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Wisconsin engineer. Volume 80, No. 6 May 1976

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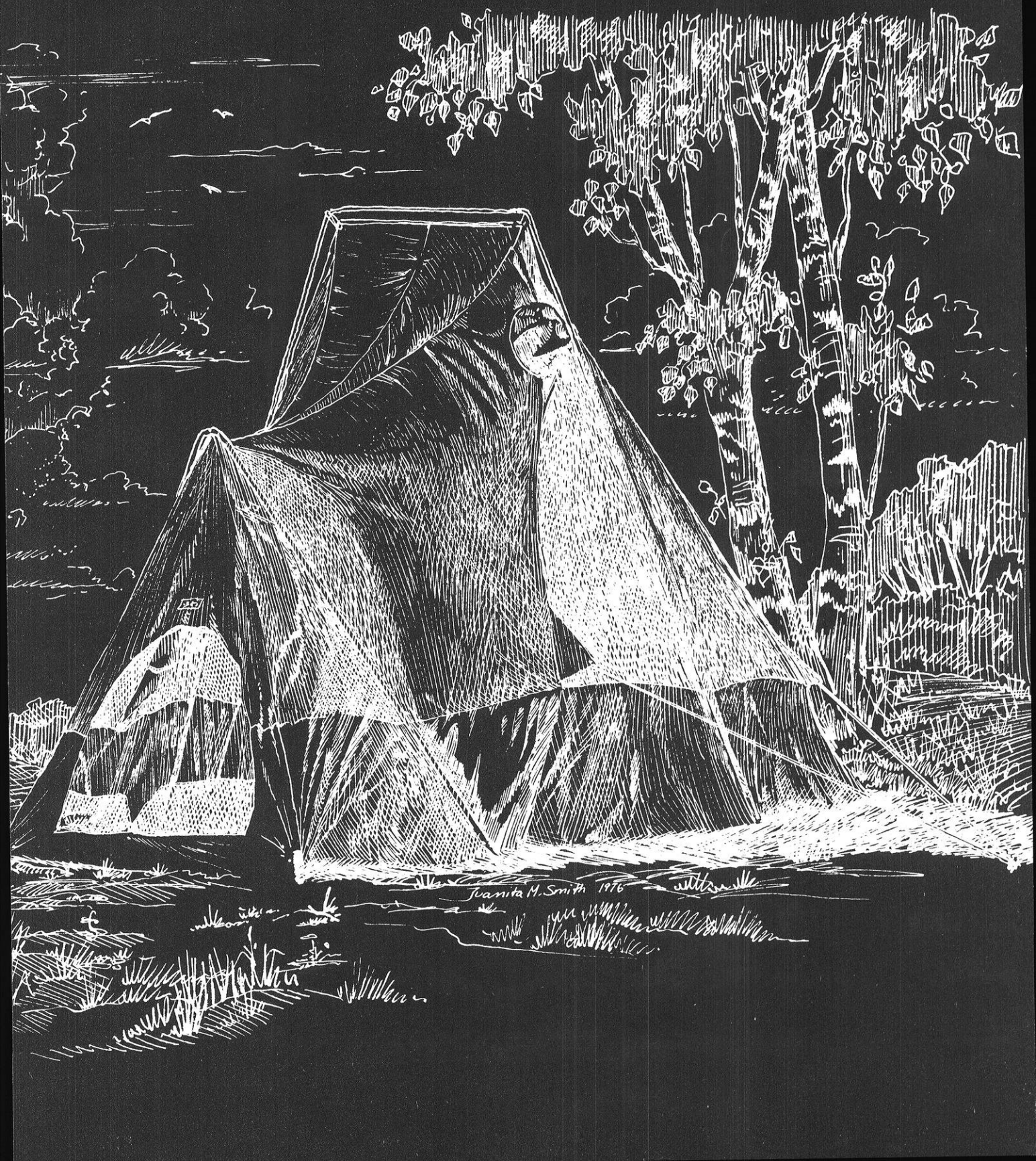
OLUME 80, NO. 6

MAY, 1976

wisconsin engineer



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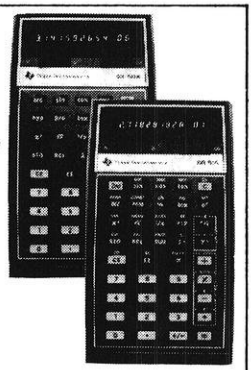

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wisconsin engineer

PUBLISHED BY THE ENGINEERING STUDENTS of the UNIVERSITY OF WISCONSIN

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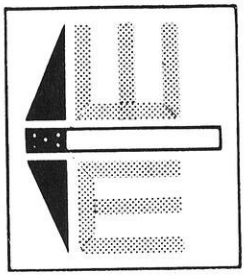

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Contents

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Publishers Representatives: LITTEL-MURRAY-BARNHILL, INC., 60 East 42nd St., New York, NY 10017 and 221 N. La Salle St., Chicago, IL 60601.

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Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

Published six times a year, Oct., Nov., (Dec.-Jan.), Feb., Mar., Apr., by the Wisconsin Engineering Journal Assn. Subscriptions: one year—$2.00; two years—$3.75; three years—$5.25; four years—$6.50. Single copies are 35 cents per copy. 276 Mechanical Engineering Bldg., Madison, Wis. 53706. Office Phone (608) 262-3494.

