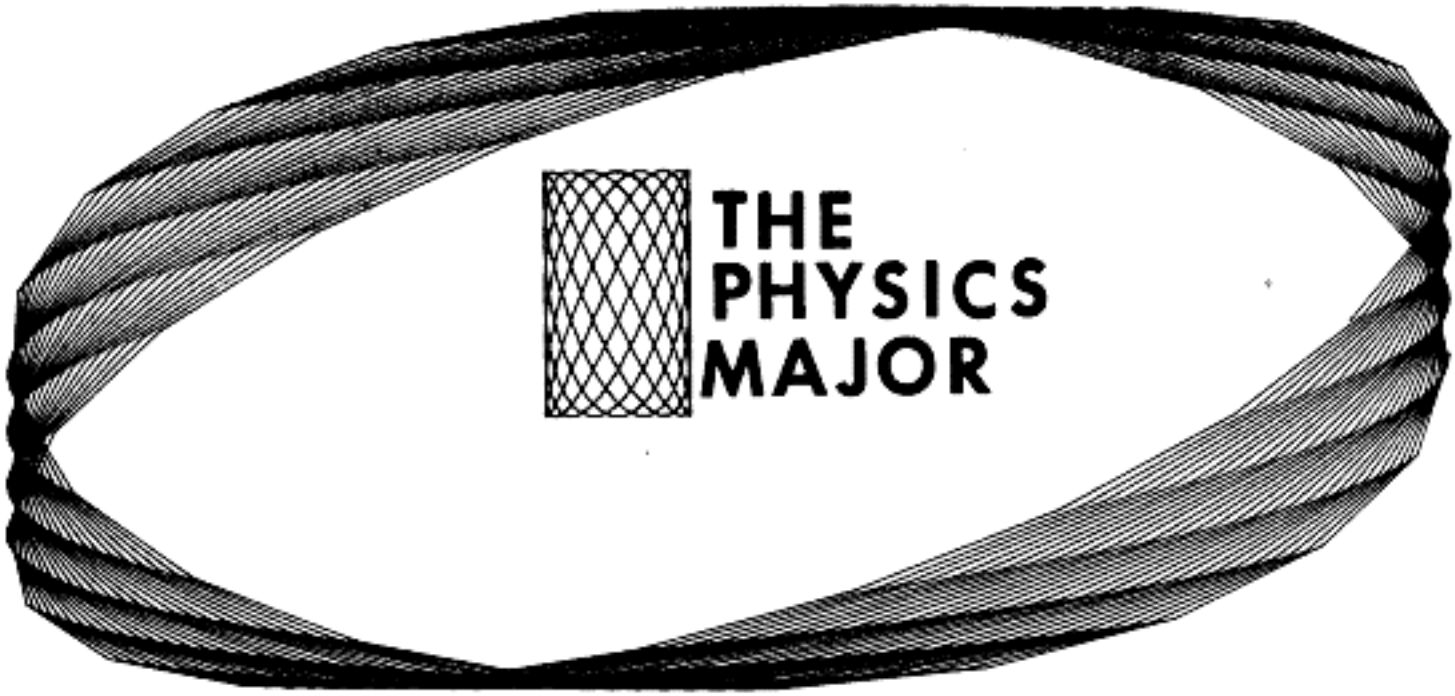

THE PHYSICS MAJOR

DeFreez Wins Internship, Makes Discovery

Senior physics major Rick DeFreez worked last summer in the research labs of Bethlehem Steel Corporation in Pennsylvania. There he made a discovery which may significantly increase the efficiency of coal mining.

Rick was one of a handful of students from throughout the nation selected to participate in the Industrial Graduate Intern Program of the American Physical Society. Most of the others were graduate students.

Bethlehem Steel, like many steel companies, mines its own coal. Coal is, of course, the most abundant source of energy available in this country.

Nowadays most coal is mined by machines. The machines tunnel directly into the seams of coal. However, coal is often accompanied by highly flammable methane gas. For this reason the law requires that the methane concentration be measured in the mine tunnel frequently - as often as every twenty minutes in Pennsylvania.

The present method is slow. After twenty minutes of mining, the machine must be removed and a miner sent into the shaft with a device to measure the methane.

He can't walk right in, though. First shoring must be put up to establish a safe roof over his head.

After the measurement is made, the roof must be taken down. It only gets in the way of the mining machine.

Thus the machine only mines coal a fraction of the time. Clearly a lot of time could be saved if the methane could be measured from a distance.

It had occurred to the researchers at Bethlehem Steel that a way might be found to do this using lasers. But they had no laser expert.

The internship program of the prestigious American Physical Society allowed them to obtain one for the summer.

They chose DeFreez, the star student in the Gas Lasers and Holography course taught by Dr. Isaac Bass at Sonoma State.

Working with a special $100,000 laser borrowed from the U.S. government, DeFreez demonstrated, in just seven weeks, that laser light scattered off coal dust could be detected from a distance.

Light absorbed by methane molecules is missing from the scattered beam. Careful measurement and data analysis reveals the actual methane concentration.

Rick believes that eventually a technician will be able to point a device containing a production laser at the end of the mine tunnel, press a button, and read the amount of methane there.

First, Bethlehem Steel plans to patent the discovery.

Meanwhile DeFreez is back at Sonoma State, helping to teach the laser course. His mentor, Dr. Bass, is on leave, pursuing more advanced research with lasers at Stanford University.

Number of Majors Hits All Time High

At the end of October 1979, the department of physics and astronomy counted 75 physics majors, up four from a year earlier, the largest number yet.

The percentage of undergraduate students majoring in physics at Sonoma State continues to be the highest by far in the California State University and College system.

Physics majors are not lonely at Sonoma State University.

Sonoma State University

Laser Research

by Jacques P. Schlumberger

Lasers now read product codes on groceries, and perform delicate eye surgery. Soon they will read video disks in many home computer centers. After that, who knows? Research and development in the field of laser technology goes on at a dizzying pace.

Last Spring, five students at Sonoma State University participated in an experiment of their own. Under the direction of Associate Professor Isaac L. Bass of the department of physics and astronomy, students Rick DeFreez, Mary Silber, Eric Reiter, Roland Begin, and Johannes Raab took a prototype course called 'Gas Lasers and Holography.' "The course," explained Bass, "was an attempt to find, within our resource constraints, a program suitable for the wide interest within our department. Lasers are increasingly important in science and technology. Moreover, they are a device which has special appeal for students."

