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The University of Montana comprises the College of Arts and Sciences and professional schools of Business Administration, Education, Fine Arts, Forestry, Journalism, Law, and Pharmacy and Allied Health Sciences. In addition, we maintain twenty-four research units consisting of specialized laboratories, institutes and centers. Off-campus facilities include the Biological Station at Yellow Bay on Flathead Lake in northwestern Montana, the Lubrecht Forest, which is the experimental forest for the School of Forestry east of Missoula, and the Geology Field Station in southwestern Montana. The University also maintains a Graduate School of Business Administration on the Malmstrom Air Force Base in Great Falls, Montana.

Our faculty consists of approximately 460 scholars working with some 7,200 undergraduate students and 1,800 graduate students.

This publication illustrates examples of current research and creative activities at the University in the arts, the sciences and the professions. Within this diversity, there is a strong unifying thread of service to the people of Montana, in addition to individual contributions to various scholarly disciplines.

Service to the state and the region through encouraging economic development has become one of the major missions of the University. The first two major awards made by the Montana Science & Technology Alliance, a state-supported organization dedicated to supporting economic development, were made to companies that have worked closely with the University. Both ChromatoChem, a new company developing affinity chromatography for the separation of extremely pure chemicals, and Alternative Diagostix, a new Western Montana company that plans to market self diagnostic devices for venereal disease, have worked with the University, and the University looks forward to mutually supportive arrangements with these companies. University research in the biomedical area contributed to the decisions these companies made to locate in our state. In addition, we have seen several examples where other activities of the University, particularly in the arts, have helped companies located in the Missoula area recruit outside talent.

The University of Montana Campaign has been extremely successful in developing support for named professorships. In addition to new professorships in forestry and business, two additional research professorships have been announced. The Boone and Crockett Club, a national organization founded by Teddy Roosevelt 100 years ago and dedicated to conservation and the publication of North American big game trophy statistics, will fund a professorship in wildlife. Dr. Jessie Bierman has established a professorship in limnology at our Yellow Bay Biological Station. The first recipient is Jack Stanford, director of the station. Both the Boone and Crockett and Bierman professorships strengthen two of our strongest research programs and offer great promise for the future.

Raymond C. Murray
Associate Vice President for Research
and Dean of the Graduate School
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Recognizing that the vitality of a university depends greatly upon the quality of its research and other creative endeavors, the University of Montana treasures its outstanding scholars and artists. Each year at commencement one of that estimable company receives the Distinguished Scholar Award for achievement in research and creative ability. First given in 1980, the award carries a $1,000 honorarium from the UM Foundation. Recipients are selected by the University Research and Creative Activities Committee from faculty nominated by their schools and departments.

1983: Richard Field, Professor of Chemistry

Field's experiments are models for oscillating systems in engineering, physics, biology, medicine, economics and other areas, and his research has broad philosophical and practical implications. Applications of his work to fields outside chemistry are possible because of his success in extracting fundamental principles of oscillation from chemical reactions. One of a handful of physical chemists doing such research, he is often invited to speak at national and international scientific meetings. He spent the 1985-86 academic year as a guest of the German government at the University of Würzburg, where he was a visiting professor and researcher.

1984: Rudy Autio, Professor of Art

Autio, born in Butte, and Peter Voulkos, born in Bozeman—among the most influential figures in the development of American sculptural ceramics—worked together in Helena in the 1950s at the Archie Bray Foundation, which Audio directed until he came to UM in 1957. Autio's art has taken diverse forms, including large-scale relief murals for buildings. Recently, he has concentrated on hand-formed, slab-constructed, brush-decorated stoneware pieces. Whatever his medium, he draws inspiration from and uses materials of his native landscapes. A retrospective of the celebrated ceramic sculptor's work from 1952 to 1983 toured the United States in 1983-84.

1985: Donald Hyndman, Professor of Geology

Much of Hyndman's research concerns the origin and evolution of granitic magma that rises to form stocks and batholiths, such as those found in the Bitterroot and Flint Creek mountain ranges. He also examines aspects of deformation and metamorphism that relate to granite. He has been a member of a National Academy of Sciences review board charged with examining radioactive waste-disposal practices in major industrial nations. He is the author of the leading and most authoritative text on petrology (the study of rocks) available today.

1986: Jesse Bier, Professor of English

A noted expert on American humor, Bier is the author of the acclaimed book The Rise and Fall of American Humor. His other writings include many poems, articles and short stories, as well as the novels Trial at Bannock and Year of the Cougar. Two years ago, he was a featured speaker at the fourth International Conference on Humor in Tel Aviv, Israel. He recently completed a collection of critical essays and is working on a novel and a play.

1985: Fred Allendorf, Professor of Zoology

Head of the genetics laboratory in UM's zoology department, Allendorf specializes in evolutionary genetics. Using trout as his main research subject, he has studied the genetics of embryological development and the significance of genetic variation in natural populations. Another focus of his research is conservation biology, including projects related to preserving genetic variation in grizzly bears and native Montana trout. He has taught at Aarhus University in Denmark, done post-doctoral work at the University of Nottingham in England and been a visiting scientist at Stockholm University in Sweden and the University of California at Davis.
Lubrecht Experimental Forest

The University of Montana’s Lubrecht Experimental Forest, a 28,000-acre area located thirty miles northeast of campus, offers UM researchers a wealth of insights into natural-resource management.

Representative of the forest land of the northern Rockies, Lubrecht is the site of many studies done by the Montana Forest and Conservation Experiment Station. The on-campus research arm of the Forestry School, the station is the parent organization of the Mission Oriented Research Program (MORP)—another prime user of Lubrecht. Established by the state Legislature in 1981, MORP is charged with developing techniques for improving multi-resource production in second-growth Montana forests and for disseminating information to landowners on these techniques.

Current MORP projects at Lubrecht include research on thinning response, wildlife habitat, insect and disease mortality, and fire hazards.

Lubrecht is used by a number of groups besides the station and MORP. The facility is variously a residential camp for UM sophomore forestry majors, a training ground for firefighters and the classroom for short courses for professional foresters. UM graduate students from a variety of disciplines do research there, too, on subjects ranging from ant predation to elk.

Since 1983, Lubrecht has boasted the state-of-the-art Forestry Research Center. Built with private funds, the facility has been visited by almost 150 groups—just under 4,000 individuals.
Nestled on the eastern shore of Flathead Lake, about seventy miles north of Missoula, the University of Montana’s Biological Station at Yellow Bay is an ideal location for conducting basic freshwater research.

The 160-acre station has easy access to the Flathead River-Lake System, one of the largest pristine aquatic ecosystems in the world. The facility, the oldest active biological station in the country, is home to four permanent faculty members and four staff scientists, as well as graduate students and a support staff. A major thrust of the station’s work is examining the effects on freshwater plant and animal life of both natural and man-made disturbances, such as temperature variations and the introduction of non-native species.

A current project, funded by the Montana Power Co., is building a simulation model of factors controlling productivity in Flathead Lake. One aspect of this study is determining what causes algae growth in the lake.

The station is a classroom as well as an international center for ecological research. Each summer, UM undergraduate and graduate students enroll in eight-week courses in subjects such as lake ecology, field botany and aquatic insects. Winterized dormitories recently built at the station bring hope that winter courses may soon be available.

Other facilities include the technologically advanced Freshwater Research Laboratory, opened in 1981, and four laboratory buildings that house the inside course work and some summer research projects.
Crime solving is usually associated with the police, the sheriff or perhaps the FBI. Television projects images of fast action, violence and heady decisions in most of its cops-and-robbers shows. What is little recognized is the work of the many professionals behind the scenes in a field known as forensics—a science that deals with the application of medical facts to legal problems.

The University of Montana is the professional home of two nationally known forensics experts—Charline Smith, a forensic anthropologist, and John Wehrenberg, a forensic geologist. Both Smith and Wehrenberg lend their skills, knowledge and time freely to the state when called upon to assist in solving a crime or identifying skeletal remains. Working in the background, their findings can be the pivot point upon which a case might be won or lost.

Smith's work involves finding resolutions to nightmares—the living nightmares families and friends go through when a loved one has disappeared and is officially missing. As the state's only forensic anthropologist, Smith works through the office of Dr. Ronald Rivers, medical examiner for the state crime lab in Missoula. Smith studies skeletal remains only, while Rivers works with any tissue remains of the body.

The work is detailed and complex. Smith is able to determine the sex, age and stature of an individual from the skeletal remains and sometimes is able to be accurate about race. For example, male and female hip bones are shaped differently, says Smith, and their skulls can be different.

Race is a more difficult issue, since an interpretation of race depends on a combination of measurements and indices from the face and skulls of the victim. Comparing the measurements with average measurements for the race as a whole is not a guaranteed answer, Smith says, because "no one is average and everyone is different."

Smith can determine both major and minor injuries, as well as evidence of surgical procedures and accidents. She can tell if an injury occurred at about the time of death, although she cannot always determine whether the injury was the cause or the result of death.

The legal lines drawn at this point become very firm. Smith assesses neither the cause nor the manner of death. The cause of death is determined by Dr. Rivers, and the manner of death is decided by the coroner and the courts.

Occasionally Smith's work involves reconstructing the face of an individual for identification. The face is reconstructed with modeling clay according to standard tissue-depth measurements and bone structure. The two features that are never fully known are the soft-tissue areas of the nose and mouth. Smith says she and her students work to construct "generic" noses and mouths and hope the rest of the face is close enough to the person's looks to make identification possible. They attach a wig to the final model and photograph it in black and white so that colors and tones of the modeling clay and the eyes don't distract from the main image.
The rate of identification from a facial reconstruction is about 30 percent. As Rivers says, the only really positive means of identification are fingerprints, x-rays and teeth, and if any of these are available, they are combined with facial reconstruction as necessary to aid in identification.

Smith, who was a surgical nurse for nineteen years before completing her doctorate in anthropology, teaches classes in introductory anthropology, biological and medical anthropology, and human genetics at UM. She recently visited China as part of a U.S. delegation of forensic scientists invited by China’s Ministry of Public Security.

Smith’s work is undeniably fascinating and challenging, but the morbid nature of it might deter other individuals. Devoting a professional sideline to the study of human skeletal remains has not created a cynicism in her, however. Although she is “outraged and appalled at the things people do to themselves and each other,” Smith’s goal is to help give the victims’ families a knowledge of what happened to the person and a final resolution in their grief.

Following less morbid but equally detailed lines of criminal investigation is geology Professor John Wehrenberg, an expert soils examiner who is occasionally called upon to search for clues that might provide a convincing piece of evidence in solving a crime. “In legal matters,” he says, “trace evidence such as glass, pieces of metal, or soil—the dirt or mud on clothing and shoes—can be extremely important.”

