INSIDER

Newsletter for the Employees of Ames Laboratory ■ Volume 16, Number 9 ■ October 2005

Barton Guests on "Talk of Iowa"

Joins President Geoffroy on WOI radio program

"Can you tell me a little about Ames Laboratory," host Katherine Perkins asked director Tom Barton during WOI Radio's "Talk of Iowa" program on October 6. "Just tell me when to stop," chuckled Barton, adding, "It's a story I love to tell."

Barton was the guest of Iowa State University president Gregory Geoffroy on the interview program broadcast from the WOI studios in the Communications Building on the ISU campus. The one-hour program gave Barton ample time to educate the public on Ames Lab's mission to conduct basic and applied research in support of the Department of Energy's efforts to solve the nation's energy problems. Two examples he used to demonstrate that support were magnetic refrigeration and lead-free solder.

Magnetic refrigeration technology uses an alloy of gadolinium-silicon-germanium to generate the cooling effect in refrigerators. In addition to being an efficient technology, the material is environmentally friendly, unlike the Freon gas used in conventional refrigerators.

The second example, lead-free solder, removes harmful lead from the environment. Painting a picture in the listeners' minds, Barton asked them to envision a motherboard on a computer and all the tiny solder joints it holds. Replacing the solder used on all those joints in all those computers would remove what Barton called a "huge environmental jeopardy" caused by the lead that's being introduced into the environment.

"We have solder licenses in the United States, all of Asia and Europe. Its use is becoming widespread, and we're very proud of it," said Barton. He also noted that the Lab has an extremely strong program in analytical instrumentation and instrumentation development, referring to Ed Yeung's capillary electrophoresis unit that can analyze 96 samples at a time and has been developed into a commercial instrument. "That's all work that comes from fundamental research at Ames Lab," Barton told the radio audience.

Barton spoke for approximately 30 minutes on Ames Lab's mission of research, technology transfer and education.

Responding to a question about how the Lab is contributing to nanoscience research, Barton used the example of his own wedding ring. In its current state, the gold is stable to chemical reactions, but he said that's not true when you get down to the level where you're looking at clusters of a small number of gold atoms. He explained that those clusters are extremely reactive. "The properties have changed because of the nanoscale," said Barton. He noted that the phenomenon has led to theoretical *continued on page 2*

Barton Guests on "Talk of Iowa" *continued from page 1*

research at the Ames Lab led by Mark Gordon, director of the Lab's Applied Mathematics and Computational Sciences program, to understand why the properties of atoms change on the nanoscale level and also to predict how the properties of other nanoscale materials will be changed by becoming nanoscale.

This topic set the stage for further discussion of what Barton called the "bioscale." "Something the Ames Lab is doing is introducing a 'bio' component in our major research programs," he said. "It's very exciting." As an example, he explained work being peformed by Surya Mallabpragada, director of the Lab's Materials Chemistry and Biomolecular Materials program, to create "pentablock" copolymers, which mimic biomaterials in that they can change their properties by changing temperature or pH. Ultimately, he said it's a way to look at what nature does and mimic it in the lab to create things on the nanoscale.

How the Laboratory moves products like the capillary electrophoresis unit from the research stage to the market stage, was another question asked by Perkins. "We don't actually do that," Barton said, "but ISU does, which is a tremendous benefit of sharing and partnering with a university." He added that although federal laboratories have tried to do technology transfer, they've never been as good at it as universities. Following up on Barton's comment, Geoffroy said the ISU Research Park is the place to go for anyone wanting information on how to commercialize an idea.

Barton said the Laboratory does make a contribution to business and industry through its expertise in materials science. He referred to ISU's Institute for Physical Research and Technology's Companies Assistance Program, which relies on the Laboratory's materials expertise, facilities and instrumentation to help Iowa companies solve technical problems.

Picking up on something he had touched on early in the program, Barton elaborated on the Laboratory's commitment to education. "One of the things we're as proud of as any science we've accomplished are the students we've produced," he said. Barton explained that when he talks about an Ames Laboratory graduate student, he means a student who's received all their stipend from Ames Lab, had all their research paid for and has been housed by the Lab. "Since 1947, more than 3,000 Master's and Ph.D. degrees in science and engineering have been granted to what I describe as Ames Lab graduates," said Barton. Commenting further, he called those graduates an example of 'catalytic' technology transfer. "It goes out and grows and develops, and I consider it the most important thing we do," he said.

