

Boxer of Artistic Bent

Jim Walston Designs Christmas Cover

Jim Walston, creator of this issue's Christmas cover, is a little guy with a big talent.

Inquiring wrinkles on his forehead and a serious demeanor hide a wry humor and an oblique approach to the job of a Sandia illustrator.

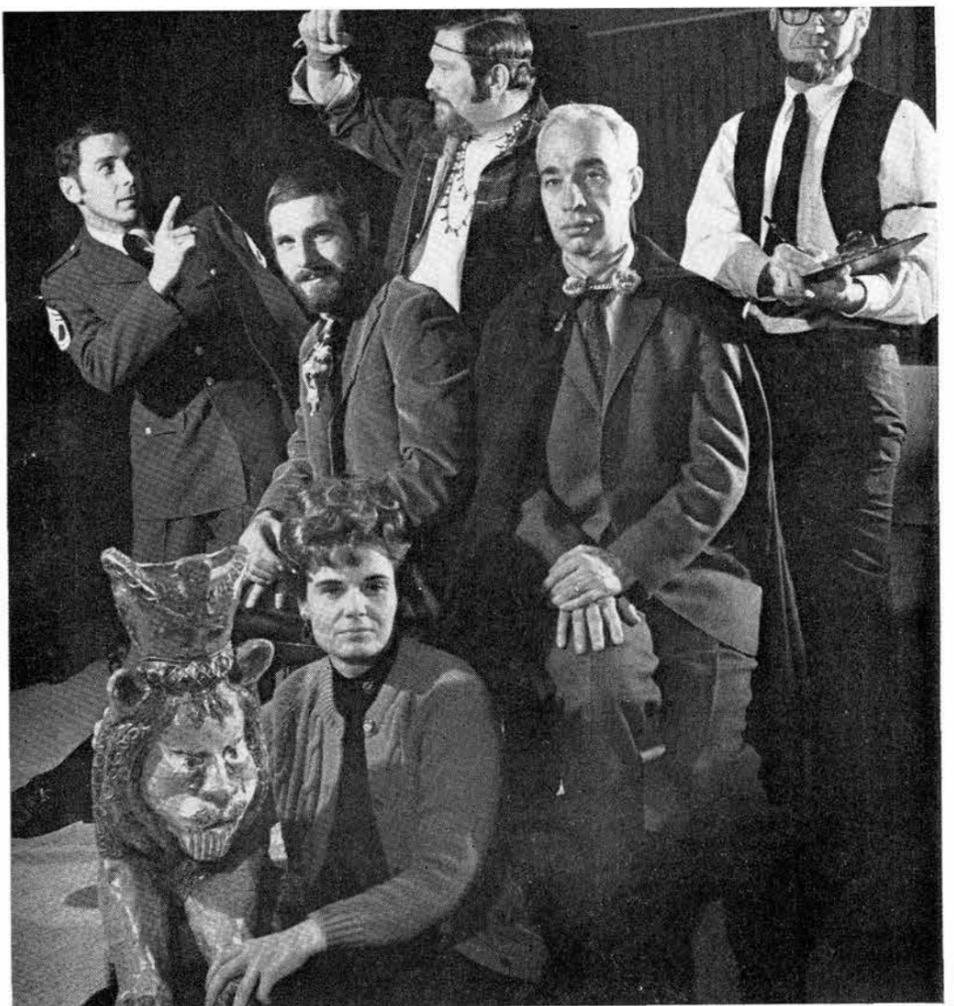
You've heard the words "a musician's musician" or "a poet's poet." At Sandia, Jim is an artist's artist. He breaks up co-workers in Graphic Design Section 3417-3 with his caricatures, cartoons and jokes.

In addition to a body of serious work which has brought him seven national awards from such organizations as the Technical Illustrators Management Association and the National Association of

Industrial Artists, Jim is a skilled cartoonist. For 13 years, his cartoons and illustrations have been used in Sandia security, safety and fire prevention posters as well as for illustrations for LAB NEWS articles and several other company publications.

Prior to joining Sandia in 1956, Jim worked as an illustrator for an aircraft company in Wichita, Kans., and for a tool and die company in Sioux City, Iowa, his home town, where he is remembered not as an artist but as a Golden Gloves champion.

He studied art at Morningside College in Sioux City, but WWII interrupted and he served with the U.S. Navy in the Pacific on an attack transport.



THE LION THIS WINTER is found at the Old Town Studio where he's having a thorny problem solved. With the aid of these Sandians, Old Town Studio is presenting "Androcles and the Lion" by George Bernard Shaw. The two-act play is based on Aesop's fable in which a lad named Androcles pulled a thorn from the foot of a lion. The lion later repaid the kindness by not eating Androcles when he was thrown into the arena by the Romans. Director Bruce Hawkinson (4135) has recast the play into modern times with the ROTC replacing the Roman centurions, football players as the gladiators, and hippies as the persecuted Christians. Sandians in the production are (standing) Bob Lassiter (4112), a centurion; Elliot Harris (3454), a reformed Hell's Angel; and Crawford MacCallum (5231), editor. Seated are Bruce, the director, and Bill Busby (4113) who plays Caesar. In front is Frankie Weldon (7632), stage manager. The play runs tonight, Saturday, and Sunday at 8 p.m. Tickets are \$2 for adults and \$1.50 for students. For reservations call 242-4602.



LUMINARIAS, a New Mexican tradition, will light Albuquerque on Christmas Eve. Photo of Old Town Plaza was taken by Bob Casper (2641). Los Altos (at Coors Road and Bridge St.) will have its traditional luminaria display arranged by Florencio Baca (4574). Other luminarias will glow in Lee Acres and the Country Club areas.

Authors

D. E. Amos (1722), "On Half-Space Solutions of a Modified Heat Equation," October issue, QUARTERLY OF APPLIED MATHEMATICS.

J. M. Worrell (1721), "On Continuous Mappings of Metacompact Cech Complete Spaces," Vol. 30, pages 555-562, PACIFIC JOURNAL OF MATHEMATICS; "On Collections of Domains Inscribed in a Covering of a Space in the Sense of Alexandroff and Urysohn," Vol. 26, pages 405-420, PORTUGALIAE MATHEMATICA.

E. J. McGuire (5234), "K-Shell Auger Transition Rates and Fluorescence Yields for the Elements Be-Ar," Vol. 185, No. 1, PHYSICAL REVIEW.

SEGA Gives Awards Elects 1970 Officers

The Sandia Employees Golf Association (SEGA) wrapped up the season recently with an awards banquet and election of 1970 officers.

Dave Klein (AEC) won the SEGA championship for the second year in a row. Jim Leonard (9521) was runner-up. Jerry Smith (7263) received the Presidents Cup with Ivars Gals (9251) named runner-up. Most improved golfer for 1969 was Walt Halpin (1641).

Preston Herrington (9211) is the SEGA president for 1970. Vice president is Wayne Lathrop (9221). Bill Parker (4251) is secretary-treasurer and Lyle Diamond (1526) is director of handicaps. Jim Davis (9227) and Art Verardo (9242) are board members.

Marionette Shows by Ron Day Will Benefit Local Family

Ron Day (3131) and his wife Mary Kay will give nine benefit performances of their special Christmas marionette show at Coronado Center on Dec. 22, 23 and 24. Money raised from the 50-cent admissions will benefit a local tragedy-struck family — a widow with 11 children.

Recently the family suffered the loss of a child in an auto accident which was followed shortly by the death of the father.

The marionette show — with original script, characters, settings, and music — will be presented in the Coronado Center Town Hall at 10 a.m., 1 and 3 p.m. on each of the three days. The half-hour performances will be followed by a sing-along of Christmas carols.

Supervisory Appointment



BILL GARDNER to supervisor, Personnel and Payroll Management Systems Development Division 4116, effective Dec. 1.

Bill began work at Sandia in 1958 as an interviewer with the skills inventory group. He subsequently was an interviewer and recruiter with the employment and placement organizations. In 1961 he became an administrative assistant to the manager of the Tactical Weapons Development Department. He later was a job evaluator in the wage and salary group and, in 1964, joined his present division.

Before coming to Sandia, Bill was an engineering trainee with Western Electric.

A graduate of UNM with a BBA degree, Bill is vice chairman of the Greater Rio Grande Chapter of the Association for Computing Machinery.

Bill, his wife Sue (formerly with Division 3151), and their two children live at 3535 Florida NE.

Take Note

Ray Mosteller (9132) walked off with two top trophies in a recent Sandia Base Command Invitational Pistol Shoot. Ray took first in .45 calibre competition and second in .22. Both were in the expert-master category.

Mary Harrison, supervisor of Personnel Services Division 3255, has been elected a professional member of the National Training Laboratories Institute — the only such member in New Mexico.

NTL Institute originated in the late 1940's under auspices of the National Education Association (it has since become an independent, nonprofit corporation). Programs based upon the laboratory method of solution of human relationship problems have become generally known as "sensitivity training." The programs are regularly conducted by professional membership of NTL Institute.

As part of professional member requirements, Mary has attended intern programs in human relations and in personal and organizational development.

Organization 1600 Christmas Project

In what may be the longest continuing Sandia Christmas project, people in Directorate 1600 have again bought shoes for children at Riverview and Longfellow schools. This is the 12th year that the group has collected money to buy shoes for needy children. Chairman of this year's project was Paul Scates (1640). Co-vice chairmen were Don Lewis (1650) and Robert Manhart (1610). More than 100 pairs of shoes were purchased this year.



STANDING IN FOR SANTA are Dora Montoya (3204) and Floyd Narcott (1525). The gifts for children at the Los Lunas Hospital were collected by Division 1525. The collection will continue until Christmas Eve when the gifts will be taken to the hospital. Anyone wishing to give toys, clothing, or personal hygiene items to the children should bring the gifts to Bldg. 836, Rm. 125.

