Popeye Power for the Future

Remember Popeye, the squinty-eyed cartoon sailor with bulging forearms and a corn-cob pipe? Popeye always had a ready solution when he needed an infusion of instant energy. He simply gobbled down a can of spinach.

Earlier this year, ASU scientists combined biology and electronics to create the world's first bionic photosynthetic energy system. They used an enzyme of spinach to get the job done. The researchers built a cell-like machine that mimics biological photosynthesis, the process that powers all green plants on Earth.

ASU chemists Ana Moore, Devens Gust, and Thomas Moore reported their work in the April 2 issue of the international journal *Nature*. They developed their system with assistance from ASU post-doctoral researchers Gali Steinberg-Yfrach and Edgardo Durantini, and with Jean-Louis Rigaud of the Curie Institute in Paris, France.

The new system duplicates a plant's ability to capture energy from sunlight and harnesses this energy for human manipulation. The scientists built an artificial membrane-based system that uses light to power the production of adenosine triphosphate (ATP). ATP is the carrier of chemical energy in all living organisms.

To mimic nature's biological engine, the scientists devised a chemical system that pumps protons across a membrane from the outside of a cell to the inside. The pumping action creates an imbalance in proton concentration across the membrane. As a result, the protons flow through a protein and generate biological energy.

"Our focus was on how to capture solar energy and convert it to a useful form in the same way that photosynthesis does," Gust explains. "We are tying to see how far we can go in mimicking the way photosynthetic bacteria convert light energy into ATP chemical potential. Living organisms have been doing this for billions of years. But this is the first time humans have been able to get it to work."

The technology has potential ramifications that rival the way 1960s semiconductor research at Stanford University led to the birth of the Bay Area's Silicon Valley.

"The photosynthesis research at ASU could help to drive the 21st century economy of central Arizona," says Jonathan Fink, ASU's interim vice provost for research.

The Moores, Gust, and dozens of ASU students have experimented with artificial photosynthesis for 20 years. During the past 18 months, they have validated the ability to copy the process of capturing light energy, the first step in developing an artificial power system.—Dennis Durband

For more information, contact ASU's Center for the Study of Early Events in Photosynthesis at 602.965.1963. Or visit via Internet: http://photoscience.la.asu.edu/photlsyn/

Optical microscope image of B_6O particles.

Making the Hard Stuff

You want the hard stuff? ASU scientists know how to make the hard stuff. In fact, they recently took an indirect route to create the world's third-hardest material.

Postdoctoral students Hervé Hubert and Laurence Garvie intended to make B_2O, a potentially ultra-hard material. Instead, they created a material that could replace diamond and tungsten carbide in specialized technological applications.

The researchers synthesized a low-density compound of boron suboxide (B_6O). The only harder materials are diamond and cubic boron nitride.

The new material has several unusual properties. The compound crystallizes (under the applied conditions) as particles up to 30 micrometers in diameter—about 1/1,000th of an inch. Each looks like an icosahedron, a solid figure with five-fold symmetry and 20 triangular faces.

Some viruses display this shape on a much smaller scale.

Paul McMillan, director of ASU's Center for Solid State Science, says that the material is the largest known icosahedral particle.

Several useful applications are possible. The boron suboxide surface wears evenly, so it can be used as an abrasive. It might also work as ball bearings, as a substitute for diamond, or as a cutting tool.

The new material also has potential use in the semiconductor industry. The arrangement of atoms in the boron material gives it interesting electronic properties. Boron suboxide also is stable at high temperatures. Diamond is not.

Hubert and Garvie mixed boron and boron oxide in varying proportions under pressure 50,000 times greater than atmospheric pressure at sea level. The mixing also took place at temperatures hotter than 1,700 degrees Celsius (3,092 degrees Fahrenheit). The tiny orange-red grains formed 30 minutes after the mixing, heating, and intense pressure.