When asked how the Laboratory inspires future generations of young people to enter technology fields, Barton highlighted the Science Bound program that reaches out to minority students in Des Moines public schools. The program begins in the 8th grade, and if the students fulfill the contract they and their parents sign by doing things like taking certain courses, maintaining a certain grade point and committing to majoring in something related to science at ISU, they are provided a tuition-free scholarship to Iowa State. "It's one of the most heartwarming programs," he said.

Barton also talked about the Lab's Science Bowl programs. The high school bowl is entering its 16th year, while the middle school bowl will hold its third event in 2006. "We need to do everything we can to celebrate science in our lower grades to make it just as popular and exciting as scoring a touchdown on Friday night," Barton said.

Wrapping up the radio program, President Geoffroy commented on the rebidding process the Lab is going through for its contract. Geoffroy said the rebidding is part of a congressional mandate. "We believe we will be the best bidder for that contract," he said. As the basis for his confidence, Geoffroy said the Lab is so tightly integrated into ISU that it's "almost impossible" any other outside organization could run the Lab. "We will go through the process and hope to manage the Ames Laboratory for decades," he said.

As for the future of the Ames Lab, Barton commented that like any administrator he was concerned about the future of the Lab's budget. "I can't imagine anyone operating on federal dollars who isn't concerned about where they will come from in the future," he said.

As a bright spot, however, Barton said the Lab's funding level has been up slightly the past few years, which he attributed to efforts to constantly introduce new initiatives as erosion occurs in basic programs. He referred to the $1.6 million dollars in funds the Lab has received to research hydrogen storage materials as one example of a new initiative.

"We're also proposing a national facility in metabolomics," he said. Metabolomics is the effort to understand the chemical processes that take place within the cells of plants. "We just got our foot in the door with over $1 million in DOE start-up money for metabolomics research," he said. ■

Barton, President Geoffroy and host Katherine Perkins share a light moment prior to the kick-off the "Talk of Iowa" program.

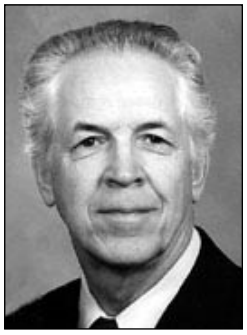
Gordon named LAS Master Teacher

Mark Gordon, Applied Mathematics and Computational Sciences program director and an Iowa State University distinguished professor of chemistry, has been named an ISU College of Liberal Arts and Sciences master teacher for 2005-06. This is the seventh year for the LAS Master Teacher program, which recognizes teachers who have a reputation for using unique methods to enhance student learning. An important part of Gordon's style with graduate students is his intense personal interest in and energy dedicated to them. He has served as a true mentor to his students, providing extra guidance or freedom, as needed. He has consistently arranged for his graduate students to attend national meetings, getting exposure for them as they prepare for their independent careers. The number of external honors accumulated by his graduate students is inordinately high. An outstanding classroom teacher at all levels, Gordon teaches graduate courses for both chemistry majors and non-majors.