Congratulations

Mr. and Mrs. Howard Stuart (2492), a daughter, Stephanie, Oct. 24.

Mr. and Mrs. Orlando Rodriguez (4574-4), a daughter, Janice Marie, Nov. 6.

SANDIA LAB NEWS

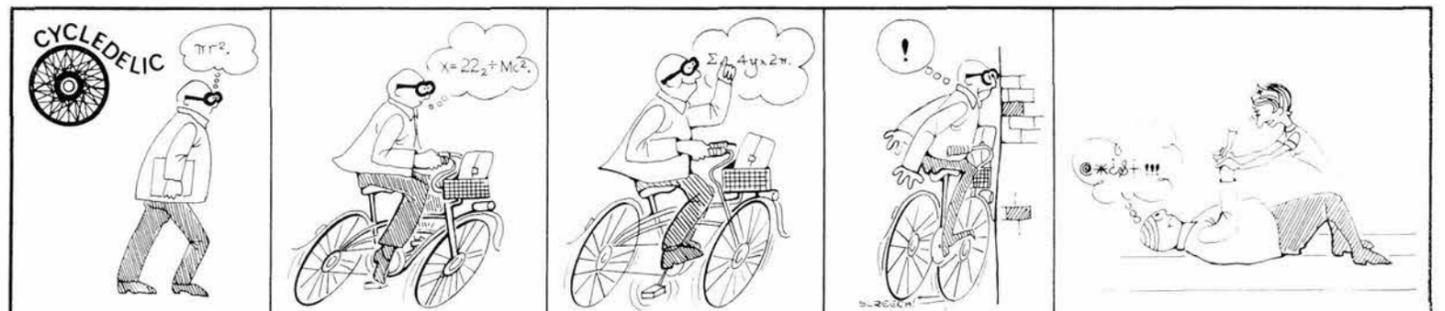
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7



Family Holiday Traditions Carried On in Sandia Homes

Christmas in the United States derives many of its customs from other countries. LAB NEWS discussed these holiday customs with Sandians who themselves observe special customs or prepare symbolic foods during the holidays.

Gabe Gutierrez (8253)

"The evening before, as well as Christmas Day, remains a time for our family and relatives to get together. My wife — who happens to be an excellent cook — likes to prepare special Mexican dishes. Guests during the holiday season share our **champurado** (a drink made from chocolate thickened with corn flour); **posole** (a thick soup made of pork, hominy, garlic, chile and lettuce); **tamales** (mixture of minced meat, red peppers and corn meal wrapped in corn husks); **empanada** (meat and fruit-filled pies); **muñuelos** (a crispy fried pancake with sugar sprinkled on it).

"The children receive homemade **piñatas** filled with candies, fruits and nuts. Although we have a tree decorated, **El Nacimiento** (the nativity scene) is always placed under it.

"When we spend the holiday season in Guadalajara or Chihuahua, we participate in **Las Posadas**. Each day before Christmas, groups of people go door to door asking for food and lodging. After being turned away by several of their neighbors, the group is accepted into one home (pre-arranged) where they attend a Catholic Mass and are later fed. It's symbolic of Joseph's search for a place for Mary to give birth to the Christ child."

June Ferreri (8261)

"Gift-giving, feasting and family gatherings receive more emphasis by the Japanese family on New Year's Day rather than Christmas. Because Buddhism strongly influences our family get-togethers, our main celebration closest to Christmas occurs during the first three days of the New Year. At that time, relatives and friends give and receive gifts for the joy of doing so; there is no religious meaning involved. Pictures on special serving plates used during this time are symbolic. Cranes mean good luck; pine, long life.

"A typical meal served on these dishes is **sushi**. Made in roll form, its outer covering is seaweed followed by a layer of rice and seasoned with sugar and vinegar. The center is filled with shrimp, egg, spinach and pickled ginger. Eaten in cold slices, it complements other courses of the meal. Also included are Japanese-style chicken made with small Japanese potatoes, carrots, soy bean by-products and different types of roots, such as bamboo shoots and water chestnuts. It's truly a festive time."

Anna Isham (8253)

"Each year our family celebrates Christmas on Christmas Eve. About 18 of us get together for dinner and later we open our gifts. Dessert is the traditional Danish rice ring — essentially a rice pudding with apricots in the center and formed in a mold. A single almond is hidden in the ring and whoever finds it supposedly gets a special blessing the following year. Festive holiday cookies that our family has made down through the years are also served.

"Another Danish tradition is the Christmas plate. Every Christmas since 1895 a limited number of blue and white porcelain plates in Danish motif have been designed and sold at Christmas. The mold is destroyed, so some of the plates have become rather valuable and are much sought after by collectors. My mother has quite a collection and my sisters and I each have our own collections. The plates help us relate to Danish tradition at Christmas time."

Dave Abrahams (8231)

"In the Jewish faith, we don't celebrate Christmas as a holiday, but in December we do celebrate Hanukkah, which means the Festival of Lights. This holiday continues for eight days with special religious ceremonies and serves as a time for re-dedication of the Jewish spirit.

"Actually, the holiday is based on an ancient legend. It seems that when Judah Maccabee and his followers recaptured Jerusalem in 165 BC, they found that the sacred temple had been desecrated. When the temple was rededicated, the High Priest could find only enough undefiled oil to maintain the rekindled Eternal Light for a single day. This caused considerable dis-



COMPARING CHRISTMAS TRADITIONS from other lands are (from left) Mary Sites (8232), Tony Luna (8222), June Ferreri (8261), Jerry Jones (8146), Bobbie Balanda (8232), Anna Isham (8253), Dave Abrahams (8231), Tom Dadian (8312), and Gabe Gutierrez (8253).

appointment and to prepare new holy oil required eight days. Nevertheless, the small container of consecrated oil was used, and according to rabbinical tradition, a miracle occurred: the lamp burned for eight days and eight nights on the small amount of fuel until the new oil was prepared.

"To commemorate the start of the holiday, we always light the first candle on the Hanukkah candelabra (or Menorah) in our home with the "servant light" and an additional candle is lit on each successive night until all eight are aglow. As the candles are lit each evening, we recite blessings and prayers, sing songs, and according to our family tradition give our son a small gift. The Menorah is always kept in a prominent place in our home."

Tom Dadian (8312)

"Christmas to Syrians is a joyous occasion. To this day we consider it the ideal time for family and friends to make eating a ceremony instead of a habit. It's our custom to use the recipes passed down from generation to generation. Far Eastern cooking is like Arabic dancing — vivid, exotic, enchanting. Seasoned with herbs and spices, moistened with olive oil and butter, rolled in cabbage and grape leaves, the food is a pleasure to look at and to eat.

"Heading the array are the hors d'oeuvre — **kibby** (raw, lean, ground lamb or beef blended with cracked wheat, onions and spices). Other platters are filled with **roz** (rice dotted with browned noodles); **batinjan mihshee** (baked eggplant stuffed with lamb and pine nuts); and **warak inib mihshee** (diced lamb, rice and spices rolled in tender grape leaves and mellowed with lemon juice). Then there's the Turkish coffee and the almond candies. It all seems fitting for a season of rejoicing."

Jerry Jones (8164)

"In our home, Christmas begins with Advent, the four-week period preceding Dec. 25, and a time of religious significance. In the Christian calendar, the year begins with Advent, which means "coming" and, so, is a series of joyous days of preparation, anticipation, and Sunday celebrations, leading up to the date Christ was born. It is an expression not only used in the church, but comes into our home in the form of the Advent calendar. Since our children were young, we have followed a ceremony of opening a window in the calendar each new day and finding an Advent expression in the form of a small figure. You open the last window on Christmas morning.

"Our family also continues the tradition of using the Advent wreath which holds much symbolic meaning. The wreath is round, no beginning or end, testifying to the eternity of God's creation; it is of evergreen, recalling that our faith, hope and love are always alive; and the candles represent Christ as the light of the world — one of the four is lighted each Sunday in Advent."

Tony Luna (8222)

"Christmas in the Philippines was one of the happiest days. Although my family now celebrates Christmas conventionally, there are times during the season when older Filipino friends get together to talk of past Christmases. We talk of the house-to-house visits on Christmas Eve. You'd take your guitar, accordion, ukelele or bamboo flute along and "serenade" your neighbors. In return, they would offer candies and cookies.

"Beginning early Christmas Day, families gathered to spend the day visiting and carving pieces of meat from a well-seasoned roasted pig. Trees were decorated with ripened oranges, mangos, bananas, guavas and pomelos.

"Rice cookies were the specialty. Making them today is difficult because equipment — such as the coconut grinder to get coconut juice — is hard to come by. They are made from a sweet rice flour, brown cane sugar and coconut juice. This dough-like mixture is wrapped in banana leaves and roasted in bamboo stems.

"No matter how late it was on Christmas Eve, or on any day until Jan. 1, every guest was offered a portion of the cookie. The size of the cookie depended upon the number of guests you expected to share it."

Bobbie Balanda (8232)

"One of the main dishes in the buffet on Christmas Eve in Lithuania has always been the golden aspik of fish. Originally, I am told, Christmas Eve was a fast day when you didn't eat meat, so fish was very popular. But now, when I make the fish aspik for our annual Christmas Eve smorgasbord, I do use some meat.

"First the gelatin is prepared and, when nearly firm, to it are added sliced, crisp-cooked celery, spices, lemon, and the fish — already poached and flaked. This then is molded in the shape of a large fish and served on a bed of greenery with rye bread and special salad dressing.

"After we've had our fill from the smorgasbord, we sit down and relax over mead, or midus as the Lithuanians call it, more commonly known as honey wine. This is a dessert wine and the bouquet is really quite something.

"The custom goes back to the Vikings and Anglo Saxons who also drank mead. I imagine grapes were rather limited in the northern sections of Europe in those days, so they used honey since it too will ferment into wine. I got the recipe from my uncle who claimed there were two different kinds — prepared one way it would go to your head, the other way you'd remain clear headed but you couldn't walk. I've never proved this myself, but it makes a good story."