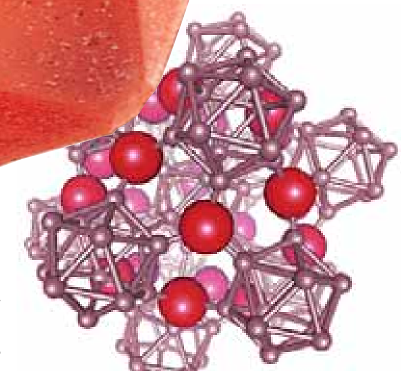
"We were not looking to make this kind of external form," Hubert says. "We were looking to form a pure material and trying to grow boron suboxide single crystals. We stumbled on this by accident. At first, we did not understand how these icosahedra could form."

Scanning electron micrograph of an B_6O icosahedra some 9 micrometers wide. The image is colorized.

"The material is prepared in a bulk powder form. But much more work is needed to make it in a thin film form that is potentially interesting for the semiconductor industry," Hubert explains.

In addition to Hubert and Garvie, ASU scientists McMillan, William Petuskey, Peter Buseck, Michael O'Keeffe, and former postdoctoral researcher Bertrand Devouard all participated in the research.—Dennis Durband

Images courtesy Hervé Hubert, Ph.D.



Structure model of B_6O shows oxygen atoms (red), and boron clusters.

Materials science research at ASU is supported by the National Science Foundation. For more information, contact the Center for Solid State Science, 602.965.4544. Or visit via Internet: http://www.asu.edu/clas/csss/

A Furry Factory Against Scary Scorpions

Pamela is a regular blood donor, just like millions of Americans. In fact, she has donated more than eight gallons of blood during her 15-year career. Pamela's donations have saved lives.

Another Red Cross volunteer? Another conscientious citizen? Not quite. Pamela is a goat. She also is a bioengineering marvel that might save your toddler's life. You see, Pamela's job involves saving people from scorpions.

Pamela works for the Antivenin Production Laboratory at Arizona State University. She specializes in manufacturing an antivenin. Scorpion antivenin is a medicine used to combat the potentially life-threatening effects of a bark scorpion's stings.

Bark scorpions *(Centruroides sculpturatus)* are tiny desert creatures that pack a big punch. Their sting brings pain and numbness. The sting is also potentially deadly. In Mexico, for example, people—mostly small children—still die each year after being stung by scorpions.

But in Arizona, there has not been a single documented scorpion sting-related death for more than 30 years. Work by Pamela and her anti-venin producing ancestors is partly responsible for that happy record.

Pamela's boss is Marilyn Bloom. Bloom is an ASU research specialist who specializes in immunology.

According to the Arizona Poison Control Center, nearly 5,000 people get stung by scorpions each year in Arizona. Most stings occur in Phoenix, Tucson, and other metropolitan areas where rapid growth continues to displace the 36 species of scorpions that call Arizona and the Sonoran Desert home.

Bark scorpions are the most common Phoenix-area sting offenders. Unfortunately, bark scorpions also are the only species of Arizona scorpion considered "potentially medically important," or potentially fatal, according to Bloom. Those facts amount to a good news-bad news scenario.

Pamela gets a bit of posing assistance from Marilyn Bloom.

John C. Phillips Photo

The good news is that bark scorpions are only found in Arizona, Mexico, and a fringe area of New Mexico. Here in the United States, at least, antivenin is readily available.

The bad news is that nearly five percent of all people who get stung by bark scorpions suffer severe reactions to the sting. Those reactions can be life threatening, especially in young children or elderly victims.

A common scenario might unfold as follows. A cheerful toddler transforms into a child who is racked with pain. Her eyes or face begin to twitch. Her limbs go numb. Swallowing becomes increasingly more difficult. The child may vomit. As tiny eyes roll back into her head, the parents panic. They remain absolutely clueless as to the cause of all this pain.

There is neither swelling nor a mark where the child was stung.

They do not know it yet, but the parents owe Pamela the ASU goat a debt of gratitude.

Antibodies created by her body and processed from her blood into an antivenin serum await the sting victim at the hospital. The antivenin is stored in tiny five-milliliter vials.

One of the tablespoon-sized amounts of antivenin will be injected into the child. Twenty or 30 minutes later, the terrorized toddler will almost certainly start transforming back into a cheerful child. If not, a second dose will do the trick. The child should be able to go home the same day.