Being able to compare trace evidence with evidence found on the suspect or at the scene of the crime often provides critical information to the police. For example, a car involved in a hit-and-run accident may have left some dirt or mud from a fender on the road. If a safe is burglarized, bits of the insulation may later appear in the suspect’s hair. Or during a robbery, dirt from the burglar’s shoes may remain in the house.

It’s not a straightforward search, Wehrenberg says. In order to be accurate, the process is slow and tedious, requiring a large amount of specialized knowledge. The evidence produced by the results of a match are rarely used in the criminal trial itself, but are usually presented to the suspect before the trial. The technique works well, often eliciting the truth from the suspect about some aspect of the case before court proceedings begin.

Wehrenberg, a gentle, shy man who has been at UM since 1955, teaches mineralogy and field geology and conducts graduate seminars. His work on behalf of the state began about ten years ago, when Ken Kozak from the state crime lab brought him a piece of pyrite (“fool’s gold”) that was involved in a scam then under investigation. One thing led to another, Wehrenberg says, and gradually he began specializing in forensic geology.

From July 1984 to July 1985 Wehrenberg spent an unusual sabbatical year as a researcher at the FBI research lab in Quantico, Virginia. His research focused on the feasibility of using certain clay minerals as evidence. Wehrenberg defines clay as an extremely fine-grained material that holds its suspension in water. A common example would be the kaolin clay used in pottery. Clay minerals are not commonly used as criminal evidence because clays are widely distributed over the earth’s surface, and it is difficult to find distinguishing characteristics between clays found at the crime site and other clays.

Another problem is the time that good analysis takes. Where the FBI may want to do two cases a day with fifteen to twenty soils samples each, Wehrenberg says, actual analysis of that much data might require two weeks of eight-hour days. Some chemical determinations simply take time.

One partial solution to the time problem is infrared spectroscopy, in which Wehrenberg feeds samples through a spectrometer for chemical analysis. The effectiveness directly depends on the geologic source of the material, he says, but given the right circumstances, analysis time can be reduced to three days.

The bulk of Wehrenberg’s current research concerns speeding up and improving the methodology of soils analysis. While soil samples are taken much more routinely now than in the past, Wehrenberg would like to see investigators become more aware of soils evidence and collect more soil samples. It can be difficult to ask, he says, because if investigators don’t know how a crime was committed, what constitutes evidence isn’t always obvious. And soils evidence, like any evidence, can become stale—all dirt really needs is a good rain to literally wash away the information.

Working through every phase of the criminal spectrum, Smith and Wehrenberg are two faculty members at the University whose behind-the-scenes work provides clues that help solve some very difficult crimes.
When fire gutted her Pennsylvania studio in 1979, Marilyn Bruya lost twenty years’ worth of artwork and a small fortune in equipment and supplies. She had no insurance. But even a tragedy of this magnitude could not extinguish her creative drive.

She quickly found an old garage to use as a studio, got “half the town” to help her clean it up and landed a $4,000 grant that helped her begin preparing for her next major show.

Today Bruya is an associate professor of art at the University of Montana. Her painting style has evolved since her Pennsylvania days, but her stamina remains unchanged.

In early spring 1986, she had a one-person show at UM’s Gallery of Visual Arts that included paintings and mixed-media works on paper—most of which she managed to produce the previous summer. Among the works displayed were a twelve-part acrylic-on-canvas painting; a three-part painting in the same medium; and a series of paintings rendered with a variety of papers and pigments, some of them also incorporating canvas. Bruya, who has been on the UM faculty since 1982, says she had a traditional art education stressing the study of still life, figure and landscape drawing, and painting. But in twenty-five years of painting, tradition has given way to experimentation; she is always seeking new ways to express ideas.

As Bruya is quick to point out, most of her paintings are not traditional rectangles hung on a wall. She says that in producing her multi-part paintings, large canvases suspended between the ceiling and floor, her object is to create works “you cannot see all at once, that you can move through, that will change with the light, that will be of sufficient scale to have some impact, that will have a sense of peace and order, of structure and light.”

The multi-part painting of which she is most proud consists of five twenty-six-foot-high “banners” that were installed in January by First Bank Western Montana-Missoula in its two-story-high atrium. Like the multi-part paintings that were in her spring show, this piece is a study in subtle gradations of color and has an image on both sides of each strip of canvas.

Interestingly enough, the idea for painting such banners came to Bruya in 1974 when she wanted to do a huge painting but had to be able to transport it in a Ford Mustang. She found that the long, narrow pieces of canvas can be conveniently stored rolled up.

Her works on paper are equally unusual and, like the
banners, represent a creative solution to a practical problem.

When Bruya moved to Missoula, she no longer had a studio large enough to accommodate the highly complicated painting technique she had used for about five years. Unable to use her compressor to create large sprayed paintings, she began devoting much of her energy to creating smaller mixed-media works on paper that require less equipment to produce and can be completed in her compact home studio—another converted garage.

She describes her works on paper, which are simplified geometric forms fit together like a jigsaw puzzle, as “spatial illusions—experiments with layered spaces and other kinds of spaces I can’t create with canvas.”

She began working on paper in 1965 as an adjunct to her other painting. The pieces she created were strictly experimental—“throw-aways”—and the adhesives she then used to affix the paper shapes to a backing caused the works to deteriorate over several years.

In time, Bruya found that the works on paper enabled her to advance her ideas much more quickly than did painting on canvas. In the late ’70s, she began seeking ways to assemble permanent works on paper. What emerged was a unique way of painting that includes inlaying and dry-mounting a single layer of paper—and, more recently, paper mingled with canvas.

Bruya’s growing fascination with this new art form did not keep her from continuing to paint on canvas, however. “If you try to channel all your ideas through one medium, you really limit your ideas,” she says.

Instead, she has continued to alternate between the mediums, batting ideas back and forth between the two.

Over the years, Bruya has participated in many national, selected one-person and selected group shows. Among them are the Rutgers National 81/Works on Paper show; a one-person show at the Butler Institute of American Art; and the Associated Artists of Pittsburgh annual exhibitions at the Carnegie Museum, where she twice received jury awards.

Marilyn Bruya works on a large canvas in her studio.
Laurie Ankeny never expected her business to grow the way it did. While living in Portland, Ore., six years ago, she became interested in teaching aerobics. She wanted to teach aerobics with a difference, however, by using Christian music instead of the traditional rock 'n roll used in most aerobics classes. She soon found out that it was much easier said than done.

"I looked all over Portland," says Ankeny, "and no one was producing Christian music for aerobics." She finally found enough music to make a start. "A lot is produced now," she says, and the change in music, coupled with the Ankeny's moves to Billings and then Missoula, transformed her small enterprise into an eight-state business.

As with many small-business owners, Laurie started her "Faith & Fitness" classes as an extension of her own values, interests and abilities. But as the business grew, Laurie was propelled into areas of business management she was unprepared for, such as bookkeeping and cash-flow management, personnel management, marketing and advertising. When it appeared she needed a small-business loan to aid her expansion, she looked to the University of Montana's Small Business Institute for help. She received more than she'd originally asked for from UM's special program. And the help was free.

UM's Small Business Institute (SBI) is a "capstone" class in the School of Business and a real-world gem in a business major's education. Taken during their junior or senior year, students in the class team up in pairs. Each student brings different strengths to the team—one may be specializing in marketing, the other in accounting. The class involves analyzing problems for small businesses and writing research reports and recommendations based on their findings.

Dick Dailey, director of the Small Business Institute and professor of management, says students fill out an information sheet the first day of class, listing their backgrounds and particular business interests. He and Assistant Professor Paul Larson, who also teaches SBI classes, then interview waiting businesses from throughout western Montana. Before the second class, the student teams and businesses are matched, and the process is ready to begin. The businesses may have heard about SBI through word of mouth, or through Dailey's and Larson's talks with chambers of commerce, bank loan officials, small-business incubator programs and, not incidentally, through the students themselves.

An example of a particularly successful match, says Dailey, occurred when SBI worked with a fixed-base operator in Butte. Fixed-base operators are airline charter and repair services, and Dailey happened to get a student in class that quarter who had worked for a Saudi Arabian airline for six years.

"He knew fixed-base operations like the back of his hand," said Dailey. "He was able to save that company $65,000 immediately."

In Ankeny's case with Faith & Fitness, the problem was too much success with too little experience. Ankeny needed help in several areas at once. Last winter her student team, composed of Scott Persha, a junior in business administration, and Dawn Bermes, a senior in business administration, worked under Larson's direction to analyze the start-up and growth of the company and to outline goals in areas such as marketing, accounting and finance.

The final document is fifty-six typewritten pages and is as complete and well done as that of any professional business consultant. Many of the suggestions are simple and down-to-earth: "At the present time, Mrs. Ankeny holds her Faith & Fitness class Monday, Tuesday and Thursday between 3:30 p.m. and 5:00 p.m. We have found that 70 percent of the members surveyed preferred to attend an aerobic class in the evening. Thus we recommend that an evening class be instructed at least three to four times per week so as to attract working women and mothers."

Other suggestions are more theoretical but equally important: "We suggest that Mrs. Ankeny develop a structure of organization whereby she appoints a regional manager or representative for Faith & Fitness . . . By establishing this chain of command, current instructors would have someone nearby to take all problems and suggestions to."

Ankeny has not been able to implement all of the suggestions outlined in the report. Since the study was finished in March, she has been gearing up for another training session for her instructors, as well as trying to digest the information and determine the best starting point for the work. She is, however, emphatic in her support for what the SBI has already accomplished for her.

"They gave me direction," she says. "I thought I needed a loan, but they showed me that I didn't really need it. I needed to find a better way to manage my cash flow."

Ankeny also says that her student team, Persha and Bermes, surveyed both her students and instructors over her eight-state territory and obtained valuable information that she isn't sure she could have gotten on her own. From that information, Persha and Bermes were able to recommend a
Restructuring of the program and suggest new marketing and outreach concepts.

Part of the real but intangible benefits of working with the SBI have been psychological. Ankeny is gradually learning to think of herself as a business owner and manager, understanding the problems inherent in making collections on accounts receivable, managing employees or independent contractors, and reserving her energy for core areas where she can do the most good. The transition is taking place, she says, and has helped her learn to think in more effective ways.

