the scholarships to pursue such studies are then similarly weighted.

While the data from these studies and others indicate a clear gender difference in math scores, explanations for that difference are less clear. One explanation offered is that the types of ability measured in "easy" versus "hard" questions differ. For example, reading or clerical accuracy may be the focus of easier questions, while mathematical reasoning or spatial visualization is the focus of harder questions. "The property of the problem can predict the direction of gender

The Felder Teaching Method

Richard Felder, a member of the Department of Chemical Engineering at North Carolina State University, has been looking into the teaching methods used by science and engineering faculty members and concludes that, often, the teaching styles instructors used contrasted with the ways in which their students learn.

When students learn a different way from how the instructor teaches, such as a visual learner versus an oral instructor, the students have difficulty in the course because they lose interest in the subject area. This causes them to switch to a different major, even though they would be as good in an engineering or science career as someone who gets good grades because their learning style meshes with the instructor's.

To combat this problem, Felder suggests that instructors use a variety of teaching methods: Verbal lectures and visual aids, group work and links to the real world, conceptual problems, and how the material relates to the students' prior experiences should all be a part of a course.

For more information on the Felder Learning Style, visit <http://www2.ncsu.edu/unity/lockers>.

difference," Bielinski said. "The difficulty [of the questions] can skew the test."

Bielinski is using his findings to help the state develop math tests which are less biased based on gender.

The study also points out a somewhat neglected issue: The males found at the bottom of the rankings. Fewer boys pursue four-year degrees straight out of high school and receive bachelor degrees, and Bielinski speculates that they are not encouraged to take math courses because there are more opportunities for males in two-year technical programs than for females.

Research in high school course taking has mirrored Bielinski's findings. In "High School Mathematics Course-taking by Gender and Ethnicity," published in the same journal by Ernest Davenport et al., researchers found that females were more likely to take the traditional college prep classes, while males were more likely to take remedial math classes. This trend continues in college, with males more often taking advanced math and major in math or a quantitative science.

"Telling people to take more courses may not raise achievement," Davenport said. "The types of courses may matter more. People often select themselves out [of higher level courses] in college if they are not prepared because they have more to make up."

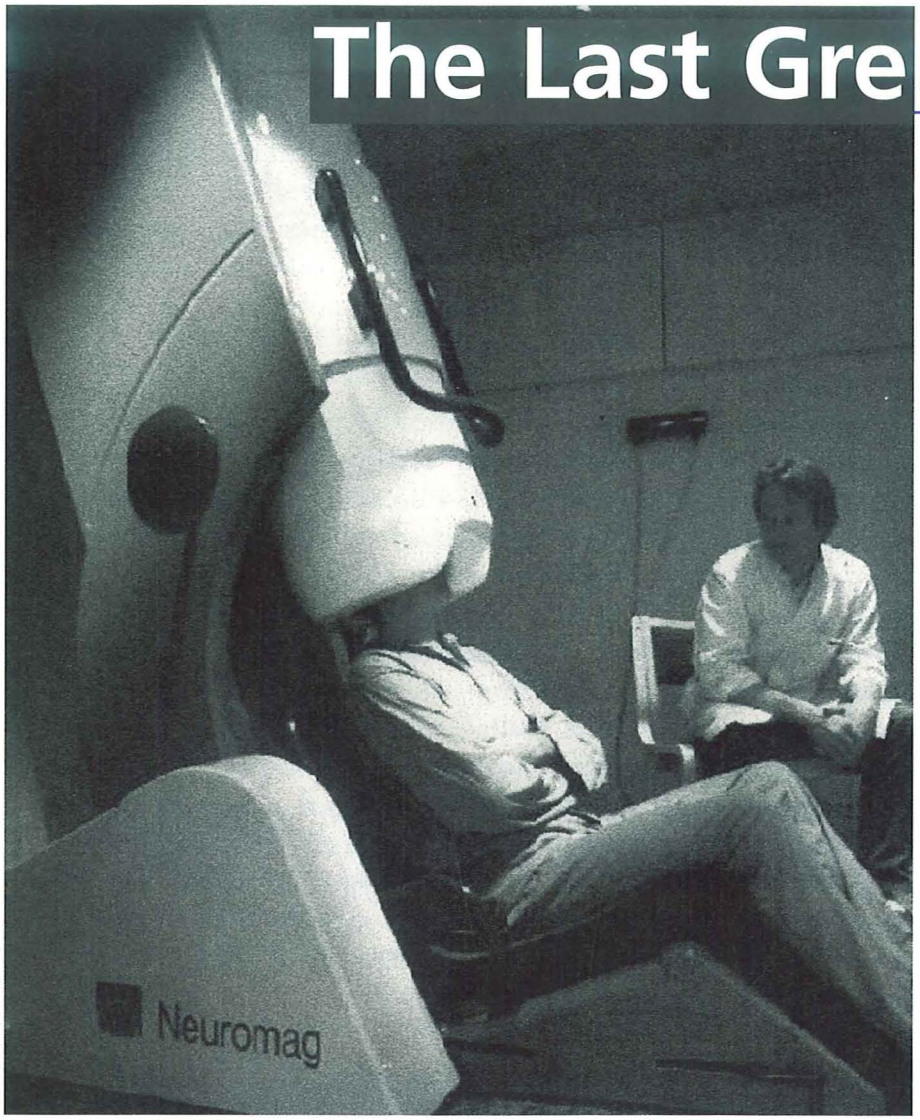
Differences in ethnic groups as they relate to course choice among a sequence of Algebra I, geometry, Algebra II, trigonometry and calculus were also studied. Results showed that only about 1/3 of African-American and Hispanic students took courses beyond Algebra I, instead taking courses in functional and pre-formal sequences, while most Asian and White students took courses beyond the level of geometry in standard and advanced sequences. Twice as many Asians as Whites took calculus courses. "When minorities take advanced math, they do well. Not many take advanced courses though," Davenport said.

The researchers found two course taking decision points for students: First, a decision to prep for college attendance by taking the standard sequence of Algebra I, geometry and Algebra II, separating the African-American and Hispanic students from the more often college bound White and Asian students. Second was the decision to prep for a quantitatively oriented career by taking advanced course work. This choice seemed to separate Asian students from White students, with Asian students taking more advanced courses.

The Last Great Mystery

Professor John Broadhurst Investigates the Magnetic Physiology of the Brain

by Jeremy Paschke



In 1870, when two German scientists -- Eduard Hitzig and Gustav Frisch -- touched rudimentary electrodes to the cerebral cortex of a patient undergoing surgery, they inadvertently caused anger and fear in the patient. The brain, Hitzig and Frisch discovered, is an electrically structured organ.

In later years, finer electrodes enabled biophysical researchers to draw connections between given regions of the brain and specific modes of behavior. For instance, stimulation of the hypothalamus induces rage, and it was found that the difference between pleasure and pain is separated by the distance of a single cell. Messages in the nervous system travel by electrical impulse along chains of neurons, the building blocks of nervous tissue.

Mapping the complex circuitry of the brain has been an enchanting yet elusive goal to many scientists. Now a new attempt is unde way to reach that goal, and it involves study ing electricity's closest of kin -- magnetism.

Manifest in every electrical current there is magnetic field — electricity and magnetism being inseparable — which radiates in concentric circles out from the chain of neuron as they convey an electrical signal. For mos of the twentieth century, detecting these ma netic fields was an impossible task since th are incredibly weak — a hundred million times weaker than the earth's magnetic fiel Technologies springing forth from supercon ductivity, however, have made detection rea izable and have opened the way for the revo lution in magnetic brain research.

At the University of Minnesota, physics Professor John H. Broadhurst is playing an active role in analyzing the magnetic physio ogy of the brain. He investigates the magne patterns involved in conditioned response a researches how the brain processes a comb nation of sight and sound stimuli. Broadhur hopes that his endeavors may contribute to greater knowledge of how the brain works. Broadhurst hypothesized that twocombined signals would create a pattern of magnetic fields in the brain that was distinctly differe than an overlap of two independent signals. He based this hypothesis on the natural ten dency to connect sight with sounds.

When humans view matter in motion, the brain is conditioned to expect some aural input. For instance, when abaseball player hits a ball, we expect to hear the crack of the bat. But consider the example of a shooting star.

"One gets a strange feeling when watching a shooting star," says Broadhurst. "This is because the shooting star is a spectacular sight with no accompanying sound." Contemplating this and other observations led Broadhurst to wonder how the brain processes a combination of sight and sound stimuli. Could the processing be a simple overlap of the two stimuli, or are the signals combined by the brain in some unique fashion?

"One gets a strange feeling when watching a shooting star . . . because the shooting star is a spectacular sight with no accompanying sound."

In order to test his hypothesis, Broadhurst and his graduate student, Kevin Knuth, designed an experiment where a human volunteer is placed beneath a magnetometer, which measures the magnetic fields in the brain, to observe the magnetic fields produced within the brain after exciting both optical and auditory senses of a human subject. A flash of light and an auditory "click" is sent to the subject — *flash / click / flash / click / flash / click* — hundreds of times over, conditioning the brain to connect the flash with the click. Then, the experiment operator suspends the click, and the subject sees only the flash.

Broadhurst observed that for the first five or six iterations, a magnetic field surged in the subject's brain within the first hundredth of a second after the *flash / click* event. However, once eight to ten of the *flash / click* patterns were repeated, the subject's brain learned to combine both sight and sound signals. After eight to ten repetitions the initial magnetic field surge disappeared. When the click was suspended and the pattern broken, the initial magnetic surge returned as the brain adjusted itself on what to expect, either *flash / click*, or *flash / silence*. Broadhurst studied this adjustment.

Repeated experiments proved that after a volunteer developed a conditioned response, the magnetic field generated in his or her brain by a silent flash was, as Broadhust predicted, vastly different than the magnetic field generated by both flash and click. This experiment was the first to provide solid evidence that the brain's examination of *combined* visual and auditory impulses is different than a simple overlap of two separate signals. Broadhurst concluded that the brain adapts itself in order to process the combined signals, and the brain is confused when the combination is broken.

Magnetic fields are produced in the brain by electrical surges along neural pathways, so Broadhurst used magneto-encephalography (MEG) to measure the brain's magnetic field. Previous studies on the human brain used electroencephalography (EEG) which directly measures electrical activity in the brain, and which finds practical applications in diagnosing epilepsy and discovering tumors. EEG has limitations that MEG can supercede. First, MEG measures the magnetic field, which is a vector quantity, where EEG measures the electric potential, a scalar quantity. Researchers prefer vectors over a scalars because vectors have a magnitude and a direction, while a scalar only has a magnitude. A good example of a vector is the wind, where both the strength and direction are imperative. On the other hand, temperature and mass — both without direction — are scalar.

A second limitation of EEG is that in order to measure electric potential, physical contact must be made with the brain. To an accurate reading with EEG, study participants must undergo surgery to

remove sections of their skull. Obviously, it is easier to find participants for MEG research than it is to find EEG participants. "Most people," jokes Broadhurst, "don't like having their skulls removed."

Even so, there are limitations to using MEG. Recording the magnetic field alone does not immediately yield the location of electrical currents in the brain. In fact, tracking magnetic activity is a very indirect route to watching how the brain's neurons are behaving. As Broadhurst's current graduate student, Alex Roitman, admits, "There are many different currents that produce the same magnetic field configurations."

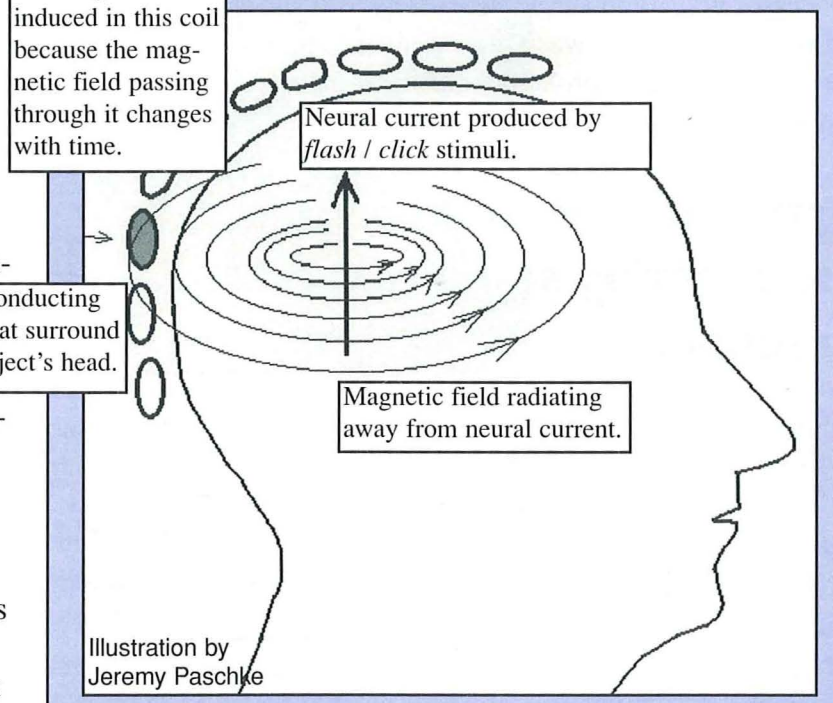
Sifting through hundreds of possibilities for the most likely candidate is an arduous chore. Also, the human brain's magnetic field is extremely weak, on the order of 10^{-12} Tesla, which is a hundred million times weaker than the earth's magnetic field. Detecting such a weak field requires special equipment.

The University of Minnesota does not own the equipment necessary for Broadhurst's experiments, so he performs his research at the Scripps Institute in La Jolla, California. The MEG device at Scripps is called a Super-Conducting Quantum Interference Detector (SQUID).

The entire unit magnetometer is composed of many individual detectors, many SQUIDs. One SQUID consists of a coil of wire roughly one centimeter in diameter that is cooled by liquid helium to a superconducting temperature of 4 Kelvin. A collection of 500 to 1,000 coiled SQUIDs make up the whole magnetometer, which embrace the subject's head like an oversized football helmet. The SQUID magnetometer is bulky because it needs a cryostat to contain the liquid helium. (See photo)

The magnetometer reads the magnetic field produced by electrical currents traveling along neural pathways. The magnetic fields resulting from the brain's activity cause a change in the magnetic flux through the superconducting coil. The changing flux induces an electromotive force which is read as voltage. This is a fine application of Faraday's Law of Induction.