Bloom and Pamela create antivenin in partnership. Bloom provides the expertise, Pamela the biological magic.

The process begins when Bloom injects Pamela with a small, diluted dose of bark scorpion venom. Bloom knows that the doses she gives Pamela must be very small because bark scorpion venom is a neurotoxin. Neurotoxins are poisonous proteins that attack the nervous systems of both animals and humans.

By injecting only a small, oil-diluted dose of venom, Bloom ensures that Pamela does not suffer the same painful effects as a normal sting victim.

Bloom further protects Pamela by injecting the venom into her muscle. Since neurotoxins spread quickly through the series of nerves located just under the skin's surface, they tend to shock the system when they hit. Injecting the venom deeper into muscle slows the rate it is absorbed by the goat's body. Bloom's precautions allow Pamela's body to process the venom gradually.

Bloom typically injects Pamela once a week for about four weeks. The goat's body reacts to the venom—which is known as an antigen, or unfamiliar protein—by producing antibodies.

Antibodies are the product of an immune system reaction similar to the reaction that happens when humans are given a flu shot or other type of vaccine. Pamela's immune system automatically manufactures the antibodies to protect itself against the venom's neurotoxins. The antibodies circulate through her bloodstream.

After several weeks and many injections, enough antibodies are present in Pamela's blood to begin the sequence of donations. Bloom draws a cup of blood in a process that is similar to a human blood donation, then races with the sample to her lab.

In the laboratory, the collected blood is allowed to clot. Allowing the blood to clot makes it easier to separate the solid red and white blood cells from the serum, or liquid part of blood. The serum contains the antibodies to bark scorpion venom.

Bloom uses a centrifuge to spin the blood sample at very high speed. During the centrifuge process, Pamela's blood separates into its solid and liquid parts. The pure goat serum is then filtered, sterilized, bottled, and frozen.

Bloom repeats this process once a week for several weeks each winter. Pamela and three other special ASU goats are the lifesaving donors.

Once enough serum has been made to meet the pending seasonal demand, Bloom sends it to a medical laboratory for packaging. The goats and Bloom's handiwork will be in Arizona hospitals and clinics by early March—just in time for the onslaught of warm weather-related stings.

—Lindsey Michaels

For more information about work at the Antivenin Production Laboratory, contact Marilyn Bloom, Department of Microbiology, at 602.965.6443. Send E-mail to Marilyn.Bloom@asu.edu.

Teaching the World's Teachers

Your sleek F-16 fighter plane rolls off the IP, on course toward target. The machine is 12 tons of metal, wire, high tech composite material, and jet fuel hurtling along at 600 miles per hour.

Adrenaline pumps but you hold the sensitive sidestick with a feather-light touch. Your eyes swivel with your neck braced against g-forces: you scan terrain and sky through the flight information glowing on the HUD. The bearing cursor pins the target ahead. Check range. Pitch up in a straining 4-g climb. Roll with the target coming into view over your shoulder. Roll out, steer the LOF across the target, and... weapons release. Your target boils up into smoke and debris.

The action must be taking place high above the parched terrain of some Middle Eastern desert. Or perhaps near the treetops of some Asian jungle? Maybe above a placid blue ocean?

Wrong. Wrong. And wrong. Every bit of action occurs right inside an office at Arizona State University's East Campus.

Inside that office, four talented young men have designed a leading edge multi-media educational program for Air Force pilots. Dubbed "War in a Box" by its creators, the system includes a computerized briefing, minute-by-minute fly through, and a step-by-step mission debriefing capability. In addition to high performance fighter aircraft, the flight training program also works for jumbo C-130 transport planes, A-10 ground attack fighters, and many other aircraft.

"Our job involves building a computerized shell or backbone system that the Air Force can use to train for multiple missions," says Karim Gayraud. "Because we obviously don't have the security clearance or desire to input the details of real missions, we have designed our program so that Air Force personnel can do that for themselves."

Gayraud is a member of the ASU Digital Media Technology Group. He says that most Air Force missions start with digital data that is downloaded from satellites and other information sources. Squadron commanders then hand out mission specifics to each pilot in printed form. Demonstrating how all those assignments fit together is then done using decidedly low-tech methods: handheld models or chalkboards.