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A Place for Engineers

by Jack Burke

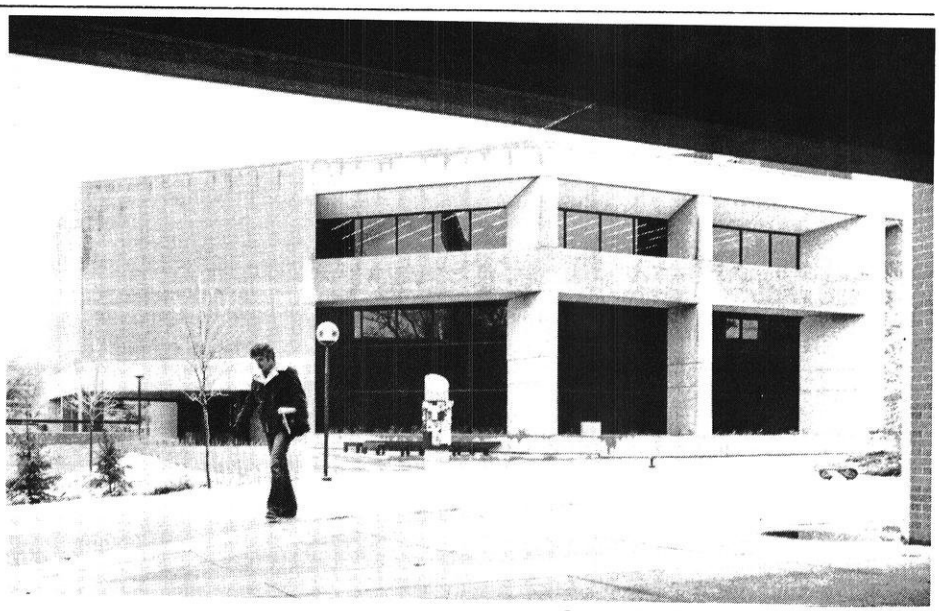


Photo By Norman L. Lenburg

Its doors didn't open until mid-April and it won't be dedicated until Engineers' Day, Oct. 8, but the University of Wisconsin-Madison's new Engineering-Physical Sciences Library is a busy place already.

Some 250,000 books and documents were put on the shelves during spring recess, and it took at least several weeks after that to organize things properly, according to the library director, LeRoy G. Zweifel.

"We have a limited amount of furniture right now," he says. "Most of it still is out on bids, and that takes a lot of time. But we expect to be in good working order soon."

Almost 18 months in the building and more than a decade in the planning, the $3.8 million library is an imposing four-story structure, located just south of Union South, on N. Randall St. It was erected in a modified triangular form and with an outside stone surface similar to that of Union South, with which it shares a common terrace. The two buildings could almost pass for twins.

Most of the volumes of the College of Engineering have been located on two floors of the Mechanical Engineering Building on University Ave. Other books and documents were shelved in other locations on the engineering campus, some in remote storage areas.

The new facility will support informational needs of the computer sciences department, and such specialized programs and centers as water resources, environmental sciences, eutrophication, instrumentation, space sciences, and oceanography. It also will serve as home for the University-Industry Research program's information services division, judged to be one of the nation's finest. This division serves Wisconsin industry and business.

Another phase of library operations is the Federal Reports Center, serving various colleges and departments on campus.

In addition to the book areas, the new library provides office space, reader stations, computer areas, storage areas for collections, and utility space.

The building's interior was planned on a "siphon" arrangement. This means the lower floors were designed for heavier use and will house the most often requested materials. These areas are open longer hours then the upper two floors, to allow late study.

"The library was designed to function as a scientific and technical information center," Zweifel explains. "It makes use of present and anticipated technologies which maximize information availability. Even now we have one of the finest collections in the United States. The library certainly is a much needed facility for one of the country's major engineering colleges."

Strang Partners Inc., Madison, which designed the Steenbock Agriculture and Life Sciences Library on the west campus, also designed the new Engineering and Physical Sciences Library. It was erected by Gilbert Builders Inc., Verona, which also constructed the Zoology Research Building.

Jack Burke *has been the editor of the UW News Service since 1961 and is the former Associated Press Editor.*

Geodesic: The New Look In the Wilderness

by John Christensen

Ten years ago camping usually meant cramming sixty or so pounds of bulky canvas, a Coleman lantern and assorted children into the family station wagon and heading in the general direction of Yellowstone National Park. Backpacking was still an exclusive realm limited to hardy and dedicated purists.

A new generation of ecologically enlightened campers changed all that in the late 60's and early 70's. While conventional campers remained trapped on the highways in mammoth motorhomes, the new breed set a course on the high road to the wilderness. Following one of America's oldest traditions, they journeyed to the wild country's free and open space.

The sport's rapid growth fueled a previously small industry. Fierce competition for the vast, new market initiated a trend toward the constant development and improvement of equipment. Successful outing firms present themselves as leaders in research and design. Though the result has often been a confusing variety of gaudy, sophisticated and expensive gear, modern technology has been successfully applied to a member of backpacking tents that have recently appeared on the market.

Current innovative tent designs include sweeping, aerodynamic structures, updated adoptions of the Indian tepee, domes suspended from arcs, and among the most interesting, a tent that faithfully employs the geodesic concepts advanced by R. Buckminster Fuller.

