COLUMBUS, O., Jan. 18.----A portable X-ray machine that could be used for on-sight inspection of bridge welds and for emergency battlefield or accident-scene radiography has been developed by a team of Ohio State University engineers.

Weighing only 40 pounds, the 150,000-volt X-ray unit is completely self-contained and has no need for an outside power source because it operates through piezoelectricity.

Piezoelectricity is a natural phenomenon which occurs when pressure is applied to or released from certain types of crystals. The size of the electric charge that develops depends upon the number and size of crystals used and the amount of pressure applied.

Dr. Robert C. McMaster, professor of welding engineering, headed the Ohio State work under a contract from the Ohio Department of Highways and U. S. Bureau of Public Roads. Project engineer was M. L. Rhoten.

The Ohio State unit uses a stack of 3½-inch ring-shaped crystals which are put under pressure through a manually-operated hydraulic pump or by explosion of a small blank cartridge.

The pressure creates a very brief electric pulse which fires an X-ray tube. Coupled with Polaroid film, the machine produces almost instant X-ray pictures. It also can produce X-ray negatives.

(MORE)
X-ray unit - 2

The unit is capable of radiography through one-eighth inch of steel or two inches of aluminum. Also under development are 300,000-volt and 500,000-volt models of the equipment which would increase the X-ray capability, but which would not be as lightweight and easy to use in the field.

The researchers point out that until recently little has been done to tap the power potential of piezoelectricity available from either natural crystals, such as quartz, or artificial crystals.

The most common use for piezoelectric crystals is in microphones and phonograph cartridges.

The speed of the piezoelectric charge in firing the X-ray tube also opens up the possibility of high-speed, action-stopping radiography, in much the same way that a stroboscopic light source makes high-speed photography possible, the engineers say.

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Release on Receipt

COLUMBUS, O., May 1.-- --Who would guess that a group of engineers -- especially university professors would fall for buying electricity by the pound?

As far-fetched as it sounds, Ohio State University researchers order electricity by the pound from such piezoelectric crystal manufacturers as the Cleveland-based Clevite Corp.

The researchers calculate that in the past few years they have used about one-half ton of the electricity-producing crystals -- enough to generate 8,000 megawatts (8,000 million watts).

Though the phenomenon of piezoelectricity has been known since the late 1800's little had been done to tap its power potential until the Ohio Department of Highways and the Bureau of Public Roads began sponsoring research at Ohio State in 1962.

Several practical uses have already been found and many more are on the way according to research chief Dr. Robert C. McMaster, professor of welding engineering.

He explains piezoelectricity this way: certain crystals, especially quartz, give off an electric charge when mechanical pressure is applied to them. More crystals and more pressure yields more electricity. And the reverse is true, he continues. When electricity is applied to the crystals, they vibrate, thus giving off mechanical energy.

(MORE)
Piezoelectricity - 2

The lead-zirconium-titanium crystals used by Ohio State researchers are man-made into virtually any shape, though a doughnut-like crystal is the one most often used. Crystal costs range from less than $2 to about $35, in size from one inch to five inches in diameter, and in thickness from \( \frac{1}{8} \) to \( \frac{1}{4} \) inch.

Project head Merle L. Rhoten has developed a piezoelectric x-ray machine based on the pressure-gives-electricity portion of the crystal. The small machine, which is capable of 150,000-volt charges, can x-ray through an eighth-inch of steel or 2 inches of aluminum. It was designed for highway bridge weld inspection, weighs only about 15 pounds, and is completely portable.

The pressure is provided either by a blank cartridge (quite like a revolver cartridge) firing against the crystal stack housing, or by a hydraulic hand-operated pump. Larger units have also been built, but are not as portable as the 150-KV device. Rhoten reports the largest electric discharge yet has been 3.6 billion watts, obtained from a 600-KV x-ray unit. A 1,000,000-volt unit is now being built.

Another project head, Charles C. Libby, has pioneered a portable riveting machine which taps the other half of the piezo potential. Libby feeds electricity into a transducer, which through the vibrations of the crystals, changes electricity into mechanical energy. These vibrations, at about 10,000 cycles per second, move a steel transmission line up and down about 35 thousandths of an inch. This motion drives a rivet-head die, which in turn deforms rivets in eye-blink time, about three-tenths of a second.