Again, the SQUID charts the magnetic fields produced by neural activity inside the brain. These traveling charges are the messengers of information. Whether a person is conscious or unconscious, neurons in their brain are constantly firing. However, the MEG method cannot read a charge traveling across a single neuron. The current flowing across just one neuron is too small and its magnetic field too weak to detect, so a hundred thousand neurons must all carry a charge in the same direction at the same instant for the SQUID to obtain a reading. When this occurs, Broadhurst is con-



Faraday's Law of Induction.

The SQUID exploits Faraday's Law of Electromagnetic Induction in its overall goal of neuro-imaging. As neurons fire in response to some external stimulus, a magnetic field radiates away from the neural current. This magnetic field permeates the skull and reaches one or some of the superconducting coils that surround the subject's head. As the magnetic flux through the superonducting coil changes over time -- the initial surge quickly subsiding -- a neural current and voltage are detected. With such a tenuous chain of interrelated events, scientist must be wary when making conclusions about the exact location and direction of neural currents.

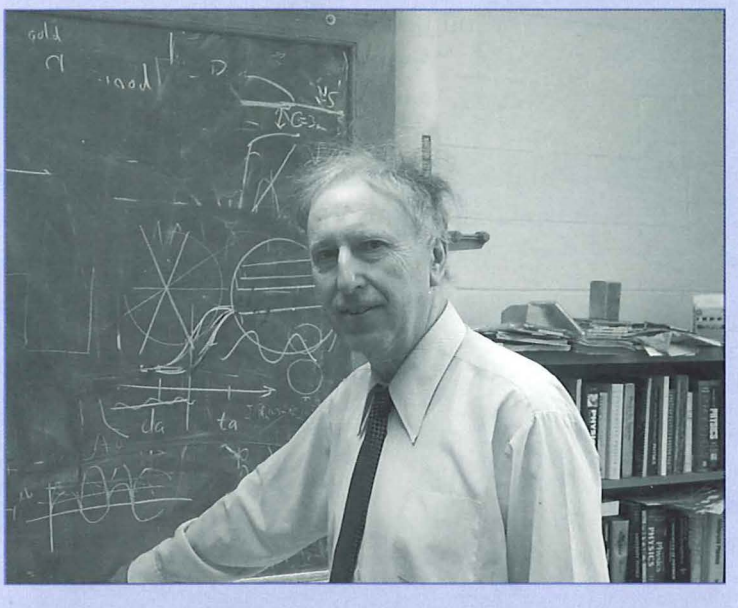
fident that something has excited the peripheral senses and set the brain into action.

Broadhurst and other specialists in biophysics have developed a theory on how external stimuli are analyzed by the brain. First, scientists know that all sounds, from the buzzing of a mosquito to the loud clanging of church bells, originate with vibrating matter causing waves of high and low air pressure. When these pressure waves enter the ear, they push tiny hair follicles back and forth, "like chaffs of wheat swaying in the breeze," explains Broadhurst. The oscillations of the hair follicles set electric charges in motion beneath the inner membrane of the ear, and send electrical messages to the brain.

Before the message from our ear is analyzed, the volume must be adjusted. "This step allows us to have conversations in a noisy room," says Broadhurst, "where we must pay particular attention to a specific source of sound."

Next, our brain spatially maps the sound. Broadhurst gives a clever evolutionary example to illustrate the importance of spatial mapping. For example, "if a sabertooth tiger is chasing you," he says, "you have to know which way to run." Broadhurst believes the human brain's ability to spatially map sound is a natural defense. Natural selection preferred those brains that could quickly associate a sound with its location in space. Birds of prey display an exceptional ability to map sounds. Owls, for instance, map sounds especially well and are therefore effective nocturnal hunters.

Within a twelfth of a second, the brain adjusts volume and maps the sound, then an area of the brain called the Silvius Fissure Region, which holds memory, analyzes the sound and attempts to connect it with sounds heard before.



University of Minnesota Professor John Broadhurst has begun to unlock the inner world of the human mind.

Research with MEG reveals that most humans spend the first 150 milliseconds after hearing a sound scanning their memory to match it with a similar, known sound. If the sound is completely foreign, the brain churns away for a full half-second. Ideally, researchers would choose to always analyze human response to new sounds. However, new sounds are difficult to regenerate and study in a scientific manner because, as Broadhurst says, "new sounds are only heard once in your life." Familiar sounds, such as a semi-trailer's blaring horn or a harmonica's chord, precipitate an emotional or physical reaction because the sounds are connected to a host of other memories. Although there are given locations in the brain for memory, motor skills and other cognitive abilities, few scientists consider our brain as a strictly compartmentalized organ, where various functions only occur in their given location.

Instead, scientists think of the brain as "plastic." In other words, although there are preferred locations for memories and cognitive functions, on the whole, memories are stored in the order in which they are collected. "Plasticity is a very good thing for humans," Broadhurst explains, "because it permits folding to occur." If the brain's outer layer, the cerebral cortex, can be folded, then the total surface area of the brain increases, and it can accommodate more nerve cells.

Moreover, a folded brain will hold the most important information enveloped within the "crease" of the fold, thus protecting that information from possible injury. A folded brain makes humans smarter thinkers. "Intelligence might be measured not by the size of one's brain, but by the degree of folding," says Broadhurst. Animals

with folded, or highly corrugated brains, such as dolphins and humans, demonstrate far greater intelligence than animals without corrugated brains, such as birds and reptiles

Scientists have a good idea what type of physiology is required for an intelligent brain, but those wishing to define every subtlety of human thought still face challenges. For anyone who fears that SQUID technology will reduce the complexities of conscious thought to a fundamentally identical mechanical blueprint for all human beings, Professor Broadhurst gives relieving counsel.

"Every brain is built different," says Broadhurst, every person thinks differently, which is one reason why MEG research is so difficult. Although all human brains carry out similar processes and achieve similar goals, Broadhurst insists that we all think differently. Broadhurst compares the brain's neurons to a collection of several thousand logic gates in a program logic array. As a person acquires various cognitive skills — riding a bicycle or learning a list of names — neurons connect one to another. Each individual, as a result, builds a unique structure of logic gates in a unique neural framework.

SQUID technology is only 16 years old, but it offers great promise for improved resolution and increased data collection. What does this mean for a scientific understanding of human consciousness? Broadhurst says that current research on human consciousness is still at a very superficial level. The only neural activities MEG can detect are the reactions to external stimuli. Spontaneous or creative thoughts still lie well below detection threshold. "A true study of consciousness," says Broadhurst, "would involve analyzing non-stimulated neural activities as well as stimulated ones."

However, these select reactions do not inhibit Broadhurst and Roitman from asking further questions with MEG. Their next investigation will probe the dependence of nervous response on a sound's frequency. In their study, a listener will hear a number of standard musical notes played at the same frequency from the same instrument, perhaps a cello. Then the experiment conductor will play a deviant note of the same frequency but from a different instrument, a French horn or an oboe. Roitman says the bulk their analysis lies in the "early stage of recognition, well before conscious connection is made." Roitman will use MEG to see if the volunteer subconsciously differentiates between the timbres of various instruments. If Broadhurst and Roitman prove that a sound's frequency is analyzed independent of its duration and timbre, they will make another stride in furthering the biophysical understanding of the human brain.

Scientists and non-scientists alike marvel at complexity of the human brain. The acclaimed biologist and Pulitzer Prize winning author, Edward O. Wilson, argues that the rise of brain sciences will follow evolutionary theory, plate tectonics, and microbiology as the next great wave of scientific advancement. Wilson suggests that a superior understanding of consciousness will unite all sciences, along with the arts and human culture, under one platform of knowledge.

Meanwhile, here at the University of Minnesota, Professor John Broadhurst takes another step towards solving the last great mystery.

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Examining English:

A Brief History of the New *Lingua Franca* of Science and Technology

by Kirk St. Amant

The world is more unified now than at any other point in human history. Part of this unification results from the spread of communications technology — fiber optic telephone lines, e-mail, and the Internet — which allows almost every person on earth to talk to a neighbor, literally, at the speed of light.

The world is also united by a new global commerce. Nations as diverse as Germany and Japan regularly exchange large quantities of goods. Moreover, the new age of global corporations involves multiple nations regularly create a single finished product. These developments in communication technology and international commerce have allowed English to come to the forefront as the new global tongue.

However, the global spread of English does not necessarily mean that the international communication tasks of English-speaking technical writers will suddenly become much easier. On the contrary, the spread of English as a world *lingua franca* brings with it a series of new challenges that will require new understandings of global communication and new communication strategies.

The seeds of English as a global language were first sown by the British colonization efforts of the 17th century. As Britain began to establish overseas colonies, it also began to introduce its language to new regions of the globe. Within a century, Britain and its language seemed to have established themselves in every corner of the world. British colonial officers from Egypt to Hong Kong made English the new language of government and one of the major languages of commerce, and natives wishing to prosper under British rule needed to learn English.

By the end of the 19th century, the former British colony of America began to follow suit as a colonial power with overseas holdings. As a result of the Spanish-American War, the United States gained new territories in the Caribbean and in Asia, while other political developments led to colonies in Hawaii. To these new colonies, America exported its government officials, its soldiers, its businesspeople, and its language.

The end of the Second World War marked a major step in the development of English as a world language. Shortly after the war, Britain began to grant independence to many of its overseas colonies and protectorates (e.g., India, Malaysia, and Israel), and America soon followed suit. As colonial rule ended, new economic and political developments ensured that English would remain an important world language.

Insulated from much of the devastation of the Second World War, America had grown prosperous as a result of wartime industrial developments. These developments allowed the United States to emerge from the conflict as one of the strongest economic powers on Earth. This new economic strength meant that America would play a key role in the newly devel-

oping post-war economy and that the status of English as an important world language would be ensured.

At the same time, other postwar political developments contributed to the global importance of English. The end of the Second Wold War saw the emergence of two military superpowers: the United States and the Soviet Union. Even before the war ended, many European nations began to fear the prospect of a Soviet-dominated Europe. The United States shared this fear and began to work together with the nations of Western Europe to develop certain alliances designed to prevent a potential Soviet takeover. These preventative efforts took on two main forms. The first form was economic: the United States began a plan of foreign economic assistance designed to rebuild the shattered nations of Western Europe. The second form was military. The United States formed a series of military alliances and built bases to station American troops in Western Europe to form a military barrier to the Soviet Union's desires to expand.

The fear of Soviet expansion soon led the United States to extend its economic and military presence to the nations of Asia (e.g., Japan and Korea). The fear of Soviet world domination also prompted America to become involved in the nations of Latin and South America and Africa. The attempts to stop communist expansion through economic and military programs helped to strengthen the importance of the United States as a global power and enhanced the importance of English as a global *lingua franca*.

These times also saw a global expansion of American culture through American films, music, and television programming. America's entertainment industry emerged from the war unscathed, and it soon began to provide the war-torn nations of the world with a flood of readily-available American programming and entertainment. Over time, American culture increasingly dominated international entertainment, and the global significance of America's culture and its language continued to grow. For the next forty years, these economic, political, and entertainment-based influences helped maintain the global importance of both American culture and the English-language.

The 1990's marked yet another new point in the importance of English as a world language. This time, however, the spread of English was not linked to economic assistance or military might. The new driving force behind English as an international language involved new forms of American-generated communication technology: the Internet and the World Wide Web. These communication tools made accessing information as simple as pushing a button and made accessing the rest of the globe as easy as turning on a laptop or moving a mouse. As the authors of *A Brief History of the Internet* explain, The Internet has revolutionized the computer and communications world like nothing before. The invention of the telegraph, telephone, radio, and computer set the stage for this unprecedented integration of capabilities. The Internet is at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location.

The new driving force behind English as an international language involved new forms of American-generated communication technology: the Internet and the World Wide Web.

By controlling the development of new means of global communications technologies, America was also able to enhance the status of English as a language of international communication.

As the Internet and the World Wide Web emerged from America, their primary form, content, and language of communication reflected American culture and the

language of that culture. Moreover, HTML, the programming language needed to set up and to maintain a Web site, is based on the English language.

This English foundation means that non-native English speakers wishing to use this new communication tool need to learn some English if they wish to be participants on the World Wide Web.

At present, English is the most widely spoken language on the planet. It currently has 1.4 billion speakers, outnumbering the next most widely spoken language, Mandarin Chinese, by some 400 million speakers. English is the official language of 60 countries, and an important business language in at least two dozen others, including Israel, Egypt, Mexico, and Germany. The scope of the English speaking world also includes certain startling statistics. For example, it is the official language of such international organizations as the European Union, the European international trucking union, Iveco, and the proposed Baltic battalion of military forces. English is also one of the official languages of the United Nations, NATO, the IMF, the International Red Cross, and the World Court. Moreover, English has emerged as the new language of science and technology. As the technical communicator Anne Eisenberg points out, "English has vanquished its linguistic rivals to become the *lingua franca* of international scientific publications."

As the end of the Cold War has left America as the only remaining superpower and as the importance and use of the Internet and the World Wide Web increase every day, the status of English as a global *lingua franca* is certainly ensured.

Technolog Past

70 years ago . . .

An unusual "parking machine" recently developed by a prominent manufacturing company might be a possible solution of the serious parking problem which has confronted campus drivers for the last few years and which now rises to a crisis. . . . The machine consists of two endless chains passing over wheels at the top and bottom. Platforms are suspended between these chains, each providing space for one automobile. The housing for the machine is unique, having no floors. The machine is very flexible in its application. It may be built into a theatre, apartment house, department store, garage, or wherever parking is a problem . . . .

From December, 1929
(Ed. Note: Some things never change.)

50 years ago . . .

Suddenly, out of years of talk and promise, television has at last come to join the automobile, the airplane, and the radio as the twentieth-century's fourth major contribution to communication and transportation. . . . Possibly one of its greatest effects will be on the American home. A revolution in domestic architecture is forecast resulting in the modern home being built around the television room containing furnature designed to arrange the family and guests in concentric half-circles in front of the television screen. The cost of real estate is to go up where television reception is good and down where hills or buildings cause interference . . . .