Mary Sites (8232)

"In many countries festive goodies baked and eaten during the Christmas season are said to bring good luck and health. In our family at this time of year, my husband and I spend several days making French cookies, called **galettes**, which are baked with an iron much like a waffle iron, but with a long handle. We package these in gay wrappings for relatives and friends.

"This tradition came down from an aunt who originally lived in France near the Belgium border and is still using a 100-year-old galette iron given her by her mother. Because of her age, she is no longer able to make the cookies for the whole family, so she had a similar iron made for us.

"The portion which holds the cookie measures about eight by four inches and opens on a hinge much like a book. The handle is almost two feet long. One batch takes about five pounds of flour, two pounds of sugar, a pound of butter, a dozen eggs, whiskey or brandy, and a few other ingredients. This makes roughly 100 cookies so we need several batches.

"The process takes some time because first you have to get in and really knead the dough which is very dry at first until softened by the melted butter. The dough is held overnight and then rolled into small weiner shapes which are baked individually by holding the iron over a fire, a half minute on each side. At first you might think they taste too bland, but they really grow on you."

Hartmut Spetzler (8311)

"In Bavaria and until a few years ago here in the United States, we used wax candles on our Christmas tree. The candle is the symbol of light and Christ is portrayed as the light of the world. Christmas Eve is the big thing for us, not Christmas Day. Everything including the tree is kept hidden from the children until then. A bell ringing signifies that the "Christmas Man" — the Christ Child — has come with gifts for everyone. Then follows music and carol singing, and later the whole family takes part in the opening of each gift.

"Instead of Santa Claus, we have St. Nicholas who comes each year on Dec. 6th, accompanied by his helper, Knecht Rupprecht. Supposedly, they bring gifts to the children who have been good, but leave switches and coals if they have been bad. My wife, who is Dutch, still bakes many of the traditional Christmas cookies and breads, including the German **springerles**. These are embossed anise-scented cookies which are said to date back to the mid-winter pagan celebration, **Julfest**, during which Germanic tribes sacrificed animals to their gods. The poor, unable to afford the slaughter of their animals, offered token sacrifices of animal-shaped cookies."

Retiring

Mary McClure, acquisitions librarian in Technical Libraries Operations Division 3421, is retiring Dec. 31. She joined the Laboratories in February 1954 and has worked in the Library since June 1954. Before coming to Sandia, Mary was employed by the Manhattan, Kans., public library.

Mary and her husband, who retired about a year ago, have been preparing for retirement for about five years. They are building a home in Columbus, N.M., which is about three miles from the Mexican border. "The house is almost finished," Mary says, "and we hope to be able to move in January." The McClures say they selected Columbus for their retirement home because of the climate and the extremely pure water.

Mary says her plans consist mainly of "having fun." They own an Indian artifact collection and rock polishing equipment. She will also work part time in the village library.

Speakers

E. J. McGuire (5234), "Proton and Electron Excitation and Ionization Cross Sections and Stopping Power Calculations for He-Na," University of North Carolina Working Conference on Inelastic Processes Involving Inner Shells of Atoms, Nov. 14-15.

J. F. Reed and W. H. Curry (both 9322), "Aircraft Separation Problems Associated with Nuclear Ordnance — A Survey," First Annual Aircraft/Stores Compatibility Symposium, Nov. 19-21, Ft. Walton Beach, Fla.

J. M. Hueter (3134), "Value Engineering," University of New Mexico mechanical engineering students, Nov. 25.

D. W. Swain (5243), "The Relation Between Ion Acoustic Waves and Moving Striations in a Low Pressure Discharge," American Physical Society, Nov. 12-15, Los Angeles.

A. W. Johnson (5243), "Lifetimes of the Rotational Levels of the $B^2\Sigma^+_g(v=0)$ Level of N^+_2 ," American Physical Society Meeting, Nov. 17-19, New York City.

O. E. Jones (5130), "Shock Induced Dynamic Yielding in Single Crystals," Solid Mechanics Seminar, Nov. 18, Pasadena.

C. H. Williams (5224), "A Mass Spectrometric Study of the Positive and Negative Ions from Carbon Vapor," Thermochemistry of Carbon Conference, Nov. 24-25, AF Materials Laboratory, Ohio.

T. P. Wright (5231), "Polarization Effects in Starfish"; J. M. Hoffman (5233), "Starfish Northern Conjugate Optical Data," DASA High Altitude Nuclear Effects Symposium, Dec. 2-4, Sandia Base.

T. T. Shishman (2332), "Program Magyar — A Single Collision Model Neutron Heating Code for Component Design"; Walter Herrmann (5160), "Effect of Strain Hardening and Strain Rate in Elastic-Plastic Wave Propagation," Nuclear Survivability Working Group on Propulsion and Ordnance Systems, Dec. 3-4, Kirtland AFB.

H. L. Webster (7451), "Humidity Measurement," Arizona Environmental Symposium, Dec. 4, Phoenix.

J. L. Ledman (5535), "Current Experiments in Fracture Toughness and Stress Corrosion at Sandia Laboratories," University of Texas Student Chapter of AIME, Dec. 4, El Paso.

David Emin (5151), "Discussion of Small-Polaron Motion," University of California Physics Department Seminar, Dec. 5, Riverside.

E. P. EerNisse and R. J. Chaffin (both 5112), "Carrier Trapping and Recombination in Avalanche Diodes," IEEE Specialist Conference on Avalanche Microwave Devices, Dec. 10-11, New York City.

R. A. Graham (5132) and W. P. Brooks (7346), "Shock Wave Compression of Sapphire"; M. L. Merritt (9150), "Ground Shock and Water Pressures from Milrow"; P. C. Lysne (5133), "Comparison of Hugoniot and Release Isentropes for Four Dry Tufts," Fall Meeting of the American Geophysical Union, Dec. 15-18, San Francisco.

A. C. Saxman (5114), "Light Beating Spectroscopy and Its Application to the Study of Critical Points," UNM Physics Department Colloquium, Nov. 7.

Cherry L. Burns (3432), "Life on the LAB NEWS," Albuquerque Chapter, Society of Technical Writers and Publishers, Nov. 21.



Charles Cundiff of Weapons Training/Field Engineering Division II 1614 is retiring Dec. 31. He joined the Laboratories in December 1954 in manufacturing relations engineering where he worked for a year and a half. Since that time he has been with the military liaison group.

Charley is a graduate of the U.S. Naval Academy, class of 1933, and of George Washington University with a BS degree in mechanical engineering. He served in the Navy for 30 years and is a retired Rear Admiral. He has been a senior Patent Examiner in the U.S. Patent Office; Chief Engineer on the U.S.S. Copahoe, Bennington, and Wasp; and a naval inspector of diesel engines for General Motors Corp., Cleveland Division. He is a registered professional engineer in the District of Columbia and an unlimited chief engineer in the U.S. Merchant Marine.

Charley and his wife Catherine, who also works at Sandia in Salary Administration Division 3113, have three children and two grandchildren. One of their sons is serving in Vietnam as an artillery officer.

The early months of Charley's retirement will be filled with repair work on his home. "But next fall," he says, "we will purchase a travel trailer and spend the winter in Mexico. My wife likes to swim and I'm a scuba diver and underwater photographer."

Charley has many other interests: he is a member of the American Society of Mechanical Engineers, the Society of Naval Architects and Marine Engineers, and past president of the Mercedes Benz Club of America — New Mexico Division. He has written several text books on marine engineering. He is also a photographer and mountain climber — the Jungfrau and Matterhorn in 1952, the Grand Tetons in 1955 and Long's Peak in 1965. "I still do a little climbing in the Sandias," he says, "but I'm more interested in scuba diving now."



Edith Miller, editorial assistant in Technical Information Division I 3411, will retire the end of this month. Since joining Sandia in September 1952, she has worked in the document department, document investigation, typing pool, and has been with the Technical Information group about 10 years.

Edith's husband Maxwell also works at the Laboratories in Plant Systems Division 4511. They have two children and five grandchildren.

Edith is taking early retirement, "thanks to Sandia's fine retirement plan," she says. "I'm very happy to retire at this time." Edith says, "I have just been elected to a three-year term on the Board of Deacons at the First Presbyterian Church." The function of this group is to visit church members who are shut-ins or hospitalized. Edith is also substitute organist at various other churches. "When I do retire," she says, "I'm going to have time to play the organ more and resume my interest in music."

Her friends are familiar with one of her favorite hobbies — knitting. She has been involved for a number of years in the 3400 Organization Christmas project. Her special interest has been knitting caps and mittens and encouraging others to take part in the project. In addition to knitting, Edith enjoys sewing and needlework.

Sympathy

To Evelyn States (7631-1) for the death of her husband William on Nov. 17.

To Ruth (3132) and Jerry Brooks (4251-2) for the deaths of her father and sister in Albuquerque, Nov. 12.

To Haddon Redding (4142) for the death of his mother-in-law in McAllister, Okla., Dec. 4.