The tent, called the Oval Intention, was introduced by the North Face company several months ago. For now the tent represents the peak of advanced backpacking technology and design.

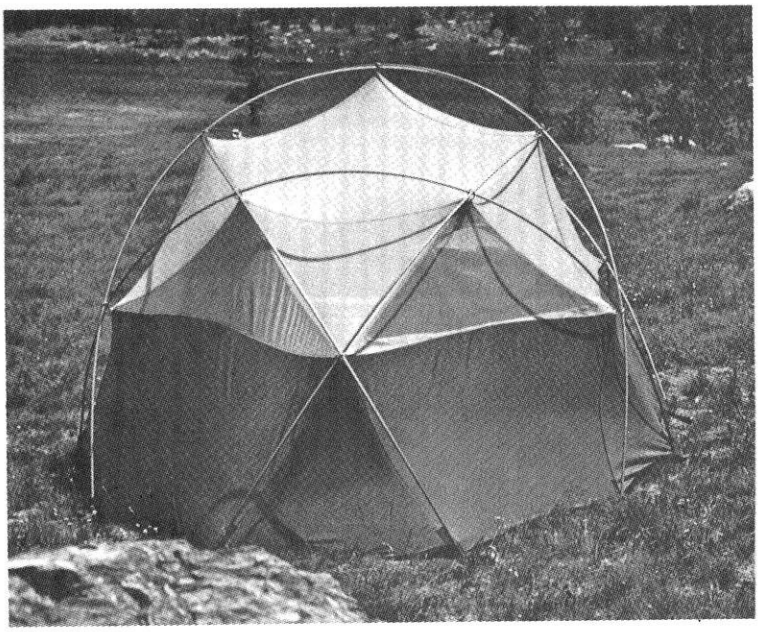
The unique shelter has functional as well as aesthetic value. The tent weathers any storm, sheds snow and rain well and provides maximum interior volume for weight. In many ways it is a backpacker's dream come true.

Geodesic domes are Fuller's creation. Using spherical trigonometry, Fuller divided a globe into spherical right triangles. A dome is a portion of a globe.

The plane that passes through a globe's center is called a great circle sphere. It will divide a globe exactly in half. Fuller discovered 31 great circles in the rotation of an icosahedron, one of the shapes from which a dome can be developed. By projecting the icosa onto the globe you arrive at a spherical icosahedron.

A dome is a multifaceted polyhedron with all the vertices on the surface of a globe. A dome could be developed from a tetrahedron, octahedron as well as an icosahedron. Domes retain the symmetry of all these forms as well as their duals in the triacon breakdown.

The structure encloses the most volume with the least surface area, while resisting internal and radial pressure.



The Oval Intention: the Cadillac of the tent world.

The North Face Oval Intention was designed by Bruce Hamilton, a Fuller student, and Mark Erikson. They developed a system of tough, flexible aluminum shafts sliding through rings on the tents surface to achieve the desired geodesic form.

The advantages of geodesics in tent design are obvious. The sphere is the most efficient enclosure of

space ever conceived. The tent grows stronger as tension on the surface increases. The pressure of wind and snow on any part of the structure will be distributed equally over the surface. The equal distribution of stress effectively resists the element's harshest blows. In storms the tent draws tight, and remains silent. There is none of the ceaseless flapping in the wind backpackers have wearily grown accustomed to.

Though the tent is free standing, it can be anchored in extreme conditions. When set up it is light and rigid enough to toss around. Though it appears complex it can be erected in about ten minutes. The shelter's appearance when set is dreamy and ethereal.

Tom McMahn, midwest representative for North Face, notes that, "not everyone needs an Oval Intention." Nor could everyone afford one. The tent should be considered by backpackers who are not only serious but have extra cash to spare.

Alone with North Face two other firms have broken away from the crowded field to emerge as the vanguard of design and craftsmanship. Jan Sport, Sierra Designs, and North Face have introduced a number of unorthodox backpacking tents.

Jan Sport's line of dome shaped tents was introduced three years ago. At the time the firm had built a solid reputation around its well known packs.

The Mountain Dome and Trail rise from a hexagon base pattern. Sections of fiberglass poles are connected and run from web pockets at each hexagon corner, through nylon sleeves, over the top and down the opposite side into matching web pockets. The fiberglass poles form three arcs dividing the tent into slowly curving pie shaped wedges that meet at the peak.

The large Mountain Dome sleeps four. The smaller Mountain Dome and Trail Dome sleep three. Though the volume to weight ratio is good, the largest tent, at thirteen pounds, is far from ideal. The large

The Mariposa: sleeping in a cathedral.

tent requires twin carrying sacks, one for the pole system and the other for the tent itself. The smaller models are more efficient, weighing about eight pounds and packing into a neat 19-inch sack.

These dome tents seem to have a dual nature. At times they bring to mind simple but efficient nomadic shelters, the Eskimo igloo or the Mongolian yurt. They are also distinctly space-age in appearance, and reflect the concepts of a cool no-nonsense technology.

The tent also incorporates a number of utilitarian design features including a form-fitting rain fly, mosquito netting and doors providing complete and easy access.