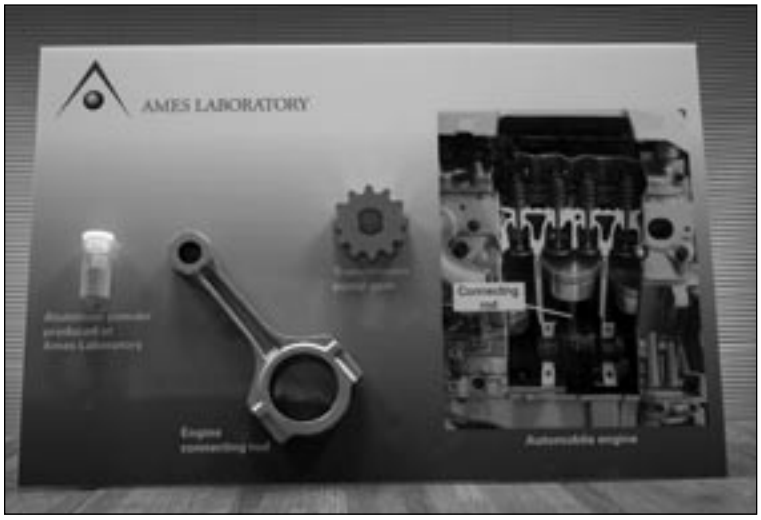
Mark Gordon

Charles Fullhart Dies

Word has been received of the death of Charles Fullhart on September 2. He was 80. Fullhart worked at the Lab from 1951 until his retirement in 1986. He began his Ames Lab career as an assistant engineer in the High Energy Physics program. He later moved to Facilities Services where he worked as an electrician. Memorials may be given to St. Andrews Lutheran Church Family and Youth Ministry in Ames.



Charles Fullhart



HQ Exhibit

This display showing automotive parts made from powdered aluminum was part of an exhibit at DOE Headquarters that showcased technology developed at the Office of Science Laboratories.

Hansen Lecture Draws Huge Crowd

Professor Carl Lineberger (center) of the department of chemistry, University of Colorado-Boulder, spoke to a full house when he gave the annual Hansen Lecture, Oct. 13 in the Spedding Hall auditorium. Every seat in the auditorium was taken and chairs were being rolled in from the adjoining conference room when Professor Lineberger began his talk on "Radicals, Reactive Intermediates and Transition States: Chemistry Along the Reaction Coordinate."

The Hansen Lecture was established in 1999 to honor Robert S. Hansen, who was the director of Ames Laboratory for 20 years and an Iowa State University distinguished professor of chemistry. Hosts for this year's Hansen Lecture were senior chemist Pat Thiel and Applied Mathematics and Computational Sciences program director, Mark Gordon, both ISU distinguished professors of chemistry.

More Bucks for Science Bowl

This year is the sixth in a row that Pella Rolscreen of Pella, Iowa, has contributed to the Ames Laboratory/Iowa State University Science Bowl. The Lab received a check for $1,000 from the Pella Rolscreen Foundation . The money will be used to help pay for the costs of food, lodging, supplies, etc. for the 320 high-school and middle-school students who will participate in the 2006 Science Bowl.

Hy-Vee, Inc. of West Des Moines has once again demonstrated its support for programs that encourage high-achieving students to excel in math and science. Hy-Vee, Inc. has donated $1,000 for the Ames Laboratory/Iowa State University Science Bowl. This is the sixth year Hy-Vee, Inc. has made a donation to help pay for the costs for holding the Lab's Science Bowl competitions.

"Radical" Means

Researchers solve century-old chemistry conundrum

For close to a century, chemists debated the nature of the mechanism that triggers the Fenton reaction, one of the most powerful oxidizing reactions available for breaking apart organic compounds. Back and forth the controversy persisted, generating a profusion of professional articles that supported either one or the other of the likely candidates – short-lived, difficult-to-measure hydroxyl radicals or the extremely rare iron(IV), or Fe(IV). Which one was the highly reactive Fenton intermediate that could initiate the oxidations of countless substances, from biomolecules, such as proteins, sugars, fatty acids and nucleic acids to the pollutants found in smog and industrial wastes?

Decades passed, and the identity of the elusive Fenton intermediate remained a mystery. Now, however, Ames Lab senior chemist Andreja Bakac and assistant chemist Oleg Pestovsky have generated, characterized and ruled out iron(IV) as the Fenton intermediate. Their irrefutable research results tip the balance heavily toward hydroxyl radicals, or OH radicals, as the crucial intermediate – the means by which the Fenton reaction is carried to completion.

Fenton facts

Discovered in 1894 by H. J. H. Fenton, the Fenton reaction is the oxidation of aqueous iron(II), or Fe(II), with hydrogen peroxide, a versatile, safe and effective oxidant. (An oxidant is a substance containing oxygen that reacts chemically with other materials to produce new substances.)