Roy B. McCauley, professor and chairman of the department of welding engineering and overall chief of the piezoelectric-based...
research, during a recent interview, said, "The foresight of the Ohio Department of Highways in enabling us to carve useful knowledge out of virgin research areas has made possible the broad spectrum of developments which are -- and will be -- of benefit not only to Ohio industry but also to industry across the nation."

Pressed to talk about these "virgin areas," McCauley reported, "The highway department paid for the research which made possible a revolutionary transducer now being licensed for use in the foundry industry. The x-ray machine we developed to test bridge welds, when the word got out, brought phone calls from doctors who saw uses for it in on-the-spot x-raying of accident victims; one doctor suggested we move to the battlefield in Vietnam with our instant x-ray machine.

"Naturally the Ohio Department of Highways is mission-oriented," continued McCauley, "and specifically for their use we delivered a vibration-powered post driver. And we expect, within a year, to channel vibratory energy into concrete technology; that is, apply this energy to cement used in road surfaces and other structures to induce it to mix better, set quicker, and dry stronger by applying vibration to it."

McCauley thinks Ohio State research and Ohio Department of Highways sponsorship can lead to a relatively low cost traffic tangle preventer. Piezoelectric crystals mounted in or near the highway act as "traffic-observers." He explains that the motion of a passing car or truck is sufficient to cause the crystal to generate a signal; the signal can then be "read" and such information as speed, weight, direction, and traffic density can be centrally monitored and controlled for large urban areas.
COLUMBUS, O., March 7.-- -- A 15-pound sonic riveting machine which does the same work as the traditional, all-at-once, 10-ton blow has been developed by Ohio State University welding engineers.

Called a "sonic transducer," the machine delivers thousands of tiny taps to replace the single, high-force thud typical of riveting operations.

The 20-inch-long, 15 horsepower device was developed in Ohio State's Sonic Research Laboratory under the direction of Dr. Robert C. McMaster, Regents' professor of electrical and welding engineering.

The machine, which changes electrical energy into mechanical energy, works like this:

Electricity passes through man-made piezoelectric crystals where it is changed into vibrations. The vibrations travel to the end of the transducer where they move the tip up and down 3½-thousandths of an inch about ten thousand times a second.

It is these short, but very fast strokes, that do the work of a much larger one-time thump, the engineers say.

The researchers call the machine "sonic" because it vibrates in the same range as audible sound does -- up to 20,000 cycles per second. It is not sound which heads the rivet, they explain, but mechanical vibrations in the same cycle-per-second range as sound waves.

(MORE)
The device is said to rivet any metal that can be riveted and at least one metal -- titanium -- which is practically impossible to rivet by other means.

McMaster predicts that use of the transducer would allow major reductions in the size, strength, complexity and cost of currently used riveting machines. And static forces now required to rivet could be reduced 50 to 100 times.

For example, he said one large airplane manufacturer has a wing panel riveter located in an area the size of a football field. It cost $3 million. A commercial version of the much smaller and less costly Ohio State device could duplicate the massive machine's capabilities.

Charles C. Libbey, welding engineering research associate and project supervisor for the riveting research, noted that strength of riveting done by the new method is high, and flow lines of metal around the rivet head are exceptionally smooth.

Although the device is not yet on the market, its development already has led to two patents for the Ohio State researchers, and eight others are in process.
Release on Receipt

COLUMBUS, O., Nov. 5.-- --An Ohio State University researcher claims that the ultrasonic welding section of the American Welding Society handbook, bible of the welding industry, has stymied acceptance of new, and somewhat revolutionary, ultrasonic welding.

The main beef of Prof. Charles C. Libby, of the sonic power laboratory in the university's department of welding engineering, is that the ultrasonic chapter of the handbook says ultrasonic welding is limited to the joining of thin films and fine wires.

Libby says that his laboratory has joined one-inch steel bars and ultrasonically welded three-eighths-inch rods to three-eighths-inch plate. According to Libby, the welding handbook suggests that ultrasonic welding is limited to 0.01-inch steel or aluminum and fine wires such as are common in electrical relays and transistors.

Libby is concerned about the welding handbook because, in his words: "The book is putting an industry bushel over our research light.

"We have found a way to deliver great power to a welding surface -- much greater than is needed for the routine welds described in the handbook."

Libby, anxious to have the work of his laboratory more widely accepted by industry (the laboratory already has several firms (MORE)
licensed to manufacture under its patents), says that the handbook chapter on ultrasonic welding has cost companies who weld a lot of money.