Aesthetics in the Mini-World

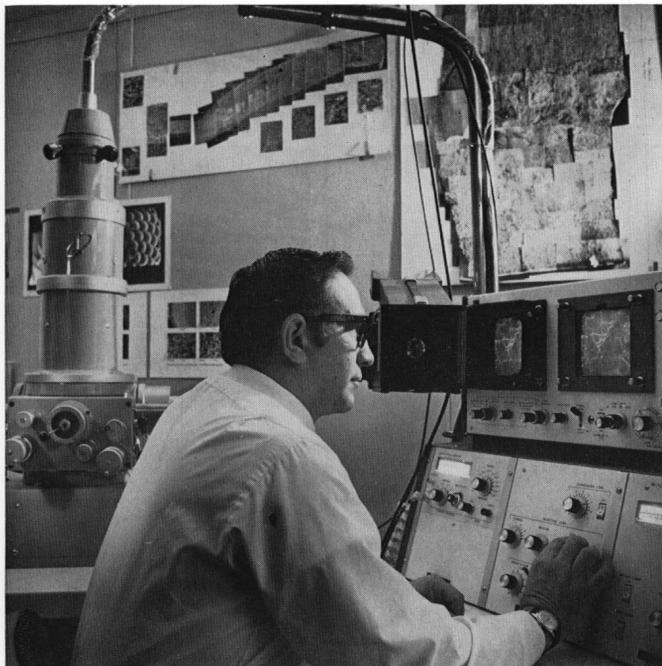
"May I have eyes to see/Beauty in this plain room/Where I am called to be" wrote poetess Nancy Byrd Turner. Technology since has given mankind many new "eyes to see." Strange beauty, previously invisible, is now revealed through electro-optics. Among the more exciting instruments which give us new "eyes to see" is this scanning electron microscope.

It provides a three-dimensional view of nature on a sub-micron level.

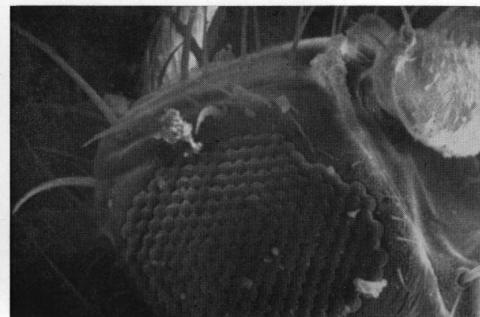
Sandia now has three of the scanning electron microscopes. They are of immense value to the Laboratories in fractography, microbiology, surface kinetics, and myriad analytical tasks. But there is another aspect to work in the mini-world. These pictures, taken during studies of both organic and inorganic

materials, reveal the symmetry and beauty of nature on a scale seldom seen.

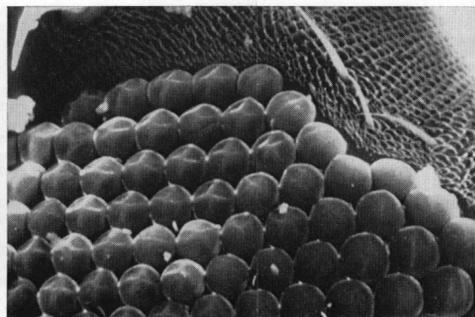
Advantages of this instrument over earlier electron microscopes are higher resolution and three-dimensional image forming capabilities. The scope used for these pictures is a JEOLCO JSM-2, which has a magnification range of 22X to 140,000X and a resolving power of 200 angstroms.



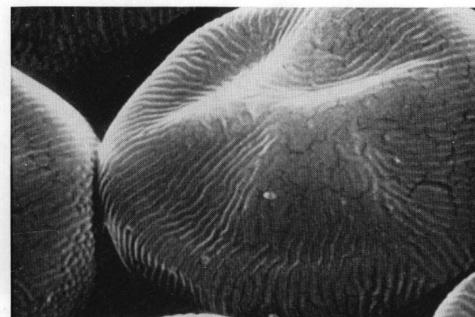
Chuck Miglionico (5522) looks at the fracture face of an alloy sample. The scanning electron microscope is a valuable analytical tool.



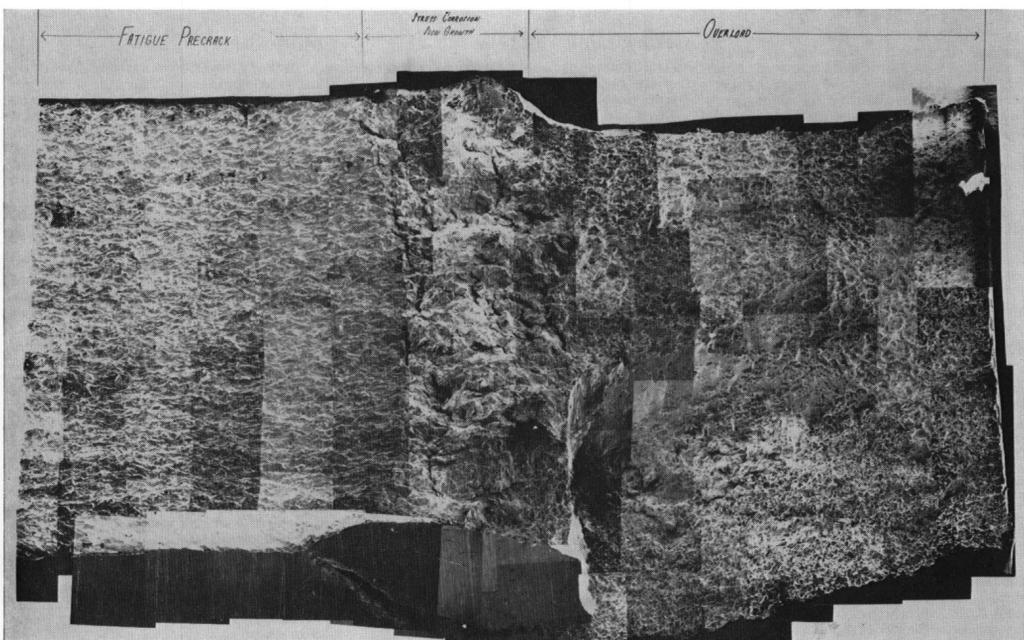
Head of a gnat at magnification of 300X. The instrument is capable of magnifying up to 140,000X.



At 1000X, individual lenses of the gnat's compound eye are clearly visible.

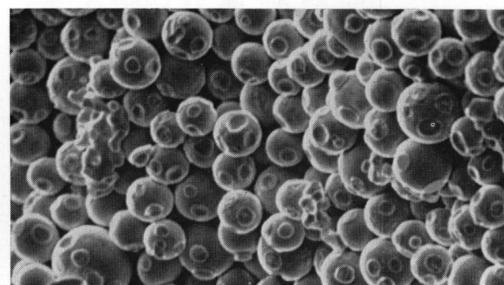


A single lens in the gnat's eye is approximately 10 microns across. Picture was taken at 10,000X.

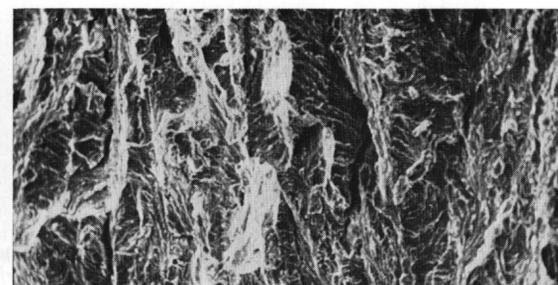


Montage of a fracture face made from 200 separate photos reveals the failure mode of an alloy. The microscope is used

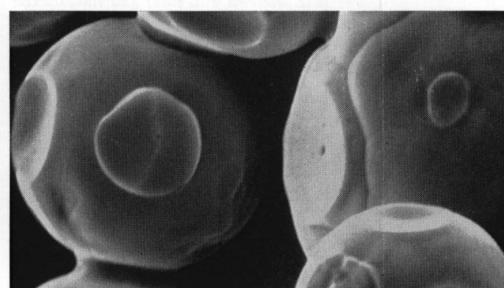
for studies in, among other things, surface kinetics, fractography and microbiology.



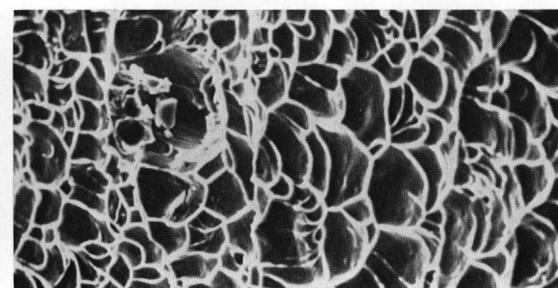
Fracture surface of sintered tungsten spheres approximately 10 microns in diameter. A magnification of 1000X was used.



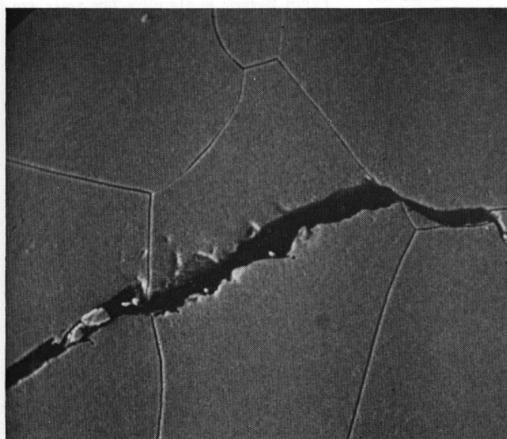
An alloy fracture face showing the results of stress corrosion. The sample was put under strain and exposed to corrosive materials.



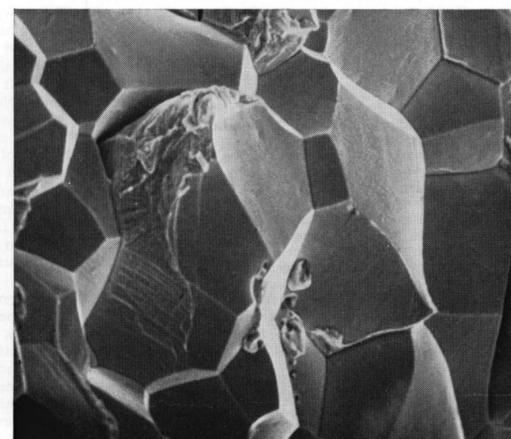
The same tungsten spheres at 6000X magnification. Flat areas are points of contact and fracture.