Sierra Designs and North Face each produce a pair of tents that seem to be each other's equivalent in design and function. The Sierra Design's Mariposa and the North Face Morning Glory are remarkably alike in design and execution. The North Face Dandelion and the Sierra Designs Pleasure Dome are nearly identical.

I discusses these obvious design similarities with Tom McMahn. While admitting design parallels McMahn contends, "It always seems like we came out with the design first. We're one of the largest companies and we have considerable resources to invest in research and development." He conceded however that, "Sierra Designs still make some of the best in the way they're constructed and hold together."

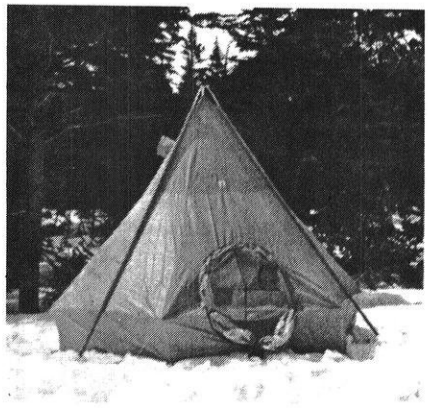
The Morning Glory and Maripose are roomy, strong, four-person expeditionary tents. Their designs are as unconventional as they are beautiful. They employ a long, steeply sloping, swept-wing form.

The tents resemble somewhat stylized hunting birds or butterflies. The design's aerodynamic structure sheds wind and snow more effectively than A-frames.

While not truly backpacking shelter, they are very lightweight for the volume they provide. The Morning Glory weighs in at 12 pounds and the Mariposa at 14.

McMahn recommends these tents for outing where the load can be divided or is not a factor, such as a canoe trip. They offer an alternative to tent claustrophobia during miserable weather. This is no minor advantage, considering the emotional consequences of waiting out an extended storm in a small A-frame with even the closest friend or lover. The Mariposa and Morning Glory offer an escape from such severe tests of friendship. Besides, nothing short of a Lear jet approaches the graceful, flowing beauty of these tents. It's like camping in a Frank Lloyd Wright designed cathedral.

The Dandelion and Pleasure Dome are modeled after Native American tepees and doubtless have earned immediate approval from admirers of Indian lifestyles. The design, however, has more to offer than mere nostalgic appeal. Native Americans, after all, knew what they were doing. The steep pitch sheds snow and rain exceptionally well. The hexagonal floor



The Pleasure Dome: 20th century tepee.

plans provide plenty of room for three persons or two persons and a lot of gear. The structure is firm and rigid.

Like the Morning Glory and Mariposa, these are tents for situations that permit splitting the load. Nylon and aluminum are a lot lighter than lodge poles and buffalo hides however, and a lone hiker could probably manage either of the ten-pound tents.

As for the nostalgic appeal, you may not feel like Cochise, but you might feel better intruding on the environment in a shelter that's been a part of the American landscape for a long time. North Face has just introduced an extremely lightweight, an amazing four pounds, inexpensive and simple recreational tepee-styled tent, called the Grasshopper. McMahn says the tent is aimed at the casual and bicycle camping market. For the money, it's a nearly ideal summer shelter. Despite the unfortunate center pole (a design flaw that keeps the cost down) the tent's design and construction should make it adequate for moderate climatic conditions. It's extremely well-ventilated and designed to shed rain away from the tent. The tent is not yet available but should be considered by anyone who considers weight and economy important factors. The price particularly is a welcome departure from the soaring cost of outing equipment.

According to McMahn the consumer has responded favorably to innovative tent design. "The Jan Sport tents have been well received. We're experiencing amazing acceptance of the Oval Intention. We have more orders than we can fill. If there wasn't a demand for this kind of thing nobody would be doing the research."

He went on to predict an expanded line of North Face domes. While adding that, "the A-frame is still a good tent above timberline, but domes and other designs may just replace the A-frame entirely."

Bold departures from traditional tent design are a result of the stimulus provided by a constantly growing consumer market. Currently an estimated six million backpackers spend $400 million a year on clothing and equipment. Their interest and enthusiasm supports several major publications and dozens of manufacturing firms. Corporate giants in minuscule independents compete for the lucrative market.

Most wilderness campers are aware that strength, durability and light weight in equipment are essential, and outing firms structure their selling points around this awareness. The emphasis on quality and advanced design has turned backpacking into a rich man's sport. A successful outing firm presents itself as a leader in research and development. Design innovation has become a major sales theme.

McMahn explains, "We see the market as a pyramid. We design for the peak of that market, opinion leaders and serious backpackers. We hope a good, strong, high quality image will filter down to the market's base."

One wonders how anyone could have survived in the wilderness before the advent of advanced design and marketing. A brief shopping trip through outing centers gives the impression you won't survive without at least $500 worth of the latest goods. Out on the trails, novices carry one hundred pounds of the latest equipment, the better part of which is completely unnecessary.

Backpacking's popularity has contributed to the growth of sister sports: kayaking, rock-climbing and most significantly, cross country skiing. The concept of wilderness adventure has clearly gained wide appeal, often to the disgust of the sport's early adherents. The nation's most remote and inaccessible regions are in danger of becoming congested. It is now possible, for instance, to reach Mt. Ranier's lofty summit to find a small community of candy-colored tents, instead of the anticipated sense of breathtaking isolation.