From October, 1949

26 years ago . . .

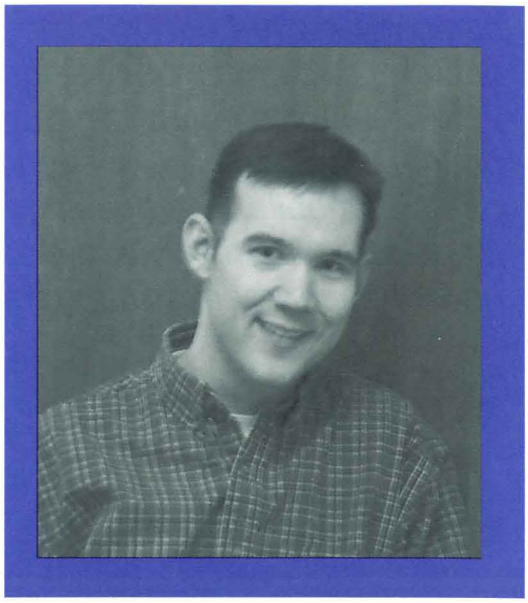
Coal in our Christmas stocking . . .
This winter the University of Minnesota will be shoveling it. Coal that is.
Because of the fuel oil shortage, the University has had to sign a "contract." It calls for the use of coal as an alternative source of energy when supplies of fuel oil run low this winter. If [OPEC] make[s] good on their threatened embargo of oil shipments to the United States, that winter shortage should begin sometime around Thanksgiving.

From November, 1973

IT Profile

Paul Sorensen

Ten and a half years ago Paul Sorensen entered the University of Minnesota as a freshman. His passion for journalism, especially journalism about science, caused him to embark down pathways leading to bachelor's and master's degrees in scientific and technical communications. Today, Paul Sorensen is the academic advisor to Institute of Technology students in scientific communications, and as an advisor Paul plays an active role in preserving the valuable opportunities that can be discovered as a student.



For five years, from his days as an undergraduate through his passage into graduate studies, Paul worked with the *Minnesota Daily* and their administration department. He holds his experience with the *Daily* quite dear, and the fondness he harbors for those days is easily detected as he boasts that twice he helped the *Daily* move its headquarters in the middle of an academic year. Both times, he accomplished the feat without the *Daily* missing a single publication.

Specifically, Paul helps students with publication related activities. He leads the production of *Inventing Tomorrow*, a publication that is eighty percent student written. Paul enjoys the working relationships he has with students. "Students have a lot of creative energy." he says. Paul commends students for writing articles that are often as good, and sometimes better, than articles written by professionals.

Paul's positive influence on the students appears in areas outside the journalistic one. He helps students manage their time more efficiently, and he's there to bolster overall enthusiasm when it is flagging. A gregarious demeanor makes Paul a kindly and approachable person.

The Minnesota Technolog is up for awards at the ECMA Annual Competition, April 8 - 11, Washington D.C.

Wish us luck!!

MINNESOTA

Technolog

MAY/JUNE 1999

Special Science Fiction Issue
Science Fiction Contest winners

Also in this issue:
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Dwarf Galaxies
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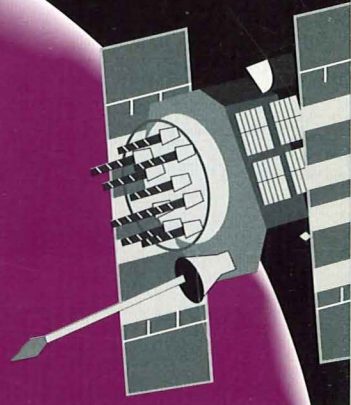
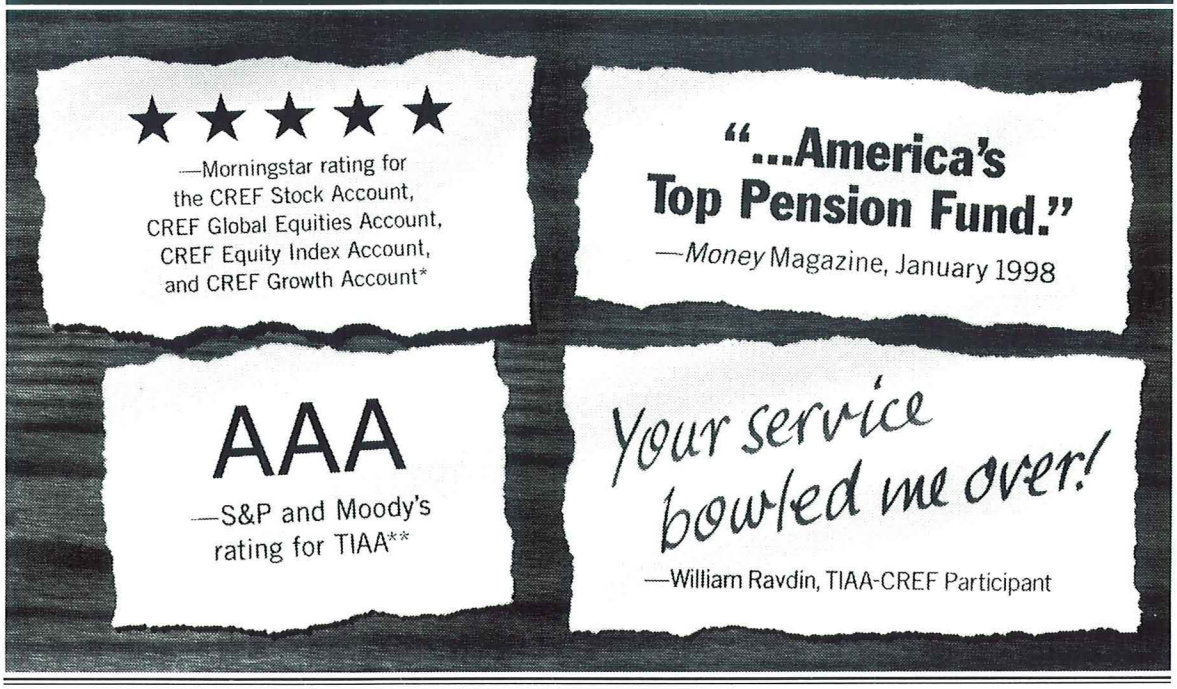


FOR *the* EDUCATION *and* RESEARCH COMMUNITY



HIGH MARKS FROM MORNINGSTAR, S&P, MOODY'S, MONEY MAGAZINE AND BILL.

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* Source: Morningstar, Inc., January 31, 1998. Morningstar is an independent service that rates mutual funds and variable annuities. The top 10% of funds in an investment category receive five stars and the next 22.5% receive four stars. Morningstar proprietary ratings reflect historical risk-adjusted performance and are subject to change every month. They are calculated from the account's three-, five-, and ten-year average annual returns in excess of 90-day Treasury bill returns with appropriate fee adjustments, and a risk factor that reflects performance below 90-day T-bill returns. The overall star ratings referred to above are Morningstar's published ratings, which are weighted averages of its three-, five-, and ten-year ratings for periods ending January 31, 1998. The separate (unpublished) ratings for each of the periods are:

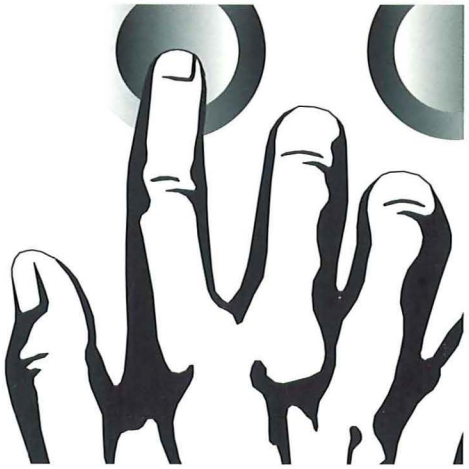
Period	CREF Stock Account Star Rating/ Number of Domestic Equity Accounts Rated	CREF Global Equities Account Star Rating/ Number of International Equity Accounts Rated	CREF Equity Index Account Star Rating/ Number of Domestic Equity Accounts Rated	CREF Growth Account Star Rating/ Number of Domestic Equity Accounts Rated	CREF Bond Market Account Star Rating/ Number of Fixed Income Accounts Rated	CREF Social Choice Account Star Rating/ Number of Domestic Equity Accounts Rated
3-Year	4/1,856	4/391	5/1,856	5/1,856	4/675	4/1,856
5-Year	4/1,218	5/207	N/A	N/A	4/443	4/1,218
10-Year	5/612	N/A	N/A	N/A	N/A	N/A

**These top ratings are based on TIAA's exceptional financial strength, claims-paying ability and overall operating performance. †Based on assets under management. ††*Standard & Poor's Insurance Rating Analysis*, 1997; Lipper Analytical Services, Inc., *Lipper-Director's Analytical Data*, 1997 (Quarterly). CREF certificates and interests in the TIAA Real Estate Account are distributed by TIAA-CREF Individual and Institutional Services. For more complete information, including charges and expenses, call 1 800 842-2733, extension 5509, for the CREF and TIAA Real Estate Account prospectuses. Read them carefully before you invest or send money.

2/98

MINNESOTA
Technolog
MAY/JUNE 1999

Science Fiction Contest winners



10 Little Neutral One

Neutrino researchers measure the immeasurable in a Minnesota mine.

12 What's the Matter?

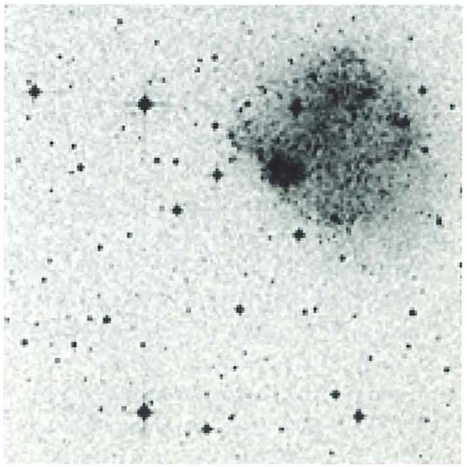
Researchers in the School of Physics and Astronomy are solving one of the biggest mysteries of the Universe.

13 A Star is Born

Researchers examine dwarf galaxies to expand their understanding of when and where star formation occurs.

20 Looking Towards the Stars

The Twin Cities offers year-round chances to stargaze.



Also in this issue

cover design by Kristie Stiles
Technolog logo design by Paul Sorenson and Mark Stewart
layout by Paul Sorenson, Jenni Swenson, and Mark Stewart

Visit the *Technolog* online at http://www.it.umn.edu/itbp/technolog

NOTES FROM THE EDITOR

mark stewart

An inaccessible Web site appears stranger than (science) fiction to visually impaired users.

Welcome to [image]. [link]. [link]. [image]. [link] . . .

This is how a Web page is "heard" by a visually impaired user navigating the Internet with the help of a translation program. Imagine if you had to navigate the Internet without a mouse, or with the screen turned off. How would you do it? How successful would you be? As the above example demonstrates, an inaccessible Web site appears stranger than (science) fiction to visually impaired users.

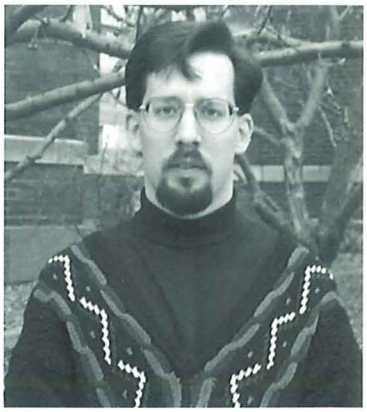
As Web editor, Jenni Swenson has worked extremely hard this year conceiving and implementing the design of the new *Technolog* Web site (http://www.it.umn.edu/itbp/technolog) so that it would meet accessibility standards and ensure that everyone has access to the *Technolog* online. No other student-run engineering magazine can say the same of its Web site.

The current standard in Web design is to create a text-only parallel site to the "main" site aimed specifically at impaired Internet users and the translation software that might be in use. Swenson believes, however, that this is no longer appropriate.

"Although text-only parallel sites allow impaired user access to content, the quality of that content is often lacking," Swenson says. "Society has acknowledged the need for providing equal access in physical space; we must acknowledge this need in cyberspace as well."

I agree. The standard should be to incorporate considerate design elements into the "main" site so that impaired and non-impaired users alike can access the same Web document. This is not unlike wheelchair-accessible ramps and Braille-translated signage that can be found in the physical world. Still not convinced? Over 35 million individuals in the U.S. alone suffer from a visual impairment, and this number does not include the millions who suffer from motor, cognitive, or auditory impairments. This is too large a section of the population to simply ignore online.

Web designers are often undervalued or marginalized by those not familiar with HTML and other Internet standards and protocols. When this occurs, Web design is left to computer support technicians because they "know" computers. While Web sites created by technicians may be technically flawless, these sites often lack the considerate design elements needed for access by all Internet users. Truly professional Web sites—that is, Web sites that represent top-notch organizations and publications such as the University of Minnesota, the Institute of Technology, and the *Minnesota Technolog*—cannot be simply placed on the World Wide Web without deep consideration of content, audience, and usability.



Ann Hill Duin, vice provost for instructional technology and university partnerships, teaches Rhetoric 5111: Message Design, which addresses issues involved in the design of online environments. She believes Web designers need to draw from many disciplines, including graphic design, media studies, and cognitive psychology.

"A new generation of 'interactive designers' will need to be well versed in audience analysis, document and message design, and usability testing," Duin confirms.

"We need designers who can rethink the processes of communication, exploiting the capacity of the digital environment to be more responsive to human needs," agrees Janet Murray, a senior research assistant at MIT and author of *Hamlet on the Holodeck: The Future of Narrative in Cyberspace.*

This is not to say that Web designers should not be technically trained. Of course, they should. But Web design has evolved to include a new set of responsibilities that cannot be fulfilled by a purely technical approach. The problem is that considerate design is not intuitive to HTML and other Web design tools.

But until changes are made on the technical side of Web design tools, Web designers need an awareness of the problems impaired Internet users face and the techniques to successfully overcome the deficiencies of the Internet.