With the War in a Box format, the Air Force can download data directly to computer disks. The disks allow commanders to present the situation visually, using up to three films and a narrative simultaneously.

They also can demonstrate items such as forces, faces, and integrated flying formations using 3-D images. As a result, pilots can see their exact target and air defenses surrounding it, the terrain, and both the waypoints and formations they and other members of their squadron must navigate.

Each pilot can then use his disk to "fly," step-by-step, through his exact portion of the mission. Terrain details are both vivid and exact throughout the flight, thanks to data that is downloaded from Geographical Information System sources.

Three-dimensional views of planes, terrain, and ground items—including shadows—even change perspective as the plane flies. The system was also designed to allow on-the-spot replays.

"Instructors used to have to climb into the simulator with the student to review the flight. And as soon as the next guy came in, that flight record was erased," explains team member Shane Edmonds. "Our system lets the pilot bring a complete record of the flight, right down to where his eyes were looking at each instant, back to an electronic debriefing."

By projecting multiple flight recorder disks simultaneously, the squadron commander and pilots can watch the entire mission as it unfolds.

Far from a CD-based aviator game, the War in a Box program relies upon complex Internet and network-type multi-media technologies—complete with sophisticated security encryption capabilities. War in a Box was even featured during the Air Force's gala 50th Anniversary celebration festivities.

The ASU researchers must now work to make the program more "real time," Gayraud says. That is because the Air Force eventually wants to beam up-to-the-minute weather change data directly to cockpits.

Air Force commanders also want War in a Box training accessible via laptop computers so that pilots can practice out of class—no matter where in the world they might be at any given time.

"War in a Box is a glitzy attention getter. But it's actually just the first step toward the Air Force's Squadron 21 project," says Gary Grossman, associate professor of information and management technology and director of the International Projects Unit at ASU East. Squadron 21 refers to the Air Force's goal of putting military operations on-line as much as possible.

"Operating an Air Force base is extremely intricate and involved. It's much like running a small city," Grossman says. "Our goal is to develop a computerized backbone system that allows on-line accessibility for everything from training to housing to maintenance and scheduling by anyone from anywhere. Access would be bounded only by each person's security clearance."

Learning Skills And River Dynamics

In traditional science classes, instructors teach techniques and logical thinking skills by having students perform specific experiments and exercises. In most cases, the instructor already knows the results. Real science, however, probes into dark, ambiguous areas where things are not understood. It is much too uncertain and confusing an operation for the classroom.

But does it have to be that way? William Graf decided to try an "academic experiment" of his own.

The ASU Regents Professor of Geography used his Geography 598 class as the laboratory. "Geographic Information Analysis" is designed to teach students how to use Geographic Information Systems software, a key tool for professional geographers.

Graf used the class to focus

For example, the base commander could easily access whatever he needed, the housing officer what he needed, etc.—all on computer screens. All of which would make training military personnel and tracking things much, much easier, Grossman maintains.

The media group that created War in a Box is actually just one small part of Grossman's International Projects Unit. That unit's main focus is global educational concerns.

"The International Projects Unit was conceived as a means by which ASU could deliver its tremendous talents and resources to the world," Grossman explains. Many developing nations believe that educating people is the key to sustaining long-term economic growth.

"Say what you will about the U.S. education system, but with regard to teacher education, it's considered better than any system in the world at providing a means by which the masses of society can be reasonably well educated," Grossman adds.

Many countries are eager to learn our teacher education methodologies and models, not just content materials. All of which, Grossman says, gives ASU a chance to have a tremendous impact globally.

The ASU International Projects Unit is already partnering with governments and businesses in Turkey, Thailand, India, Moldovia, and Malaysia on major educational projects.