Lightweight wilderness shelters have gone through several surprising evolutionary changes with the growth of the sport.

The first backpacking tent was carried by Edward Whymper on his Matterhorn assault in 1862. His simple A-frame tent weighed 23 pounds, measured 6½ feet long packed, and cost about $25. At the time this clumsy canvas shelter was a comparatively lightweight and portable tent.

Today's backpacking tent is usually made of a coated nylon material, with fiberglass and aluminum support poles. It's

(continued on p. 12)

The Eureka Drawtite: exo-skeleton for wind resistance.

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ANS Midwest Student Conference

by Cynthia Klement

On April 2 and 3, 1976, the University of Wisconsin student chapter of the American Nuclear Society was host to the 1976 American Nuclear Society Midwest Student Conference. The purpose of the student conferences is primarily educational and tutorial. The conference is designed to provide a medium for the exchange of new ideas and information between students, by bringing together students of different disciplines in the field. A second learning purpose of the student conferences is to demonstrate the breadth or scope of nuclear science and engineering to the students by bringing together the various specialties and sub-specialties emphasized by the different schools in attendance. A final purpose is to illustrate to the students the concept and practice of a professional meeting as a vehicle for new ideas, for information exchange, for the strengthening of professional relationships and the many other meeting outcomes, thereby further encouraging student participation in the Society as regular members after graduation. In addition, the conference often provides the first opportunity for a student to present orally and in a technical format a paper on a scientific or technical subject within a fixed time frame to a largely unknown but sympathetic audience.

The conference was held at the Edgewater Hotel in Madison and its theme was: Nuclear Energy: A Declaration of Independence. Over 180 students and faculty attended along with representatives of Sierra Club, Common Cause, and some contributing companies. The conference is funded through contributions from nuclear related industries, ANS sections, and the Energy Research and Development Administration (ERDA).

Joan Etzweiler receives the "Outstanding Paper" award in the Fusion Systems and Plasma Physics category.

Dr. Richard Roberts, Assistant Administrator for Nuclear Energy, ERDA, was the keynote speaker on Friday and gave the welcoming address. He spoke on ERDA and especially on the nuclear energy programs. The address was open to the public. A "Certificate of Appreciation" was presented to Dr. Roberts by Octave Du Temple on behalf of the ANS, following the talk. It was awarded to Dr. Roberts for his work with the student conferences. Professor Max Carbon, chairman of the nuclear engineering department, spoke on behalf of the department and gave a review of the development of the student conferences.

Over 60 technical papers were presented by students from universities throughout the midwest. These include: Purdue University, University of Notre Dame, University of Missouri, Northwestern University, University of Cincinnati, Ohio State University, University of Illinois, Iowa State University, University of Michigan, University of Missouri-Rolla, Kansas State University, Michigan Technological University, and the University of Wisconsin. Half hour time slots were given to each presentation with three papers running concurrently. Papers presented ranged from design projects, thesis research and laboratory projects' to subjects concerning the role of nuclear science and engineering in our society. Papers were divided into nine categories: Applications of Nuclear Technology, Measurements I & II, Nuclear Power Production I & II, and Fusion Systems and Plasma Physics. One award was given per category for "Outstanding Paper." These papers were judged by attending

faculty and industrial representatives. Two University of Wisconsin students received these awards. Joan Etzweiler was awarded the distinction for the Fusion Systems and Plasma Physics category for her paper entitled, "Scaling of Measured Plasma DC Resistivity in the Small Wisconsin Octupole." In the Nuclear Power Production II category, Cliff Strawitch received an award with his paper, "Divertor Experiments." Other University of Wisconsin students who submitted papers included: Magdi M. H. Ragheb, Ralph Flynn and Pat Hanrahan, Randy G. Lott, John B. Whitley, John Darby, John Nightingale, Everett Ramer, and Tak Yun Sung.

At the awards banquet held on Saturday in the Great Hall of Memorial Union, Robert Marshall, Dean of UW Engineering College spoke. Guest speaker at the dinner was Mr. Sol Burnstein, Executive Vice-President of Wisconsin Electric Power Company. He spoke on the need for people in the nuclear sciences to become publicly involved in nuclear issues. Mr. Harold Forsen, vice-president of Exxon Laser Enrichment Division and former UW professor, presented the awards. Certificates were given along with checks totaling $300.

During the ANA Awards Banquet, Dean Marshall addresses the conference.

Cynthia **Klement** *is an electrical engineering freshman and intends to go on to get a MBA in Business. Her goal is to apply Business Administration and Communications to an Engineering background.*