The pervasive nature of the Fenton reaction accounts for scientists' longstanding efforts to unravel the century-old mystery surrounding the famous Fenton intermediate. And no wonder – the reaction operates or is employed almost everywhere, with both good and not-so-good effects. It's critical in the treatment of organic pollutants that are introduced into the environment by the uncontrolled use of such things as pesticides and herbicides, among many other man-made contaminants. It's vital within the industrial chemistry arena, where researchers investigate catalysts with the goal of making various chemical processes go faster and in a more selective and efficient manner. In contrast, the Fenton reaction plays not-so-benign roles in the biology of aging and disease, contributing to certain types of DNA damage that may not self-repair and accumulate with age.

Closing in on the chemistry

"Knowing the nature of the intermediate is crucial to understanding the role of Fenton chemistry in issues related to environmental and atmospheric chemistry, as well as human health and aging," says Bakac, who is also an Iowa State University adjunct professor of chemistry. "The fact that we have now eliminated iron(IV) in Fenton reaction and confirmed it in ozone reaction, may provide a foundation for the development of new and useful catalytic reactions based on iron(IV)."

Ames Lab's basic research effort was done in collaboration with Carnegie Mellon University in Pittsburgh and the University of Minnesota in Minneapolis. An article by the collaborating scientists describing their research and its indisputable results will appear in an upcoming issue of *Angewandte Chemie*, one of the world's foremost chemistry journals. *Angewandte Chemie* gave the article a "Very Important Paper," or "VIP," rating, which less than 5 percent of their manuscripts receive.

As with many scientific achievements, the work done by Bakac and Pestovsky that eventually ruled out iron(IV) as the Fenton intermediate did not initially have that goal. "We started out studying aqueous iron(IV) for several reasons," says Bakac. "It is a very unusual species, but in stabilizing biological environments, iron(IV) has been found to play a role, especially in enzymatic reactions. And as soon as you find something that is considered unusual to actually function in real life, you know it's not that uncommon – it just hasn't been recognized before."

Preserving a life: ***Andreja Bakac demonstrates the device that allows her and Oleg Pestovsky to generate and freeze iron***

innovative apparatus was the brainchild of both Carnegie Mellon's Eckard Münck, who came up with the idea, and the Ames group, who built and perfected the device.

Andreja's idea

"Iron(IV) was not a totally unknown species when we started looking at it," says Bakac. A research group in Denmark had done the reaction of iron(II) with ozone and proposed that iron(IV) was produced," she explains. "That was about a decade ago, and the work kind of went unnoticed."

While reviewing the literature relating to iron(IV), Bakac came across the Dutch papers again. "As I read those papers, I figured if that was iron (IV), then there ought to be much more chemistry there, some of it potentially important in both catalytic and biological contexts," she says. "Of course, nobody knew whether iron(IV) was really involved. It was some sort of intermediate that hadn't been characterized. This is where Oleg and I got involved."

Bakac and Pestovsky set out to generate this species from iron(II) and ozone and look at its chemistry. "All along we were hoping to find that this really was aqueous iron(IV), a simple but probably extremely reactive species," Bakac says. "The initial reactivity data were truly exciting and consistent with an iron(IV) species, but still we had no proof," she adds.

Mössbauer "magic"

"We saw some beautiful chemistry, but we definitely needed to identify this species," says Bakac, "so we got in touch with Eckard Münck at Carnegie Mellon. He's the world expert in Mössbauer spectroscopy, which is considered to be the most definite of spectroscopic methods when working with iron."

Bakac explains that iron(IV) is a short-lived species, lasting about 10 seconds at room temperature. Although that is orders of magnitude more than some intermediates she works with that live only milliseconds or microseconds, Bakac notes that the 10-second life of iron(IV) did present a problem.

Very "cool" stuff: ***Although you can't see it in this photo, a delicate spray of newly generated iron(IV) has frozen instantly to the inner walls of this copper cylinder that has been cooled to liquid-nitrogen temperature (77 Kelvin, or minus 321 degrees Fahrenheit). The frozen solid sample can be packed in a liquid-nitrogen-cooled dewar and shipped overnight to Carnegie Mellon in Pittsburgh for Mössbauer analysis.***

"It was a lot to deal with when we were producing the material here and the group that was analyzing it was in Pittsburgh," she says. Fortunately, the two research teams collaborated and found a way to get a sample from Ames to Pittsburgh before it "died."