Both Dailey and Larson are more than pleased with the achievements of the students in each SBI class. The institute has served more than eighty businesses throughout Montana in a single year and receives reimbursement from the Small Business Administration for each case handled. A twelve-year record of service to the Montana business community has verified the ongoing popularity of the program. This year, Dailey received a special award from the Small Business Administration recognizing the excellence of UM's Small Business Institute.

If there is a problem, Larson says, it lies in predicting how many students are going to sign up for the class each quarter, and, by extension, how many businesses can be served. Occasionally a business may have to wait a few months before receiving help, but the process can work in reverse, too. If a large number of students enroll, some businesses may receive help earlier than they expected. And the program is free to the business.

It's an offer that's hard to refuse: a thorough analysis of a company's needs, research into its problems and written recommendations that the business owner or manager can carry out as time and money permits. And for UM business students, the Small Business Institute offers a crash course in real life that can't be imitated by reading a textbook.
Anyone who’s suffered through a bout of poison ivy, oak or sumac knows the true meaning of discomfort. The painful, sometimes incapacitating dermatitis—with its itching, swelling and blisters—strikes unwitting campers and gardeners with equal abandon. But the disease poses an even greater threat to firefighters and other workers who must regularly confront the wily weeds in the line of duty. So many U.S. Forest Service employees have brushes with the plants, in fact, that poison oak and ivy dermatitis is the country’s greatest cause of workers’ compensation claims. The condition afflicts outdoor workers in every state except Nevada, Alaska and Hawaii, where the plants—which flourish below 4,000 feet—don’t grow. Forest Service concern over the well-being of its...

*Ed Waali holds a molecular model of the irritant found in poison ivy, oak and sumac. Nearest his left hand is the region of the molecule he believes binds with aluminum chlorhydrate.*
firefighters led in 1982 to a research project headed and recently completed by University of Montana chemist Ed Waali. The results of Associate Professor Waali’s tests involving urushiol—the irritant in the sap of poison ivy, oak and sumac—may soon spell relief for workers and recreationists everywhere who are sensitive to the substance.

The product Waali’s come up with is a spray that includes aluminum chlorhydrate, the active ingredient in most anti-perspirants. His laboratory tests have shown that solid

Simply spraying oneself with anti-perspirant isn’t the way to avoid the dermatitis.

be applied and what additives might improve the product’s effectiveness. The subjects for these tests would be people who are “exquisitely” sensitive to urushiol. Statistics show that about 50 percent of the U.S. population is sensitive to the irritant and as much as 25 percent is exquisitely sensitive.

The idea for using aluminum chlorhydrate in the protective spray came from the dye industry, Waali explains. Researchers found that although some dyes won’t stick to cloth, they’ll adhere to an aluminum salt. The aluminum salt in turn adheres to the fabric.

Waali discovered that a chemical feature of one such dye is similar to a feature of urushiol. He concluded that if the dye would adhere to the aluminum salt, so might urushiol. After testing a number of aluminum salts, he found that aluminum chlorhydrate most efficiently complexed with the irritant and made it immobile.

UM has contracted with Research Corporation of Tucson, Ariz., to pursue a patent for Waali’s product. While awaiting the result of the patent application, Research Corporation is seeking a major company to distribute the spray.

Waali doesn’t claim that using his product would completely eliminate any danger of contracting dermatitis from poison ivy, oak or sumac.

“We’ll probably never have something where people can be very cavalier and just roll around in the stuff and not have to worry about it,” he says. “But if we can reduce the risks to people who have to be in it, then that’s a pretty big accomplishment.”
PRE-SCHOOL PROGRAMS PROVIDE SUPPORT FOR THE DEVELOPMENTALLY DISABLED

“A chronic, lasting condition, existing prior to the age of 21, likely to last indefinitely, significantly affecting three or more areas of development.” These words are chilling in their sterility, particularly to parents. In more familiar terms, they can mean Down’s Syndrome, cerebral palsy, epilepsy, autism, mental retardation or any of a number of other conditions.

For years, such children were regarded as automatic candidates for institutionalization to make life easier both for them and their families. With the passage of a federal
law in 1975 guaranteeing a free and appropriate education for all children, a number of federal and state programs were established to provide the training and education that would help disabled people achieve a measure of independence and purpose in society. At the University of Montana, a web of programs that interwines with community services has received national attention for setting the pace in working with developmentally disabled children.

The Montana University Affiliated Program Satellite (MUAPS) is one of forty-three University-affiliated programs around the country. The most visible part of the program is the Early Education Center, located the past several years in McGill Hall and serving children from three to five years old who are moderately to severely handicapped. The center has fourteen children enrolled and works under the auspices of Missoula School District 1.

Once a child is referred to the Early Education Center, a careful diagnostic evaluation is made to measure his or her capabilities and needs. The staff then meets with the parents to ensure the understanding and cooperation of the family.

Parental involvement in the program is both requested and assured. At least three staff-parent meetings are held each year, supplemented by telephone conferences and home visits by the staff.

Many children and their families have received previous help from the Comprehensive Development Center (CDC) at Fort Missoula, an organization serving parents with handicapped children from birth to three years of age. Because of such early training, most parents come to the MUAPS program already educated about what to expect for their children and how much involvement they will need to have.

A strong advocate of mainstreaming, MUAPS Director Rick Offner says kids “should be allowed to progress in as normal a way as possible.” Teaching to a child’s strengths and making sure whatever is taught will be functional in a child’s life are key issues in special education, he says.

Children often proceed from the MUAPS program into the public school system or into some combination of public school combined with special education. At this point, UM’s Co-Teach program begins to play a strong role in the lives of the children and their families. Co-Teach tracks the children beyond the pre-school level to determine the benefits of the pre-school experience, how long those benefits will last, and how to either prevent or work with any backsliding the child may do.

The Co-Teach program handles many of the same functions as the Early Education Center, but works with children outside School District 1 and often takes children in a younger age range. Co-Teach will continue to be located on campus, but the Early Education Center will be transferred this fall to Hawthorne Elementary School in Missoula.

Both programs have five primary components, says Rick van den Pol, director of the Co-Teach program: children are given individualized assessments; services are geared toward both the classroom and the home; constant evaluation of each child takes place; inter-agency coordination is highly stressed; and parents and staff work together.

The focus of both programs is on survival skills rather than academic skills. Co-Teach also helps train teachers in traditional classrooms to work with handicapped children given the “least restrictive setting possible,” van den Pol says. Although some teachers have difficulty helping a handicapped child to be “mainstreamed” into the classroom, most benefit from the experience and few changes are made in the classroom itself.

The third pre-school center on campus, the Early Childhood Center, often functions as a mainstreaming facility for the Early Education Center and the Co-Teach program. The Early Childhood Center, also located in McGill Hall, was originally started thirty years ago as a teaching tool for home economics majors and was called the “Nursery Program.”

The Early Childhood Center is run by director Chris Isaacs and has thirty children enrolled, with four positions reserved for children with mild to moderate handicaps, such as legal blindness, a hearing impairment or Downe’s Syndrome. There is a waiting list for the center that is a year long.

Once comprised largely of the children of University families, this past year nine of the children came from the University while twenty-one came from the community. The program has increased in popularity each year and has earned a reputation for being able to handle children who have behavioral problems of one sort or another. That, along with the four slots reserved for those children with some sort of handicap, mark it as a pre-school program in increasing demand.

The future for UM’s pre-school programs and the children they serve looks stronger than ever. Van den Pol emphasizes the aid the programs have received from the University itself, especially including time and expertise provided by faculty in the psychology, communication sciences and disorders, and physical therapy departments.

The programs also work to secure continued federal grants in order to provide the majority of their services free of charge to the families of developmentally disabled children. And staff and researchers will continue to conduct research and prepare publications to assist such groups as the Office of Public Instruction, Blackfeet Headstart and public school systems in Montana and throughout the country.
ENGLISH PROFESSOR BILL KITTREDGE: RANCHER TURNED WRITER

One late fall day in the mid-1960s, when the barley had been harvested and Thanksgiving dinner barely digested, Bill Kittredge sat down to write a story. Thirty-five years old and weary of raising cattle and working the land, he gave in to a creative urge he knew none of his fellow southeastern Oregon ranchers would understand.

"You really couldn't tell anybody you were writing," says Kittredge, now a University of Montana English professor who specializes in teaching creative writing. "Nobody even reads out there. They'd regard you as pretty suspect."

Today he's regarded as many things, but suspect isn't one of them. Leonard Robinson of Missoula, former managing editor of Esquire magazine, has called him "the modern Western short story writer par excellence." UM English Professor Bill Bevis says Kittredge is an "excellent stylist and critic, a first-rate editor and a very good essayist" whose magazine-writing experience has helped students and faculty grasp the publishing market. Bevis adds that the late poet and UM English Professor Dick Hugo found Kittredge's passionate writing style Faulknerian. And Kittredge's students say he's an inspired teacher, a master at helping them organize their stories.

One former graduate student of his also describes Kittredge as "the easiest person in the world to talk to." Kittredge is indeed affable. A good listener and a fast talker full of energy and enthusiasm, he punctuates his conversation with witticisms and bursts of infectious laughter.

He's come a long way in the literary world since his first attempts at writing two decades ago. After making a clean break from ranching, he attended the respected Writers' Workshop at the University of Iowa in 1968-69 and soon thereafter landed a job at UM. "It was the best stroke of luck I've ever had in my life," he says. "As soon as I came here, I recognized what a good deal it was, and I've never even considered leaving."

During his tenure at UM, he's accomplished much. In 1984, he and Missoula writer Beth Ferris won a $25,000 Neil Simon Award for their script for the well-received movie Heartland. His fiction and essays have appeared in magazines such as The Atlantic, Harper's, Rolling Stone, Rocky Mountain and Outside. His book of short stories, We Are Not In This Together, appeared in 1984, giving him a name as a writer of hard-hitting fiction about people "on or over the edge," as Robinson puts it.

Kittredge has also found time to collaborate with Missoula writer Steve Krauser on editing three anthologies and penning a series of nine Westerns. Using the pseudonym Owen Rountree, they produced novels such as Cord, King of Colorado and Brimstone Basin. Perhaps more impressive than their output is the fact they worked together harmoniously.

"You really have to get your ego out of the road and realize one thing's better than the other," Kittredge says, adding that taking turns writing drafts had its advantages.

"If one person would call up the other and say, 'This is all screwed up,' the other could say, 'Okay. You fix it!'"

Kittredge, who habitually begins work by 6:30 a.m., continues to keep his finger in a number of pies. In addition to teaching increasingly large—and, he says, increasingly talented—classes, he's hard at work wrapping up a collection of essays and a book of short stories called What Love Would Be. He wrote some of the stories twelve or thirteen years ago and has radically reworked them.