In so doing, its members are often called upon to identify related needs and locate potential business allies. As a result, businesses that are interested in global expansion can often gain valuable introductions and insight through the ASU group.—Lindsey Michaels

For more information about the ASU International Projects Unit, contact Gary M. Grossman, Ph.D., College of Technology and Applied Sciences, 602.727.1533. Send E-mail to: Ggrossma@imap1.asu.edu

Probing and Poking Mars

Scientists plan to prod and poke the surface of Mars to learn more about its temperature. Two high-tech instruments called microprobes will ride aboard the Mars Polar Lander. The spacecraft is due for a January 1999 launch.

Scientists will use two microprobes to measure the red planet's thermal conductivity. They want to know exactly how fast heat travels in the materials of which Mars is made.

Marsha Presley is an expert on Martian thermal conductivity. An ASU geology department research associate, Presley is one of nine researchers on NASA's Deep Space-2 Mars Microprobe science team.

Presley says that the project is designed to provide a glimpse at the subsurface of Mars. That glimpse may open a window into the planet's history. By studying the history of Mars and its climate, scientists hope to gain better understanding of the more complex system here on Earth.

When the Mars Polar Lander arrives at Mars in late 1999, two basketball-sized aeroshells carrying the microprobes will deploy from the spacecraft. The aeroshells will crash into the South Polar Region of Mars at 400 miles per hour and shatter on impact. The microprobes will be driven into the planet's surface.

The microprobes are less than 18 centimeters in length. After insertion, they will extend one component up to six feet beneath the planet's surface. A second component, tethered to the first, will remain at the surface.

The microprobes are designed to operate for 50 hours in temperatures as low as -180 degrees Celsius (-292 Fahrenheit). The devices will search for evidence of subsurface water ice. They also will provide data that allows scientists to characterize both the thermal and physical properties of the dirt. Presley's job is to translate that data into meaningful information. —Dennis Durband

Mars-related research at ASU is supported by NASA and the National Science Foundation. For more information, contact the Department of Geology at 602.965.5081, or visit via Internet: http://europa.la.asu.edu/

students' efforts on a serious research question being asked by the Central Arizona-Phoenix Long Term Ecological Research (CAPLTER) project. The project is an ongoing, revolutionary study of urban ecology funded by the National Science Foundation.

"We looked at the Salt River where it runs through metropolitan Phoenix and tried to answer some critical questions," Graf explains. "How has the Salt River's channel changed over the past 60 years? And what caused the change?

"Further, as a scientist and educator, it was an experiment to see if I could really do what we say we can do—combine research and teaching," Graf adds.

During the project, the students learned how to use a complex Geographic Information System software system called "Indrisi." Teams of students analyzed separate 1.5-kilometer "reaches" of the river. They used the software and any data they could glean from historical records, aerial photographs, and site visits. In the end, each team presented its findings to a meeting of the 50-scientist CAPLTER team.

"We took the students from a cold start and had to produce scientific results in 15 weeks," Graf says.

The findings have interesting implications that may affect future CAPLTER research. In each of seven reaches, the students found that the river had changed from a spreading, meandering channel with islands and sandbars, to a dramatically narrower, straighter channel. The result is a faster running river that now takes soil away rather than depositing it. In areas where the river has deposited rock and topsoil for millennia, it now carves an increasingly deeper bed.

One of the key sources of information was the map library at ASU's Noble Library. The collection includes a series of aerial photographs showing the river as it existed over a period of time going back to 1935.

"We imported that information into our GIS. The students used that system to analyze and make statistical summaries," Graf says.

There was plenty of fieldwork as well. Student teams spent weekends running around the river bottom. Teams visited gravel miners, gained access to mines, talked to property owners, and investigated hydrological records at Salt River Project, a major power and water utility in the Phoenix area.

The cause of the change is, not surprisingly, human influence. In the upper urban reaches, gravel mining is responsible, accelerated by rapid Valley growth. As the river proceeds into the heart of Phoenix, city development has artificially "streamlined" the river area, straightening and narrowing the channel. As the river reaches the city's west side, increased velocity causes it to carve a channel all on its own.

"The class developed a great deal of confidence in these students," Graf says.

This educational "experiment," the professor would argue, is one that bears repeating.
—James Hathaway

Looking for Life Beyond the Earth

Understanding the nuances of life is essential if the goal is to find new life forms, particularly when the search extends to hostile alien environments.