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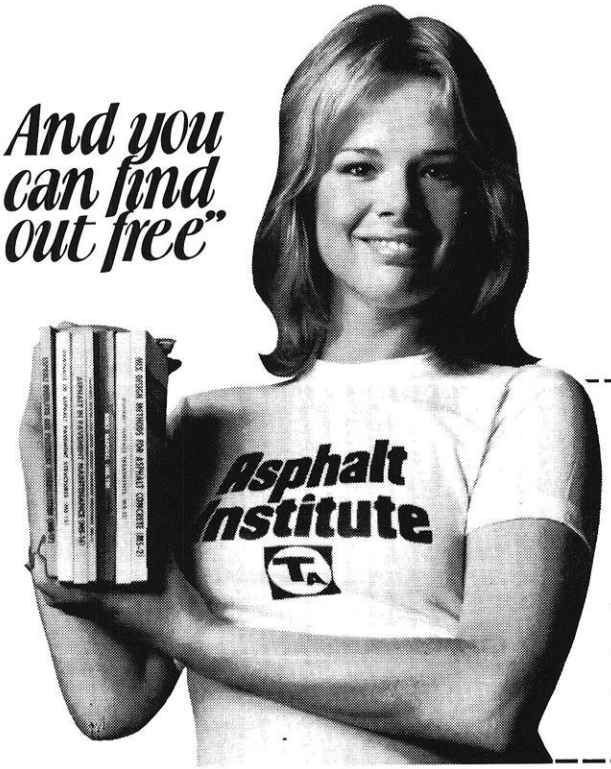

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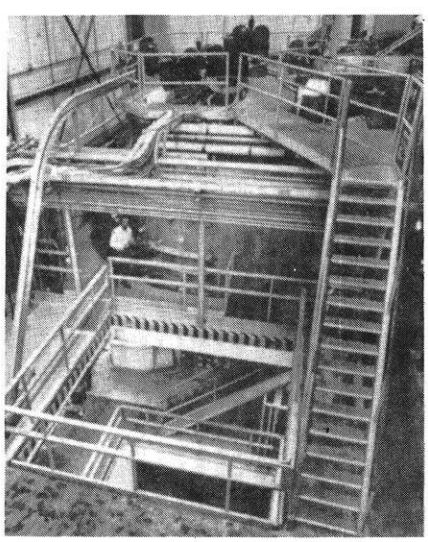
What's the Matter?

by Steven B. Krogh

During the years 1905 - 1913, Sir Ernest Rutherford and his collaborators, Geiger and Marsden, performed an ingenious series of experiments on the scattering of alpha particles by atomic nuclei. This was the first successful attempt to examine the inner structure of the atom. The relationships between the mass, charge, and size of a nucleus - previously a complete mystery - were revealed. By 1925, all observed sub-atomic phenomena could be explained in terms of only three basic particles - protons, neutrons, and electrons - and photons of electromagnetic energy.

But progress does not stand still. Man's unceasing desire to extend his knowledge (and confound himself in the process) soon discolored this simplistic picture of the atom. In 1931, Wolfgang Pauli suggested the existence of another particle, now called a neutrino. Since then, well over a hundred other particles have been found, each with its own peculiar characteristics. Although this may sound like a very confused state of affairs, research now being done may finally provide us with a much more precise, clear-cut impression of nuclear structure and interaction.

At present, the most plausible theory to explain this huge menagerie of particles is known as the Quark Theory, first postulated by Gell-Mann and Zweig in the early 1960's. In its original form, it was suggested that there were three elementary particles, now called the up, down, and strange quarks. These could combine to form all existing particles (excluding the Leptons, a class which includes electrons, neutrinos, and muons). Several minor discrepancies in this theory were cleared up with the addition of a fourth quark. All known particles and interactions could now be explained in terms of the Quark Theory. In fact, this revised theory was so appealing, that the fourth quark was whimsically named the "charmed" quark.



The 15 ft. Bubble Chamber

But, attractive as it is, a theory is not fact until it is proven. Countless hours have already been spent in the efforts to find a quark in its "free" state, unattached to other particles. Most of these investigations have made use of the quarks' most outstanding characteristic - that of partial charge. Protons and electrons have been thought to have the smallest possible amount of electric charge (other than no charge at all). Quarks, if they exist, would have only a fraction of this fundamental charge.

With this in mind, experimenters have fired streams of particles into specially-made "obstacle courses" of electric and magnetic fields. The apparatus used is designed such that only a partially charged particle could make it through to detectors at the other end. The result: after years of effort, no free quarks have been found.

But there is another approach. The existence and characteristics of the up, down, and strange quarks were postulated on the basis of other particles known at the time. The charmed quark, however, came from the assump-

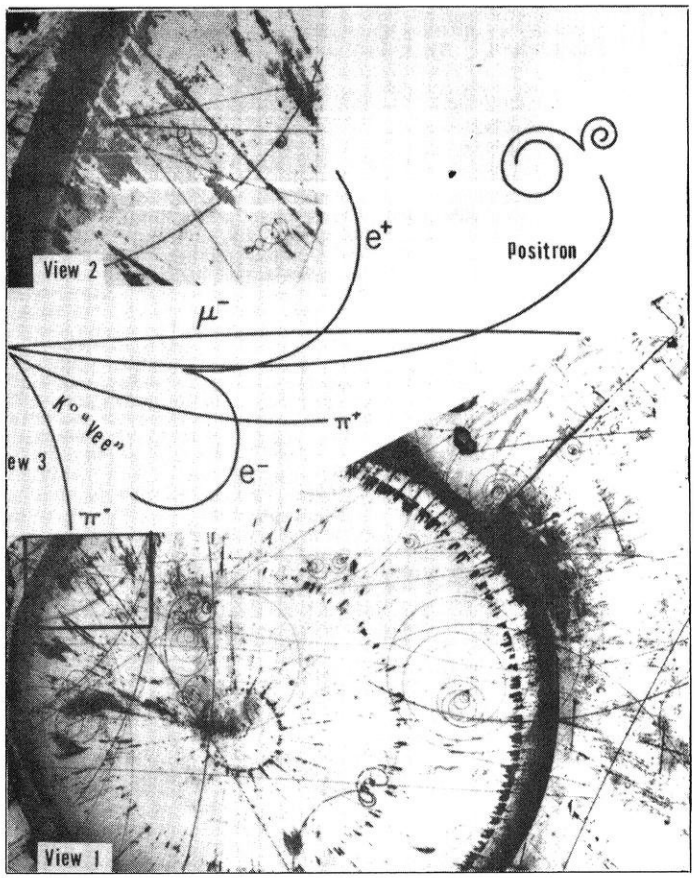
tion that the other three quarks exist. If one were to discover a new particle which exhibited charm (that is, it has properties such that one of its constituents must be a charmed quark), this would be strong evidence that the Quark Theory is correct. The exciting part is that such particles may have just recently been found. In fact, several research groups, within the last eighteen months, have observed several nuclear interactions (events) which seem to have the characteristics of the decay of charmed particles.