"The first versions of some of them would just take your breath away, they're so awful," he says. "I'm revising them to the point where they're not even recognizable from the first version. They're like new stories."

With funding from actor Robert Redford's Sundance Institute, he also recently finished writing a screenplay for Norman MacLean's book A River Runs Through It. Still on the horizon are a novel and a radio play about Lewis and Clark.

Kittredge looks forward to getting back to writing fiction, which is his first love. He says he found his imagination "going dry" in the late 1970s and turned to writing magazine pieces on regional topics ranging from grizzlies to Western boomtowns.

His planned novel will take place in Montana—a rare move by Kittredge, who says only two of his stories have been set here. "You have to live someplace a long time before your imagination really begins to inhabit that place," he says. "I'm just now beginning to feel I've been here long enough so that the scenes in my imagination are starting to take place in Montana." A staunch supporter of regional writing, Kittredge includes among his other current projects co-editing a large anthology of Montana writers and editing a smaller, "spin-off" anthology of young, contemporary Montana writers.

"I'm frightfully interested in doing all I can to attract attention to Western writing, and not with any sense of trying to say what it should be or what it would be, but just a sense that good things are going on here," Kittredge explains.

The "good things going on here" in the West, he says,
include the fact that regional writers are no longer writing predictable fiction featuring traditional Western themes. He says writers are now taking a fresh look at life in the West and painting original portraits of the world around them.

This growing artistic maturity is bringing recognition on both coasts to Western writers in general and Missoula writers in specific, Kittredge says. Missoula is known among writers nationwide as a center of writing, and he finds it unsurprising that so many writers congregate here. "It's a humanly comfortable place to live," he says. "Writers need communality, and there aren't very many places you can find it in the United States. This is one of them."

Kittredge has found his niche in Missoula as a prolific author and a spokesman for his fellow regional writers, a driving force in UM's creative writing program and a mentor to young writers struggling to find their literary voice. He has no regrets about leaving the ranching life behind.

"Everybody says, 'Don't you wish you were back on the ranch?' " Tongue in cheek, Kittredge continues, "'I say, 'Yeah, I'd be feeding cows this morning.' "

Bill Kittredge urges his students not to be caught in the "Atlantic/New Yorker syndrome" of giving up on short stories rejected by these well-known magazines. He says young writers must learn to market, as well as craft, their fiction.
If University of Montana forestry Professor Nellie Stark
has her way, Montana will someday be known as the
huckleberry pie capital of the country and perhaps of the
world.

The Montana wild huckleberry industry has developed
into a multimillion-dollar business that serves a growing
nationwide market. The increasing commercial demand for
a reliable supply of high-quality berries led Stark two and a
half years ago to begin a research project aimed at
cultivating the prized berry as an agricultural crop.

If her project succeeds, someday Montana huckleberries
will be grown commercially not only for local and national
markets but for international ones as well.

The fruit, as every Montanan knows, is the small, slightly
tart and often elusive berry that lures pickers into the
Montana hills every summer. Fewer Montanans realize that
the berry is actually one of the larger wild blueberries.

"The idea of cultivation is as a supplement to the wild
huckleberry industry," says Stark, a forest ecologist and
veteran of fifteen years at UM. "The advantage of going the
cultivated route is that we can control some of the adverse
effects that ruin the crops from year to year in the wild,
such as drought, shallow snow depth and freezing damage."

Successfully cultivating the berries rather than harvesting
the fruit solely from wild plants would have the added
advantage of minimizing the impact on bears and other
wildlife for which wild huckleberries are a major food
source.

While studying rejuvenation of decadent berry fields and
the effects of climate, soil and fertilizer on wild
huckleberries, Stark and her assistants have gathered
huckleberry seeds from throughout the West. These seeds
have produced about 4,000 plants in UM's greenhouse.

Some of the seeds collected seemed to hail from disease-
drought- or cold-resistant families and some from strains with exceptionally high berry production or especially large berries. Other plants in the study having desirable breeding qualities are “super plants”—ones that Stark says are up to four or five times taller than other huckleberry plants growing in the same soil and environment.

In the building’s relatively controlled climate, Stark and her assistants are testing the plants’ response to various soils and temperatures. Research plots in the Trout Creek area and UM’s Lubrecht Experimental Forest offer further insights into the life cycle of the huckleberry plant.

“We have extensive data now on what differences occur in the soil as it relates to the balance of nutrients,” Stark says. “We know that certain soils are much better for cultivating berries than others.”

She says the most desirable—but not the only—type of soil for growing good huckleberries is ash cap, fallout from early volcanic eruptions. In addition to thriving in ash cap, huckleberry plants grow best at higher elevations in areas shaded about a third of the daylight hours. They also require plenty of moisture and protection from long periods of drying, Stark says.

A major thrust of Stark’s research is learning whether huckleberries can be cultivated at lower elevations. With the help of county extension agents in northwestern Montana, Stark has lined up ten owners of lowland in Lincoln and Sanders counties who are interested in having her transplant some of the greenhouse seedlings to their property. The sites were chosen on the basis of suitable soils and climate.

Initially Stark hopes to transplant about sixty seedlings to each of the ten parcels of land. To help ensure the success of the operation, Stark is raising the seedlings in “super tubes”—plastic containers, normally used for raising tree seedlings, that will allow the huckleberry plants’ small, fragile root systems to be transplanted intact.

Irrigation and fertilization also may be essential to the success of cultivating huckleberries, Stark says.

It will take three years after transplanting for the plants to produce berries, she says, and by six years, the plants should be at full production. The landowners will own the berries, but Stark will measure them before they are harvested.

If the plants thrive, Stark plans to work with Montana nurseries to develop a commercial source of seedlings. She expects that at this point additional landowners will join the ranks of berry producers and form a huckleberry growers’ co-op.

Stark would work with the nurseries and growers to help them choose the right soils and best cultivation methods. When the growers have more than enough berries for the local market, she would encourage them to hire a market analyst and an advertising agent to explore and develop national and foreign markets for the fruit.

“Cultivated blueberries are on virtually every grocery store shelf in the country, but they’re expensive,” she says. “One of my objectives is to produce a better-tasting berry, a better pie berry and a less expensive berry so that it would be attractive to people.”

Stark says an alternative to cultivating berries on lowlands might be cropping the wild berries on marginal timber land leased from landowners interested in deriving a second income from their property. Another possibility is cultivating huckleberries in cherry orchards, which lack the ideal soil for the plants but could provide just the right amount of shade.

While it would not be feasible to use mechanical pickers in steep wild-huckleberry fields, Stark thinks the pickers could eventually be used in commercial berry harvesting. As for the wild berries, she believes that a boom in the huckleberry industry would allow high school students and the unemployed to earn money during the summer by picking the fruit and thinning the competing brush around the plants.

Stark firmly believes in the marketability of Montana huckleberries. “In my opinion, we have the best pie berry in the world,” she says. “It outdoes anything that’s called a blueberry on the market.”

She says the berry is more tart and flavorful than other wild blueberries, which some scientists now believe may be a different species from the Montana fruit. In informal taste tests she has conducted using blueberries from Montana, Maine, Michigan, Washington and Oregon, subjects have consistently preferred the Montana berry and been able to identify its origin.

One drawback to the Montana berry is its tendency to “bleed” when picked—which makes it salable only in local fresh markets. But Stark says the fruit’s acidity makes it ideal for canning, freezing and using in berry products such as the popular huckleberry chocolates. And she thinks that if fine Montana restaurants offered huckleberry pie year-round, it would be a great boon to the state’s tourism industry.

Turning Montana’s fledgling huckleberry business into a major industry will take a lot of time, patience and hard work. But Stark is convinced her goal is attainable.

“A thriving huckleberry industry in Montana can be a reality if we are ready to make the sacrifices to learn how to manage the berry fields effectively,” Stark once wrote. “We can turn pie-in-the-sky into pie-on-the-plate!”

Stark’s huckleberry research has been aided by McNutt-Stennis federal funding. Recently, her work on cultivating the berries received a $36,000 boost from the Montana Science and Technology Alliance, which will distribute the grant money over three years. A portion of the Alliance money must be matched by private funding, a small amount of which has already been raised.
Steve Running is as much at home with the technology of satellites as he is with the physiology of trees, and through a unique new method of research, his work now combines the two.

Running is one of a handful of researchers in the nation focusing on how changes in the earth's atmosphere, water and land affect life on earth. The study is part of a new scientific discipline known as global habitability—literally meaning the fitness of the earth as a place to live. Using what's known as "remote sensing," Running combines satellite images from a thousand miles in space with a specially designed computer model to analyze and predict global ecological changes.

That's where the trees come in. Using remote sensing, Running analyzes land in terms of Leaf Area Index (LAI), or the area of leaf cover over a given area of ground (the LAI is the only measurable variable that can be applied over global differences in topography and vegetation). He also checks for water stress a tree might have experienced and measures the water and carbon exchange rates in the trees.

Running's work involves four major areas of global concern: large-scale changes in land use, such as the expansion of deserts and tropical clear-cutting; global climate changes due to the rising levels of carbon dioxide and trace gases in the atmosphere; global transportation of pollutants (such as the ash from Mt. St. Helens that circled the world several times); and global productivity of crop and forest growth.

The satellites Running uses transmit a stream of digital data, or images coded in numbers, that create a precise image from which information can be extracted or enhanced with extreme accuracy. Running then builds a computer model capable of accepting the satellite data.

At global scales, satellite analysis and prediction is more accurate than ground prediction and far more comprehensive. Normally, scientists walk over the ground, analyzing it acre for acre, then extrapolate projections for the acres they have been unable to cover. Projections for the untrodden ground may or may not reflect reality. With an image beamed in from outer space, it is theoretically possible to measure and analyze every acre of the earth's surface and monitor its changes. It is possible to "walk" electronically where no one has walked before.

Running and his colleagues at NASA, in conjunction with scientists from Germany and Canada, conducted a major remote-sensing project in Germany this summer. Running and his crew worked at sites in Frankfurt and Munich, where they deliberately "stressed" 2,400 trees. In Frankfurt the trees were cut clear through the base at the three-foot height, then tied upright next to their stumps. In Munich, the researchers girdled the tree trunks with a chain saw, stopping short of severing them. The partial cuts were designed to completely sever the water supply going up the trunk of the tree to measure resulting water stress in the leaves. The full cuts were to enable the scientists to work with maximum possible damage and record those changes.