For years, ASU scientists have engaged in a disparate, but broad-based search for ancient and current life forms, both on Earth and throughout our solar system. They use a variety of advanced technologies as they search, ranging from sophisticated molecular analysis techniques, to robots and advanced sensors for exploring distant planets and moons.

Regardless of their discipline, however, the central unifying question has always been the same: Does life exist beyond the Earth?

Now, thanks to a new NASA research initiative, the once disparate efforts of ASU researchers will be connected by more than similar goals. Earlier this year, ASU was one of five university partners selected for membership in NASA's new "virtual" Astrobiology Institute.

The institute will coordinate ongoing ASU research with the work of scientists at other institutions around the country. The Astrobiology Institute plans to take advantage of the next generation of Internet technology. It will be administered by the Ames Research Center in California, NASA's center of excellence for astrobiology and information technology.

The new institute will use Next Generation Internet (NGI) and advanced telecommunications to link together the investigators and students at separate member institutions around the country. The NGI will also be used to speed the development of many "virtual" institute activities, and to advance research and education in astrobiology.

"I'm excited for the whole university," says Jack Farmer, who coordinated the successful ASU proposal. Farmer joins ASU this fall as a professor of geology after working as a research scientist with the exobiology branch of the NASA Ames Research Center.

Looking to the future, NASA's new initiative and ASU are a natural fit, says Jonathan Fink, ASU's interim vice provost for research.

"ASU's participation in the NASA Astrobiology Institute places Arizona in the forefront of a world-class research effort to study life in the universe. Recent discoveries of organisms that exist in extreme environments on Earth, together with the discovery of planets in other solar systems and the evidence suggesting that water is present elsewhere in our own solar system hint at the possibility that life may exist elsewhere," he says.

"We will be exploring how life might develop in nonterrestrial environments. In the process, we hope to gain new insights on how life developed on Earth."
—James Hathaway

Garbage Shines Like Gold When Digging for History

History seldom arrives on a silver platter. Some days you dig it up.

While excavating the Canaanite farming village of Tell Abu en-Ni'aj (Arabic for "Mound of the Father of Ewes") in the Jordan Valley, members of an ASU winter field school uncovered clues that may help explain the origins of ancient civilization.

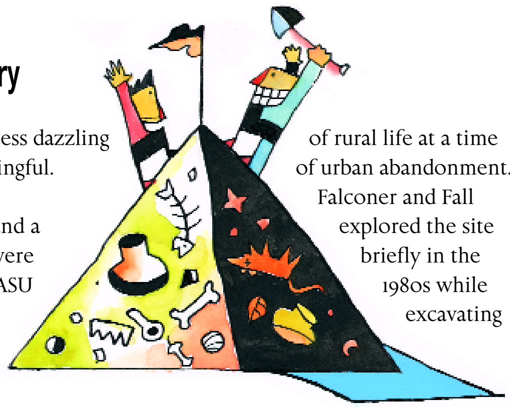
"If you're looking for the foundation of society, it might be found more readily in the countryside than in the city," says Steven Falconer, associate professor of anthropology.

Falconer codirected the field school with geography professor Patricia Fall and Jennifer Jones, an anthropology doctoral candidate. Nine undergraduates were among the 20 ASU students who attended the four-week field school in 1997.

The 4,000-year-old historical clues the team dug up did not come from crumbly tablets or solid-gold statuettes. They came from something less dazzling but no less meaningful.

Garbage.

Almost a ton and a half of artifacts were shipped back to ASU for analysis. The pile of stuff consists mostly of animal bones, broken pottery, fragments of stone tools, and plant remains such as burned seeds.



"All this material is basically Bronze Age garbage," Falconer says. "But this garbage is very eloquent. It tells us something about the foods these people ate, the products they manufactured, and the way they used the landscape around the site. So we try to assemble this fairly unglamorous data to talk about everyday life. That's our goal."

So far, the researchers have found some surprising results.

Located in northern Jordan near the Israel border, Tell Abu en-Ni'aj offers archaeologists a rare glimpse of rural life at a time of urban abandonment. Falconer and Fall explored the site briefly in the 1980s while excavating the nearby village of Tell el-Hayyat ("Mound of the Snakes"), which flourished later during an urban heyday.