"We designed and built a device that allows us to generate iron(IV) and immediately cool it down to liquid nitrogen temperature and freeze it in a fraction of a second," says Bakac. "We then packed the solid into a liquid-nitrogen-cooled dewar and shipped it overnight, as quickly as Fedex would go, to Pittsburgh. There, the Carnegie Mellon team collected the Mössbauer spectrum at liquid helium temperature."

Mössbauer studies of the Ames samples done under Münck's direction by Carnegie Mellon research associate Emile Bominaar and graduate student Sebastian Stoian proved the intermediate generated by Bakac and Pestovsky was exactly what they were hoping for – the iron(IV) species.

In addition to the Carnegie Mellon work, contributions by Lawrence Que and his postdoctoral associate, Xiaopeng Shan, at the University of Minnesota further confirmed the iron(IV) species. "They took our sample to Stanford University to get an X-ray absorption spectrum, or XAS, and that spectrum was consistent with the oxidation state of iron(IV)," says Bakac.

The Mössbauer and XAS analyses, combined with all the chemistry carried out at Ames Lab, told Bakac and Pestovsky what iron(IV) looks like and what it does. "For the first time we knew what both iron(IV) and OH radicals would do and could figure out which one is involved in the Fenton reaction," says Bakac. "Nobody knew how to make iron(IV) or look at it before so that we could distinguish between the two."

Identical experiments, different products

At that point, knowing the nature of the intermediate, Bakac and Pestovsky decided to carry out some very specific experiments. In one set of experiments, they oxidized a substance with iron(IV), and in a parallel series of experiments with an identical substrate and under identical conditions, they oxidized the substrate using the Fenton reaction.

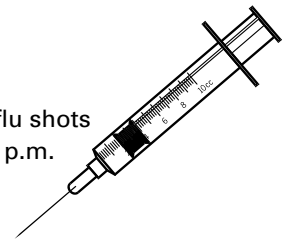
"The products were different," says Bakac. "And more than that, the products generated from the Fenton reaction were identical to those known to be formed from reactions involving OH radicals. So we both ruled out iron(IV) as the intermediate and indirectly confirmed OH radicals," she says.

Bakac and Pestovsky's work took about a year, and not every sample was good. "There were times when we thought our samples weren't surviving the trip, so on one occasion Oleg actually traveled to Pittsburgh with all of our equipment to make the sample there," recalls Bakac. "It's been rocky at times, but we knew we had something special, and that kept us going."

In addition to ruling out iron(IV) and indirectly establishing OH radicals as the Fenton intermediate, Bakac and Pestovsky's research shows iron(IV) to be a very useful chemical species. "The fact that iron(IV) is very short-lived doesn't matter because in catalytic reactions you make it in situ and use it immediately," says Bakac. "There are certainly situations in chemistry and biology where various iron(IV) complexes, including our aqueous iron(IV), may be involved," she suggests, then adds, "just don't go searching for iron(IV) anymore in Fenton chemistry." ■

~ Saren Johnston

Flu Shot Notice



Occupational Medicine will provide flu shots to faculty and staff from 10 a.m. to 4 p.m. weekdays, Nov. 2-18. (Please note that no shots will be given on Tuesday, Nov. 8, due to a room scheduling conflict.) The flu shot clinic will be held in 205 TASF.

The immunizations are provided by ISU at no cost to employees. Flu mist will not be provided this year. For more information regarding the flu shots, call 294-0874.

"Easy Ways to Save Energy" Campaign

On October 3, 2005, U.S. Energy Secretary Samuel W. Bodman announced the senior leadership of DOE would travel the country as part of this comprehensive, national campaign to educate American families, businesses and government agencies on "Easy Ways to Save Energy." The campaign features:

- An informative "Energy $avers" guide outlining easy ways to improve home energy efficiency available through the Department of Energy, or, online at *www.energysavers.gov*.
- An aggressive public education effort including online, print, radio and television ads featuring the "Energy Hog" - a character similar to McGruff the Crime Dog and Smokey the Bear.
- An "Energy Hog" curriculum to be used by teachers in grades 3-8 featuring web-based games and take-home activities.
- A series of radio public service announcements in English and Spanish featuring energy saving tips that have been distributed to 4,500 stations across the United States.