One of the most spectacular applications of lasers is in holography. This consists of a laser beam shone through a prepared piece of photographic film to produce a three-dimensional image. The film itself is essentially a stored diffraction pattern. Physics student Roland Begin worked extensively with holograms. One possible application of Begin's work might be in the field of urban planning and development. Do you wonder how a new park or a new building might look in a particular community? Try imposing a three-dimensional image on a holographic photograph of the community. Better yet, try a life size holographic image on location.

After completing a set of practice experiments devised by Bass, Rick DeFreez and Mary Silber chose two experiments from the Stanford University graduate program in applied physics.

"In one of these," comments DeFreez, "we saw the potential of tunable ultraviolet lasers. If frequencies can be mixed together, it just might be possible to use lasers in the transmission of electricity."

Isaac Bass is now on sabbatical working with noted physicist Robert Byer at Stanford. Bass is conducting research in CARS (Coherent Anti-Stokes Raman Spectroscopy). One possible application is analysis of the combustion process through the detection of different molecular species. "There has been a virtual renaissance in Raman spectroscopic techniques with the advent of lasers," Bass noted before he left.

Development of laser technology has far outstripped our imaginations. When the first laser was built, less than twenty years ago, could anyone have imagined the application of the laser today in both science and technology? Perhaps the only true prediction to be made about the laser is that it will continue to surprise us.

George Johnston Studies Plasmas

Professor George Johnston, a plasma theorist and ten-year member of the SSU physics and astronomy department faculty, divided his time last summer between assignments at the Lawrence Berkeley Laboratory and U.C. Irvine.

At U.C. Irvine he worked on "thermal instability in a sheared magnetic field", a problem which is a piece of a puzzle which might describe the "trigger mechanism" for the eruption of a solar flare.

At Berkeley, Dr. Johnston worked with a plasma theory group on "resonant interaction theory" which would help to explain "frequency characteristics" of certain particles. The present mathematical theory doesn't adequately account for resonant particles; ie. frequency values "blow up" to infinity when calculated by current methods, according to Dr. Johnston.

At Irvine, there is much interest in solar flare eruptions. Flares cause disturbances in the earth's magnetic field which cause radio wave interference and may influence weather phenomena such as droughts.

A solar flare is a sudden outburst of particles from the sun. Theories state that magnetic field energy is converted into particle energy on the surface layer of the sun. There is a "strip region" on the sun which has been identified as "flare territory". One side of the strip has a magnetic charge opposite that of the other just prior to the flare eruption. "The folk wisdom" in plasma theory, as George calls it, is that when a flare eruption occurs, magnetic field energy is converted into particle energy (x-rays, energetic electrons, etc.).

The big question, which George worked on, is what is the "trigger mechanism" of solar flares? Why do the flare regions remain stable for extended periods of time, and then suddenly release tremendous amounts of energy?

Johnston worked on this problem for about a month before moving on to Berkeley, but he plans to return to the problem with his colleagues. George said that his idea for the work came as a result of an Italian colleague's research. The hope is that the trigger mechanism of solar flares can someday be discovered. This might ultimately lead to the ability to predict flares.

George spent the rest of his summer at the Lawernce Berkeley Laboratory, where he is a participating guest. He now visits the lab weekly to keep in touch with resident colleagues.

The problem he worked on there was related to "resonant interaction" of particles. The problem is an important one as resonant interactions may cause the configuration of our solar system to eventually change.

Professor Johnston is currently working on a method of obtaining an approximate solution to the Schrödinger equation in one dimension. He feels he has worked out a better method than the present one (WKB). This month he is presenting a paper on this work at a Boston meeting of the division of plasma physics of the American Physical Society. The new method eliminates the existing assumption that there must be a bound state.

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Van Gieson Goes to M.I.T.

Frank Van Gieson of Santa Rosa, a 1979 Sonoma State University physics graduate, was offered over $50,000 in teaching and research assistantships at eight prestigious universities.

The universities included Stanford, Illinois, Purdue, University of Southern California, the University of California, Davis, and the Massachusetts Institute of Technology.

Van Gieson chose to attend M.I.T. because its materials science program is considered the best in the nation, and it will allow him to continue his work in economics.

His studies will emphasize solid state physics and lasers, and he hopes to eventually move from scientific research into management.

Van Gieson graduated from SSU last June, cum laude and with distinction, with a double major in physics and mathematics, and a minor in economics. He came to Sonoma State from Montgomery High School in Santa Rosa.

Student Profile: Roland Begin

Perhaps the most versatile student in the department of physics and astronomy is Roland Begin.

Roland will graduate with a B.S. in June and then enter graduate school in solid state physics or material science. He is especially interested in applying his talents to energy-related problems.

Begin started his studies at the University of New Hampshire, in his home state, but left during the turmoil of the late 1960's. When he entered SSU in 1976, it was to study psychology and physics. Although he has since dropped the psychology major, he remains deeply interested in theoretical problems related to quantum mechanics and what he calls "the stubborn persistence of extrasensory phenomena." Last year he wrote an extensive paper on hidden variable theories for Dr. Sam Greene's course on Quantum Mechanics, Mind, and ESP.

Begin also has interests in the philosophy of science. He has taken several philosophy courses and continues to read widely.

Within his major department, Roland has particularly enjoyed courses in mathematical physics (with Dr. Tenn), the history of physical science (with Dr. Karas), and gas lasers and holography (with Dr. Bass). He has continued to work with lasers and has done some independent research on holograms. He is currently working on a paper on a holographic model of memory and perception.

Roland supported himself as a psychiatric technician at Sonoma State Hospital for five years, usually working nights while going to school days. He recently quit to devote full time to his studies in his final year. In recognition of his excellent academic record, he was awarded one of the new merit scholarships contributed to SSU by the Bank of Sonoma County.

Two years ago, Roland Begin was one of a small group of students who arranged and conducted a regional meeting of the Society of Physics Students at SSU. It was he who introduced Nobel laureate Felix Bloch to the large crowd in attendance at the highly successful meeting.

Roland is married to Nancy Weber, a writer who earned her B.A. in philosophy at Sonoma State. He is proud that she has published some of her poetry in a national magazine.

Having attended three universities, Roland knowledgeably states, "I appreciate this school largely for the fact that it is small and has close faculty-student interaction."