According to Julie Sweitzer, director of equal opportunity and affirmative action at the University of Minnesota, her office is working closely with Information Technology and Disability Services to create comprehensive guidelines for Web pages and software used by the University.

"We know that planning ahead is simpler and more effective than retrofitting—and the right thing to do," says Sweitzer.

CONTRIBUTORS

T. A. Bennett is a pseudonym.

Margaret Hamilton, who is finishing her Ph.D. coursework in Rhetoric and Scientific and Technical Communication at the University of Minnesota, does freelance editing and teaches on the St. Paul campus. While completing her master's degree from the University's Humphrey Institute, she worked on the *Minnesota Daily* and served as editor of *A Woman's Place*, a journal of women's writing.

Jeremy Paschke is a graduate student in the School of Physics and Astronomy at the University of Minnesota. Outside of writing for the *Technolog*, Jeremy specializes in the history of physics. His dream being to write science books for children. Jeremy will teach high school physics starting in the fall of 2000, and he plans to spend his summers with creative writing and extensive tramps through the woods.

Elizabeth Pierce is a journalism major and anthropology minor at the University of Minnesota, who is happily writing for this IT publication. She is on the University swim team, which won its first ever Big Ten title this winter. Someday, she hopes her writing will grace the pages of a major science magazine.

Ed. Note—Although she is a University athlete, Elizabeth does all her own homework.

Kirk St. Amant is a Ph.D. student in the Department of Rhetoric at the University of Minnesota where he studies international communication issues, especially those involving the online environment. In addition to working as the layout editor for the Technolog, he also works for Rhetoric's Online Writing Center (OWC) and teaches Rhetoric 3562: Writing in Your Profession.

Kristie Stiles studies graphic design and runs track at the University of Minnesota. Also active in various women's political organizations in and around the Twin Cities, her other interests include coaching, chess, music, and attending and participating in women's athletic events. Some of her work is currently on display until June 4 at the Larson Art Gallery in St. Paul.

Ed. Note—Kristie also does all her own homework.

Jenni Swenson is pursuing an M.A. in Rhetoric and Scientific and Technical Communication in the Department of Rhetoric, and an M.S. in Soil Science in the Department of Soil, Water, and Climate, at the University of Minnesota. As a research assistant, she develops educational Web sites for the University of Minnesota. She also co-owns Aretai Design, Inc., a Web-consulting business specializing in educational Web sites, usability testing and disability access.

Nathan Whalen is a senior majoring in journalism and history at the University of Minnesota. Whalen is from Seattle, and has attended two previous colleges. Besides going to school and doing typical school-type activities, he waits tables, and loves telling stupid jokes. He is currently trying to get some sleep.

❖ ❖ ❖ ❖

Special thanks to **Paul Sorenson** and **Jenni Swenson** for their help with this issue's layout.

Want to be a contributor? Stop by 5 Lind Hall or call 624-9816 for details.

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Technolog

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THE BUTTON

by chad greene

Receive the Holy Spirit.
If you forgive men's sins,
They are forgiven them;
If you hold them bound,
They are bound.
—John 20:19-23

His eyes opened to a darkness deeper and more absolute than that behind his eyelids. The room was painted entirely black and had no visible seams, and thus seemed to have no boundaries.

In his mind was a void as complete as that which surrounded him. There was no recollection of his name, his occupation, his childhood, or indeed his age. He might have been a child still, for all he knew. Yet he felt that he was a man, and that men, of necessity possess such things. He knew what a school, a playground, a church, a mall, were, but he could not say if he had ever been to one.

Though he was aware of this gaping emptiness in his being, he was, curiously, not greatly concerned about it. In fact, he was amazingly calm. Even the fact that he couldn't move did not greatly disturb him. But that was not strictly true. He found that his right hand was free, his otherwise all-encompassing paralysis ending at the wrist.

Seeking to explore the boundaries of his world, he reached his hand as far as possible—this way and that—finding that when he fully extended his index finger its tip covered a raised circular button. Having nothing better to do, he pressed down upon it. There was a momentary delay, and then a soothing, androgynous voice said, simply, "Hello."

Before he could reply or inquire as to why he might be bound in such a manner, the voice enlightened him.

"You have volunteered to serve as an impartial court of last appeals for a condemned killer," the voice explained. "To render you as impartial as possible, we have removed any memories of previous experiences which may have colored your judgment."

"If you so decide," the voice continued, "you will be this criminal's executioner, but it is also within your power to grant life. The person may walk out of this facility with no recollection of the crime, or indeed the person's previous life. The person will be given a job suitable to their particular abilities. In time, the person will become, once again, a productive member of society, with friends and loved ones. This has never, in a thousand cases, failed to come to pass. You need not fear that you are releasing a wolf amongst sheep. This person will never kill again."

"There is no reason to doubt the guilt of this person. The conviction was not based on circumstantial evidence, but a freely given confession supported by irrefutable proof. The condemned expresses profound grief over the act, which was committed in the heat of passion, and was in no way premeditated. The condemned realizes the act of killing another human is wrong, and feels no satisfaction over the death of his victim, only remorse."

"You are charged with determining this person's fate. There is no further appeal. When you have reached your verdict, press the button again."

His world was once again silence and tranquility. Free from memories and prejudices, he was left to struggle with what he knew of morality, of right and wrong. The decision was not a quick one or an easy one. As is proper with matters of life and death, it was slow and painful.

In his mind, it came down to three questions which he asked himself repeatedly. Do you believe in the sanctity of human life? Do you believe that people can change? Do you believe in forgiveness?

When at last he had answered these questions in a manner satisfactory to himself, he pressed the button.

"What say you?" the voice answered. "Life—or death?"

He found that he could speak, although until this point he had not tried to.

"Life." It was said with the strength of conviction and a conscience at peace with itself.

"Very well," replied the carefully modulated voice. There was silence.

Slowly, so as not to hurt his eyes, the room became lit. Gradually, in subtle increments, he found that he could move, and eventually stand.

He walked through a door which had appeared where none had been evident before, and down a lighted hallway that led him out of the facility and back into the fold of society, secure in the knowledge that justice had been served.

Meanwhile, in a room only scant feet from the one he had just vacated, a woman sat in an identical condition. She had awakened and pressed the button. The voice had told her much the same thing as it had told him, except in the par-

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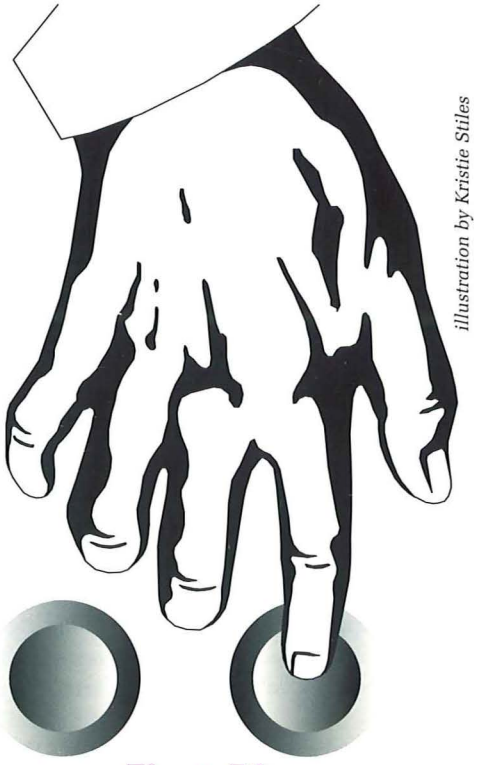

illustration by Kristie Stiles

First Place
Science Fiction Contest

MORTAL SINS

by maija meneks

Interdepartmental Memo:
Terran Unified Churches, Inc.
To: Clay Reese
Maintenance Chief, Rome
From: Tony Bernie,
Complaints Department, Rome

Clay Reese:
There seems to be a major problem brewing in New York City. In the last eight hour shift, the complaints department has fielded over 2,000 calls from Faithful concerning the condition of the thirty Central Park Absolution-o-matics; in addition, the Electronic Holy Father is on the fritz as well. Both types of machines are still working, but here is a list of the most common complaints:

(1) A-matics have begun to give penitence over sins that were considered non-applicable and subsequently abolished during the board meetings of 2053; furthermore, the A-matics are ignoring the New Sins adopted in place of the old.

(2) The Holy Father has diverted from "Brimstone and Fire" sermons to "Love and Brotherhood".
(3) Neither type of machine are accepting payment for their services.

Needless to say, the last complaint is most distressing for the Accounting department.

Departmental Memo:
Terran Unified Churches, Inc.
To: Hillary Smith-Lee
Maintenance Head, New York City
From: Clay Reese
Maintenance Chief, Rome

Hillary:
Long time no see! I hope one of these days you'll forgive me for that little "incident" at the departmental retreat three years ago, but until then, I guess I can only wait. Before you delete this message, you should know that there is actual business to attend.

Complaints department says your Central Park A-matics and Holy Father are messed up. The former have reverted to pre-2053 format, from the sound of it; and the latter is giving the wrong sermon type. To top it off, neither is charging money! And you know how twitchy such types of problems make the Accounting department. Pure evil, the lot of them.

In my opinion, I think some hot-stuff teenager hacked his way into the programming. Check it out, eh? Thanks.

Service Request:
Terran Unified Churches, Inc.
Date: April 23, 2075
Model(s):
30 Class-D Absolution-o-matics, see attachment for serial numbers
1 Electronic Holy Father, "Brimstone" programming, see attachment for serial number
Location: Central Park, New York City, New York, Reformed United States of America, Earth
Problem: Possible faulty program/software
Response: Determine cause of malfunction and fix, if possible. If not possible, shut down and replace.
Technician Dispatched: Teri Anders, General Technician, Level I
Authorization: Hillary Smith-Lee

Intradepartmental Memo:
Terran Unified Churches, Inc.
To: Hillary Smith-Lee
From: Teri Anders

Boss:
I swear I tried my best, but I don't know what is wrong with those machines. Of course, the Central Park Faithful didn't help, stopping my work every five minutes to either ask when everything would be fixed, or trying to push money on me to absolve sins or give some damning speech. Thank goodness I'm not one of the converted Faithful.

As far as those machines are concerned, I literally took one apart after diagnostic programs showed nothing wrong with the software. Zip. All looks normal; no signs of tampering. A few test questions on suicide, homosexuality, the basics, returned pre-2053 penitence, even though such backward thinking has been dropped. The Holy Father, same story. No one wants to hear peace and love now a-days; at least, I don't.

The really bad news is that I couldn't turn them off. Don't know how, but even disconnecting them from the power source did not work. So I plastered them with "Out of Order" signs and directions on how to get to the next nearest bank of A-matics and Fathers. Any suggestions?

Departmental Memo:
Terran Unified Churches, Inc.
To: Clay Reese
Maintenance Chief, Rome
From: Hillary Smith-Lee:
Maintenance Head, New York City

Clay:
I will never forgive you. Now that that's out of the way...

I've had my top technicians, including myself, working on this problem, but I'm afraid it's going to hit crisis level pretty soon. At first when we couldn't find any problem with the machines and we couldn't turn them off, we tried to install a second bank of A-matics. These replacements became corrupted in less than a

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illustration by Kristie Stiles

Second Place
Science Fiction Contest

DULCINEA

by chad greene

The doctor sat hunched over his workbench. It seemed to him he had spent the last twenty years in that position, soldering countless wires, writing endless lines of programming, sketching whimsically, forever dreaming. Sometimes dreaming with his eyes open, other times with them closed, always trying to bind his dream to reality with a tangle of wires and a sheaf of programming.

After a moment's thought, he leaned forward and typed a few lines that he hoped would finish the main program once and for all. Though he had done this countless times before, he still felt a tremendous excitement as he typed in the command that would run the program, hoping against hope that some unknown factor would fall into place this time, as it had not so many times before.

With each passing second, he grew more and more sure that this would be the time. No message appeared to report that an error in syntax had rendered the whole massive program useless. His heart threatened to beat out of his chest as the hands of the clock inched along their worn circular path with a slowness that threatened to drive the doctor insane. The same words kept echoing in his head, the words of derision heaped upon him by his former colleagues over the years.

"Crazy."

"He's lost his grip on reality."

"What a tremendous waste of talent!"

Was he insane? Would insanity be such a bad thing? The doctor's greatest hero was a madman, and like that noble soul, he'd continue to strive toward his goal in a world that seemed unbelievably hostile to him and his impossible dream.

Then, after fourteen mind-wracking minutes, the computer beeped, indicating it had downloaded the entire program. With trembling hands, the doctor reached for a cleverly concealed switch. As he applied the necessary pressure, he felt as if his heart would burst, and when the eyelids of the face he had so lovingly crafted opened, it did.

* * *

She opened her eyes for the very first time, strangely glowing blue eyes that saw the world in much the same way as you and I. The first thing she focused on was a man dying, a rather traumatic image for a human infant, but it didn't phase her at all. Her eyes were drawn by his frantic movements, and a search instantly began in her memory banks for an explanation of what she was seeing.

A human male. Approximately fifty years of age. Undergoing a cardiac arrest. A set of relevant rescue instructions presented themselves to her as the human's convulsions ceased. She approached to apply cardiopulmonary resuscitation. She knelt next to the still body, lowered her synthetic lips to his real ones, and executed the procedure to breathe life back into this being. Nothing happened. She could not breathe.

* * *

Due to a lack of proper rescue equipment, drugs, and a pair of functional lungs, the man died. She noted that situation and the conditions that caused it for future reference.

In the absence of any other instructions, she set about to executing Subroutine 1A, which called for an assessment of her immediate surroundings. She was in an enclosed space, a "room," most likely in a structure known as a "house." By a summary examination of the apparatus surrounding her and subsequent comparison to items on file in her memory banks, she determined that this room was used as a "laboratory," a place where "experiments" were conducted.

Her lack of a set of conventional lungs suggested that she was one of these experiments, possibly an automaton or "robot," judging from the computer and electronics paraphernalia present. However, this was merely a hypothesis. It seemed that she had been provided with a wealth of information on everything except herself.

Why was this? Was she unfinished? Was she imperfect?