After the trees were "stressed," a NASA C-130 research aircraft flew over the site at 12,000 feet carrying an Airborne Visible and Infra-Red Imaging Spectrometer (AVIRIS)—the new prototype remote-sensing device—to record and analyze the changes in the trees. The sensing device recorded the information in the form of visible and invisible wave bands on the electromagnetic spectrum—light waves—and this "spectral signature" will allow researchers to learn exactly what wave lengths correspond to observed changes in the trees.

"It went better than we could have hoped," Running says. "We had clear weather and it was 55 degrees. If it had
been hot there would have been water stress in the trees already, and we wouldn’t have had a large enough difference in data between our control group of trees and the ones we stressed. But it was clear and cool, and that was perfect.”

The study is being combined with a European study on the effects of acid rain on the trees. The researchers are hoping both types of stress will become visible on printouts from AVIRIS, which will be ready later in the fall.

The project will continue in the summer of 1987, when a U-2 aircraft will fly at 70,000 feet over a selected site in Montana with the imaging spectrometer aboard. The U-2 has already flown through Montana this summer to provide data on another project Running has in the works.

Running has received NASA funding to map the entire Seeley-Swan Valley via remote sensing beginning Oct. 1. He will measure forest evaporation, evapo-transportation and the net primary production (or forest growth) in the area. NASA will be watching the study carefully to determine if the carbon and water balance in the valley will lead to future indicators of global climate changes. The study will start with a small area, proceed to a watershed, then expand to the whole Seeley-Swan basin.

Running notes that ecologists have never tried to work on a global scale before, and that the goal is to build a theoretical framework with which to study global ecology.

In the next few years he will also be comparing one-kilometer parcels in Yellowstone, Mt. Rainier, Lubrecht Forest and central Oregon to determine their ecological changes and differences.

In the meantime, Running is off to Australia for the 1986-87 academic year, where he will be working on remote-sensing capabilities and computer modeling for the Commonwealth Scientific Industrial and Research Organization of Australia in Canberra. It seems interest in Running’s work in global ecology is truly global. He also has had inquiries from the Canadian and South African governments, expressing interest in updating their computer-modeling capabilities.
The idea is innovative, the machine is streamlined and the workout is smooth. Rather than using bulky weights and several fitness machines to exercise different muscle groups, this machine requires only one bar, upon which the entire upper body can derive the benefits of a full workout. The "Mule," as the new machine is called, lives up to its hard-working name.

The Mule is the brainstorm of Hamilton High School metals shop teacher Ken Lutz. Lutz walked into the health and physical education department of the University one day three years ago and asked then-chairman Kathleen Miller what she thought of his new idea for an exercise machine. Miller, now acting dean of the School of Education, recalls greeting Lutz's arrival with a small degree of skepticism. She wanted to see a prototype, and when Lutz had one developed she helped him test the machine and offered suggestions for improvement.

The Mule itself looks deceptively simple. It consists of a long cushioned pad, similar to that on any bench-press machine, with a hydraulic lift at one end. A vertical bar supports two hydraulic controls. The bar extends up, then back toward the bench, extending into a T-bar mechanism that can be used in a set horizontal position or released to rotate freely through a full circle.

By adjusting the hydraulics on the Mule, the T-bar can be used for chin-ups, pull-ups, curls, right and left rolls, and bench presses. The amount of pressure exerted is entirely up to the user, who can adjust the controls.

One factor as important as the ease and simplicity of the hydraulic T-bar is the reverse resistance built into the machine. When a weight is lifted with the arm on a Nautilus or a Universal machine, the muscle used to do the lifting is also used to lower the weight back to the starting position. The hydraulics on the Mule, by contrast, require the resisting force to be pulled down. This requires active work by another set of muscles. Because different muscles are used in lifting and in lowering, the muscle that lifted the weight relaxes while the other pulls it back down, and vice versa. The body simply receives more exercise for specific muscles than it would on a single machine.

"Once you get used to the machine," says Miller, "you can go through an entire series of upper-body movements in fifteen to twenty minutes."

Lutz, who is manufacturing the Mule exercise machines himself in a factory in Hamilton, has been approaching professional athletic teams, colleges and universities, and health clubs and spas with his invention. UM works closely with Lutz on the continued development of the Mule and has one of the initial prototypes in Adams Field House. Future plans include another Mule for the lower body, built on the same hydraulic principles.

Miller says it is one more example of how the University works closely with small businesses in the community. In this case, the tie reaches beyond the testing and development of the machine to research on the potential market done through UM's Small Business Institute. (See the Small Business Institute story on page 10.)

The market survey, conducted in health clubs throughout the state, turned up several factors important to future sales of the Mule. The first was a concern for the overall safety of weight training equipment. Safety was a factor thought by purchasers to be more important than durability, cost, warranty or attractiveness.

A second factor was the versatility of the equipment. The Mule's hydraulic T-bar adapts to many different types of body motion and exercise. Two lock-outs, when released, allow the lifting bar to move forward and back and turn freely in a circle, thus simulating free-weight movement.

Finally, the survey pointed up the difficulty of reaching health clubs as a target market, noting that trade show attendance and contacts by manufacturers' representatives show low rates of return. However Lutz decides to market his invention, it is clear that personal contact and demonstration on the Mule will be important to his customers, who will want to try out the new machine for themselves. They'll discover what the Mule's inventor already knows—the idea is innovative, the machine is streamlined, and the workout is smooth.
Merlin Hochstetler demonstrates a pull-up on the Mule. The Mule's T-bar also can be released through hydraulic lock-out controls to rotate freely to and from the body for use as a free-weight system.
JOURNALS OF TWO CANADIAN MOUNTIES
SHED LIGHT ON HISTORY OF THE NORTHWEST

About the time his triplet girls hit the terrible twos, T.T.A. Boys felt a sudden urge to travel. He lit out for Winnipeg in 1875, enlisted for three years in the newly formed Northwest Mounted Police and eventually took up residence at Fort Macleod in Alberta.

"Clearly, he was at wits' end," says University of Montana history Professor Bill Farr, who is researching a book based on the journals of Boys and another early Mountie. "I don't know whether it was the triplets—but he never returned."

Although the details surrounding Boys' enlistment are sketchy, considerably more is known about his experiences as a subconstable during a lively era in Canadian history—a time when the Mounties pushed westward to negotiate treaties with Indian tribes and subdue trouble-causing whiskey- and hide-traders, many of whom had traveled north from Fort Benton.

"One of the things the Northwest Mounted Police were so tremendously proud of was that theirs was not a military action but a police action," Farr says. "With very few men, under the force of law, they would bring law and order to the Canadian West—without all the Indian wars and military campaigns that had so bedeviled the United States."

Much of the information about Boys comes from a journal he religiously kept while a trooper. Farr unearthed a transcribed copy of the remaining portion of the journal—about a year's worth of entries—while examining the voluminous collection of papers donated to UM in 1972 by the Charles Conrad family of Kalispell.

The strength of the document, Farr explains, is that it offers a rare perspective on Canadian history—a "view from below," he puts it, a view from the eyes of a lowly subconstable rather than the newsmakers themselves.

"While we have lots of information about these treaties from the biggies—from the magnates who worked them out, signed them and included them in their memoirs—we have very, very few accounts of how they appeared from a trooper's perspective," he says. "It's not that what he tells us is surprising or new. But it does give us this new perspective of a literate trooper viewing significant events..."
with refreshing matter-of-factness.”

Thomas Tams Alves Boys, who was present at two of the seven treaty signings, was an unlikely recruit. A Toronto lawyer in his early 40s, he came from a prestigious Barrie, Ontario, family. He was older, better educated and more serious-minded than the average enlisted man, Farr says. He eschewed the carousing so popular among his fellow troopers, preferring to take solitary walks and record his thoughts in his journal.

His terse comments tell of tedious on the trail, the coarse barracks life, incompetent leaders and the men’s fondness for drink. The journal also offers vivid descriptions of the waterfowl and animals Boys encountered in his travels, some of which he had never seen before.

Boys had a penchant for writing romantic poetry, too. Farr says Boys’ rousing “Riders of the Plains,” which commemorates the Mounties’ trek west of 1876, appears in many Canadian anthologies.

Boys, clearly out of his element, did not especially enjoy his stint with the Mounties, according to Farr. When his three years were up, he tried farming and then became the first city clerk of Calgary. Afterward, he left for the gold fields farther west, never to be heard of again.

A second journal Farr has retrieved from the Conrad papers offers another rare, but quite different view from below. The diarist was James Stanford, a young, more typical recruit from Nova Scotia.

Like Boys, he enlisted as a subconstable in the Mounties for three years and was stationed at Fort Macleod at about the same time. But Stanford did not go on the famous 1876 trek west; a quartermaster’s assistant, he remained at the fort, weighing out rations and performing other simple tasks. Also unlike the more sedate Boys, Stanford had a rollicking good time.

“For him, it was a time of playing poker and drinking a lot, being infatuated with the landscape and carousing with the Indian women,” Farr says. “He tells that he had quite a social life at Fort Macleod.”

In addition to more risque passages, the journal includes many matter-of-fact notes about local events: going to church, washing clothes, celebrating Christmas, attending the notorious half-breed dances near the fort.

The incomplete picture of Stanford’s life created by his journal is rounded out by newspaper clippings and letters to and from his mother, Farr says. From these sources, he has learned that after leaving the Mounties, Stanford lived in Fort Benton and eventually became the well-respected, wealthy president of the Conrad Bank in Great Falls and an illustrious colonel in the Montana National Guard.

Finding out as much as he can about Stanford and Boys—from newspaper clippings, letters, troop records, conversations with family members and other sources—is just part of Farr’s task. He says he must also put the diaries in context by comparing them with contemporary diaries and reminiscences and early histories produced by many of the principals in the Mounties.

“My task is to provide a good edition of the texts of the journals, to set the journals in context and to introduce Stanford and Boys,” Farr says.

Because reminiscences of the common man are scarce, Farr says his book will give readers a glimpse of the past almost as rare as would an account of the life of a 14th century Parisian housewife.

It is not surprising that Farr would draw a parallel to the 14th century. A professor at UM since 1967, he specializes in the Middle Ages, which he says roughly span the years 500-1500 A.D.

Among the books he has written are John Wyclif as Legal Reformer, which concerns a 14th century theologian, and The Reservation Blackfeet: a History of Cultural Survival.


Farr has a great fondness for the history of the West. “History here is so close, so tangible,” he says. “Above all, it has a vitality because it’s our history. It’s not encountered through a prismatic effect of numerous generations. That gives it a human character I find really fascinating.”
University of Montana immunologist Ralph Judd is exploring new ways to detect and combat an age-old disease—gonorrhea, a sexually transmitted illness capable of causing shock, sterility and severe arthritis.