An Interview with John Dunning

by Jacques P. Schlumberger

Professor John R. Dunning has run the spectrum from high energy physics to energy problems to nuclear physics. A native of New York, Dunning came to SSU in 1968 after three years of teaching and research in high energy physics at Harvard University.

After receiving his B.S. in 1960 and his M.S. in 1961 in physics from Yale, Dunning went on to earn his Ph.D. in high energy physics at Harvard in 1965. "When I first came to Sonoma State," he explains, "I wondered what to do." Dunning saw the question of environmental pollution as an area in need of research. Thus he developed the mass spectrometer lab, for which he received a $25,000 grant.

A year later pollution standards changed, and the mass spectrometer was no longer able to meet those standards. "I found, however," says Dunning, "that we could date chemicals and that got me into nuclear physics."

In 1971 Dunning went to Los Alamos to learn neutron activation analysis. The department bought a detector and Hewlett-Packard contributed a multi-channel analyzer. "Eight years later," according to Dunning, "we have a first class facility. We can tell you almost anything you want to know about content, from the trace elements in human hair to the amount of mercury in fish livers."

Dunning's growing concern over energy questions led him to teach a course on nuclear physics. In 1973 he and colleague Gary Sposito received a National Science Foundation grant to give a seminar on geothermal power. "Out of the geysers came the idea for a course in X-ray fluorescence." Dunning went to Oak Ridge for training.

X-ray fluorescence is a method of qualitative analysis using the color emissions of excited electrons in x-rays. Dunning set up the system at SSU in cooperation with the department of geology. "Thus," he explains, "we have three systems here--the mass spectrometer, the neutron activation analyzer, and x-ray fluorescence. Between them all we can cover a fair range of elements."

Dunning hopes to take a sabbatical at Stanford next year. There he plans to work with synchrotron radiation, an intense source of x-rays which can be filtered and tuned to various wavelengths. He intends to work with Professor Keith Hodgeson in developing an x-ray fluorescence program for undergraduate chemistry labs.

Last summer Dunning attended a seminar at Stanford on "The History of Technology in America". It dealt with the place of science in civilization. "We tried to wrestle with the question," Dunning explains, "of whether it is better to investigate something, or whether that knowledge is better left untouched."

In examining the present directions of science and technology, Dr. Dunning thinks that we are far too critical of ourselves. "We are going through a period of questioning," he notes. The exception to this, he points out, is in the electronics industry, where research and applications continue in large leaps.

This has led to an important shift in the nature of scientific research. "The significant research in physics is no longer conducted in the university setting," comments Dunning. "It is in industrial and military settings. The push is toward immediate application, not long-term development. The university is no longer the best place to learn, and the apprenticeship system in industry is becoming more and more necessary in order to learn physics. We are no longer funded as we were ten years ago, and Sonoma State has drawn closer to industry out of necessity." Dunning points particularly to the fine relationship of the Department of Physics and Astronomy with Hewlett-Packard and Optical Coating.

Despite budget cuts, John Dunning continues to encourage and emphasize modern laboratory research techniques at Sonoma State.

Student Profile: Mary Gardner

"I think more than I did before I came to school."

Those are the words of junior physics major Mary Gardner. Mary is also an artist, a gardener, a poet, and a reader on such diverse topics as mysticism and space colonization.

"It titillates my imagination," is the reason she gives for her enthusiasm for living in space.

Before entering Sonoma State, Gardner worked as a secretary, bookbinder, gas station attendant, and as a teaching assistant in an experimental school. She still likes teaching and may possibly enter the field. She devotes a great deal of time to raising her sons, now 12 and 13.

Why physics? "It is a way of exploring consciousness, particularly my own."

Math has always been Gardner's most difficult subject, but, she states firmly, "I am determined." This fall she will finish the last course in the calculus sequence as well as the introductory calculus-based course in quantum and statistical physics.

Mary Gardner has also taken advantage of several of the nonmathematical courses the department has to offer. She especially enjoyed Dr. Sam Greene's special topics course in Quantum Physics, Mind, and ESP, and recommends it highly to others. (It will be offered again in the spring of 1980.) She is currently taking Greene's course in cosmology.

Richard Karas in Greenland

by Larry Webb

It has been sometime since department chairman Richard Karas did his dissertation research at UC Berkeley, but he hasn't stopped "playing with balloons".

Since the late 1960's Dr. Karas has made a number of trips 'poleward' and with the aid of large research balloons, has studied the effects of particle precipitation on the upper atmosphere.

Funded by a $110,000 National Science Foundation Grant to a research group at UC Berkeley, Dr. Karas and three colleagues (including his dissertation advisor from Berkeley) have gone to Greenland for two consecutive summers. There, they have studied x-ray bombardment which results in an effect referred to as 'the northern lights'.

Aristotle, Captain James Cook, and Ben Franklin all spoke of the northern lights. Until as late as World War II, they were considered to be weather phenomena. Noted magnetospheric scientist James Van Allen noted that the northern lights were pale green with pinkish edges. Sounds beautiful, but beauty wasn't what Van Allen was mainly interested in... He was interested in the particles bombarding the top of the atmosphere. He confirmed his 'bombardment hypothesis' and conducted a number of experiments on the subject, including one done from the first satellite set into orbit in the late 1950's.

Rich explained that increased solar activity, such as flares, causes the strength of the "solar wind" to increase. Plasma particles (protons and electrons mostly) are "blown" toward earth causing our radiation belts to fill up. Like a "leaky bucket", some of these charged particles from the radiation belts fall into our atmosphere, "exciting" air molecules which result in the northern lights.

The solar wind causes earth's normally-dipolar magnetic field to become tremendously distorted. Particles traveling at speeds of 400 to 500 kilometers per second "flatten" the earth's magnetic field on the day side. The night-side magnetosphere may stretch out beyond the orbit of Mars.

Dr. Karas mentioned that there is continuing experimental research on the northern lights and the magnetosphere, with much to be pieced together. He said there is a great deal of work for theoretical physicists to put together the diverse effects in a clear picture of the events taking place in our upper atmosphere and near-space environment. Rich's research is a small piece of the picture.

Basically what Rich et. al. did in their summers at Greenland was to launch a number of 200-foot-diameter balloons 35 miles into space and record bremsstrahlung x-rays. The payload contained a particle counter as well as other experimental equipment. Data from the balloon-borne instruments were sent to the ground by radio telemetry. A telemetry station on a nearby hill was an ideal location to monitor the flight of the research balloons.