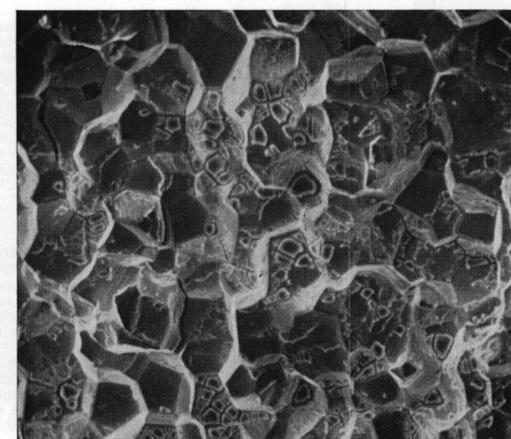
The dimple rupture mode of the same alloy shows the result of overload at point of failure. The magnification is 1000X.



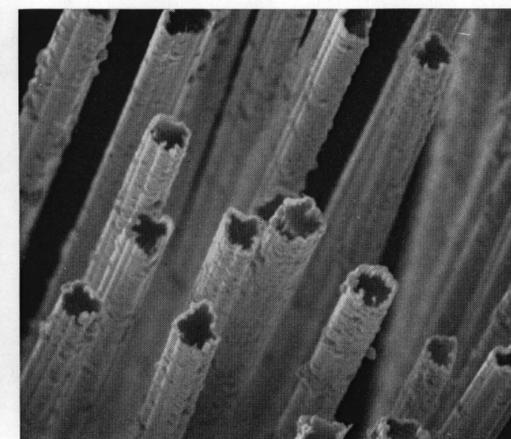
A metallographically prepared (polished and etched) sample of an alloy at 1000X.



Fracture face showing intergranular cracking. The scope has excellent three-dimensional image forming capability.



Another example of intergranular cracking but one which shows the effect of heavy oxidation. Magnification is 300X.

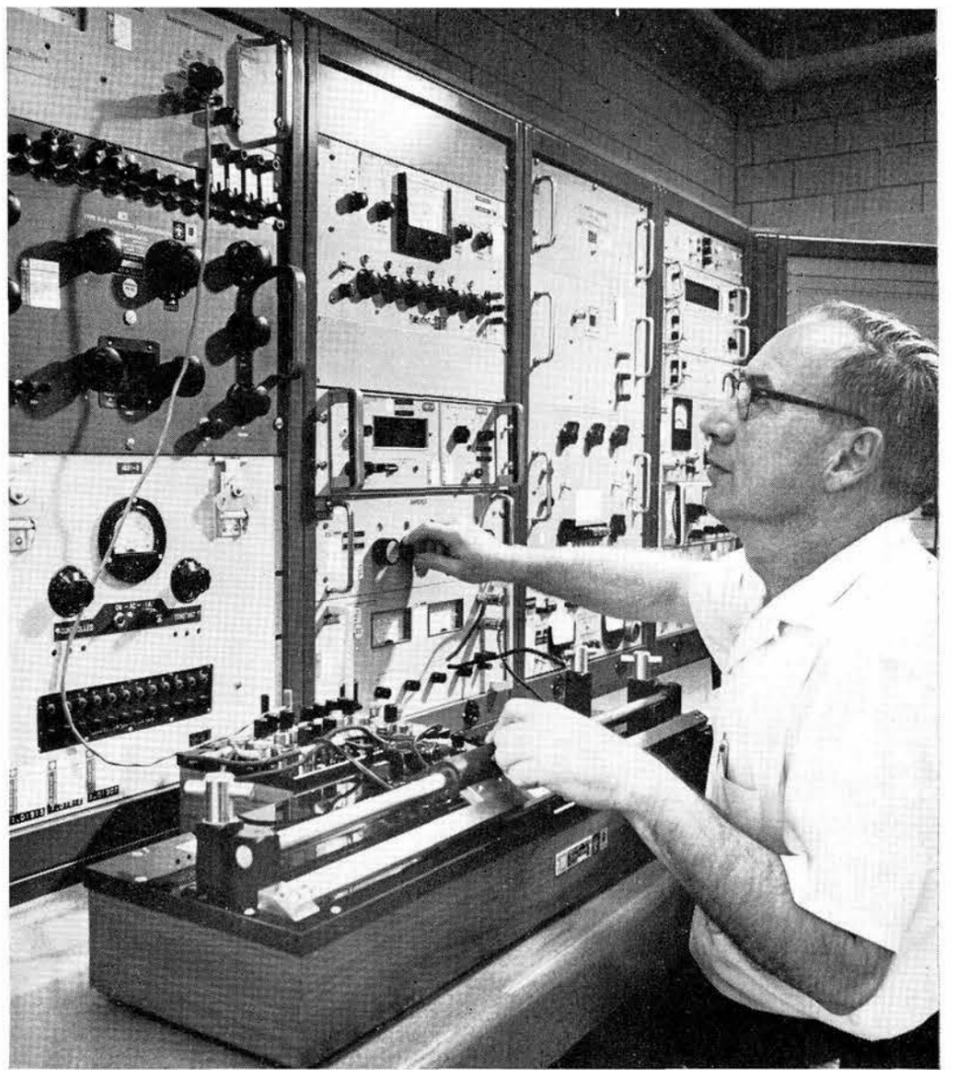


Nickel-coated fibers at 1000X magnification. The layer of nickel on the fibers are distinct.



RESCALING and refinishing meter dials is one of the jobs carried out by Kent Johnson.

Repair, Calibrate



A KELVIN BRIDGE is used by John Ingram to calibrate resistance. The shop is a Sandia standards station for calibrating and certifying electrical and electronic instruments.

--Like New Results

When an instrument needs a minor repair or when the calibration on a newly-acquired instrument has to be verified are both situations calling for the assistance of technicians in Instrument Repair and Calibration Section 4231-3.

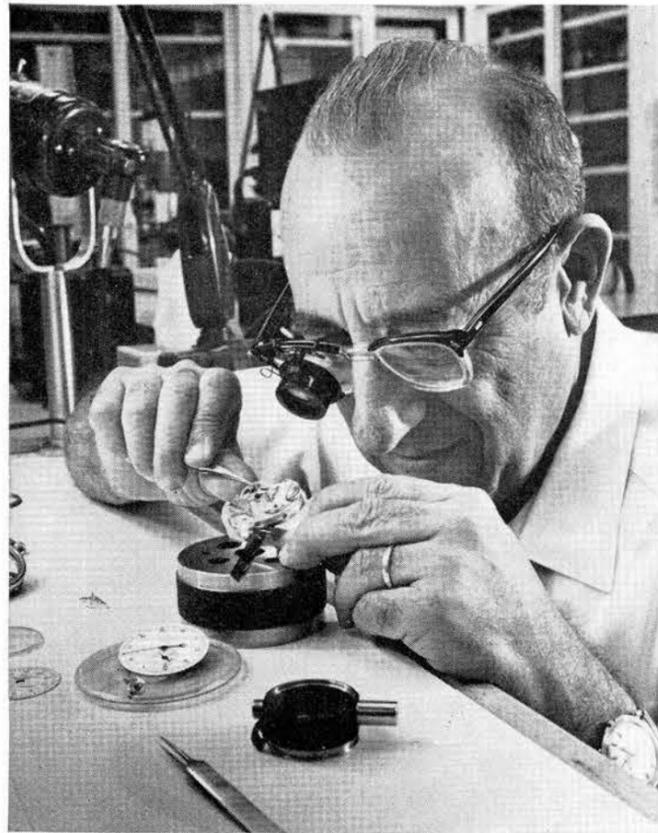
This in-plant service has the men and the equipment to handle a wide variety of jobs, but the bulk of the work (about 75 percent) is the repair and calibration of electronic measuring equipment. "In fact," says supervisor Dean Wise, "if an engineer needs a support instrument and can't find a meter to suit his special application, we can often adapt existing equipment by making a new meter dial face and resetting the dials."

On Dean's staff are instrument technicians, who are former watchmakers re-trained to repair meters, cameras, timers, stop watches, and mechanical indicators; electronic technicians; and industrial tech-

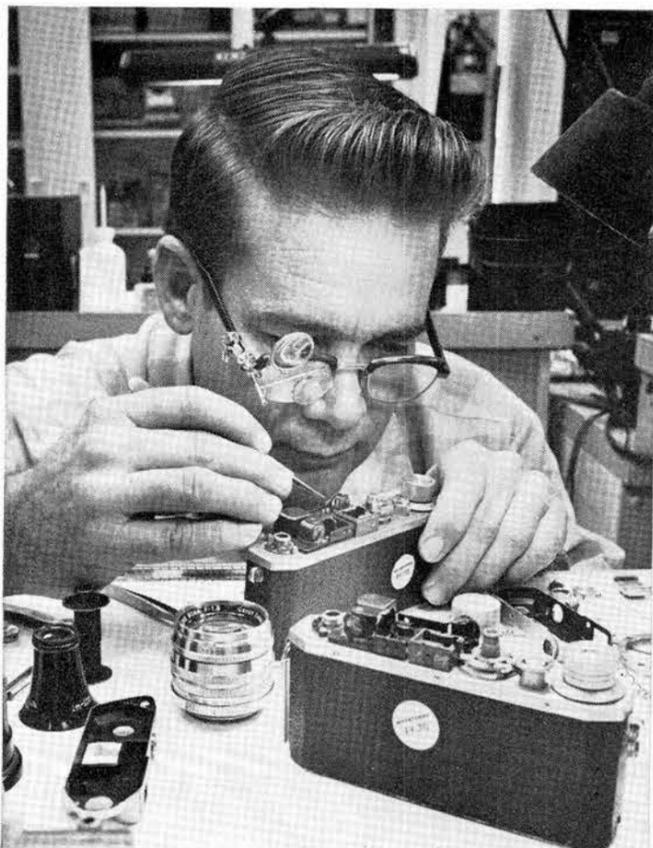
nicians who repair and calibrate "in place" equipment such as furnaces, heat control units, and recorder apparatus. In addition, electronic apprentices serve two "tours" in the shop, once when they are trained in meter repair and calibration and again near the end of their apprenticeship training when they learn about electronic measuring instruments.