One such group - a collaboration of experimenters representing the University of Wisconsin, the CERN Laboratory at Geneva, Switzerland, the University of California Lawrence Berkley Laboratory, and the University of Hawaii - has been studying interactions resulting from the collisions of high energy neutrinos with atomic nuclei. These events take place in a fifteen-foot-diameter bubble chamber at the Fermi National Accelerator Laboratory near Batavia, Illinois.

The process works as follows: the accelerator delivers a pulse of several billion neutrinos to the bubble chamber. Since neutrinos react very seldom, only about one reaction takes place every ten pulses. The chamber itself is filled with a mixture of liquid hydrogen and neon. With each pulse, a trio of cameras records what takes place in the chamber. Charged particles leave a fine trail of bubbles as they move along. By analyzing the pictures of these "tracks" of the charged particles, each event can be mathematically reconstructed and evaluated.

Between April and June of 1975, about 80,000 usable photographs were taken by the experimenters. Of these, fifteen events have so far been found which seem to involve a new, possibly charmed, particle.

The evidence for the new particle was first announced in December of 1975. At that time, only four such events had been identified. Each involved a positron (a positron is the positively charges anti-matter counterpart



Composite photograph of one of the unusual events in the Bubble Chamber.

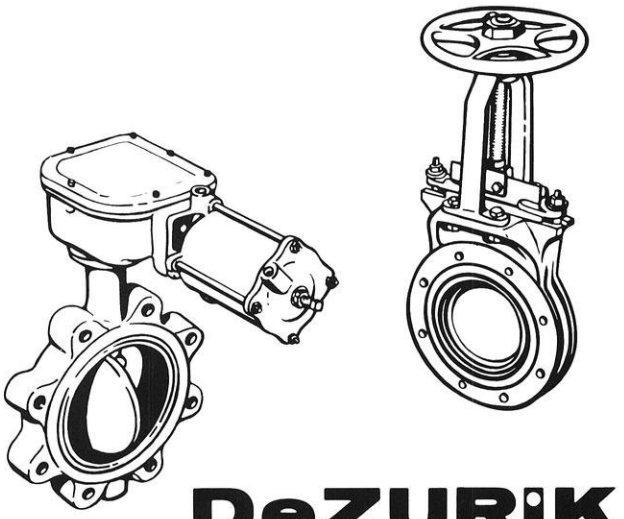
of an electron), a negatively charged muon, and a neutral K meson. In two of the original four events - and twelve of the present fifteen - the muon had struck a special detector outside the chamber. Called the EMI (External Muon Identifier), it is able to differentiate between muons and more common pi mesons.

The events are interpreted as the production of a new particle during the neutrino interaction. The original neutrino turns into a muon, while the new particle decays rapidly (in about 10^{-13} seconds) into a neutral K meson, a positron, and another neutrino. This is the first time that a neutral K meson, a particle which exhibits "strangeness", has been seen together with two leptons. Such a reaction is consistent with present theoretical models of charmed particles.

And, as in any experiment, there are inconsistencies as well. For instance, by present theory, one would expect to see a neutral K meson decay (called a "vee") in no more than about half of the events involving charmed particle production. However, of the fifteen events found so far, fourteen have vees. One possible explanation is that, since vees help to identify candidates for interactions involving the suspected new particle, it's natural that many more such events with vees would be found than without; or, it may be that experimental conditions somehow enhanced vee production. But these are only suggestions. Continued study will eventually make all the facts clear.

For many years, man has sought to find the fundamental relationships between matter and the forces which act on it. Researchers are now finding many essential and significant pieces of the puzzle. All we need is someone clever enough to put all the pieces together. Perhaps, very soon, someone will.

Steven B. Krogh *is a junior majoring in Physics and working on research in high energy physics at the university.*



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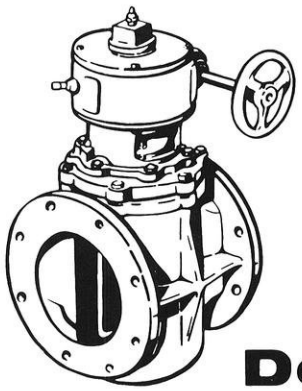

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design has evolved beyond the simple A-frame. Modern shelters weigh 4 to 13 pounds, are no more than 25 inches long when rolled, and many current designs could start rumors about an invasion of alien space craft.