The four week trip to Greenland during the summer of '79 wasn't without its ups and downs. Not too much 'x-ray data' was collected until after the ninth of 12 launches, shortly after a large solar flare erupted. Immense amounts of data were collected thereafter.

The U.S. Air Force, which maintains a base in Greenland, unexpectedly charged a $113 per person per day civilian surcharge for the use of their base as a research site. That was one of the "downs" of the project because it meant that the SSU student who was to join them was ultimately dropped from the research team.

"If the Air Force will relax that $113 surcharge, we can take a couple of students with us next time", remarked Rich. "Half of our balloons and our telemetry equipment is still up there; we will be going back next summer."

"I'll be redesigning the x-ray circuits to use integrated circuits instead of discrete electronics. It would make a great 'physics 495' project." Those students who are interested should contact Rich about assisting him.

Rich said that he is also currently looking for students with some electronics background to work with him on redesigning the safety timer and flasher which will be used for next summer's research project.

Rich holds a Ph.D. in atmospheric and space sciences from UC Berkeley, where he taught in the physics department before coming to Sonoma State in 1974. The winner of the SSU Outstanding Professor award in 1977-78 remarked that he would dearly love to teach a course at SSU on the upper atmosphere and magnetosphere.

Meanwhile, Rich will continue to spend time studying the topic by doing research in remote parts of the northern world with the hope of some day being able to share his experiences with a number of SSU students, because that's what he likes to do most.

Poland Becomes Dean of Faculty

Dr. Duncan Poland, senior member of the physics and astronomy department faculty, is rarely seen in Darwin Hall these days. After serving two terms as chairman of the Division of Natural Sciences, he was appointed Acting Dean of Faculty.

His new full-time administrative post keeps him busy attending meetings and dealing with the bureaucracy, but Duncan retains some ties with the department. He is determined to teach at least one course each semester despite his heavy schedule.

In the spring he will teach a special topics course in solid state devices. This will allow physics students to explore the inner workings of diodes, transistors, and electro-optical devices.

The OCLI Connection

Sonoma County is known for its rural atmosphere, and many people are not aware that the nearby city of Santa Rosa supports a growing number of high technology industries. One of these, Optical Coating Laboratory, Inc. (OCLI), is a world leader in thin film technology.

The applications of thin films deposited on various substrates are many. For example, OCLI has been involved in projects that range from coating windows and instrument components for spacecraft - from Gemini to Space Shuttle - to developing coated products for capturing solar thermal energy.

Toward the beginning of 1979 a link between Sonoma State University and OCLI was created in the form of a student internship. The intent was to provide a physics student both employment related to the major and a look at the realm of industrial physics and engineering. The first internship went to Stephanie Snedden, a senior known in the department for her work in astronomy. Last summer, senior physics major Lance Erickson found employment at OCLI doing computer interfacing and programming. Recently a third internship was created and awarded to sophomore Mark Zimmerman.

Snedden and Zimmerman use spectrophotometers to measure the transmission and reflection of light at various wavelengths through materials which have been coated with thin films.

Several physics graduates of Sonoma State are employed by the company in career positions. These include process engineer Ed Knudson (B.A., 1973), programmer Basil Swaby (B.S., 1974), and sales engineer Mike McBride (B.A., 1975).

Furthermore, OCLI employees Al Douglas, Rick Fischer, Paul LeFebvre, Michael Nofi, and John Reinecke are working toward degrees in physics at Sonoma State.

Last, but certainly not least, three OCLI scientists -- Dr. Joseph Apfel, Richard Winegarner, and Dr. Irv Goldstein -- have discussed their work in the department's "What Physicists Do" series.

The existence of these links between our local industry and academic institution provides the highly valuable service of allowing the physics student to make a more knowledgeable choice when considering his or her future. The student need no longer guess whether industrial physics or engineering will make a satisfying career or not. There will be at least a small amount of experience on which to base the choice.

For this one reason alone (apart from the educational benefits), it is certainly to be hoped that the link between OCLI and Sonoma State University continues to strengthen.

Reiter Patents Versatile Connector

Six years ago Eric Reiter put four washers on the ground and spot welded them together in pairs of two. When he took them apart he had two connectors.

"I was looking for a contrivance," explains Reiter, "which would make building in the real world simpler. Some systems have interchangeable parts. I wanted to make one part which would be interchangeable over a whole system."

Three years later, after much tinkering and many modifications, Reiter, a sophomore physics major at Sonoma State University, had his contrivance. "During its development I called it the 'ultimate connector,' but nothing is ultimate. So I changed the name to the 'versatile connector.'"

Reiter soon realized that so unique a design was worth patenting, a process which ended up taking a year and a half. Eric did everything himself: Preliminary design research, teaching himself how to write a patent application, making technical drawings and finally writing the application.

Receiving a patent is spectacular in itself, considering that of the more than 100,000 patent applications filed each year with the U.S. Patent and Trademark Office, an average of 70,000 are accepted. Barely 20 percent of the patents issued go to independent inventors. Getting the patent normally takes about two years and can cost up to $2,000 in legal fees. Reiter, doing all the work without the help of an attorney, paid a total of $200.

Eric Reiter is not new to the world of tinkering and building. "I've been building things for people since I was graduated from high school eleven years ago," he says. Among his accomplishments--the sun harp, a musical instrument which plays with light and was on exhibit at San Francisco's Exploratorium for six years; a 17 foot diameter multi-blade wind turbine, now working on a ranch near Ukiah; and a heliostat, which will someday direct the sun's rays into a spectographic display to be set up in the lobby of Darwin Hall.

Three years ago Reiter decided to return to school. "I came to realize," he explains, "how little I knew." He chose Sonoma State because he likes the atmosphere and the encouragement toward hands-on learning. "Here," comments Reiter, "I can get the instruments out of the stockroom and do experiments. I can do improvisations. I can figure out what the photon is, what the molecule is and what the atom is."

What about the future of the versatile connector? Reiter admits that he doesn't have the marketing savvy to peddle his product. "It is worth something," he says, "even just as a toy. It's more versatile than the tinker toy or the erector set." Other possible applications include the construction of technical instruments or furniture building. The connector can act as a holder in furniture or as a hinge in swivel chairs. Different size connectors have the possibility of interlocking with each other, thereby producing a change in scale in joining larger and smaller elements. Reiter has already demonstrated its usefulness in drafting tools and as holders for photographic equipment.