The shop is a Sandia standards calibration station for calibrating and certifying electrical and electronic instruments. Its bank of electrical calibration equipment is certified at .01 percent accuracy in DC voltage and .02 percent in DC current up to 30 amperes, .05 percent accuracy in AC voltage and .1 percent in AC current up to 50 amperes.

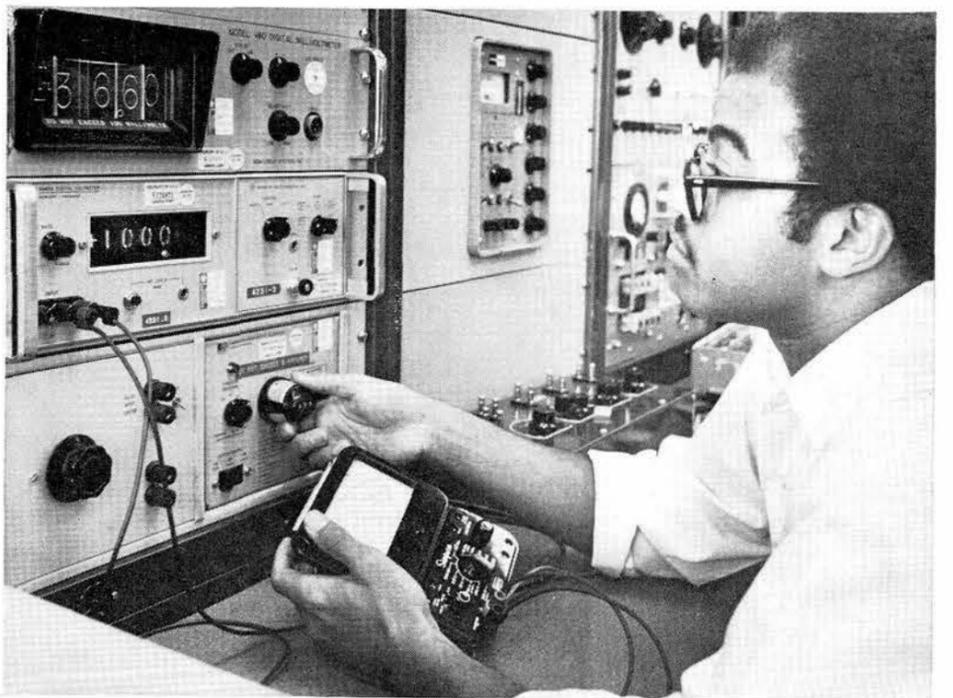
If your laboratory has an instrument repair or calibration problem, call them for assistance.



INSTALLING the balance wheel in a stop watch is a relatively easy task for Sol Azouz, a former watchmaker.



CAMERAS, timers, and mechanical indicators are typical repair jobs for Orval Talley and the other instrument technicians.



ELECTRONIC APPRENTICE Adrian Jones is calibrating a Simpson volt-ohm meter. The apprentices spend two different periods in the Instrument Repair and Calibration Section during their extensive training.

Service Awards

20 Years



Harold Goddard
1642



Lee Gornel
1911



James Kane
7250



Ralph Pena
4516



Marie Ryan
3452



Julian Silva
4614



Harold Walters
4612

15 Years



Jacob Bernal
4623



Dolores Carlson
7530



Judith Hallett
7632



Art Hasenkamp
5222



Phillip Higgins
7345



Raymond Kollman
4141



Francis Macek
7411



Albert Murphey
9253



John Wood
7532

10 Years

Mary Hauer 5223, Richard Meyer 5224, Cecil Tucker 7652, Margaret Crawford 3256, Earl Wanger 4153, William Jacklin 7326, Edward Buksa 7324, Helen Davison 1700, John Schimke 2314, James Breitenbach 7325, Ronald Wishart 8171, and Donald Stoner 8185.

Events Calendar

- Dec. 19-21—George Bernard Shaw's "Androcles and the Lion," Old Town Studio, tel. 242-4602.
- Dec. 19-20—Lobo Invitational Basketball Tournament (Colorado, Washington State, St. Joseph's and UNM), UNM Arena.
- Dec. 21—Snowshoe outing on Winsor Trail, N.M. Mountain Club, leader Bob Babb, tel. 256-9016.

- Dec. 24—Luminaria tour of Los Altos, Lee Acres, and Country Club areas.
- Dec. 24—Ceremonial dances after midnight Mass at most Indian Pueblos. Torchlight procession at Taos Pueblo.
- Dec. 26-28—Albuquerque Civic Light Opera Association presents "The Unsinkable Molly Brown," UNM Popejoy Hall.
- Jan. 1—Dances at Cochiti, Taos, San Juan and Zia Pueblos.

African Odyssey

Lengthy Flights, Earthquake, Smog Characterize Walt Herrmann's Trip

Trans-Atlantic travel with a three year old presents one major difficulty. Walt Herrmann (5160) found that his young son was more than a little confused about time zone changes. "It got so that every-time we walked into a hotel, he automatically thought it was time to go to sleep," he says.

The vacation trip Walt and his family just completed was enough to confuse anyone — it involved three nine-hour flights. They spent a week in Lisbon, several weeks in South Africa visiting Walt's parents, and a week in Rio de Janeiro.

"In Johannesburg, we rented a VW combi bus for local trips. My father is 83 years old and my daughter is 20 months old, but it wasn't much trouble to travel with them in this fashion," Walt explains.

It's 10 years since Walt visited his former home. During that time Johannesburg has grown to two million population, has become highly industrialized, and has acquired big city pollution problems. "I can remember when the skies were deep blue in color," he says, "now about half of the people burn coal for heating and cooking (which creates a constant haze), and the steel works and other heavy industries contribute greatly to the air pollution factor."

A delightful surprise was the new concept in game parks. A large estate, mainly grassland, was willed to the city of Krugersdorp and the whole 8000 acres became a

zoo. "The boundary of the area is fenced," he says, "but you are unaware of this as you drive through and see the wild animals in an open, spectacular setting. The lions are in a special fenced area, which separates them from the other animals, but you also drive through this enclosure — just be sure to keep your car windows closed."

Walt and his family visited Kruger National Park, which he found not noticeably changed in the past decade, although the elephant and giraffe populations have increased.

The mines in the vicinity of Johannesburg produce 70 percent of the free world's gold and half of the free world's uranium (slag heaps from early gold production are even being reprocessed to recover more uranium). Most of the gold-bearing quartzite is now mined at the 14,000-foot depth and engineers encounter "rock burst" problems where the rock pressure exceeds the strength of the rock.

The Herrmanns were in Capetown when that city experienced its first earthquake. Ten people were killed and 500 houses were demolished, including many of the Cape Dutch homes dating back to the 1680-1720 period. Mrs. Herrmann was in their hotel (a picturesque converted 18th century winery) when the quake occurred. Plaster fell off the ceiling and objects on the dresser tumbled to the floor.

Fishing off Cape Point has changed considerably. "We used to take an 18-foot boat out, while everyone else used big boats, and it took us a half day to get to the fishing grounds. Once there — without a radio — there was only the Antarctic beyond you. But now," Walt adds, "the sportsmen have 16-20 foot boats with outboards that 'plane' at 30 knots. You can be at the fishing grounds in 15 minutes — and the boats are equipped with radio." Walt's cousin once held the world record for big-eyed tuna with a 600-pound catch; Walt has caught a few big ones in the 250-pound range.

As to Rio, Walt describes it as a city in a beautiful setting with millions of people milling around, and indescribable traffic noise. "Driving a car there would be pure madness," he believes. "Even the taxi driver had to circle through the maze of one-way streets four times before he could edge close to the curb at our destination."

Rocket Launched at TTR For Solar Flare Data

A high altitude rocket was launched from Tonopah Test Range recently to obtain information on solar x-ray activity.

The Nike-Tomahawk rocket, soaring to a height of 100 miles, used the Sandia-developed attitude control system which kept it pointed at the sun. The early afternoon shot was timed to coincide with a period of solar flare. The launching was conducted for Lawrence Radiation Laboratory scientists.

A second launch — to measure radiation from star sources — was postponed because of wind. This shot will be rescheduled in January.

Sandians participating in the test were from Upper Atmosphere Projects Department 9220, Rocket and Recovery Systems Division 9324, Test Project Management Department 7250, and Components and Transducer Development Division 7263.

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SANDIA LAB NEWS DECEMBER 19, 1969

SHOPPING CENTER

CLASSIFIED ADVERTISING

Deadline: Friday noon prior to week of publication unless changed by holiday. A maximum of 125 ads will be accepted for each issue.

RULES

1. Limit: 20 words
2. One ad per issue per person
3. Must be submitted in writing
4. Use home telephone numbers
5. For Sandia Laboratories and AEC employees only
6. No commercial ads, please
7. Include name and organization
8. Housing listed here for rent or sale is available for occupancy without regard to race, creed, color, or national origin.