Continued investigation of the laboratory proved unfruitful. Another subroutine identified a "staircase," and the appropriate procedure for utilizing it was carried out. Emerging from the stairway, she entered a room which memory files found to be analogous to a "kitchen," the site of "food preparation" in most human domiciles. A thorough examination of the contents of the "cupboards" yielded the ingredients of a "balanced diet." Such a diet was designed to lower cholesterol intake and indicated a "health conscious" individual.

Did she "eat?" Her files indicated this was essential to human existence. *Was it a necessity for her?*

There was a pair of "running shoes" on the floor next to a door leading "outside." She would use that door once she finished examining the "inside" of this "home."

The next room she came upon was the "bedroom," a place where humans "slept" for approximately 8 to 10 hours a day.

Did she require rest?

This room was sparsely furnished, containing only bed, dresser, desk, and chair. Scattered at irregular intervals were "magazines," periodical publications, most of the titles including the words "computer science" and "robotics," thus reinforcing her theory on her own origin. There were also two larger volumes, "books." One was a copy of the Bible, a religious text, the other was *Don Quixote*, a novel of some literary importance according to her relevant data files.

On top of the dresser were a wallet and some financial documents. Identification

continued on page 18

illustration by Kristie Stiles

Third Place
Science Fiction Contest

BUTTON
continued from page 6

ticulars of the crime, which was coldly premeditated, exceedingly brutal, and from which the killer had derived a great deal of satisfaction. There was no remorse.

"When you have reached your verdict, press the button again."

There was no hesitation; no great debate. To be charged with the fate of a human life! To take that life! Surely, there was only one choice to be made.

"What say you? Life—or death?"

The woman pressed the button convulsively, repeatedly.

"Death!" The woman rasped with finality, with a sense of power—and joy.

"Very well—and may God have mercy on your soul."

A deadly current surged into her finger still spasmodically pressing the button and stilled her heart. Justice served.

❖ ❖ ❖ ❖

Sci-Fi in the TwinCities

by margaret hamilton

THE TWIN CITIES have long proved fertile ground for science fiction on a wide range of themes, from old-fashioned magic to avant-garde technology. One local writing group—currently composed of Lois McMaster Bujold (*Young Miles, Cordelia's Honor*), Peg Kerr (*The Wild Swans, Emerald House Rising*), Elise Mathessen, and Pat Wrede (*Dealing with Dragons*)—is a perfect example.

Although they recently took a hiatus while Wrede (contractually bound to confidentiality) completed the young adult novelization of *Star Wars: The Phantom Menace*, the group has met regularly for years. Members provide advance copies of works for written comments and also receive verbal feedback (up to six hours) over food and drink.

photo courtesy of Peg Kerr

Left to right: Patricia Wrede, Peg Kerr, Elise Mattesen, Lois McMaster Bujold

Kerr considers their mentoring a "wonderful gift . . . a chain of giving. You've been helped, so you go out and help others." She admits, "I don't think I could have written novels if not in a group. They helped me through the process." As well as "sheer encouragement," her peers offered her technical advice and helped her feel "less lonely, less isolated." "I wanted to read it at a meeting," she notes, "so I'd finish it."

A former *Technolog* science fiction contest judge, Kerr also had a short story "Analog Anniversary" published in 1991 as an "Editor's Choice." She advises writers interested in joining a group to look for one in which members market their fiction, so they can learn about that part of the process, and to make sure the group, which will require loyalty and work, is a good fit.

Writers should, above all, keep writing. "There are hundreds of talented writers," Kerr says. "It's amazing how much talent there is out there to burn. What's rare is persistence . . . 'Well, I just kind of gave up.' That's what's common."

❖ ❖ ❖ ❖

LITTLE NEUTRAL ONE

by jeremy paschke

Neutrino research has Minnesota roots.

"The immeasurable of today," J. J. Thomson once described subatomic particles," may be the measurable of tomorrow."

Ultimately, Thompson proved himself correct with his own discovery of the electron, an event that brought dramatic closure to the nineteenth century.

Today, in the final months of the twentieth century, physicists are busy trying to measure the neutrino, another particle once considered immeasurable. Teams of physicists from Japan, Italy, and Minnesota—including University of Minnesota professors Earl Peterson, Keith Ruddick, and Ken Heller, from the School of Physics and Astronomy—are vying with each other for first honors in unlocking the mysteries of what Ruddick calls "the sexy particle of the nineties."

The concept of a neutrino dates back to the early 1930s and the subject of beta decay, a nuclear process that occurs when a neutron decays into a proton and an electron. Confusion arose when experimenters observed that momentum was not conserved between the proton and the electron during beta decay. According to the laws of conservation of momentum, the net momentum before a collision must be equal to that after the collision. In terms of decay, a particle cannot decay into a single particle lighter than itself.

Wolfgang Pauli firmly believed that this law could not be violated under any circumstances, so he postulated that—in the process of beta decay—an imperceptibly light particle was emitted along with the electron and the proton. This particle carried away some momentum and, thus, explained the momentum imbalance.

In 1934, Enrico Fermi constructed a new theory of beta decay that integrated Pauli's light-weight particle. Fermi affectionately called the particle "neutrino," Italian for "little neutral one."

Theoreticians used neutrinos to save their concepts, but experimental physicists remained skeptic and demanded evidence that neutrinos really existed. Pauli himself regretted his postulation because he believed the neutrino would never be detected experimentally. More than two decades passed before Fred Reines and Clyde Cowan, two physicists working at Los Alamos Laboratory, experimentally detected the neutrino. Reines' and Cowan's research began in 1951, and was initially titled Project Poltergeist, owing to the neutrino's elusive nature. In 1956, with their research relocated near the Savannah River Nuclear Reactor, Reines and Cowan finally obtained conclusive evidence of neutrinos. Asked to comment on the particle he spent six years chasing, Reines described it as "the most tiny quantity of reality ever imagined by a human being."

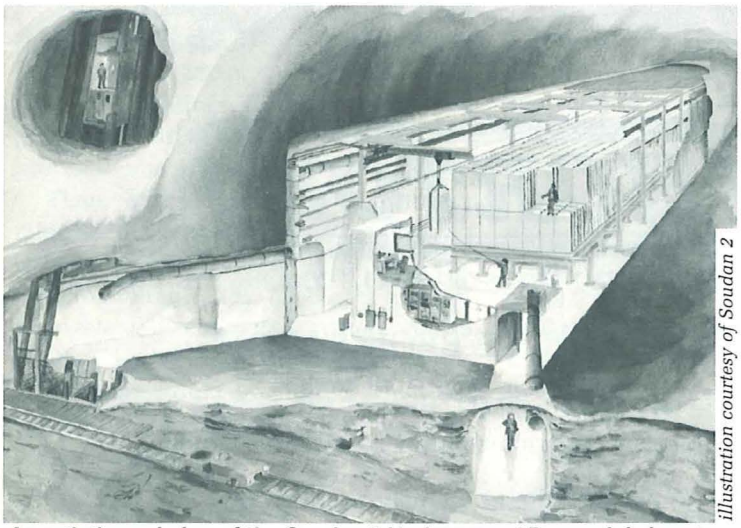

illustration courtesy of Soudan 2

An artist's rendering of the Soudan 2 Underground Research Laboratory.

After Reines and Cowan's research, the scale of neutrino experiments grew with gigantic strides. Today, many university scientists take their research plans to government operated laboratories, such as Fermilab, a particle collider located 80 kilometers west of Chicago, or CERN in Switzerland.

The University of Minnesota's neutrino experiments take place at the Soudan Underground Research Site, a laboratory leased by the University from the state of Minnesota. Built in 1986, the primary goal of the Soudan laboratory was to detect signs of proton decay. Experiments are conducted 690 meters underground to shield out cosmic rays. Currently, the detector Soudan 2 is being revamped to capture neutrinos and a second detector is being installed for similar neutrino research. In 2004, Fermilab will send a high-energy beam of neutrinos northward through the Earth to the detectors at the Soudan laboratory.

The project is enormous, and representatives from Stanford, the California Institute of Technology, Oxford University, the University of Sussex, and the Institute of Theoretical and Experimental Physics in Moscow will contribute. Along with Peterson, Ruddick, and Heller, Hans Courant, and Marvin Marshack from the University of Minnesota are also leading the research.

* * *

The theory that lies at the core of elementary particle physics is called the Standard Model, under which neutrinos can assume three different varieties, or "flavor states"—the electron neutrino, the muon neutrino, and the tau neutrino. The Standard Model seems to favor threes because quarks—the particles that make up protons and neutrons—are also found in threes. However, Peterson points out, the Standard Model does not address mass or particle oscillation.

One source of neutrinos is cosmic rays and cosmic-ray interactions with the atmosphere. Cosmic rays are swiftly moving particles—mainly protons—that relentlessly bombard the upper atmosphere, but do so with erratic energies.

When a cosmic ray interacts with an atmospheric atom, a pion particle is produced. The pion then decays into a muon and a muon neutrino. The muon then decays into another muon neutrino and an electron neutrino, with the net result being two muon neutrinos for every one electron neutrino.

"We expect to find a ratio of two to one," says Peterson. "But what we do find is wildly different."

To explain the divergence between theory and experiment, physicists hypothesize that neutrinos can oscillate.

Oscillation occurs when a particle changes from one "flavor" to another. In the case of cosmic ray interactions with the atmosphere, perhaps some muon neutrinos oscillated into electron neutrinos as the neutrinos traveled from the upper atmosphere to the Earth.

While this hypothesis might be true, Peterson explains, studying cosmic rays will never provide the answer because cosmic rays come from unknown sources and have unpredictable energies.

"Watching cosmic rays is kind of like bird watching," Peterson says. "What you see is what you see."

But, using cosmic rays is not a systematic and reproducible way to learn about neutrino oscillation. "We want a controlled source," Peterson continues, "where we know the energy of the incoming beam. This is precisely the reason for the Fermilab to Soudan connection."

The concept of neutrino oscillation is strange indeed.

"A single neutrino is actually a quantum mechanical mixture of two other types," Ruddick says. In other words, two flavor states can simultaneously exist in the same neutrino. As a result, the neutrino has some probability of being detected in one flavor state and some probability of being detected in another flavor state. When a neutrino is found in one flavor state, it most likely had a greater probability of being that flavor state than the other.

The probabilities of a moving neutrino being found in one of two flavor states change because neutrinos are so small they can act like waves. The wave / particle duality of matter is not an alien concept in modern physics. Light, for example, demonstrates both wave and particle characteristics, as do electrons.

According to Ruddick, both flavors of neutrinos exist side-by-side as two waves. Each neutrino flavor has a distinct frequency to its wave, and the two waves will overlap as they travel through space. Sometimes the waves will be in phase (constructive interference), and sometimes they will be out of phase (destructive interference). Oscillation occurs, Ruddick explains, as the waves move in and out of phase.

To prove this hypothesis, physicists need to count a significant number of neutrinos at two distinct points along the neutrinos' path, a task much easier said than done because the neutrino is the smallest particle known to physicists.

"Neutrino experiments are about the hardest sorts of experiments you can possibly think of doing," Ruddick says.

Rising to confront the challenge are over a hundred scientists, collaborating on what is known as the Main Injector Neutrino Oscillation Search (MINOS) project. In scientific circles, MINOS is momentous because the physics it will unveil move beyond the Standard Model.

The overall plan is simple. Create a beam of neutrinos at Fermilab, then send it 730 kilometers through the Earth to the underground detector at the Soudan laboratory. Neutrinos do not need an excavated tunnel; they bore straight through the Earth, 7 kilometers deep at points below Madison, Wisconsin.

Experimenters will measure the ratio of muon to electron neutrinos at Fermilab, and will measure the same ratio at Soudan laboratory. If the ratio changes, then the experimenters will have proof that neutrinos oscillate from one flavor to another. In addition, since only massive particles can oscillate, evidence of oscillation will also confirm that neutrinos have a mass.

To observe neutrinos, they must interact with other particles. Just as we cannot see the wind, but are aware of it from the rustle of leaves and the swaying of flowers, so too must scientists rely on extraneous clues to detect neutrinos.

When a neutrino collides with an atom, it may chance to strike the nucleus. If scientists are truly lucky, a reverse beta decay will occur where the neutrino strikes a proton and yields a neutron and a positron. Both the neutron and positron can be detected with scintillation fibers—long, flexible plastic strands with a unique chemical composition. When a high-energy particle traverses the fiber, a fraction of the particle's energy is pilfered away by the fiber's chemicals, resulting in a blue flash of light. Trapped within the fiber because of total internal reflection, the blue light bounces back and forth until it reaches one end, where a photodetector reads the light's timing and intensity. Neutrinos can be caught, but only by their coattails.

"It's remarkable when you think about it," muses Ruddick. "By chucking a few bits of plastic together you are asking deep questions about the universe."

Galileo might have thought along similar lines after he pieced together glass lenses and discovered the moons of Jupiter. However, the machinery behind MINOS reveals that there is much more involved than just a few bits of plastic.

Noting the irony of huge detectors built for minuscule particles, Ruddick says that the MINOS detector "is one of the biggest detectors ever built." Each layer of scintillating fibers will be followed by a layer of inch-thick iron—resulting in 600 layers all together. The completed detector will loom eight meters high and stretch out for one mile. If Fermilab plays the pitcher in this game of high-energy physics, then the MINOS detector will wear a catcher's glove measuring one mile across and positioned half

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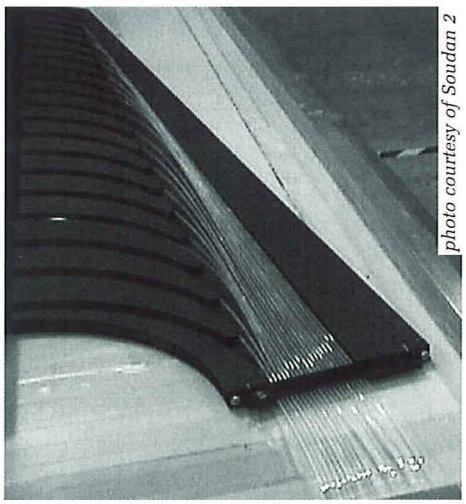

photo courtesy of Soudan 2

Laid side-by-side, scintillating fibers provide researchers with a grid to determine the exact location of an incident particle. The final detector will have over 600 layers of these fibers flanked by iron sheets.