Eric Reiter claims he's given a toy to the world. Not surprisingly, the serious-minded may find it useful as well.

Observatory Reports

A glance at the observatory reports published annually in the Bulletin of the American Astronomical Society (B.A.A.S.) reveals that most astronomy is done by full-time researchers and graduate students in large universities and national observatories.

Only a few undergraduate colleges are active in the field. Students who have not yet received their bachelor's degrees participate in astronomical research at a few small private colleges, including Swarthmore and Haverford in Pennsylvania, and Williams and the Five Colleges in Massachusetts -- and at Sonoma State University.

The department of physics and astronomy has just submitted its fourth observatory report, to be published in the B.A.A.S. in early 1980. The last three reports, written by professors Spear and Tenn, present SSU's fourteen undergraduate astronomy courses (a record?), student and faculty research and publications, the observatory, public viewing nights, and other astronomically-related activities.

The B.A.A.S., along with most of the major astronomical and physical journals, may be found in the Salazar Library.

Student Profile: Miriam Carolin

The department's most prolific researcher works at it day and night. Miriam Carolin, coauthor of six papers presented at national meetings of the two leading astronomical societies, observes the stars and galaxies several nights each week. Once a week she walks out to the observatory in the daytime to sketch and count sunspots.

In addition, Miriam takes courses in Latin and English and works on an article on Heber D. Curtis, an early 20th century astronomer.

Always eager to explain the heavens to newcomers, she is one of the regular hosts at the monthly public viewing nights at the SSU observatory. She frequently shows sunspots to groups of visitors.

Over the past several years, Miriam has visited more than a dozen elementary schools to show slides and talk to the pupils about the constellations and planets. Frequently, she is invited back for a return visit. Children whose teachers maintain they have very short attention spans sit fascinated for lengthy periods as Miriam explains the beautiful planets and nebulae on the slides.

"I have even gone past recess time," she reports. Yet the children plead for more.

A history graduate of the University of Cincinnati, Miriam Carolin discovered astronomy relatively late, after many years solely devoted to raising her family. She started with an extension course at Santa Rosa Junior College where Gerald Piché introduced her to the excitement of the universe.

Then came Comet Kohoutek, expected at one time to become the "comet of the century". Miriam took a short course on the comet offered by Dr. Joe Tenn at Sonoma State.

Significantly, the course brought her into contact with the Physics and Astronomy Department. The next semester she enrolled in one course, Discovering the Galaxies. Soon she was taking more courses and then joining Dr. Tenn in research on the spectrum of the peculiar variable star FG Sagittae. She identified several hundred lines, mostly of such rare earth elements as cerium, lanthanum, and praseodymium. These elements were produced in nuclear reactions in this star and recently brought to its surface.

Results of this work were presented by Dr. Tenn, with Miriam as coauthor, at meetings of the American Astronomical Society, in San Diego in 1975, and of the Astronomical Society of the Pacific, at Pomona College, in 1977.

As this work came to a close, Miriam turned to photometry of FG Sagittae. Aided and advised by Dr. Gordon Spear, she repeatedly photographed the star over many months. After becoming an expert in the use of the microdensitometer in the Darwin basement, she measured her films and obtained a light curve showing possible variations in the star's magnitude during 1977-78. She reported on this work at the A.S.P. meeting at Sonoma State in 1979. Dr. Spear was coauthor.

In between, Carolin worked on photoelectric photometry of VV Cephei, a binary star system which undergoes an eclipse every two decades. She was one of five student coauthors of a paper delivered by Dr. Spear at the 1977 A.S.P. meeting. (Miriam and another of the students, Stephanie Snedden, attended the Pomona meeting and visited the headquarters of the Hale Observatories on the way.)

During the past year Miriam has been engaged in photographic photography. She was one of a team (with Steve Hinch and Dr. Spear) which measured the variability of the Seyfert Galaxy Markarian 509. And she accidentally caught a nova while maintaining regular surveillance of the dwarf nova SS Cygni. Both of these results were presented at last summer's A.S.P. meeting, by Steve Hinch and Dr. Spear respectively.

As if this were not sufficient, Miriam had one of her photographs appear recently in Mercury, the Journal of the A.S.P. It was a picture of the Hyades, taken at the SSU Observatory to illustrate a popular article on cosmic distances by Dr. Tenn.

There is one more reason that Miriam Carolin is widely known in the department. For several years she has been the volunteer coffee-maker before the "What Physicists Do" lectures.

Mary SLACs Again

by Mary Silber

Editor's Note: Mary Silber, a 21-year-old junior physics major from Del Mar, California, is one of the first winners of the $2,000 Mr. and Mrs. Antonio Arana Scholarship for academic merit.

Over the summer I was a second year participant in the Summer Science Program at the Stanford Linear Accelerator Center (SLAC). This is an affirmative action program which brings twenty-five undergraduate physics, engineering, computer science, and math students to Stanford each summer. The students come from all over the country and work in various research and technical groups at SLAC.

The linear accelerator is two miles long and serves to accelerate electrons to 99.99999997% the speed of light. These high energy electrons collide with high energy positrons (the positron is the anti-particle of the electron) or they smash into stationary targets (of liquid hydrogen, for example). The collision energy goes into the production of new particles by Einstein's mass-energy relation, $E=mc^2$. These high energy experiments explore the fundamental forces of physics, explore the "elementary" constituents of matter, lengthen the lists of short-lived particles (there are hundreds of them), and add to the number of funny conservation laws (conservation of strangeness, conservation of muon number, etc.)

While at the accelerator center I attended daily lectures, given by SLAC physicists, about experimental high energy physics and theoretical particle physics. I also worked on a project for the Physical Electronics Group.

You may wonder what is meant by "Physical Electronics"... I, myself, still wonder what it means. This group is in the fairly unique position at SLAC of doing other-than-high-energy physics (that leaves a lot of physics left for them to do). Most of the group's research is in the fields of high vacuum technology, solid state, and surface science. The group developed a high current polarized electron source which was used in high energy experiments over the last two years. This same source is being used in a polarized low energy electron diffraction apparatus, built by the group, to explore material surfaces. I helped in designing part of the electron transport system for this apparatus.

In my spare time (ha!), I liked to do background reading about the already existing sources of polarized electrons, their applications, and electron spin in general. So, although mine was largely an engineering task, I also indulged myself in learning about some of the more basic physics related, peripherally, to my project.