FOR SALE

MISCELLANEOUS

- ONE large and one medium rose-beige oriental hooked rugs. Fries, 268-1362 after 5:30.
- POODLE, silver toy female, good w/children. Kelley, 265-7469.
- 300 HOLLAND & HOLLAND Magnum rifle made by Winchester, \$135 w/ammo. Newton, 255-2074.
- '67 HONDA 450cc w/goodies. King, 298-2991.
- GARAGE SALE: blender, golf clubs & toys. Porter, 2708 Alcazar NE, 298-3623.
- OVER \$300 worth of Lionel train equipment, lg. train table w/folding legs, 2 engines, lg. double transformer (needs some work), several cars, caboose, books, scenery, etc. \$45. Detorie, 299-1868 after 5:15.
- MOBILE HOME, 1968 Marlette, unfurnished, 12x65, 3-bdr., 1 1/2, \$7670 total including interest. Manriquez, 296-8162.
- GE PORTABLE dishwasher, bought May '67, \$210 new, sell for \$80, can demonstrate. Mendel, 296-6826.
- YOUTH GOLF SET, 3, 5, 7, 9 irons, 1, 3 woods, bag, putter, \$25; cornet, \$50. Nielsen, 255-2045.
- RECLINER CHAIRS, large, one white, one black, new cost \$170 for both, now \$85 or \$45 each. Smith, 898-2567.
- GREAT BOOKS OF THE WESTERN WORLD, 56 volumes w/bookcase. Renker, 296-3048 after 6.
- WALNUT COFFEE TABLE, \$30; recliner, \$20; stroller, \$10. Husa, 298-3335.

- HONDA Trail 90, '69 model, w/Bell helmet (7-1/8) & folding tire pump, 2 pr. goggles, lever shift, from street to trail gear, \$295. McDonald, 299-9269.
- PUPPIES, mother is registered sable collie, hold for Christmas, choice \$5. Hare, 1-865-7852.
- FREE PUPPIES, 8 wks. old Christmas, will hold until then, male & female. Frasier, 299-6933.
- REGULATION size pool table w/balls & cue sticks. Saavedra, 255-8110.
- AKC Rep. Pekingese puppies, hold for Christmas, golden & black, \$95; 20" girl's bicycle, \$8.50; VW chains & hub caps. Klentschy, 255-3795.
- REMINGTON electric typewriter, \$95. Overbury, 255-7788.
- REEL TYPE Power lawn mower, Craftsman 18", 6 blade, \$25, see Saturday at 1022 Lester NE. Hudson, 296-3484.
- TOY POODLES, AKC champion lines, 2 silver, 2 apricot males. Chavez, 298-0674.
- AQHA COLT, fine show prospect, gentle, intelligent, "Bright Eyes" breeding, \$520; AQHA brood mare in foal, \$500. Jolly, 877-2474.
- NAVAJO Indian pony to foal in April, gentle, perfect for small child's first horse, \$200; flashy colt, \$125. Jolly, 877-2474.
- SHOTGUN 16 ga. fox model "B", double vent rib, single trigger, \$65; guitar "Stella", \$15. Curzi, 296-5386.
- SEAR'S Wonderhorse, 2 yrs. old, half price. Trauth, 299-2176.
- LADIES accordion, Enrico Roselli, Italian made, 120 bass, 5 stops (3 treble & 2 bass), white & gold, \$200. Geisler, 299-2168.
- KNEISSEL RED STAR SKIS, 210cm, R.S., used 1 season, \$75; Zenith B&W 24" console TV, \$35. Kahn, 255-3870.
- WONDER SPRING HORSE, \$8; Evans lg. child's tricycle, \$8; dbl. bed, metal springs, \$3; '55 Buick shop manual, \$3. Bassett, 898-1840.
- AKC LABRADOR PUPPIES 13 Field & Bench Champion in 4 generations, parents OFA approved, Christmas delivery, \$100. Coburn, 268-6844.
- MINK STOLE; Robot 35mm camera; pr. chrome truck mirrors; cartop carrier racks; Webley 45 cal. revolver w/holster. Harris, 299-6664.
- REAR SEATS for '69 Ford Van or Club wagon; V-bar tire chains for 7.35x14, 15 tires. Holt, 299-5943.
- S&W Model 19 .357 combat magnum 6", new; Colt python .357 magnum, blue 6", new; Polyglass snow tires. Bennett, 268-5157.

- SKI BOOTS, boy's, 2 pr., \$10 & \$20; two iron coats w/mattresses, \$25. Peterson, 256-7514.
- CANOE, 15' Grumman aluminum square stern, complete w/motor mount, sail, paddles, life jackets, etc., \$195 or trade smaller canoe. Tiefa, 299-2763.
- BICYCLE, girl's 24", Sear's, heavy duty tubes, \$20. Moriarty, 296-1369.
- TOY POODLES, silver, male & female, very small, excellent pedigree, down payment will hold for Christmas. Shipley, 298-2433.
- TIMING LIGHT, DWELL METER; blow torch; motor manual '67 wheel puller; remote starter, set of pipe wrenches. Eaves, 299-7728 after 5.
- UTILITY POLE, 60 amp capacity, completely wired w/12" pole & guy wire, \$35. Roh, 299-3749.
- LARGE SIZE wonder horse, \$10. Minor, 636-2194.
- WHITE TOY female poodle puppy, excellent blood lines, has permanent shots. Scheiber, 299-4743.
- PORTABLE SEAR'S model stereo, detachable speakers, solid state, auto. record changer, \$20. Hughes, 299-1533.
- PHOTOGRAPHIC equipment: enlarger, Durst M600 w/2 lenses, \$90; Polaroid 180, \$100; Exakta 500 w/3 lenses, \$60; Petri 75 35mm camera, \$45. Slesinger, 299-4626.
- YAMAHA motorcycle, '68 DTI, extras available, \$550; poodle, 6 mos. old, free to good home w/no small children. Rand, 299-1048.
- STRING BASS 3/4 size, best offer over \$200, includes cover & bow. Ray, 299-1253.
- WEST HIGHLAND white Terrier puppies, 6 wks. old, AKC, excellent lines. Young, 296-1963.
- WEATHERS TURNTABLE w/Empire cartridge & walnut base, \$50. Garrison, 256-7267.
- GUITAR, Silvertone, 2 pickups, case, strap & cord, cost \$90 new, asking \$45. Ruminski, 256-0770.
- MOTORCYCLE, '68 Kawasaki 350, 2000 miles. Kelly, 298-6055.
- METAL utility trailer, \$85; antique clock, \$65; guitar, new, \$12; movie camera, Yashica, 15mm; Harpers Ferry musket, \$75. Welker, 299-1179.
- FULL STOCK PERCUSSION RIFLE, .36 cal., antique in good shottable condition, \$125; cased finely engraved dbl. percussion shotgun, Broward Damascus barrels, museum piece, \$100. Mattox, 296-4149.
- BOY'S & GIRL'S 24" bikes, \$10 & \$12.50; bike training wheels, \$1.50, baskets, 75c. Foster, 299-6240.
- FREE year-old spayed half-collie needs good home. Affectionate, good with children, too large for small yard. Doolittle, 299-5500.

- ICE SKATES, girl's leather figure, size 3 1/2, w/guards, \$7.50. Robertson, 296-4613.
- WESTINGHOUSE electric range w/hood, \$70; four nearly new 6.50x13 tubeless tires, \$30. Fink, 247-2806.
- GIRL'S English bicycle, \$20; oak desk, formica top, fluorescent lamp, \$45; standard 2-dw. steel file w/key lock, \$20. Wallace, 299-8991.
- BERETTA JAGUAR .22 cal. auto. pistol, 3 1/2 or 6" barrel, new in box, \$55. Svensson, 344-7700.
- HUMMEL FIGURINES — nativity scene — Mary, Joseph, infant, mule & cow, regular \$48, sell for \$40. Fisher, 298-0526.
- CLARINET Bb Bundy, \$25; walnut panels, list price \$17.50 ea., sell for \$12 ea. Aronson, 268-7109.
- 2 EARLY AMERICAN tan tweed swivel chairs, \$20 ea.; coffee table, \$15; lt. green sq. foot stool, \$5; 2 yellow dresser lamps, \$7. Baker, 298-3341.
- 24" GIRL'S bicycle, Sear's, blue & white, available Christmas Eve, \$18. Allen, 296-6062.
- BLACK Labrador retriever, AKC REG. Baughman, 299-3785.
- TWO 1/4 shares in 1959 Mooney Mk 20A aircraft, 180 hp, low time, new annual & paint, full panel, \$1600. Ortiz, 877-3025.
- LADIES fur coat, genuine Persian lamb, size 9, dark grey, \$35; want old hunting knives. Smith, 299-1096.
- POOL TABLE, 4x8 Brunswick Celebrity model, w/accessories. Lareau, 282-3856.
- 30" KENMORE gas range, \$25; Miami-Care range hood, \$15; 48" hardwood oval dining table, leaf, \$25. Dalphin, 265-4029.
- SIZE 7 ski boots; 74" skis. Harling, 243-3314.
- TRUMPET, \$75; picnic table, \$20; 23" TV console, \$30; chest, \$10; swing set, \$10; twin bed, \$10, 24" boy's bike, \$10. McFall, 298-1552.
- TVs 18" GE, \$50; 21" Zenith, \$60, both B&W; 23" remote control RCA color \$200, Super dual 8 projector & screen, \$100. Findlay, 299-9328.

CARS AND TRUCKS

- '49 FORD 1-ton pickup, 4-spd. trans.; camper shell, 6' long. Chavez, 299-5102.
- '68 IMPALA V8 4-dr. HT w/PS, PB, R&H, \$1200. O'Trimble, 299-0198.
- '69 RAMBLER 2-dr., radio, stick shift, under 14,000 miles, below book value. Gunn, 298-3178.
- '67 CHEVROLET BelAir 4-dr., AC, V8 engine, 5 new Polyglass tires, 23,000 miles. Snelling, 268-5895.