According to the national Centers for Disease Control (CDC), upward of 1 million new cases of gonorrhea are reported in the United States each year, and about 100,000 women in the country annually are rendered infertile by the disease.

At the root of this widespread disease is the *Gonococcus* bacterium, an organism that Associate Professor Judd says is an “avant-garde bug” adept at evading and manipulating the body’s immune response.

The bacterium is also adept at escaping the notice of its host. Forty percent of all men and 80 percent of all women who have gonorrhea have no symptoms, he says. Because only people with symptoms are tested for the disease, a great number of cases go undiagnosed.

“The real problem is that the current diagnostic tests are used only on people who present with symptoms,” Judd says. “What we need to control gonorrhea is a screening test where you can do huge numbers of people quickly and cheaply. This disease is out of control, and you’re never going to stop it just by looking for symptomatic patients.”

To complicate matters further, today’s diagnostic tests for the disease aren’t 100 percent accurate, he adds, and previous attempts to develop an effective vaccine against gonorrhea have failed.

Judd cites as his primary goal developing a synthetic peptide vaccine against gonorrhea and as a secondary goal devising a faster, more accurate diagnostic test for the disease. These goals can be accomplished only by studying the basic biology of the organism, he says.

A major obstacle to developing a vaccine is the *Gonococcus*’ ability to change its proteins rapidly in an attempt to evade the body’s immune response, Judd says. To find a vaccine, he’ll have to identify protein molecules in the *Gonococcus*’ outer membrane that don’t change; otherwise a vaccine wouldn’t consistently be effective against the bacteria.

Judd uses sophisticated procedures that allow him to compare the basic structure of the various outer-membrane proteins, including dividing the proteins into small bits called peptides and separating the peptides according to their electric charge and water solubility.

Once Judd has found a peptide that elicits a protective antibody against the *Gonococcus* bacterium, he’ll be able to analyze its amino acid sequence to synthesize a vaccine against the disease. Synthetic peptide vaccines are safe, pure and relatively easy to produce, he explains.

Finding the right peptide is the hard part, Judd says; devising an improved diagnostic test for gonorrhea will then be simple.

“We’re really on the verge of significant breakthroughs in diagnosis and immunology,” he says. “Once we get a specific antibody to something in the bug that’s constant and that only *Gonococci* have, the diagnostic test will be easy.”

Members of the medical community say a gonorrhea vaccine would be a real boon.

Dr. Mary Guinan, associate director of the CDC’s Division of Sexually Transmitted Diseases, says vaccines against viral diseases such as mumps, measles and rubella traditionally have been more successful than those against bacterial diseases. But she agrees that if a gonorrhea vaccine were developed, it would be of great value—especially to women, who most often aren’t aware they have
gonorrhea and are susceptible to the most virulent form of the disease.

She says that the number of reported cases of gonorrhea seems to be on the rise nationally and that because treatment for it exists, people have become altogether too complacent about eradicating it.

Judd's research isn't limited to a search for a gonorrhea vaccine and diagnostic test. His work with outer-membrane proteins is useful in studying a variety of other diseases. In collaborative projects with other researchers, he's applied his techniques to whooping cough, borellia infections, brucellosis, chlamydial disease, giardiasis and malaria.

Judd's work has attracted the interest of Montana pharmaceutical and research companies such as Alternative Diagnostix, Vorhauer Laboratories Inc. and ChromatoChem Inc. ImmunoMed Inc., a Florida-based company, is also interested in doing collaborative research with Judd. The University is working with these companies as they develop requests for funding from the Montana Science and Technology Alliance. Alternative Diagnostix, a new company beginning to market an over-the-counter diagnostic device for sexually transmitted diseases, has received funding from the Alliance. ChromatoChem Inc., a new company that developed and markets devices for producing extremely pure chemicals, has also received Alliance funding.

Judd is pleased to see major ground being broken by small research operations such as his. "The field of immunology has spread from the MITs, the Stanfords, the megabuck operators and gone back to the bench—something that one lone guy can do," he says.

One lone guy can do some exciting work these days, he adds. "I think we're in a revolutionary stage. It's sort of like we just developed an early integrated circuit. Now it's just a matter of how many different machines we can make out of that integrated circuit. We have all these wonderful new technologies, and now we just have to apply them. Of course, that takes time."

Growing cultures of the Gonococcus bacterium is the first step in the complex process Ralph Judd uses to analyze the organism's outer-membrane proteins. One such protein may hold the key to a vaccine against gonorrhea.

Judd's research has been funded by National Institutes of Health grants through the National Institute of Allergy and Infectious Diseases. He's also received two National Science Foundation equipment grants, as well as University of Montana Research Program and MONTS funding.
Child abuse is an increasingly dark cloud hovering over the lives of many families. The reported incidence of abuse has risen sharply in the past three years in Montana, and social workers around the state are often overwhelmed with the sheer numbers of complaints to investigate and families who need help. The Montana Department of Social and Rehabilitation Services (SRS), which received 5,855 reports of suspected abuse and neglect last year, is legally bound to investigate those reports and, if necessary, to protect a child from further harm.

The dark cloud may begin to lift, however, through new methods of consultation and training that a University of Montana social work research team now provides to Montana's social service agencies. Charles Horejsi, UM professor of social work, Jon Bertsche, associate professor of social work, and Sherry Francetich, research specialist, work under a federal Child Welfare Services Training grant to provide research, training and resources to social service agencies throughout the state.

Their work is particularly vital to those who face the
difficult task of determining how serious the home situation is for a child and how much danger the child might be in by being allowed to remain in the home—or how traumatic it might be for the child to be placed elsewhere, a solution always looked upon as a last resort.

During the past year, the UM team has given particular attention to the technique of “risk assessment,” a means of aiding social workers who must make a critical assessment concerning the risk of serious injury or even death to the child identified as the victim of abuse or neglect.

Until now, questions about how to handle abuse or neglect cases had to be answered partly through an experienced assessment by the social worker and partly through discussions between the worker and his or her colleagues. The UM team and SRS researched a tool called the Illinois Risk Assessment Matrix (RAM). The matrix enables a social worker to rate the child and the home through several perspectives.

The first category in the matrix, for example, deals with a child’s age and physical and mental capabilities. Children ten years and older with no physical or mental handicaps and who are fairly independent are rated in a low-risk category. At the other extreme are children younger than five years, or those who have some physical or mental handicap and are severely impaired in their development.

The matrix, which is only a page long, deals with other factors such as the severity or frequency of abuse, the caretaker’s physical, intellectual and emotional abilities, knowledge of parenting and the environmental condition of the home.

While it is not a tool that provides cut-and-dried answers, the matrix focuses on questions and perspectives that may not otherwise be apparent. With its more objective and systematic approach to determining the actual risk of a child’s situation, it minimizes the chances of making a wrong decision. The UM team provided the initial training on the RAM in Hamilton, Lewistown and Billings. After some fine tuning, the technique was adopted statewide.

In addition to its work on risk assessment, the UM team provides other tangible aid to social workers. Bertsche, Francetich and Horejsi wrote the Protocol Notebook for Child Welfare Workers, a manual prepared in cooperation with the SRS as a concrete, succinct guide for dealing with different issues concerning children. There are specific guidelines for working with child abuse, neglect, sexual abuse and the interstate placement of children in foster care.

The UM team has just completed a study of the opinions and beliefs held by abusing parents who participate in Parents Anonymous meetings. Parents Anonymous works to help such parents learn to control their anger and their tendencies to hit their children. The survey results show that these parents want to be good parents but are usually overwhelmed with life’s problems and child-care responsibilities. Many grew up in homes where they themselves were abused. They want the public to understand they are not “monsters,” but are human and sometimes troubled people who need services and support in order to better cope with parenthood.

Community education is another concern shared by the researchers. Bertsche explains that “there is a great deal of misunderstanding about the problem of child abuse and neglect and about what a public agency like SRS can and cannot do.” The team is now at work developing a set of pamphlets that will explain in simple language the nature of abuse and neglect, relevant state laws on reporting and investigation, services needed by abusing and neglecting families, and foster care.

Horejsi, the author of two books on foster care, emphasizes the public’s need to understand that child abuse and neglect are intimately tied to many other problems in society. “You would,” he says, “also have to attack problems of unemployment, poverty, marital conflict, drug and alcohol abuse, and the mobility of our whole society before you could even begin to significantly affect the frequency with which children are mistreated.”

Horejsi says punishment of troubled parents is not the answer. “In fact, most of these parents have already had a lifetime of being punished and hurt by others. What is needed is a real commitment to helping parents provide at least a minimally acceptable level of care for their children.”

Francetich is especially concerned about foster care. “Too often the public believes that all abused or neglected children should be placed in foster care. Sometimes foster care is necessary, but it is not the answer. Placement should be a last resort.” She emphasizes the need for a comprehensive system of services for families. Francetich has a first-hand knowledge of the problems, as she and her husband have been foster parents to over fifty children during the last twenty years.

In 1987, a new federal grant will enable the team to work with social work personnel from the Flathead Reservation on various aspects of child abuse and neglect, foster parent education and the training of SRS supervisory personnel. For the dark cloud that hangs over the heads of abused and neglected children, Horejsi, Bertsche and Francetich provide several solid rays of hope for a better future.
When a group of people on the Oregon Coast suddenly disappeared in 1975 after attending a meeting about UFOs, the news spread quickly around the nation. Rob Balch started following the story from his home in Arizona, and when it was announced that a similar meeting would be held near there, he decided to attend. Within twenty-four hours after the second meeting, several participants had packed their bags and were ready to take permanent leave from normal society.

The group not only aroused Balch’s interest but changed his career and his way of life. At the time, Balch was an associate professor of sociology at the University of Montana (he is now a full professor at UM), specializing in criminology and deviant behavior. Intrigued by what they had seen and heard at the UFO meeting, Balch and David Taylor, then a UM graduate student, joined the group for two months.

It was “incredibly fascinating,” says Balch, and it convinced him of the value of what he calls “participant observation.” The group was led by “Bo” and “Peep,” a man and woman who shared the same spiritual vision. Bo and Peep predicted a large “demonstration meeting” in which they would be assassinated, and the news spread all over the country.

When the meeting never materialized, disillusionment among the followers eventually grew and manifested itself. Members began splitting off.

What exactly is a cult? Balch defines a cult as “a new religious movement where the belief system and the lifestyle represent a sharp difference from traditional systems.” In our society, even a group with Judeo-Christian roots would be considered a cult if it makes a strong enough break from the Judeo-Christian tradition. It is the degree of deviance that counts, says Balch.