Let me tell you, it is a great thing to have a job where you feel as if part of your responsibility is to learn as much as possible. That's how I felt last summer. Needless to say, it approximated physics nirvana, and has motivated me to really learn my quantum mechanics this year.

Chasing Solar Eclipses

by Norman Whyte and Laurel Allen

If once again nature cooperates we will be observing our third solar eclipse in less than three years next February. You might ask, as we have asked ourselves many times during the months of tedious preparations, "Why study eclipses?"

Though we try to downplay any scientific significance our work may have in favor of its tremendous value as an educational tool, solar eclipses afford a unique opportunity for scientists to conduct experiments and log data which at other times would be extremely expensive or impossible. During totality the chromosphere and photosphere of the Sun are obscurred by the moon passing between it and the Earth, leaving only the corona visible. At this time the surface brightness of the corona is approximately 1/400th that of the full Moon. Sending an equipped team halfway around the world to make coronal studies is far more cost-effective than launching a space vehicle (such as the late Skylab) or constructing and maintaining a coronagraph facility.

For the undergraduate science student, eclipse studies are perhaps the ultimate 'laboratory' exercise in that adherence to the scientific method is greatly complicated. Logistics and management problems pertinent to many experimental endeavors are often overlooked in the classroom pursuit of "cookbook science". When did you last have to bring a generator to school to provide power for your equipment? An apparatus can be continually modified or upgraded in the lab to enable it to acquire the desired information by the most efficient means, but at a remote site thousands of miles from home, you have but one shot at an eclipse. It may be a year or more until a second chance. One is forced to consider every aspect of a proposed experiment and give attention to even the most minute detail which might affect its success on the very first run.

Our first trip, to Maui in October of 1977, was an exercise in mathematically predicting the elements and circumstances for a partial eclipse as a project for Dr. Spear's astronomical measurements class. Though we found data were regularly tabulated for the path of totality of an eclipse, very little reliable information was publicly available for observations outside this path. Computer programs were written for this purpose and photographs taken to check our predictions. Though clouds prevented us from making accurate time measurements, photographic analysis proved our predictions of magnitude more accurately than the University of Hawaii's Bishop Museum.

This past February we nearly froze in Montana during our first experience of totality. Since the duration of the total phase was too short to conduct a meaningful experiment, we concentrated on solving photographic problems encountered in Hawaii and on a project for our astrophotography class. We also hoped to acquire a data base for possible future eclipse work requiring a good knowledge of photographic techniques.

February 16, 1980 will find us on a mountain top at Tsavo National Park in Kenya where we will conduct infrared polarization measurements. More detailed information pertaining to our current expedition may be found in the display case outside the division office. They will be updated weekly.

Curiously, at this point in our work, more attention has been given the means we have devised to acquire data than the eventual data itself. One such innovation is interfacing a camera, optical system, and data imprinting device to a small and easily transportable computer to fully automate our experiment. This is a first for a non-government funded project.

Future plans? Eclipse studies require an enormous dedication of time and money not often understood by instructors, friends and the Savings & Loan, but we hope the three years we have until 1983 will allow us to prepare at a more reasonable pace. Though we cannot recommend such studies for anyone less than fanatical about solar eclipses, we have started a foundation account to help support future solar studies projects by aspiring SSU students.

Student Publishes in National Magazine

An article by senior psychology major Reiko Hibbett Crane appears in the November 1979 issue of Griffith Observer, a popular astronomy magazine published in Los Angeles.

The article was based on a paper for an Astronomy 100 class at SSU taught by Dr. Joe S. Tenn, and was submitted in a national essay competition sponsored by the magazine.

Crane, who received a cash prize for the article entitled "Johannes Kepler's Method: Madness or Genius?", noted that, "This is the first article I have written for publication."

But it is not her last. This fall Reiko Crane took over as entertainment editor of the Sonoma State Star. She is now seriously considering a career in journalism.

Other winners in the prestigious competition include the editors of two science magazines, authors of several books, and professional scientists at Harvard, University of California, and other universities.

Crane graduated from University High School, Westwood, California, and is the daughter of Mrs. Tomi Kuwayama Haas of Westwood and Professor Howard Hibbett of Harvard University.

Public Viewing Nights Popular

More than 3,000 persons saw the moon, planets, stars, nebulae, and galaxies at the Public Viewing Nights of the SSU Observatory last year. They came from throughout the north bay area and beyond. All ages, from a few weeks to past eighty, were represented.

The increase in the number of viewers over past years was due primarily to the increased number of nights. A small grant awarded to observatory director Gordon Spear made it possible to hold two public nights per month during the spring and, for the first time, to pay the student assistants.

Since the grant expired, the student assistants -- Paul Avellar, Teresa Bippert, Miriam Carolin, John Dotta, Brett Morgan, and Stephanie Snedden have continued to work as volunteers. They operate the telescopes and answer many questions, usually working alongside one of the astronomy instructors -- Dr. Greene, Dr. Johnston, Dr. Spear, or Dr. Tenn.

The moon remains the favorite of the youngest viewers, while their elders often appreciate star clusters, especially when they know a few facts about them. Everyone likes the planets, especially Jupiter and Saturn.

The observatory is now equipped with an automatic telephone answering device -- (707) 664-2267 -- so visitors can obtain the forthcoming schedule or check on last-minute cloud conditions.

The schedule for the remainder of the academic year is as follows:

Fri. 11/16/79, 7:30-9:30pm - Star Clusters, Andromeda Galaxy
Sat. 12/1/79, 7:30-9:30pm - Moon, double stars
Fri. 1/25/80, 7:30-9:30pm - Moon, Orion Nebula
Fri. 2/22/80, 7:30-9:30pm - Moon, Orion Nebula
Sat. 3/22/80, 7:30-9:30pm - Mars, Jupiter, Moon
Fri. 4/18/80, 8:00-10:00pm - Saturn, Jupiter, Mars
Sat. 5/17/80, 9:00-11:00pm - Saturn, Hercules Cluster
Fri. 6/6/80, 9:00-11:00pm - Saturn, Star Clusters

Small Business and Science

by Jacques P. Schlumberger

Three recent Sonoma State University physics graduates started their own small businesses upon graduation. Two of the firms are staying afloat nicely. The third is just beginning to swim.

After receiving his B.S. in chemistry and physics in 1976, Bob Lucas joined with Lynn Selby to found Solar Energy Engineering in Santa Rosa. They began with a loan of five thousand dollars. The company now employs nine people in the design, manufacture, and installation of solar collectors and components for hot water and space heating systems. Lucas personally designed and built all the machinery used in the manufacturing process. They grossed $200,000 last year.