- '55 FORD Victoria, motor has the connecting rod out. Kotrola, 265-4717 after 5.
 - '60 MGA HT, excellent heater & defroster, \$650. Dickson, 344-4090 or 298-8921.
 - '65 CHEV. pickup, V8, 1/2-ton, 8' fleetside, white over red, \$1400. Collins, 265-2808.
 - '59 FORD wagon, white, blue interior, OD trans., R&H, PS, tinted glass, \$295. Stark, 8212 Pickard Ct. NE, 299-5953.
 - '56 CHEV. station wagon, 6-cyl., 3-spd., OD, \$125; '53 Chev. 4-dr., 3-spd., \$100. Brinkley, 344-5334.
 - '65 CHEVROLET Biscayne 2-dr., 327, V8, AC, PB, PS, new tires. Hackman, 265-5483.
 - '63 GMC 1/2-ton pickup, 1 w/box, 4-spd., air, w/shell, \$950. Railey, 344-5077.
 - '66 CADILLAC coupe de ville, 48,000 miles, loaded w/extras, \$2895. Downs, 282-5148.
 - '63 GMC 1/2-ton pickup, V6, auto., lwb, \$695. Toya, 898-0491.
 - '68 BUICK Riviera, fully equipped plus Cruiseomatic, tape deck, 4 new tires, 2 snow tires, mounted, \$3700. Morgan, 299-8726.
 - '64 IMPALA 4-dr. sedan, AT, PS, radio, 283 engine, \$750. Reed, 299-7425.
- ### REAL ESTATE
- REPOSSESSED LOT, 1100 bkl. S. High St., \$1380, \$20 monthly. Chavez, 298-5091.
- ### WANTED
- LADIES SKI BOOTS, size 6 to 7; also skis around 5'7" & poles. Cupp, 255-6048.
 - METAL SKIS, 205mm, first class condition. Durant, 298-4952.
 - DRILL PRESS column, 2 3/4" diameter, floor-height; or will trade bench-height column. Holloway, 255-6938.
 - SIZE 8 ski boots; MGTD auto parts. Harling, 243-3314.
- ### LOST AND FOUND
- LOST—Man's beige top coat, keys on ring, plastic blue zippered folder, earring w/approx. 17 ruby red stones. LOST AND FOUND, tel. 264-2757, Bldg. 610.
 - FOUND—Brown leather-like button, Social Security card "JoAnn Perea", brown teen-age purse, flowered head scarf, pr. ladies black cloth gloves, ladies white cloth glove, plastic coin purse w/laway receipt, shoe buckle, rhinestone ear clip, No. 2 knitting needle. LOST AND FOUND, tel. 264-2757.



New Years Party

Coronado Club
Dec. 31, 9 p.m. to 1 a.m.

Champagne Breakfast
Dancing Upstairs
and Downstairs

Coronado Club Activities

Celebrate New Year's Eve at Club

The year 1969 will end in great style at the Coronado Club on the evening of Dec. 31. The year's biggest bash will also open 1970 with champagne, hats, noisemakers, confetti and the music of two swinging bands.

Sol Chavez and the mighty Duke City Brass will hold the upstairs ballroom while Tommy Kelly and the smiling Irishmen play downstairs. Dancing is set from 9 p.m. to 1 a.m.

At midnight a champagne breakfast will be served.

The event costs \$7.50 for member couples, \$10 for guest couples. Make your reservations now at the Club office.

* * *

Kid's Christmas Party

Tomorrow at 10 a.m., Santa Claus will arrive at the Club to pass out free goodies to children 12 years and under. Ron Day (3131) and his wife Mary Kay will present a special Christmas marionette show and a sing-along. Cartoons will also be shown. The party is free to children of members.

* * *

Teen Go Go

The youngsters can enjoy a mid-holiday bash on Monday, Dec. 29, from 7:30 to 10:30. A group called the Leather Wind will provide the rock 'n roll music. Member parents should pick up tickets (25 cents for members, 50 cents for guests) before the party.

* * *

Social Hours

With the start of the new year, the Club will resume regular Friday night social hours with a group called The Changing Times booked for Friday, Jan. 2. The Club's famous chuckwagon roast beef buffet will be spread from 6 to 8 p.m. Dancing is from 6 to 9 p.m. while special prices prevail from 5 to 9 p.m.

On Friday, Jan. 9, a big 12-piece band called The Top Hats has been booked to make the happy music. The southern fried chicken buffet is scheduled.

In the meantime, social hours continue on Tuesdays from 5 to 8 p.m. in the main lounge.

* * *

Dance Classes

A new series of advanced and beginning dance classes start at the Club on Jan. 12. Registration fee is \$20 per couple for either of the 10-week courses. Enroll at the Club office prior to the first session.

* * *

Bridge

Starting Tuesday, Jan. 6, the duplicate bridge group will meet at 7 p.m. on Tuesdays. Coronado Ladies Bridge will meet Thursday, Jan. 15, at 1 p.m. The group is starting the new year by inviting any interested bridge player to join them. No reservations are required. For additional information, call either 299-9168 or 299-1025.

* * *

Club Holidays

The Club will be open until 5 p.m. on Dec. 24 but will be closed both Christmas Day and New Year's Day.

People Count Too

Human Factors Experts Aid Design

Designers of electronic and mechanical devices which are operated by people know that Murphy's Law always applies: "Anything that can go wrong, will go wrong."

That's why they look to the human factors experts to help them reduce to the absolute minimum error-likely features of any system. And the specialists in the Systems Reliability Division 1642 do this when they evaluate Sandia-designed systems to make sure that human errors will be minimized in the assembly, testing, operation, and maintenance of these systems.

Although not all human factors specialists are psychologists (the group includes men with backgrounds in engineering and physics), they are experts in detecting areas where people are apt to make errors. Moreover, they can identify the reasons for these errors. While some errors are caused by carelessness, the human factors group believes that most can be prevented with properly designed equipment, tools, instructions, or work environments.

Here is how this group, working with engineers in the early design stages, helps insure that Sandia-designed systems will be both safe and reliable:

—A prototype tool exerted extreme tension on a torsion bar. To protect the operator, a latch held the tool under tension. But this latch was within the working area of the operator's hand, and it was quite possible for him to trip it accidentally. The tool would release with tremendous speed, and the operator could suffer serious injury. The solution: design a positive-locking mechanism that could not be inadvertently released.

—In another prototype design, the setting of an adjustable fuze was read through a small window, and at times it was hard to make out the numerals. To increase contrast, it was recommended that the border of the window be blackened. This small change markedly improved the readability of the numerals.

—The design of knobs and dials is a primary concern of the human factors specialists. Recently the armed forces requested an instrument that would be used under extreme environmental conditions. There would be glare, limited light, and vibration; and the operator had to be able to read the dials when all of these conditions occurred simultaneously. The visual acuity of the operator was the key which determined the size of the letters. In the resulting design glare was eliminated through backlighting and the letters were visible through a 120 degree arc, allowing them to be read under all of the environmental conditions specified.

—Much effort also goes into the correct design of controls. A heavy, but delicate component had to be handled without being bumped or dropped. The originally proposed lifting device was a vacuum cup with a one-point suspension. But the one-point suspension did not permit precise positioning control, and there was the ever-present danger of losing the vacuum.

A two-point suspension device suggested by the human factors group offered good positioning control as well as positive purchase on the component and was adopted.

—For reasons of safety, a shorting bar has to be attached to the terminals of a firing device while other parts in a weapon are being installed. But unless the bar is removed before the cover is installed, the firing device will not function properly. Since removal of the bar — the last operation before covering the unit — could easily be overlooked, it was recommended that the bar be redesigned so that the cover could not be installed until the bar was removed.

This illustrates a human factors principle: design a system which can't be put together incorrectly, thus making it unnecessary to depend upon instructions and operator training. If cables are to be hooked up to a unit and must not be interchanged, one should be shorter so that it can't reach to where the other should go. Another solution would be to use different connectors or keyways.

Seemingly trivial design features often can impair the functions of a system. However, by evaluating every feature of systems and components that people put together, look at, manipulate, or make decisions about, the human factors specialists try to prevent error-inducing features from entering the design.

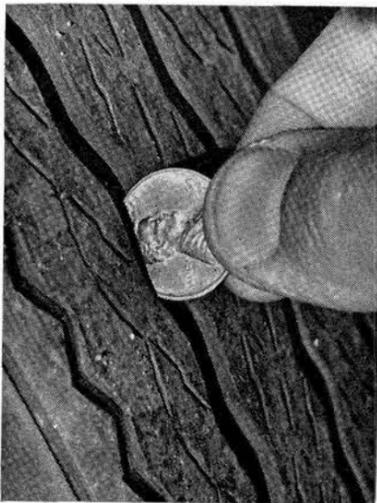
In cases where past experience or the experimental literature does not offer a solution to design problems, a formal experiment may be conducted to obtain original data. Among recent experiments was an evaluation of combination locks to determine relative error rates and opening times and an investigation of how much torque a man can exert — with and without gloves — on different types of knobs.

"No one can reasonably expect the engineer to have more than a working knowledge of behavioral science. Nor do we profess to be competent engineers," says Alan Swain, the group project leader. "We can, however, assist the engineer by identifying those aspects of his design likely to foster human error. Frequently, as several of the above examples show, we serve as a catalyst — that is, we need only point out the problems to the designer and he comes up with the solution."

The human factors group at Sandia has pioneered in the study of human reliability in systems and has developed techniques for estimating human error rates and their influence on system operation. Many of these techniques are being adopted in military and industrial settings.

Alan recently visited the Danish AEC where he described the Sandia method of human reliability analysis. Other members of the group have been called upon for human factors assistance by agencies outside Sandia. In addition, an out-of-hours course — Human Factors Engineering — has been offered for about a year and a half and has been taken by scores of Sandia engineers and technicians.

Sandia Safety Signals



If your car is not equipped with tires incorporating the new "tread wear indicator" feature, now a federal standard, there is a simple method for determining when the tread is worn to the danger level: insert a penny with the head down into a center groove. If the top of Lincoln's head is visible, the tire is down to 1/16th of an inch depth, the minimum recommended for safety.



HOW WHITE IS WHITE? The colors used on Air Force instrument panels must be in accord with federal standards. Lee Sparks (1514), member of the project engineering group, and Hank Guttmann (1642) use a color photometer to determine whether a Sandia-designed display unit meets specifications for "lunar white." The test unit is mounted on a milling machine to permit precise positioning.