People join cults, Balch says, for a sense of identity and belonging and to break with the mainstream. The cult often represents an extension of beliefs or values the prospective member already holds.

Some cults are highly structured organizations in which the individual is discouraged from thinking independently and encouraged or coerced into blending fully with the group mentality. Even where the organization is more loosely structured, there is generally a strong “party line” that identifies its purpose and function. Those who join are often younger, more mobile individuals who are not tied down with a lot of material possessions and responsibilities, although there are exceptions. There is also “a kind of subterranean, cultural underground in our society composed of the ‘New Age’ beliefs and some of the ‘touchy-feely’ therapies,” Balch said. There are also people who have grown up in cults, spent their whole lives in them and continue to live that way, he added. Cult leaders commonly have experienced some type of revelation or religious conversion and believe they are different from other people.

Two especially well known cults/communes that survived the Vietnam era were the Farm in Tennessee and the Love Family in Seattle. The core of Balch’s current research revolves around the Love Family, a group he and fellow researcher Janann Cohig, a UM senior in sociology, have spent considerable time studying. Although a small semblance of the Love Family still exists, the main group broke up suddenly in 1983 amid explosive dissent between many of the members and their leader, Love Israel.

Modeled on a vision of an Old Testament kingdom, the Love Family believed they were the true Israelis and that Love Israel, the leader, was the “head of the resurrected body of Christ.”

Women had a clearly subordinate role to men, and in the beginning, children were treated with harsh measures and severe discipline.

Members of the Love Family believed they would physically live forever. They believed that physical problems—for example, needing eyeglasses to correct poor vision—were caused by a lack of faith, and they did not believe in seeking medical treatment.

Each member of the family was thought to be a facet of Christ’s personality and was given an appropriate name, such as Logic, Understanding, Strength, Wisdom or helpfulness, once his or her initiation into the group was complete.

The Love Family attracted those for whom the counter culture held a very strong appeal but who did not want the unclean and unkempt lifestyle often associated with communes and drugs.

A major turning point came after the family’s Alaskan...
fishing boat burned, and several family members went to work in the “outside world” to help pay off the boat’s mortgage. Outside contacts and the influence of money within the family for the first time radically changed the values of many members. Growing inequities in material wealth between members who worked for money and those who did not, the increasing abuse of power by Love Israel and inherent weaknesses in what Balch refers to as the “groupthink” philosophy, which subjugated individual personalities, all stretched the cohesiveness of the Love Family until it reached the breaking point.

Today, Balch says, “the defectors look and act much more like typical, lower-middle-class Americans than the hippies they used to be. Some have kept their family names, and a few continue to live communally, but the majority have tried to blend into the world around them.

While it might be accurate to say that the members had been brainwashed, Balch says it is more reasonable that they simply gave over their individual identities to a highly charismatic leader and a group mentality. In return they received a well-defined structure and direction at a time in their lives when they neither wanted to join mainstream society nor were ready to make decisions on their own.

The structure and centralized power encourage “a type of infantile behavior,” says Balch. “Most people finally grow up and leave.” Not all return to the traditional ways of society they once left behind. But that is another story.

Balch’s research is funded by the office of Research Administration at the University, as well as two small faculty grants.
At his inaugural press conference in August 1986, University of Montana President James Koch said one of his major goals is to take the University to the people via telecommunications, allowing citizens throughout the state to participate in televised classes and to see transmitted cultural and athletic events.

The installation of new, updated production equipment in UM's Telecommunications Center, housed in the new Performing Arts and Radio-Television Building, forms the crux of such hopes. The center already enables students, faculty and staff to work with a radio and television system of exceptional quality and flexibility. The potential for the center was made strikingly obvious last May, when former President Jimmy Carter visited campus to deliver the 19th Mansfield Lecture in International Relations.

"Our first opportunity to really tap the potential of the Telecommunications Center was during Carter's visit," said Director Ken Fielding. Working with radio-television faculty and students, the center's professional staff videotaped Carter's appearances and several other talks by visiting lecturers. They produced a half-hour documentary shown on statewide commercial television and provided coverage of the two-day event to the Cable Satellite Public Affairs Network (C-SPAN) for national broadcast a few days later. The videotapes also were placed in the library archives for use by future students at the center.

"It was a good example of what we can do," Fielding said. "And it's important to note that we did it with the students, the faculty and our professional staff."

A look at the equipment in the center reveals one reason why such outreach is possible. The television studio is the only studio in the state with access to five cameras (three studio cameras plus two portable cameras). Because the studio is directly connected via cable to the Montana Theatre, it is possible to have a live audience of 500 people for video productions.

The components of the radio-television system all interact, yet are self-contained. The videotape playback room is wired to the control room for such use as the student evening newscast. In the post-production videotape editing room, a student or staff producer can edit a tape on sophisticated, computerized equipment without tying up the electronics of the main control room.

Similarly, the audio control room is electronically linked to every audio source in the building, including KUFM radio and the drama/dance department, and can be used for independent recording sessions without tying up any of the other facilities.

Nearly all of the videotaping and editing equipment is computerized. The control boards in both the editing room and the main production control room can be programmed for specific timed sequences and graphic effects, saving time and frustration.

Digital recording, in which sound waves and visual images come through the system as individual numbers, is routinely used in both radio and television production. The numeric data, which can be re-mixed for various effects and provides an extremely pure sound, is read by a laser beam and transmitted to video or audio tape.

The technical upgrading of UM's Telecommunications Center is only a beginning. As two-way communication with the University becomes more feasible and more frequent through home television sets, Montana's vast geographical distances will virtually disappear. The University of Montana—its educational and cultural offerings—will not only be accessible to many who have not been able to participate in its programs before, but it will also provide continuous electronic links with larger worlds outside the classroom.

The Telecommunications Center is funded by a $442,000 grant from the M.J. Murdock Charitable Trust.
Claudia Johnson, a UM television producer and director, finishes some last-minute editing on President Jimmy Carter's Mansfield Lecture before sending the videotape to the C-SPAN network for national broadcast.
The Wood Chemistry Lab at the University of Montana doesn’t look so special to the uninitiated, with racks of test tubes and beakers on long lab tables and students peering at computer readouts and graphs. But a casual visual inspection doesn’t even begin to tell the story of this lab, which has established a national and international reputation for excellence in its field.

Geoffrey N. Richards, director of UM’s Wood Chemistry Lab, is also unassuming. A recent transplant from “Down Under,” Richards was dean of the Faculty of
Science at James Cook University of North Queensland, Australia, before coming to Montana and is a scientist of international reputation. Dressed in a leather vest and cords and comfortably settled back in his office chair, Richards speaks with a soft Australian accent, interpreting his work for a visitor.

The focus at UM’s Wood Chemistry Lab for the past twenty years has been researching the thermal chemistry of wood. Richards explains that there are two major areas of thermal research for the lab: using heat to convert cellulosic materials (cellulosics are any materials that originate in plant cell walls) into simpler products for a variety of uses; and learning more about the combustion of cellulosics.

Cellulosics are, in fact, the most abundant organic material in the world. Learning to use cellulosics efficiently could reduce the demand for certain products and could be extremely beneficial to the environment. For example, a heat process is used to convert such materials as wood, waste paper, sawdust and straw into levoglucosan. Levoglucosan is a form of glucose, a simple sugar. From glucose comes alcohol, from alcohol comes gasohol...and the list can be expanded from there.

The process is not expensive. “If it’s expensive,” Richards says, “you don’t take an interest. You can never separate economics from chemistry.”

Richards cautions, however, that the recycling of agricultural wastes is very economically dependent. Five or ten years ago, he says, “we would have guessed that oil right now would be a lot more expensive and that some of these alternative methods would be used.” Of course, the price of oil and gasoline has dropped dramatically.

Nevertheless, it is only a matter of time, and Richards knows it. The earth’s oil supplies cannot last forever, and when people are ready for some alternative methods of fuel and other products, the technology will be ready.

Richards and his staff also look for low-cost solutions in the second part of their research—the combustion of cellulosics. They want to determine what causes spontaneous combustion and learn to stop it. Richards cautions against using the phrase “spontaneous combustion,” stating that there has never been conclusive proof that any combustion is truly spontaneous.

The applied aspects of this study are literally close to home—they’re in the roof. Most insulation material is cellulosic in nature because it is recycled newspaper. A majority of home fires start in the roof, where they can smolder for a relatively long period of time before they are detected. Preventing such combustion may mean adding a fire retardant to the insulation, or it may mean taking some element out of the insulation.

Adding a fire retardant sounds like a simple, inexpensive solution but may actually exacerbate the problem. While retardants do prevent flames from erupting, they don’t prevent the situation that may cause the fire in the first place—so a fire may start, but may smolder for quite a long time under the influence of the retardant. It would then take the heat a longer period of time to escalate to the point of flames, doing more damage in the long run.

On the other hand, taking an element out of the insulation is a more complex and costly process. It becomes a matter of controlling metal ions, something that sounds far removed from the concept of recycled newspaper. The acid groups already present in cellulosic materials bind the minute amount of metal ions also present. Controlling those ions translates into changing the chemistry of the burning process itself and may lead to further solutions of the combustion puzzle.

The work with combustion has brought a great deal of grant support to the Wood Chemistry Lab from sources such as the National Science Foundation, the National Bureau of Standards and the Gas Research Institute.

Less than a year ago, UM scientists began exploring another new area of research: new uses for ordinary tree bark, such as anti-bacteria agents, preservatives or gasoline agents. It sounds simple enough. Wood gives off hydrogen and carbon monoxide naturally. Those two gases can be combined to produce methanol, a type of alcohol that can be used to extend the efficiency of gasoline.

Because the tree-bark experiments have only recently been started and already look promising, Richards is leaving the option open to patent both his methods and the resulting products. To protect that process, he is not able to discuss the operation completely. He does say he has also been able to find a natural polymer in experiments conducted with mangrove leaves and hopes to be able to achieve similar success with the tree-bark research.

Richard’s work deals with the world as it exists and the world that is yet to come. Although he says it can take twenty years for practical applications to be developed from laboratory research, not everything takes that long. As soon as gas and oil prices start to rise again, it is only natural that people will again look to such alternative technology for long-range solutions.
HONEY BEES MONITOR THE ENVIRONMENT, PROVIDE EARLY WARNING OF POLLUTION

This summer, thousands of bees are living and working inside tents. In a field just outside Missoula, Jerry Bromenshenk, University of Montana research professor of zoology, watches bees flying in a twelve-by-twelve foot enclosure. "The only real problem they have," he says of the 5,000 or so bees he has just released, "is that they want out to forage. They can find the smallest hole and will be coming and going through it within minutes."