In Calistoga there is a company with the unlikely name of Whatworks. Whatworks is the one-man operation of Doug Hayes, who received his B.A. in physics at Sonoma State University in 1975. Hayes, a licensed general building contractor, specializes in the design of passive solar buildings, both commercial and residential. "I've found a way," explains Doug, "to combine physics, my experience in the building trade, and my love for design, mixing the three together and designing passive solar houses. The name of the game is integration."

Hayes' business will expand when he gains an architect's license. In June 1980 he intends to take the State equivalency exam in architecture. By December 1980 he will have gained the required building experience to take the licensing examination.

Who are Hayes' customers? "Up until six months ago," he says, "they were all private individuals." Recently, however, Doug has begun design work for Barrel Builders of St. Helena, one of the largest hot tub manufacturers in California. When the work is done, Barrel Builders will have a 15,000 square foot facility which will not use electricity for light.

"The idea in passive design," explains Hayes, "is to use natural resources as much as possible. I try to take advantage of the fact that hot air rises and cold air falls. I use radiant rather than ambient energy. In winter the walls and floor are heated by sunlight and kept warmer than the actual indoor ambient temperature. With proper insulation, they continually radiate energy to the inside. In summer the reverse process occurs."

Hayes also uses greenhouses as a driver for heat exchange.

Next spring, a vocational school will open on Butte Creek near Chico, downstream from two of the oldest functioning hydroelectric projects in the world. SSU graduate Roy Harthorn and his brother Allen will offer programs in new techniques for energy generation. Roy earned his Bachelor's degree in 1978 in SSU's unusually flexible B.A. program in physics, with supporting courses in the School of Expressive Arts. He is currently working toward a second bachelor's degree and teaching credential in industrial arts at Chico State University.

The vocational school will offer a two to three year apprenticeship program, not only in design and manufacture for appropriate technologies, but also in practical techniques for setting up a small business. Facilities will include a wood shop, a machine shop, a hydroelectric generator, a foundry, an experimental garden and a dormitory. Courses will include techniques of solar, hydroelectric and wind conversion. To take advantage of by-products of some local industries, Roy plans also to work with techniques of biomass conversion, a process which uses organic products such as wood chips or rice hulls (plentiful in the Chico area) to generate energy.

Roy Harthorn, who raised capital for the school as a consultant in the energy field, emphasizes the hands-on training of the program. For example, "most valves," he explains, "used in the manufacture of heat exchangers for solar water systems are overbuilt. They're far heavier than what's needed for these kinds of systems, but they're the only thing on the market. In our shop we'll be able to manufacture our own valves and our own parts, thereby obtaining the most efficient designs possible."

Tuition and operating expenses will be kept down through class projects. Roy intends to use his contacts with local agricultural equipment dealers in order to have work contracted out to the school's machine and wood shops. "It's a compromise," says Harthorn, "between hardcore technology and what's livable, but we hope to emphasize in a very practical way technologies more in rational accord with our environmental situation.."

Are there any common factors in their experiences at Sonoma State which influenced Bob Lucas, Roy Harthorn and Doug Hayes?

Harthorn points enthusiastically to the ability of the Physics and Astronomy Department to give freedom to do something outside the field of classical physics. He comments that the engineering departments at Chico are exceedingly rigid by comparison. Hayes joins Harthorn in singling out Professor Sam Greene and Electronics Technician Robert Porter as particularly important influences on the emphases and directions of their studies. Lucas refers to the total understanding which he gained in both chemistry and physics.

Each of these enterprises may appropriately be called "new age" businesses. All three businessmen are working on very real and very pressing problems of today. And all three are well on the path to finding solutions.

Student Profile: Alex Busek

In 1977 Alex Busek graduated from Santa Rosa's Piner High School with an outstanding scholastic record. Not only did he have nearly straight A's but he had already earned thirteen units of college credit by attending Santa Rosa Junior College nights and summers.

He then entered Sonoma State University with honors at entrance and with one of the first Natural Sciences Division scholarships granted.

"I chose physics because I thought it was the most important science to study, not because I had any particular aptitude for it," he says modestly.

Just completing the introductory physics sequence, Alex is looking forward to the advanced courses.

"I would like to milk the department dry," he says with cheerful enthusiasm. He was particularly interested when Dr. John Dunning took the Physics 216 class down to the nuclear lab in the basement. He is anticipating the applied nuclear physics and chemistry course this spring with enthusiasm.

Alex applies this enthusiasm to everything. A persistent questioner in all of his classes, he is determined to learn as much as possible in every course. After completing work for his B.S., he expects to attend graduate school in physics.

Alex studied German last year and found opportunity to use it on a European tour last summer.

Right now he is eager to learn computing.

SSU Physics Grads Do Well

Sonoma State University physics graduates continue to win assistantships at graduate schools around the country.

And they do it in a variety of fields.

Three recent winners of teaching or research assistantships were Earl Boysen, Michael Ingertson, and Johannes Raab.

Earl Boysen

Earl Boysen will pursue a doctorate in engineering physics at the University of Virginia. A Petaluma High School graduate, Boysen completed a Bachelor of Science degree in physics and chemistry in 1975.

Until leaving for Virginia he was employed as an engineer at National Semiconductors in Santa Clara.

Michael Ingertson

Michael Ingertson, a Los Angeles resident, will specialize in the history and philosophy of science at the University of Pittsburgh. He declined a similar offer from Princeton.

After completing a Bachelor of Arts in physics at SSU, Ingertson enrolled in the Fuller Theological Seminary in Pasadena, where he received an M.A. in theology last June.

Ingertson also studied philosophy at California State University, Los Angeles and taught a course on science and religion at the seminary.

Johannes Raab

Johannes Raab is a teaching assistant in physics at Montana State University. A native of Germany, Raab transferred to Sonoma State from the University of Colorado in 1977. He received a B.S. with distinction in June.

Johannes recently wrote that the most beneficial experiences he had as a physics major at Sonoma State were "being able to work independently in labs" and "long and difficult homework problems."

Science Teachers Study Energy at SSU

Geothermal energy as a viable alternative energy source is explored in a short course held annually at Sonoma State University for high school and junior college science teachers. The summer courses are sponsored by U.S. Department of Energy grants and use the nearby Geysers geothermal energy field for study.