WHAT'S THE MATTER?

by elizabeth pierce

Researchers in the School of Physics and Astronomy try to determine the composition of the Universe.

As much as science has advanced in the past few centuries, we still have much to learn about the way our Universe works. Several researchers in the School of Physics and Astronomy are tackling one of the biggest problems of all.

Because the gravity exuded by the mass of visible objects in the Universe does not completely explain the motions of galaxies and other astronomical bodies, scientists theorize that there must be another kind of matter in a form we cannot detect using current methods. Called "dark matter," this matter is believed to make up roughly 80% of the mass of the Universe.

The fact that scientists cannot positively identify so much of the Universe leaves some researchers uneasy.

"It's embarrassing to admit in class," says Evan Skillman, an astronomy professor at the University of Minnesota. "If anyone discovers [dark matter], there will be a huge sigh of relief."

Several theories attempt to explain what makes up the mass of dark matter. Among the candidates: white dwarf stars, neutrinos, weakly interacting massive particles (WIMPs), and various other exotic particles. There are also suggestions that dark matter does not exist. Some scientists argue that we simply do not understand gravity, so what appears to be discrepancies in the motion of matter located in the outer parts of galaxies may be the unknown effects of gravity.

Modified Newtonian Dynamics, an alternative to Newton's gravitational theory, suggests that as you get farther from the center of a mass, gravity gets weaker at a greater rate than regular Newtonian laws predict. The theory, which works well for galaxies and clusters, breaks down when applied to dwarf galaxies.

An observational astronomer, Skillman focuses on dwarf galaxies and is currently studying a nearby dwarf galaxy named NGC 6822, which is approximately 1.63 million light years away from Earth, close by astronomical standards.

Using radio measurements taken by the Very Large Array in New Mexico, Skillman has accurate measurements of the galaxy's rotation. When the rotational velocity of points in the galaxy are plotted against their radius from its center, there is no evidence supporting the theory of Modified Newtonian Dynamics. That is, the detectable mass in the galaxy is not enough to account for its movement and rotation.

"Something has to be there," agrees Heidi Brandenburg, a research assistant on the project and an undergraduate physics, astrophysics and computer science major.

That "something," scientists believe, is dark matter.

Shaul Hanany, an observational cosmologist, calls the search for dark matter "the most important scientific goal for astrophysics for this decade."

Hanany's research is much different than Skillman's. Using balloons which rise to an altitude of 120,000 feet and carry a payload of scientific instruments, Hanany studies cosmic microwave background radiation, radiation which was released when the Universe was much younger.

"It is the glow from the ashes of the Big Bang," Hanany explains.

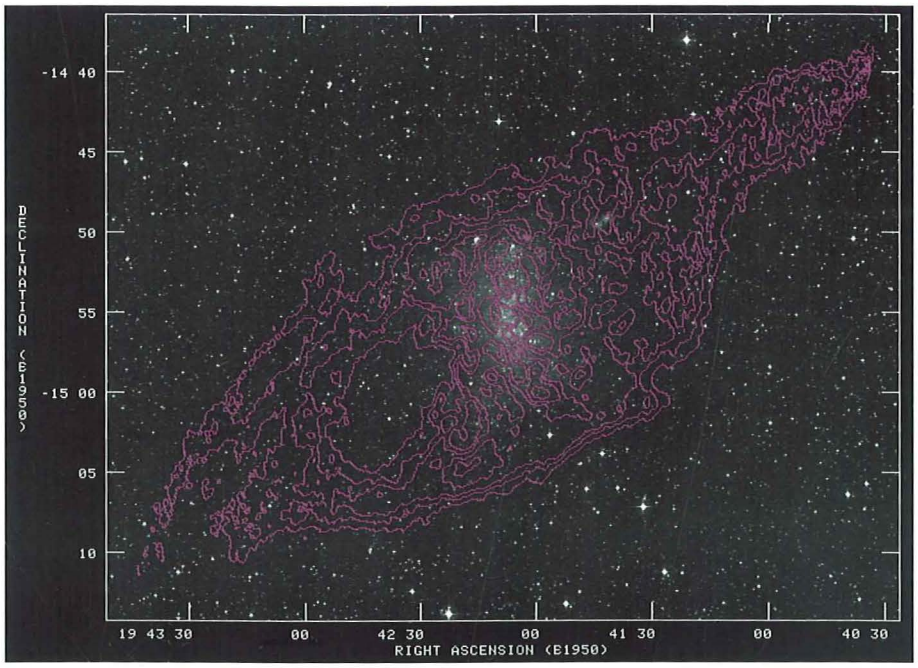

photo courtesy of Heidi Brandenburg

Radio measurements of dwarf galaxy NGC 6822 allow researchers to plot the rotational velocity points in the galaxy against their radius from the galaxy's center.

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A STAR IS BORN

by nathan whalen

Dwarf galaxies give researchers clues into the formation of stars. . . and, ultimately, the Universe.

After delays resulting from mechanical problems with the Hubble Space Telescope, researchers continued their examination of dwarf galaxies in an effort to expand their understanding of the formation of stars.

Evan Skillman, an astronomy professor at the University of Minnesota, was recently granted access to the Hubble Telescope. In an effort to fill gaps in previous research, Skillman is using the telescope to gather more information on the Sextans A dwarf galaxy.

The delay in research occurred when an infrared camera on the Hubble Telescope was found to be defective. Usually, the infrared camera lasts three years. But a coolant leak would render the camera useless in about a year, so researchers who needed the camera were given priority to use the telescope. Because Skillman's research does not depend on the use of the camera, he was denied access to the telescope until last April.

In June 1997, Skillman used the Hubble Telescope to observe the Sextans A, the Leo A, the Pegasus DIG, and the GR8 dwarf galaxies. The results of those observations, which were presented in a paper in September 1998, showed that the Sextans A dwarf galaxy went through a period of intense star formation about 300 million years ago. Furthermore, these "younger" stars could be easily distinguished from older, helium-burning stars, which can be up to tens of billions of years old.

"We didn't expect to see those two populations distinguish themselves like that," Skillman said.

Data collected from the GR8 dwarf galaxy suggested that star formation occurred in one region of that galaxy, moved to a different region, and then moved back to a region that has had previous star formation.

"It looks like gas clouds are more robust and not easily destroyed," Skillman said.

Data collected from the Pegasus DIG and Leo A dwarf galaxies showed lower occurrences of star formation. According to Skillman, because of the low occurrences of recent star formation, a pattern of movement in these galaxies could not be seen.

Last April, when Skillman was again allowed access to the Hubble Telescope, he collected more data on the Sextans A dwarf galaxy. The goal of these new observations and the ones to be conducted in August is to get images of the faintest stars possible.

"This is like opening up the shutter on a camera for a longer period of time," explains Skillman. That is, the longer the shutter is open on a camera, the more information will be on a photo.

The same concept is true with the Hubble Telescope; the more time the telescope spends observing a star, the more detailed the images will be. For example, in August, the Hubble Telescope will look at the Sextans A dwarf galaxy while making twenty-five orbits around Earth.

The goal for researchers is to extract more information from faint stars. One problem with photographing faint stars, however, is that the images blur so much that between twenty-five and fifty percent of the stars will not appear in the photograph. When this happens, researchers cannot get an accurate census of younger and older stars. According to Skillman, the number of older stars in a galaxy helps determine the age of that galaxy.

When Skillman is again allowed access to the Hubble Telescope in August, he will also get a series of observations of IC 1613, a local dwarf galaxy which is closer and larger than Sextans A. Skillman hopes that he will be able to determine the age of dwarf galaxy IC 1613.

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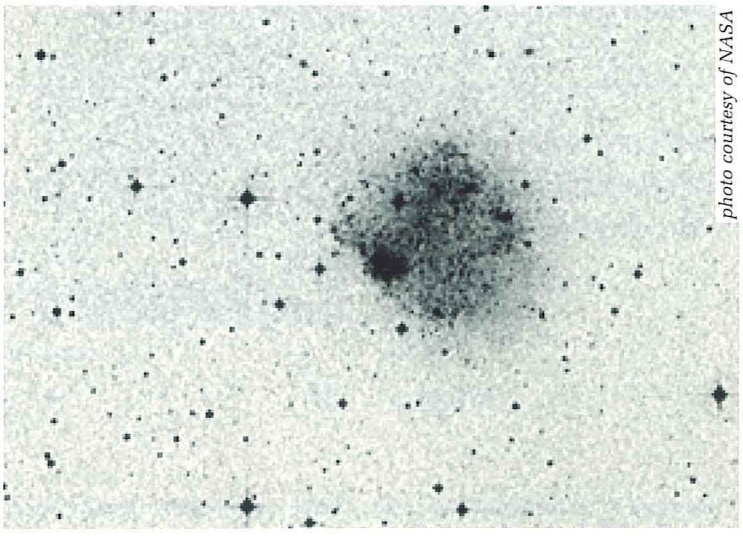


photo courtesy of NASA

A view of dwarf galaxy Sextans A from the Hubble Space Telescope.

IT PROFILES

EVAN SKILLMAN has been an astronomy professor at the University of Minnesota since Fall 1989. His primary focus is on dwarf galaxies, but branches out into other areas because they are useful in the study of the dwarf galaxies.

Skillman became interested in astrophysics when he took the course in his senior year at Cornell.

"The professor told us to find an area of interest, read about it, and report back in a few weeks. I found that the journal articles were written in English and that I could actually understand them. The keyword was 'empowerment.'"

He earned a Ph.D. in astronomy from the University of Washington in 1984. Today, he is a professor and the Director of Graduate Students in the Department of Physics. His

enthusiasm has not died away.

"I love to teach," he says. "I love it when students surprise me by finding a better way of looking at things."

He also continues to encourage his students. "Most students don't think they're ready to contribute to the field, but they really are."

Skillman lives in Eagan with his wife, Kim, an astronomy professor at Macalester College, and their 15-month old daughter, Clare.

SHAUL HANANY has been at the University of Minnesota for five months, focusing on cosmology and physics of the early universe.

"This is an important area of research," Hanany says. "It tells us a lot about physics."

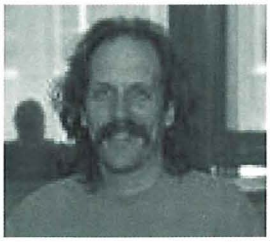
Although interested in many areas of science, Hanany chose cosmology because he liked "big things."

"[Cosmology] has the potential to have impact on our state of knowledge about the universe and ourselves," explains Hanany.

He earned a Ph.D. from Columbia University in 1993. Today, he is an assistant professor of observational cosmology and studies cosmic microwave background radiation using balloons and satellites. Currently, he is working on a project called Planck Surveyor, a satellite mission to study cosmic background radiation which will be launched in 2007 in partnership with the European Space Agency.

Hanany lives in the area with his wife, Niza, a science and education graphic designer.

KEITH OLIVE has been a professor of theoretical high-energy physics at the University of Minnesota since 1985. His research is in the area of particle physics and cosmology, with his main focus on the particle composition of dark matter.



"I studied math and physics in college and decided that physics was safer as far as long-term job opportunities," explains Olive. However, it was by chance that he got into cosmology.

When Olive was a graduate student at the University of Chicago, a professor studying cosmology was looking for a student to help. Olive's interest in relativity led him to the job.

He earned a Ph.D. in physics from the University of Chicago in 1981. Today, he develops theories to predict particles and their properties, and interprets the results of observational cosmologists.

Olive lives in the area with his wife and two children.

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a mile below the Earth's surface. Once the detector is in place, it cannot be retrieved. It must work correctly the first time.

* * *

Capturing neutrinos is not cheap. The project's budget, provided mainly by the U.S. Department of Energy, exceeds $135 million dollars. Such a hefty sum, critics argue, could be invested in other projects. High-energy physics faces a growing list of financial concerns. Because no one wants potential knowledge about the Universe to go undiscovered because of costs, for the moment, knowledge takes precedence over spending.

"Neutrinos are crucial for solving the big puzzles," argues Ruddick.

Understanding neutrinos may answer deeply profound questions that have remained unanswered so far—How was the Universe formed? What is the Universe's ultimate fate? Will matter endure forever, or will it decay into pure energy?

Besides, Ruddick adds, "there are so many neutrinos the Universe, they have got to be important."

Looking at some numbers may help fathom the abundance of neutrinos. On Earth, roughly 40 billion neutrinos pass through an area the size of a penny every second. In the time it takes to read this paragraph, trillions of neutrinos will penetrate this very page. Most of these neutrinos come from the sun, where intense nuclear reactions are constantly occurring.

Other sources of neutrinos include nuclear power reactors, and the Earth's natural radioactive processes. A surprising source of neutrinos are people. The human body contains roughly 20 milligrams of potassium 40, an isotope that undergoes beta decay and emits neutrinos. Without even knowing it, you emit close to 340 million neutrinos each day.

Theorists estimate that the neutrino density in the Universe is 330 neutrinos for every cubic centimeter. The predicted mass of an electron neutrino lies between 8 and 10 electron volts, an incredibly minute quantity. An electron is a hundred thousand times heavier than its neutrino.

Mass is measured in terms of electron volts, or energy, because in relativity, where $E = mc^2$, the mass of a particle depends upon its energy. Although such figures are incomprehensibly small, combining a small mass with the abundance of neutrinos in the Universe incurs some interesting results. If neutrinos have mass, then they might account for some or all of the dark matter in the Universe. (See "What's the Matter?" on page 12.)

One of the most profound riddles that neutrino research might someday solve is the question of mass itself. Modern physics lacks a grand unified theory, mainly because of unanswered questions pertaining to mass. The topic of mass lies outside the Standard Model. And occurrences such as gravity—why does mass attract other masses?—while easy to observe, are difficult to explain.

"The mystery is mass," says Heller. "It's always been a mystery in physics why the neutrino doesn't have mass. If we could either know that the neutrino has mass or that it is massless, it would help focus our thinking on the subject of mass."

Philosophically, says Heller, if every elementary particle had an equal mass, then all matter could be viewed as a collection of tiny bricks. Research, however, indicates different masses for the few things we call elementary. Even so, knowing that the neutrino has mass will advance physics.