Easy tips for consumers include:

- Making sure your home is properly insulated. Proper insulation in attics, ceilings, floors, crawlspaces and exterior and basement walls can save 30 percent on home heating bills.
- Installing a programmable thermostat and turning it down from 72 to 65 degrees for eight hours a day will save up to 10 percent on your heating bill.
- Replacing existing light bulbs with Energy Star® qualified fluorescent lights in the lamps and fixtures in your home; this can save up to 50 percent on lighting costs.

For more on the Department of Energy's "Easy Ways to Save Energy" campaign, visit www.energysavers.gov or call DOE's Energy Efficiency and Renewable Energy toll-free hotline at 1-877-EERE-INF (1-877-337-3463).

R&D 100 Awards

The application for the 2006 R&D 100 Award competition is available on the *R&D Magazine* Web site: *http://www.rdmag.com/awards.aspx.* Public Affairs can assist with various aspects of the application process. If you're thinking about entering the 2006 R&D 100 Awards, please contact Saren Johnston at 4-3474 or *sarenj@ameslab.gov*.

Like Science, Love Kids? Volunteer for Science Bowl Jan. 28

There's still time to throw caution to the wind and volunteer for the annual AmesLab/ISU High School Science Bowl to be held Saturday, Jan. 28, in the Memorial Union. Come on – if you've never volunteered, you know you've always wanted to try it. We'll train you. And if you're a past volunteer, you know you'll want to participate again.

Don't wait – sign up now to be a moderator, judge, timekeeper or scorekeeper at Iowa's premier math and science competition. You don't have to be a scientist to participate, you just have to complete and submit the volunteer form at *http://www.external.ameslab.gov/sbvolunteer.htm* by Friday, Nov. 18.

See you at the Bowl – Science Bowl, that is!

Holiday Auction Items Roll In

Donate a service to boost auction proceeds

For the fourth straight year, Ames Lab and IPRT employees will show their holiday spirit by holding an auction of donated goods and services. The beneficiary of this year's auction, set for Dec. 7, will be the Mary Greeley Israel Family Hospice House.

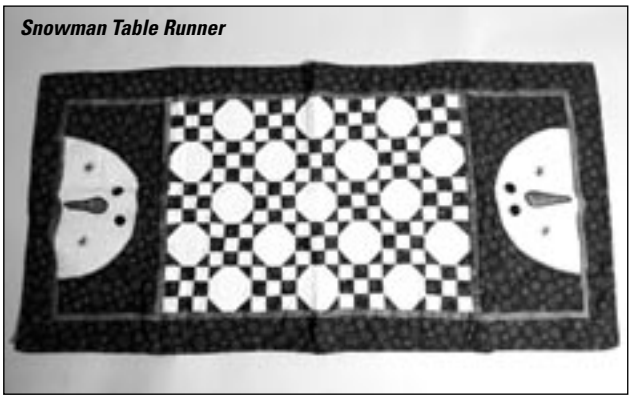
Since its inception, the auction event has raised more than $3,500 and benefitted Youth and Shelter Services, Beloit Residential Services, and the ARC of Story County. A number of items, some pictured below, have already been donated, but more items are needed.

Millions of Cats Blanket

The live auction also needs additional "big ticket" items, such as the Wine Tasting Party sponsored by Ila Huagen, Deb Covey and Saren Johnston; the Dinner Party sponsored by ESH&A staff; Carol Mack's cheesecake; or the body massage by Phyllis Mann. So think of something you like to do that you could offer. Some possibilities might include:

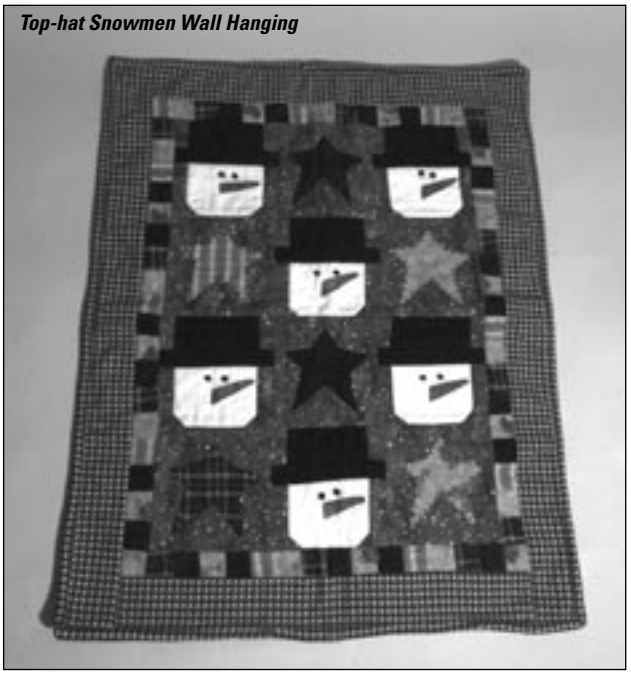
- Detail a car (for you car buffs out there)
- Organize a closet
- Paint a room
- Vacation-sit a pet
- Put together a scrapbook/photo album
- Trouble-shoot someone's home computer
- Babysit for an evening
- Snowblow a driveway
- Alter/hem a garment

Holiday Bunny?



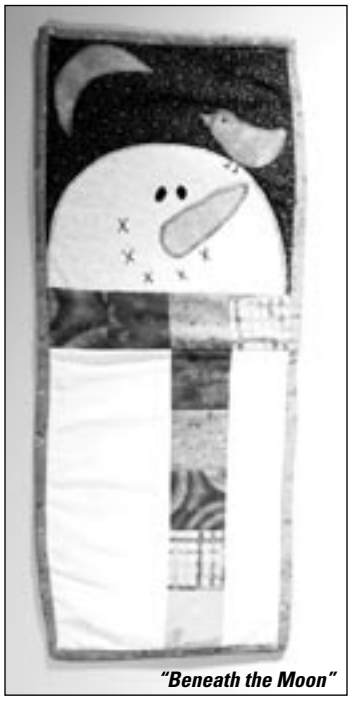
Snowman Table Runner

Decorative Pillow



Top-hat Snowmen Wall Hanging

Cat Bag



"Beneath the Moon"

In Honor of Veterans Day - Nov. 11

Guarding the Tomb of the Unknowns

Most of us are familiar with The Tomb of the Unknowns, also called the Tomb of the Unknown Soldier. Located near the center of Arlington National Cemetery overlooking Washington, D.C., the Tomb is a popular tourist attraction. More than four million people visit the hallowed burial ground annually.

The Tomb of the Unknowns rightly evokes feelings of patriotism and thoughts of both gratitude and loss. As we approach Veterans Day on November 11, sharing some information about the Tomb and those who guard it seems appropriate.

Surprisingly, the Tomb of the Unknowns has never been officially named. It contains the remains of unknown soldiers from World Wars I and II, the Korean Conflict and (until 1998) the Vietnam War. (In 1998, DNA analysis provided the identity of the Vietnam Unknown. His remains were returned to his family and were buried in his hometown.)

The Tomb has been guarded every minute of every day since 1937 – regardless of weather. The Sentinels who guard the Tomb, all volunteers, are considered to be the best of the elite United States 3rd Infantry (The Old Guard), headquartered at Fort Meyer, Va. A Sentinel takes 21 steps during his or her walk across the Tomb of the Unknowns. This corresponds to the 21-gun salute, America's highest military honor.

New Sentinels learn the history of Arlington National Cemetery and memorize the grave locations of nearly 300 veterans. They also learn the guard-change ceremony and the manual of arms.

After several months of serving, the Sentinels are tested to earn the privilege of wearing the silver Tomb Guard Identification Badge. The would-be badge holder must get more than 95 percent correct to succeed. One of the Army's rarest emblems, the Tomb Guard Identification Badge features the inverted laurel and a replica of the east face of the tomb where Greek images represent the virtues of victory, valor and peace. ■

"Here Rests In Honored Glory An American Soldier Known But To God"

INSIDER

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