Forty-two science teachers from around the country participated in the third annual "Geothermal Energy and the Environment" course in June 1979. Participants in the program came from as far away as Yorktown, New York and Star City, Arkansas to take part in the eight-day course.

"One of the main functions of the course is the study of the environmental trade-offs that are required in using this form of energy," stated Dr. Richard Karas, director of the program and chair of the department of physics and astronomy at SSU. "No form of energy production is harmless to the environment, but with geothermal energy you get far less negative impact than with any other form of energy and you aren't relying on foreign oil."

"We also have to take into consideration that geothermal energy is the second cheapest form of energy in the state," continued Karas, "hydroelectric is still the least expensive."

The specially designed course consisted of three all-day trips to the Geysers, lectures by SSU faculty on the principles involved, guest lecturers who spoke on regulation and the socio-economic impact of geothermal energy, and lab work on assessing the impact of geothermal power plants.

Richard Thomas, of Klamath Falls, Oregon, one of the teachers who participated in the course, stated, "We have a geothermal area near Klamath Falls and this has a direct relationship to this field. I wanted to find out more about geothermal energy production, in view of the possible development of the field there." Other participants mentioned the need to learn more about alternative energy production for inclusion in their current course material.

"Sonoma State is an ideal location for the study of geothermal energy production as the Geysers geothermal field is currently the largest producing field in the world and is likely to remain so for the next few years," added Karas.

What Physicists Do

What do physicists do? They work in many fields from SALT to SQUIDS. No, this is not a course in seafood cookery. It is a series of public lectures, demonstrations, and films, now in its eighteenth semester, presented by Sonoma State's physics and astronomy department.

Of special interest was the talk on SALT, the Strategic Arms Limitation Treaty, now pending ratification before the U.S. Senate. The speaker was Dr. W.K.H. Panofsky, director of the Stanford Linear Accelerator Center and advisor on arms control to every president since Eisenhower. Panofsky recently won the $25,000 Fermi award for scientific achievement.

Berkeley physicist John Clarke's squids don't swim. Neither are they salty. They are Superconducting Quantum Interference Devices used by Clarke to measure the properties of the earth's crust.

Five programs on astronomy and space are on the program. On October 1 the film "One Small Step", recounting the story of the Apollo program, was presented. "Interstellar Shells and Supershells" was the title of a talk given by Dr. Carl Heiles of U.C. Berkeley. Heiles illustrated the shapes and motions of interstellar gas structures as seen by radio telescopes.

On November 12 Dr. David Morrison of the Univ. of Hawaii described the properties of the Jovian moons Io, Europa, Ganymede and Callisto--subjects of intense study since the Voyager missions of March and July 1979. On November 19 the project scientist for the Pioneer 11 mission, Dr. John Wolfe of NASA Ames Research Center, will present the discoveries made during the September 1 flyby of the planet Saturn.

Finally, Dr. Susan Lea of U.C. Berkeley will discuss x-rays from quasars and distant clusters of galaxies. These x-rays have been detected only recently by orbiting High Energy Astrophysical Observatories.

Other topics have included a description of a new satellite experiment to test Einstein's general theory of relativity, experiments at the Stanford Linear Accelerator Center, acoustics, the physics of magic, and energy conservation.

Dr. Paul Goodwin, president of Earth Science Consulting and Technology Corporation and Adjunct Professor at Alaska Pacific University, will discuss physics, philosophy and business on November 26. Goodwin is a 1971 physics graduate from SSU.

Interested? It's not too late! Lectures are presented Mondays at 4 pm in Darwin Hall, Room 108. Come early for coffee at 3:30 pm. Posters with the complete schedule of the series are still available at the department of physics and astronomy office. Come in or phone at (707) 664-2119.

Astronomical Society Meets at SSU

The campus was filled with astronomers last summer when the Astronomical Society of the Pacific held its 90th annual meeting at SSU. Approximately 150 astronomers attended the scientific meeting held Wednesday through Friday, June 27-29. They heard scientists from Canada, Chile, West Germany and fifteen states present results of research done with radio, infrared, optical, ultraviolet, and x-ray telescopes, and also with paper, pencil, computer, and brain.

Among the papers presented were five by SSU students working with Dr. Gordon Spear of the Department of Physics and Astronomy. These included:

"Medium-Term Variability of the Seyfert Galaxy Markarian 509--An Application of the Penston Method for the Reduction of Photographic Photometry" by Stephen W. Hinch, Gordon G. Spear, and Miriam Carolin.

"Empirical Confirmation of Gravity Brightening for Three Eclipsing Binary Systems" by Neil J. Reynolds and Gordon G. Spear.

"Photographic Photometry of FG Sagittae During 1977-78" by Miriam Carolin and Gordon G. Spear.

"Surveillance of the Dwarf Nova SS Cygni during 1978 and the Nova of Serendipity" by Gordon G. Spear and Miriam Carolin.

"Recent UBV Photometry of the Be Variable 28 Cygni" by James Mills, Jr., Stephanie Snedden, and Gordon G. Spear.

Three of the papers were presented at a session chaired by Dr. Joe Tenn, cohost of the meeting with Dr. Spear.

There was considerable excitement generated in the astronomical community by papers presenting opposite conclusions regarding the distances of the quasars. These were given by Dr. Halton C. Arp of the Hale Observatories (Mt. Palomar) and Dr. Alan Stockton of the University of Hawaii.

In addition to the scientific portion of the meeting, there was a one-day course on teaching astronomy, an evening seminar on scientific applications of photography arranged by Dr. Spear, an awards banquet at the Commons, and two public sessions.

A summary of the symposium on active galaxies and quasars, written by Dr. Joe Tenn, can be found in the September-October 1979 issue of Mercury, the journal of the A.S.P. The awards presented at the banquet, to William A. Fowler, Gary Schmidt, and William J. Kaufmann, III, were described in the July-August 1979 issue of Mercury.

Nearly 300 persons from throughout northern California and beyond attended the series of six public lectures held in Ives Hall Saturday, June 30, to end the meeting. A crowd almost as large attended Arp's Wednesday evening lecture on quasars and active galaxies. Following the lecture, most of these, including some world-famous astronomers, went out to the SSU Observatory to be shown the skies by SSU students.

Students who helped with the meeting were Miriam Carolin, John Dotta, Brett Morgan, Stephanie Snedden, and Keith Soreng.