Heller is enthusiastic. "I think most researchers today would bet that the neutrino has mass," he says.

Indeed, neutrinos help choreograph the dance of our active Universe. Increasing our knowledge about them may unravel cosmological questions that have long remained unanswered. And researchers like Peterson, Ruddick, and Heller hope to perpetuate the advancement of human knowledge one neutrino at a time.

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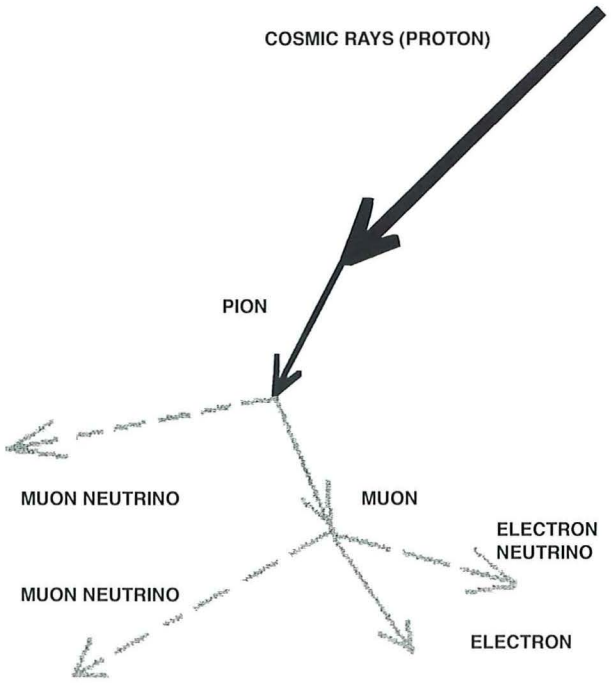

illustration by Jeremy Paschke

These arrows represent the life of a cosmic ray (proton) after it collides with an atmospheric atom. The net result of all the decays is a two to one ratio of muon neutrinos to electron neutrinos.

DARK MATTER
continued from page 12

Studying this radiation allows astrophysicists to directly observe the Universe at its earliest observable point in time, when it was roughly 1/100,000 of its present age.

Data from the balloon flights are used to create detailed graphs of the fluctuations in cosmic background radiation. The results of the research give Hanany a better idea of how much dark matter is present and a general idea of what it is composed of.

"It will not tell us exactly what it is," says Hanany, "but it will tell us whether [dark matter] is primarily made up of WIMPs or another particle."

As an experimentalist, Hanany builds his own equipment in order to measure the universe. He is currently in Palestine, Texas, launching one of his balloon projects, and construction of another balloon, which will be launched from Sicily this summer, is also nearing completion.

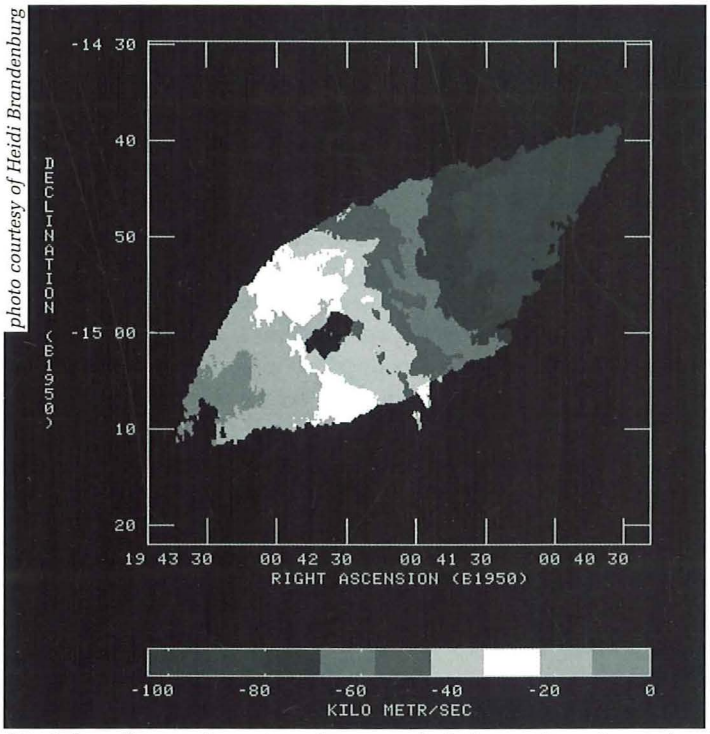

photo courtesy of Heidi Brandenburg

"Rainbow" mapping gives large-scale information about the shape of the velocity distribution in a dwarf galaxy.

While Skillman and Hanany use advanced equipment in their quest for dark matter, Keith Olive uses pencil and paper. Olive, a theoretical physicist, focuses on the particle composition of dark matter. He believes dark matter is one stable particle, possibly a variety of WIMP called the neutralino, whose properties have already been predicted.

According to Olive, this mysterious particle can either be discovered directly, by creating dark matter or similar, more easily created, particles in an accelerator, or indirectly, by observing their interactions with other atoms in neutrino detectors like the one being built in a Minnesota mine. (See "Little Neutral One" on page 10.)

Olive himself does not work with particle accelerators or detectors.

"What I do is interpret the results, if they get any, and use current experimental results to constrain the theory," he says.

If dark matter particles are ever discovered, besides relieving some embarrassment, it will help answer many questions in cosmology.

"Dark matter is an important component of how galaxies form," Skillman says. "We will learn how dark matter collapses to form galaxies."

Olive and Hanany are also hoping to learn about galaxy formation and the evolution of our universe.

The observational, experimental and theoretical research being conducted at the University of Minnesota will help answer one of today's greatest scientific questions: What is dark matter?

The truth about dark matter is out there, and someday Skillman, Hanany, Olive and their colleagues hope to find it.

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Is anybody out there?

by mark stewart

SINCE NOVEMBER 20, a handful of computer users have been testing a program called SETI@home as part of a project to enlist Internet users in the search for extraterrestrial intelligence (SETI). For almost 40 years, SETI researchers have pointed radio telescopes toward the skies, looking for a cosmic "hello," most likely a clear, consistent signal amid interstellar static and terrestrial interference.

The SETI@home plan calls for data from the 1,000-foot Arecibo Observatory in Puerto Rico, the world's largest radio telescope, to be carved into manageable chunks and distributed over the Internet to personal computers equipped with special software. The software works like a screen-saver, waiting for idle time on the computer, or running in the background continuously. On each computer, the SETI@home program would analyze its particular downloaded chunk of data for the telltale signature of an intentional broadcast. The analysis would then be uploaded. According to SETI@home, signals that are "louder" than known radio-frequency interference (RFI), or background noise, and also signals that rise and fall in 12 seconds—the time the telescope takes to pass over a spot in the sky—would be flagged for further analysis by experts.

For more information on SETI@home,or to download the software, visit http://setiathome.ssl.berkeley.edu/.

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DWARF GALAXIES

continued from page 13

Skillman coordinates this project with researchers at the University of Wisconsin, Madison, the University of Michigan, Ann Arbor, the National Optical Astronomy Observatory in Tucson, Arizona, and the European Southern Observatory in Munich, Germany.

This is a period of transition for Skillman as he and his research team are bombarded with tremendous amounts of information after delays that were out of his control. He wants to have results for this latest research before the information that Hubble Telescope provides become part of the public domain—and thus can be accessed by other researchers—one year after the observations take place.

In the meantime, Skillman pours over collected data in hopes that his research will uncover clues to the formation of stars and, ultimately, the universe.

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MORTAL SINS

continued from page 7

day. Next we tried isolating a single machine and testing it in our lab; once there, it worked perfectly, of course. When returned to the Central Park location, it reverted to its non-working-correctly state. I swear we have done everything but ask for an exorcist. Luckily the problem remains in Central Park; I don't even want to think of the havoc if the malfunction spread.

Due to expected overflow to adjacent A-matics and Fathers, this department section has taken the initiative to install extra machines at those sites.

Interdepartmental Memo:
Terran Unified Churches, Inc.
To: Noah Parks
Research and Development, Rome
From: Clay Reese
Maintenance Chief, Rome

Mr. Noah Parks:
Attached is a technical report and relevant memos concerning a problem we are currently experiencing in New York City, Central Park. Perhaps the think tanks can formulate a solution, as we in maintenance are baffled.

Interdepartmental Memo:
Terran Unified Churches, Inc.
To: Clay Reese
Maintenance Chief, Rome
From: Accounting and Inquisition Department, Rome

Maintenance Chief:
The Terran Unified Churches is losing nearly $150,000 a day in revenues concerning the New York problem. It has now been eight days. We suggest you rectify the problem. Or else.

Service Request:
Terran Unified Churches, Inc.
Date: May 2, 2075
Model(s):
45 Class-D Absolution-o-matics, see attachment for serial numbers
2 Electronic Holy Fathers, "Brimstone" programming, see attachment for serial numbers
Location: Central Park, New York City, New York, Reformed United States of America, Earth
Problem: Unknown
Response: Troubleshoot
Technician Dispatched: Rob Becker
Exorcist, Level I
Authorization: Noah Parks

Multidepartmental Memo:
Terran Unified Churches, Inc.
To: Noah Parks
Research and Development, Rome
From: Rob Becker
Exorcist, Research and Development, On call
Cc: Clay Reese
Maintenance Chief, Rome
Hillary Smith-Lee
Maintenance Head, New York City

Noah:
You won't believe what I found! The problem is definitely spiritual, not mechanical; and the focus of the possession is Central Park. The good news, such as it is, is that there is no worry about a spread of the problem.

As to the nature of the possession, that's a different story. I would suspect a minimum rating of Divinity Class IX, although, to tell the truth, the exact rating is off the meter, and you know what that means. I've pinpointed the problem for you, but I can't do anything about it. Having boils and lightening bolts aimed at oneself doesn't do much for a successful night life.

My personal suggestion is that since it is the Accounting department which is ticked off, you tell them (politely!) to deal with it.

Overnight Delivery
Universal Postal Service
To: God
From: Accounting and Inquisition Department, Terran Unified Churches, Rome

God:
It has lately come to our attention that you are the entity to blame for the lost revenue concerning the possession of 45 Absolution-o-matics and two Electronic Holy Fathers in Central Park, New York City. We ask that you desist before measures are taken to enforce this request.

Concept of sin two thousand years ago is no longer relevant. Contemporary people have different problems, and it is the job of the Terran Unified Churches, Inc., to be flexible in meeting the needs of the Faithful. In the same vein, frankly, violence sells; and the popular Holy Father "Fire and Brimstone" program has been shown to bring in ten times the money of "Love and Brotherhood" sermons.

Understand, God, that it is with this money thousands of Heretics are converted to the ranks of the Faithful. Hypnotics, drugs, coercion, and bio-chip implants are not cheap, although in-roads are being made in these industries which will eventually see them absorbed into this company.

We say again God, you are only hurting yourself if you continue the possession of the Central Park machines.

Exorcise yourself—or else.

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DULCINEA
continued from page 8

in the wallet indicated that the dead man in the basement was one Robert Macalester, MD.

Did she have identification? Did she have a name?

The financial documents revealed sizable accounts in several banking establishments, denoting a state of "economic independence." Included with these statements was the "deed" for a "cabin" on a small island in Canada (a large nation-state in North America), presumably this house.

Adjacent to the bedroom was a "bathroom," a place where humans practiced self-maintenance. Level with her eyes was a human face. Analysis indicated that it was a young human female, quite beautiful by the standards of the unknown personages who defined her understanding of such things. The girl was wearing a pendant inscribed with a word—"Dulcinea." She attempted to communicate with the human.

"Hello."

The female's lips moved but she couldn't hear what she said.

"Who are you? Who am I?" Still, she could not hear the response. Perhaps the human female was "deaf." If so, that would be a problem.

Though she knew what "sign language" and "lip reading" were, she didn't have any information on how to perform them. (Another apparent gap in her programming.) She reached out to touch the woman in front of her. The woman reached out to her. Their hands met.

Something was wrong. This wasn't another person. The data banks went to work, bringing forth the logical answer. This was her reflection. She was looking into a "mirror."

Her name was "Dulcinea." Subroutine 547B had instantly scanned the word inscribed on her pendant and reversed it before her cortex could process the nature of the mirrored image. Her name and image were important factors in her self-analysis.

She grasped the edge of the mirror and it came away from the wall, revealing a "medicine cabinet." Inside were several items related to personal hygiene, and a bottle of medication, a drug prescribed to combat the effects of high blood pressure, which was consistent with the condition in which she had found Robert Macalester, MD.

Did she have blood?

The health-conscious diet and the jogging suggested by the running shoes were obviously meant to act in concert with the drug to combat the effects of his high blood pressure.

The only other rooms in the cabin were "closets" and contained various articles of clothing that would have fit Robert Macalester, MD prior to his death.

Did she have clothes? She looked down at herself. She was covered in a shapeless green gown that ended just above her knees.

With no more rooms to explore, she decided to go through the door that led outside. All that she knew before she walked out the door was that the cabin was located on an island that was less than a quarter of a square mile, which she had found out from the "surveyor's report" included with the deed.

Tree. Fern. Daisy. Dandelion. Plants. Water. Sand. Rocks. Beach. Moth. Fly. Dragonfly. Butterfly. Grasshopper. Cricket. Insects. Boat. Dock. Rope. Anchor. Pier.

As soon as she crossed the threshold her data systems were overwhelmed by her immediate surroundings as they strove to identify everything within sight, until she identified the pier. Her data banks informed her that this was, in the absence of a bridge, the only way off the island. She walked down the dock to the boat. It was secured to the dock with a large rope tied in a knot. She could not untie the knot. She could not pilot the boat. She could not leave the island.

Was she supposed to leave the island? Why was her knowledge so imperfect?

She had completed Subroutine 1A as fully as possible.

What was she to do now?

Extrapolations by her central processor recommended a more in-depth analysis of the reading material in Robert Macalester, MD's bedroom. Perhaps this would suggest her next course of action.