Eureka tents, designed by Robert Blanchard, were an early departure from the traditional A-frame design. The tent's fabric is suspended from an exterior pole system. This exo-skeleton design altered the tent's basic appearance, while making it more wind-resistant and self-supporting. The Eureka Drawtite tents did not require stakes or guy lines. They could be pitched on snow, rock or sand. The exterior frame, an important breakthrough, is not incorporated in most tent designs. Though the company has not designed any new tents recently, they are still the acknowledged sales leader in the lightweight tent field.

Other manufacturers soon introduced new tent designs. Quonset hut tents are sold by Thomas Black and Sons, Early Winters, Mountain Safety Research, and Atlantic Back Pack. Adventure 16 and Co-workers Development Corporation (CDC) have designed four-sides tents suspended from a pair of fiberglass arcs. The design greatly increases interior volume. Jan Sport employed the concept in their recently introduced line of tents.

The introduction of new tent designs will continue. Even the geodesic design in tents will eventually be surpassed. In a sport and industry as wide open, freewheeling and rapidly growing as wilderness camping, no end is in sight. The concepts and materials of modern technology have been successfully applied to wilderness conditions. The science of wilderness engineering is yet in its infancy.

John Christensen *is a senior in Ag Journalism. He has written for the Cardinal and is the former editor of "News from Home." He has backpacked and camped in Europe and North Africa.*

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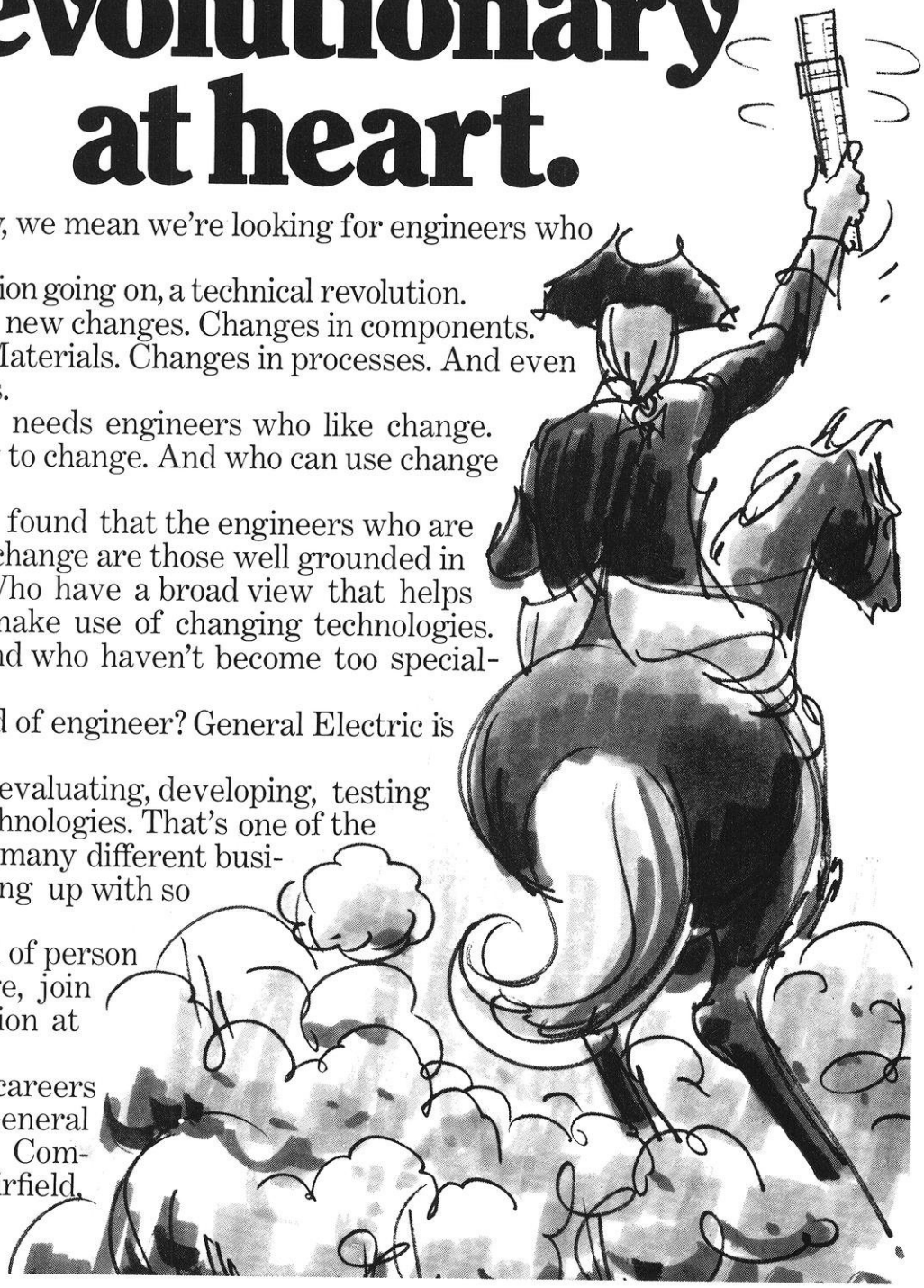

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