The purpose of the field school was to gather data to compare and contrast the sites, Falconer says. Members expected to see a tale of two villages.

Instead, they discovered that the communities shared much in common. For example, very few bones of wild animals were found at either site, suggesting that the inhabitants were dedicated farmers at both places and times. Plant and animal remains also corresponded.

"The similarities between the two sites have led us to argue that there's a resilient element of rural village life that persists whether there are cities or not," Falconer says. "This suggests that in some parts of the world perhaps cities don't figure quite so crucially in the life of everyday people as they do elsewhere."

More than 500 people lived at Tell Abu en-Ni'aj from 2300 to 2000 B.C. "They're the Canaanites you read about in the Old Testament," Falconer adds.

What are the ultimate implications of snooping through these mounds of garbage?

"I like to think that we're able to illuminate this part of ancient civilization that otherwise we wouldn't know much about," Falconer said.—Erik Ellis

The Jordan Valley Village Project is supported by the National Geographic Society, the National Science Foundation, and the Wenner-Gren Foundation for Anthropological Research. For more information, contact the Department of Anthropology at 602.965.6312. Or visit via Internet: http://www.asu.edu/clas/anthropology

Excavating McEntee

A Jervis McEntee landscape is a window to a simpler era. The artist's intimate portrayals of northeastern America evoke a sense of nostalgia, heightened by the melancholy cast of his dusky, autumnal scenes.

As a painter in the mid-19th century, McEntee may well have understood this nostalgia. The Civil War and its aftermath was a time of great disruption and dislocation in America. As the nation transformed into an industrial society, McEntee's paintings "satisfied a need among an urban, educated public for vicarious visual escape," says J. Gray Sweeney, a professor of art history at ASU.

Sweeney describes the historical and social context of McEntee's work in his lavish full-color catalogue for the exhibition, "McEntee and Company," which was displayed earlier this year at the Beacon Hill Fine Arts Gallery in New York. The catalogue is the first scholarly study of this Hudson River School painter.

Beacon Hill Gallery sought out Sweeney for his expertise on 19th century American painters, which includes a study of Thomas Cole, founder of the Hudson River School. Sweeney says that the collaboration was an excellent opportunity for him.

"This is the first time a major New York art dealer has come as far as Arizona for scholarly expertise," says Sweeney. "They are one of the top galleries in New York that deal in historic American paintings. I knew their reputation and that previous publications they'd done were impeccable."

For the exhibition, Sweeney dug up information on McEntee that he had collected since the mid-1980s. He describes the study as an example of the "new" art history, a "synthesis of biographical, institutional, cultural, political and economic readings of the artist."

McEntee's diary, an important document in American art history, provides critical information in the catalogue. According to Sweeney, the diary offers "a rare psychological insight into the mind of the artist." For example, McEntee writes:

"I look upon a landscape as I look upon a human being—its thoughts, its feelings, its moods, are what interest me; and to these I try to give expression. What it says, and thinks, and experiences, this is the matter that concerns the landscape painter."

Sweeney says that Beacon Hill's excellent reputation helped the gallery amass its impressive collection. Upon hearing about the exhibition, many collectors brought forth long unseen works for study. "It would have taken me years to find all the pictures that Beacon Hill produced in less than a year," Sweeney says.

—Diane Boudreau

Images courtesy J. Gray Sweeney, Ph.D., and Beacon Hill Fine Arts Gallery

Above: *Autumn Landscape*, c.1868, oil on canvas, 30 x 54 inches. CIGNA Museum and Art Collection.

Left: *Seaside Landscape*, 1873, oil on canvas, 24 x $42\frac{1}{2}$ inches. Mead Art Museum, Amherst College.

Below: *Autumn*, c.1862, oil on canvas, 18 x $15\frac{1}{8}$ inches. Century Association.

For more information on "McEntee and Company," contact Gray Sweeney, Ph.D., School of Art, at 965-1677. Send E-mail to: ifgxs@imap1.asu.edu.