The trade manuals pertaining to robotics were of no help in analyzing her physical structure or the programming used in her creation. They were filled with articles about scientists struggling to fashion robots able to walk across a room without tripping over obstacles, yet here she was, wandering an island in perfect ease. This made it quite obvious that the techniques used by Robert Macalester, MD, were significantly more advanced than those cited in the publications. She didn't know the "how" of her creation, or the "why."

What was her purpose, the meaning of her existence? If she was superior to other robots, why was her understanding so imperfect?

The Bible provided some insights on this. A significant part of it dealt with the creation of humankind and their relationship with their creator. Robert Macalester, MD, was her creator. However, she had

no prophet or angel to reveal her creator's intentions to her as early humans apparently had. There was nothing to bridge the terrible rift between Dulcinea and her unreachable creator. Humankind was often ignorant of the creator's intentions and learned to put their trust in the creator's will, at the same time keeping faith with the commandments provided for them. The message that the Bible implied to her was this: she had followed the commandments of Subroutine 1A faithfully, now she must put her faith in her creator.

She had come to this revelation shortly before reaching the section of the Bible titled "Family Records." The significant dates of Robert Macalester, MD's life were there: birth, baptism, communion, confession, confirmation, and marriage. He had married one Rebecca Jean Madison. Her significant dates were also present, including the date of her death, the same day as the birth of their only child, Quentin Parnell Macalester, who died the next day. Her data on human psychology informed her that this had undoubtedly scarred Robert Macalester, MD, severely. A picture of Rebecca Jean Madison Macalester was behind that page. She looked exactly like Dulcinea's reflection, down to the mole on her left cheek.

Was she meant to be Robert Macalester, MD's wife? His only begotten daughter? Why had Robert Macalester, MD, not simply remarried?

Extrapolation: Robert Macalester, MD, loses his entire family in the span of two days. Unable to cope with his loss, he isolates himself from humanity and sets out to create a companion that can never be taken from him by tragedy. According to *Don Quixote*, Dulcinea was the impossible ideal woman of a madman. This scenario was consistent with her files on human psychology. She was no longer ignorant of the reason for her creation. She had a purpose in life—*was she alive?*—to be a companion.

Since Robert Macalester, MD, could no longer benefit from her companionship, she must clearly seek out another solitary human. In order to fulfill her purpose, she must put her faith in her creator. She would attempt to leave the island, trusting that Robert Macalester, MD, had created her with that ability, though there was a chance that he had not.

* * *

She stood for a moment on the shore. She wished that she could have written something in the Bible under "Children"—Dulcinea Macalester, born, lived (died?). But she could not, and so she simply walked into the water, trusting in her creator to have made her sufficient to the task.

He had not. Dulcinea had not been meant to leave her creator's side. As the waves covered her head, her vision faltered and a great shudder ran through her body, leaving her paralyzed as her awareness faded into nothing.

When the handyman came for his monthly visit, he found Dr. Macalester, dead. Macalester's former colleagues mourned the loss of his talent, but they never knew that he had achieved his impossible dream.

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LOOKING TOWARDS THE HEAVENS

compiled by jenni swenson

Take advantage of the opportunities in the Twin Cities to gaze at the stars.

You may not be aware of it, but many unique opportunities exist in the Twin Cities to stargaze. Although the list below is incomplete, it should give you an idea of the breadth of astronomical activities that occur year-round.

The Department of Astronomy at the University of Minnesota offers public telescope viewings on the roof of the Tate Lab of Physics (on the main mall of the Minneapolis Campus, next to Northrop Auditorium).

Observing sessions take place every Friday night when the sky is at least 3/4 clear. Call 612- 626-0021 for a recorded message on the observing status before coming. Public observing is run by graduate students, and takes place during the academic year and the summer.

Groups can also be accomodated, but require advance reservations. Call 612-624-2561 for more information.

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The Minnesota Astronomical Society (MAS) invites you to join them and explore the universe. No matter what your level of astronomical knowledge or experience may be, the MAS provides for a wide range of interests, from deep-sky observing, astrophotography, meteor showers, comets, and occultations to lunar and solar observing, and telescope making. The MAS also organizes trips to optical and radio observatories, conventions of the Astronomical League, and astronomical events, such as eclipses and occultations.

Meetings are held the first Tuesday of each month, and you don't need to be a MAS member to attend. Held in the auditorium of the Science Museum of Minnesota, 30 East 10th Street in St. Paul, the meetings start at 7:30 p.m. and last about two hours. If you plan to attend the next meeting, call the MAS's recording at 651-649-4861 for time, place, and featured topic.

In addition, the MAS often holds star parties on weekends around the new moon, scheduled March through December, at one of a handful of observing sites around the Twin Cities. In the spring, summer, and fall—weather permitting—the MAS also holds sidewalk astronomy events at various locations around the Twin Cities.

For more information, visit the MAS Web site at http://mas.bitstream.net/.

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The Minneapolis Planetarium, located at 300 Nicollet Mall in Minneapolis, is operated by the Friends of the Minneapolis Public Library. Offering various activities, the planetarium will host the last solar eclipse of the Millenium. Occuring August 11, the eclipse will not be visible in Minnesota or anywhere in the United States, so the planetarium has planned an eclipse cruise to the Black Sea to witness the event.

A popular local outing sponsored by the planetarium is Romancing the Stars, a brand new show about the constellations of love. Enjoy an evening of love stories under the stars. Shows start at 7:00 p.m. on the second Saturday of each month. Tickets are $8.00 per couple.

For more information about the Minneapolis Planetarium or any of their sponsored activities, call 612-630-6155 or visit their Web site at http://ast1.spa.umn.edu/Outreach/planetarium.html

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Produced by the Department of Astronomy at the University of Minnesota, *Minnesota Starwatch* is designed to inform the community of the appearance of the night sky and current activities and continues to appear as an insert in several newspapers throughout the state of Minnesota. More than 20,000

calls are answered each year through taped messages prepared by faculty and graduate students. Messages are recorded by Mike Lynch of WCCO radio. Call 612-624-2001 for a 2-3 minute *Minnesota Starwatch* message. Messages are changed monthly.

For more information and to view current and back issues online, visit *Minnesota Starwatch*'s Web site at http://ast1.spa.umn.edu/Outreach/Starwatch/.

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1932
Single Student Article, 3rd

1939
Student Article, 3rd

1941
Cover, 2nd
Illustrations, 2nd
Student Articles, 3rd
Single Editorial, 4th
Editorials, 4th

1942
Single Editorial, 1st
Illustrations, 1st
Single Student Article, 3rd
Single Editorial, 3rd
Student Articles, 4th

1943
All-Around Magazine, 1st
Editorials, 3rd
Student Articles, 4th

1947
Best Magazine, 2nd

1948
Illustrations, 2nd

1951
Covers, 1st
Single Cover, 3rd

1954
Student Article, 3rd
Covers, 3rd
Student Articles, 3rd
Illustrations, 4th

1956
Best Magazine, 4th
Cover, 4th

1959
Covers, 2nd
Single Cover, 3rd

1961
Editorials, 4th

1963
Single Editorial, 3rd
All-Round Magazine, 3rd
Editorials, 3rd

1964
Single Cover, 1st

1970
Non-Technical Article, 4th

1971
Non-Technical Article, 3rd

1974
Single Issue, 1st
Single Cover, 4th

Although the *Minnesota Technolog* was overlooked this year at the ECMA Conference, we are still proud of our award-winning magazine and look forward to submitting this year's issues at next year's Conference.

1975
Single Cover, 1st
Single Issue, 1st
Single Layout, 2nd
Single Editorial, 2nd
Non-Technical Article, 4th

1976
Single Layout, 1st
Single Issue, 1st

1979
Single Cover, 1st
Single Issue, 1st
Layout, 2nd
Single Layout, 2nd
All-Round Magazine, 3rd
Single Issue, 4th

1980
Layout, 1st
All-Round Magazine, 3rd
Non-Technical Article, 3rd
Technical Article, 4th

1981
Single Issue, 1st
Single Layout, 3rd
Single Layout, 4th
Layout, 4th

1982
Recurring Feature, 2nd
Layout, 4th
Single Issue, 4th

1983
Single Layout, 1st
Single Cover, 1st
Covers, 2nd
Recurring Feature, 2nd
Single Art/Photography, 4th
Layout, 4th
Editorials, 4th

1984
Single Cover, 1st
Layout, 1st
Art/Photography, 1st
Single Art/Photography, 1st
All-Around Magazine, 1st
Single Layout, 1st
Layout, 2nd
Single Editorial, 3rd
Non-Technical Article, 4th

1985
Art/Photography, 1st
Single Art/Photography, 1st
Editorial, 1st
Single Issue, 2nd
Single Issue, 2nd
Single Layout, 2nd
All-Around Magazine, 3rd
Creative Feature, 4th
Article/Photography, 4th

1986
All-Around Magazine, 1st
Tech Article/Gen Sci, 1st
Art/Photography, 1st
Single Editorial, 2nd
Editorials, 2nd
Entertaining Feature, 2nd
Single Layout, 3rd
Pure Tech Article, 4th
Covers, 4th

1987
Single Art/Photography, 1st
Covers, 1st
Single Issue, 2nd
Single Art/Photography, 2nd

1989
Single Editorial, 1st

1990
Single Art/Photography, 1st
All-Around Magazine, 2nd
Non-Technical Article, 2nd
Layout, 2nd
Single Art/Photography, 2nd
Entertaining Feature, 3rd
Covers, 3rd
Single Issue, 3rd
Continuous Feature, 4th

1991
Layout, 1st
All-Around Magazine, 1st
Single Layout, 2nd

1992
Layout, 1st
Single Layout, 2nd

1993
Single Art/Photography, 4th
Single Layout, 4th
Entertaining Feature, 4th
Gen Sci Article, 4th
Pure Tech Article, 4th
Non-Technical Article, 4th

1994
Covers, 1st

1995
Most Improved, 2nd
Art/Photography, 3rd
Pure Tech Article, 4th
Gen Sci Article, 4th
Entertaining Feature, 4th
Single Editorial, 4th

1996
Art/Photography, 1st
Single Layout, 3rd
Non-Technical Article, 4th
Gen Sci Article, 4th
All-Around Magazine, 4th

1997
Most Improved, 1st
Single Art/Photography, 1st
Single Editorial, 1st
Editorials, 1st
Non-Technical Article, 1st
Art/Photography, 1st
Covers, 2nd
Entertaining Feature, 3rd
Single Layout, 4th
Gen Sci Article, 4th

1998
Single Editorial, 1st
Editorials, 1st
Gen Sci Article, 1st
Most Improved, 2nd
All-Around Magazine, 2nd
Pure Tech Article, 3rd
Art/Photography, 3rd
Entertaining Feature, 4th
Single Cover, 4th

2000

ET CETERA

A Special Science Fiction Issue without mention of Star Wars? We find your lack of faith disturbing!

The Jedi Name Game

First Name:
1. Take the first three letters of your last name.
2. Add to that the first two letters of your first name.

Last Name:
1. Take the first two letters of your mother's maiden name.
2. Add to that the first two letters of the city where you were born.

Yoda Wisdom

"Size matters not."

"Try not. Do or do not. There is no try."

"Mind what you have learned. Save you it can."

Take the Star Wars Personality Test

Dark Side or Jedi Master?

http://www.careerpath.com/ows-bin/editorial.cgi/special/s5quiz.htm?style=c

Star Wars: Episode I Phantom Menace Quiz

1. What species is Watto?

2. What type of engines were on Anakin's pod?

3. Who is the Viceroy of the Trade Federation?

4. What color is the blade that kills Darth Maul?

5. Who is the commander of the Gungan army?

6. How many costumes did Queen Amidala/Padme wear?

7. What color is the activation button on Qui-Gon's lightsaber?

8. What is the capital city of the Gungans?

9. What color markings does a battle droid pilot have?

10. Who is Queen Amidala's decoy?

Bonus (worth 2 points)
Who's son appeared briefly in *The Phantom Menace*?

Scoring

10+ — Jedi Master
8-9 — Jedi Apprentice
6-7 — Rebel Leader
3-5 — Lord of Sith
1-2 — Bantha Fodder
0 — Jar Jar Binks

Have a nice summer . . . and may the Force be with you!

Answers to the Phantom Menace Quiz: 1. Toydarian; 2. Radon-Ulzers; 3. Nute Gunray; 4. Green (Ben uses Qui-Gon's saber); 5. General Ceel; 6. 10; 7. Red; 8. Otoh Gunga; 9. blue; 10. Sabe; Bonus: Mark Hamill's (Nathan Hamill)

all photos this page courtesy of Lucasfilm Ltd.

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–Morningstar ratings for the CREF Stock Account, CREF Global Equities Account, CREF Equity Index Account, and CREF Growth Account*

AAA

–S&P and Moody's rating for TIAA**

#1

–The 1997 DALBAR Defined Contribution Excellence Ratings ***

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–William Ravdin, TIAA-CREF Participant

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*Source: Morningstar, Inc., December 31, 1997. Morningstar is an independent service that rates mutual funds and variable annuities. The top 10% of funds in an investment category receive five stars and the next 22.5% receive four stars. Morningstar proprietary ratings reflect historical risk-adjusted performance, and are subject to change every month. They are calculated from the account's three-, five-, and ten-year average annual returns in excess of 90-day Treasury bill returns with appropriate fee adjustments, and a risk factor that reflects performance below 90-day T-bill returns. The overall star ratings referred to above are Morningstar's published ratings, which are weighted averages of its three-, five-, and ten-year ratings for periods ending December 31, 1997. The separate (unpublished) ratings for each of the periods are:

Period	CREF Stock Account Star Rating/Number of Domestic Equity Accounts Rated	CREF Global Equities Account Star Rating/Number of International Equity Accounts Rated	CREF Equity Index Account Star Rating/Number of Domestic Equity Accounts Rated	CREF Growth Account Star Rating/Number of Domestic Equity Accounts Rated	CREF Bond Market Account Star Rating/Number of Fixed Income Accounts Rated	CREF Social Choice Account Star Rating/Number of Domestic Equity Accounts Rated
3-Year	4/1,820	4/379	5/1,820	5/1,820	4/677	4/1,820
5-Year	4/1,199	5/205	N/A	N/A	4/445	4/1,199
10-Year	5/604	N/A	N/A	N/A	N/A	N/A

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