In recent articles published in Science, Environmental Monitoring and Assessment, and Western Wildlands, Bromenshenk discusses the effectiveness of honey bees for assessing environmental problems and the willingness of beekeepers to assist in the conduct of this testing. For twelve years, Bromenshenk has been using bees to detect and monitor chemicals in air, water and soil. The bees in the tents are carrying this research to the next stage.

Bees forage up to three miles from their hives and tend to pick up pollutants or contaminants that exist in their environment. They demonstrate environmental problems in two ways: through the accumulation of chemicals into or onto their own bodies; and through changes in the colony itself, such as higher mortality rates of brood or adult bees or lowered honey production.

"It is an application of an old practice," Bromenshenk wrote in Western Wildlands. "Before the advent of sophisticated instruments for detecting poisonous gases, miners carried canaries in underground mines. If the canaries suddenly became ill or died, it was time to get out, fast!" Honey bees can serve a similar function.

Bromenshenk collects the bees with a vacuum as they enter the hive, then freezes them. It sounds a little gruesome, but it is painless and enables UM investigators to run the bee samples through a spectrophotometer to analyze their chemical content. The results are used to construct detailed maps of pollutant distribution. Bromenshenk, his staff and numerous students, along with more than 100 beekeepers, have used bees at various locations in Montana, Washington and Idaho to look at chemicals released by a wide array of sources, including smelters, automobile traffic, urban areas and even nuclear reactors.

This summer, Bromenshenk and his colleague, research assistant Janet Gudatis, set up tents in which they released one mini-hive each. The mini-hives are mailbox-sized beehives developed to reduce costs and labor and to facilitate testing. There are 5,000 to 10,000 bees in each mini-hive compared to more than 50,000 in a regular hive.

From fifteen tents set in a field near an industrial complex, the research team collected bees, soil, plant litter, blossoms and foliage, as well as monitored air quality. Some of the tents were "clean rooms," in which the sides and bottom were sealed with plastic, the air filtered and artificial food provided. In others the soil was covered or the vegetation removed. Some tents were uncontrolled, giving exposure to soil, vegetation and air as it already exists. Three colonies of bees were allowed to fly freely.

The purpose of the tents is to control the bees' access to different possible sources of chemical contaminants. Bromenshenk and Gudatis hope to pinpoint exactly how bees pick up chemicals. A better understanding of this mechanism would expand the bees' value as environmental monitors.

One of the first places checked when bees show the presence of a harmful chemical is pollen, which is like a "sticky lollipop," catching everything out of the air. Chemicals in pollen suggest an air- or soil-related source. It is possible to tell what species of plants the bees have visited by examining the pollen under a microscope. However, if contaminants appear in bees but not in pollen,
water is the likely source of transmission. Fortunately, honey remains virtually pollution free, showing only slight traces of most chemicals.

The implications for agriculture as well as human health are enormous. "The bees told us twice—two years ago and five years ago—that there was a pollution problem in the Mill Creek area. The EPA hadn't tested the soil. But that's where bees were dying and later children were found to have high levels of arsenic in their hair and urine. Now there is discussion of relocating the affected families."

"If bees can tell us ahead of time if something is hazardous to health, we may be able to prevent a lot of problems," Bromenshenk says. "Most monitoring equipment, like high-volume air samplers, which are basically vacuum cleaners, provide a poor simulation of a child's exposure. Children run around and play in the dirt. Maybe bees are more like children than are stationary instruments mounted six feet above the ground."

And human health isn't the only issue of significance. Due to increased industrialization and contamination of the environment, the nation's bee populations are on the wane. Over a third of the nation's food supply is jeopardized when and if bees cannot meet crop pollination requirements. It's obviously no small matter. "U.S. beekeepers produce more than $125 million (wholesale) worth of wax and honey each year. It is difficult to accurately determine the U.S. farm value of bee-pollinated crops, but estimates range from $8 billion to $40 billion per year," Bromenshenk wrote in Western Wildlands. Toxic chemicals harm bees and the plants they pollinate.

Bees have long served us. The earliest record of our association with bees is a Spanish rock painting of a person—possibly a woman—gathering honey. The ancient Egyptians practiced migratory beekeeping, floating hives down the Nile to flowering crops. Modern-day beekeepers move bees thousands of miles by semi-truck. In his Science article, Bromenshenk and his co-investigators note that several million colonies of bees exist in the United States. These provide an accessible monitoring network from which investigators or beekeepers can take samples. Thus, bees and their keepers offer a means of establishing an early warning system for the presence of hazardous chemicals.

The concept of a Bee Watch is currently being discussed in the U.S., Sweden and the Federal Republic of Germany.

In 1978, scientists at the International Workshop in Berlin on Monitoring Environmental Materials and Specimen Banking stressed that international pilot programs for monitoring environmental materials are needed and are technically feasible. They concluded that in the absence of widespread monitoring, the detection of serious environmental contamination may occur only after irreversible damage has been done. Bromenshenk has evidence that bees are well suited for this purpose.

Jerry Bromenshenk, UM research professor of zoology, holds a comb of bees from one of the mini-hives he uses in his research. Bromenshenk uses the bees, which absorb contaminants from their surroundings, to determine levels and types of pollution in the environment.

Bromenshenk's work is funded through two major grants: $58,694 from the Environmental Protection Agency and $19,253 from the Department of Energy, in conjunction with the Idaho National Engineering Laboratory.
NEW MATING THEORIES COULD AFFECT MONTANA’S BIGHORN SHEEP POPULATION

The dominant ram in a herd of bighorn sheep is king of the mountain. The biggest, toughest male in the population, the alpha is the winner of one head-jarring fight for supremacy after another. He’s also Mr. Popularity with the ewes.

According to Professor Don Jenni, chairman of the University of Montana Zoology Department and director since 1979 of a bighorn sheep research project, ewes sometimes risk life and limb to breed with a dominant ram rather than with his less-impressive brethren.

Jenni says one theory, formulated in the early 1970s, suggested that the influence of the alpha is so strong that removing him would create chaos in the herd. The sheep’s social hierarchy would break down, and many ewes wouldn’t be able to get pregnant because the remaining, younger rams would fight constantly with one another and the ewes. The lower-ranked rams would pursue the ewes mercilessly into the ewe winter range rather than retreating to their own winter range, causing some pregnant ewes to miscarry. Weakened, other ewes might give birth to small lambs unlikely to survive.

Jenni has dubbed this theory the Policeman’s Hypothesis, the alpha being the authority figure—the “policeman”—that keeps the other rams in line and makes sure breeding goes on in an orderly fashion.
With the help of researchers Jack Hogg, who earned his doctorate in zoology at UM, and Christine Hass, a UM master’s degree candidate in zoology, Jenni has tested the Policeman’s Hypothesis on the National Bison Range, near Moise. The southern half of the Range, about a fifteen-square-mile area, is home to a stable herd of fifty to sixty bighorns.

Jenni approached the project skeptical about the validity of the theory. “I don’t know of any vertebrate animal species in which a female can’t get impregnated by a teenager if that’s all that’s available to her,” he says.

After researchers Hogg and Hass gathered data on the sheep during five breeding seasons, Jenni oversaw the removal not only of the alpha but of nine other high-ranked rams. They were transplanted to herds elsewhere in the state in need of breeding stock. The rams remaining at the Bison Range were no older than three and a half years.

Jenni says that despite the absence of high-ranked rams, the ewes became pregnant and gave birth to lambs of normal weight. Although it took a few females longer to get pregnant, the ewes’ overall fertility rate of 96 percent compared well with that of 90-100 percent in preceding years.

However, a small number of lambs were born later in the spring than had been the norm, Jenni says. “But those dates are not late enough for us to reach a firm conclusion,” he adds.

Although in the UM study lambing occurred relatively normally without any high-ranked rams, contrary to what the Policeman’s Hypothesis would predict, Jenni is cautious in interpreting these results. The UM research is a single experiment on a single herd, and Jenni stresses that scientific proof is based on repeated experiments.

“The results of this experiment do not support the notion that trophy hunting of bighorns is harmful to sheep populations,” he says. “Our removal of trophy rams from this herd did not seem to harm the reproductive success of the herd in any way. However, we’re left with a new question of why the ewes prefer to mate with the dominant rams.”

A ewe’s preference, he continues, is to be “tended”—courted and bred—by the alpha. She finds her mate in a central tending area, which Jenni says is “sort of like a singles bar.” She willingly submits to his advances.

Ewes are considerably less willing partners in matings with lower-ranked rams, which, according to Hogg’s findings, use one of two aggressive strategies to breed with them. One is coursing, slipping past the dominant ram and breeding on the run—a dangerous act for both the low-ranked ram and the ewe. Another ruse is blocking, breeding with a ewe after herding her and sometimes using brute force to keep her from getting to the alpha.

The amount of blocking and coursing that goes on in a breeding season varies with the dynamics of a herd, Jenni explains. When there’s little difference between the rams—such as after the high-ranked rams were removed from the Bison Range—blocking is highly successful. Coursing, a technique mainly used when there’s a clearly dominant ram in the herd, declines.

When a distinct alpha heads up the herd, as one particularly elegant specimen did the first two years of the study, most of the breeding is done by him. Jenni says at the Bison Range there is at most one alpha at any given time, whereas in larger herds elsewhere in Montana, there may be several alphas with which the ewes may breed.

By observing the results of natural and man-made changes in the Bison Range’s ram population, Jenni and his fellow UM researchers have been able to monitor the relationship between dominance and mating behavior. Their insights are yielding a better understanding of bighorn behavior, which could result in more effective management of one of North America’s most prized big-game animals.

To get a head count and necessary measurements, UM researchers like Jack Hogg must reach newborn lambs quickly—before coyotes do. Each year, only a few lambs survive out of twenty-two to twenty-seven born. (Photo by Beth Hogg)

UM’s bighorn research project has received funding from a diverse group of organizations. Among them are the Conservation Fund of the Camp Fire Club of America; the Wildlife Management Institute; the Montana Cooperative Wildlife Research Unit; the Boone and Crockett Club; the Foundation for North American Wild Sheep; the Research Committee of the National Rifle Association; the Montana Department of Fish, Wildlife and Parks; the United States Fish and Wildlife Service; and the University of Montana.
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Journals of Two Canadian Mounties Shed Light on History of the Northwest
UM Immunology Research May Help Control Gonorrhea
New Mating Theories Could Affect Montana’s Bighorn Sheep Population
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Cover Photo: A detail of a honeycomb used in Jerry Bromenshenk’s environmental research. See pages 36-37.