He says the handbook is correct when it advises that the welding of plastic is economical but he thinks the downgrading of ultrasonic metal weldments is an industrially expensive oversight.

The welding industry is apathetic about ultrasonic welding because available equipment is severely limited (thin films, fine wires), says Libby.

"The next logical step is for a manufacturer of welding equipment to build a machine which will do what we do, and eventually, the handbook will be correct."

The American Welding Society's six-volume handbook does not include tips on research progress regardless of how near a development may be to making a dent in an industrial process, reported Libby, who is a member of the board of directors of the Columbus, O., section of the American Welding Society and is currently at work on handbook revision.

-cep-
NSF funds new center for welding

"ON CAMPUS" 11-13-80

A Center for Welding Research, the first of its kind in the country, has been established at Ohio State as part of a National Science Foundation program to advance technology in fields considered essential to this country's welfare.

The new center is funded through a five-year grant under the NSF program, which is designed to foster university-industry interaction by uniting the research strengths of universities with industry requirements. The first year's grant is for $264,582; the five-year total is planned for $1,064,582, the NSF announced.

The Ohio State center is headed by Professor Roy B. McCauley, former chairman of the Department of Welding Engineering.

The NSF grant was one of 111 September research contracts and grants totaling $6,388,492 reported to the University's Board of Trustees on Nov. 7.

Welding is a "vital fabrication process and is associated with a large part of this country's gross national product," McCauley said.

"Studies, conferences and addresses by leaders in the American welding field have shown that many nations are more active in welding research than the United States," he said. "In many cases, progress in these countries is marked by aggressive research and development at major centers and institutes."

The NSF program, in its Directorate for Engineering and Applied Science, establishes centers which then operate with increasing industry support. Several private companies are contributing $30,000 each per year to support the effort to maintain the welding center. Among these are Bishopric, Inc.; Caterpillar Tractor, GATX, General Electric, General Motors, IBM and Westinghouse Electric.

Plans call for the NSF to phase out of the effort as industry increases its support during the initial five-year period. The result will be a welding research program totally supported by industry, the NSF announcement said.

Other research contracts and grants reported to the trustees included three agreements from the U.S. Department of Education:

- $359,286 to fund the Educational Resources Information Center (ERIC) Clearinghouse on Adult, Career, and Vocational Education, at the National Center for Research in Vocational Education.
- $330,291 to support the Academic Faculty of Exceptional Children in assisting state and local educational agencies in evaluating handicapped children and in developing educational programs for them in Ohio, Indiana, and Illinois.
- $186,082 to continue support of training in physical medicine and rehabilitation in the Department of Physical Medicine.
Engineering robot ‘does not compute;’
welds, paints instead

By Debbie Knuth

There is a new engineering student on OSU’s campus who can hold 100 pounds in his hand and reach 13 feet in the air and eight feet around him.

He has been known to take his welding tools and bend them or try to drive them into the cement floor of his work area when something goes wrong. Other students must stay out of his reach when working with him because of the force with which he is able to hit someone.

Cincinnati-Milacron, sporting a blue and yellow outfit, is a robot.

Dick Richardson, assistant professor of welding engineering, said the Cincinnati-Milacron T3 robot is not what people think he is.

He is not a walking robot with two arms, two legs, a body, a head, and a mechanical voice that says, “That does not compute.”

Rather, Cincinnati-Milacron is a steel structure resembling a gigantic human arm. He extends from a five-foot, steel base and when a tool is attached to his wrist, he has the dexterity of a human arm, Richardson said.

“The robot is distinguished from conventional machines in that it can reach and do complex motions. It’s human-like in its dexterity.”

“In the motions he makes, he looks like a human doing the job,” Richardson said.

Welding engineering students were introduced to the robot when the Cincinnati-Milacron Co. donated him to the university autumn quarter.

Cincinnati-Milacron made his public debut last week at an open house sponsored by the Department of Welding Engineering.

Cincinnati-Milacron is similar to robots being used in the industry to perform hazardous jobs such as painting and spot welding, Richardson said.

Students are learning to “teach” the robot to do various things just as robots in industry are taught. They must lead the robot through each step of a program they have written, then push the program button, Richardson said. The robot remembers everything.

There is an element of fear that the robot will not do what he was taught to, because of an error in programming, Richardson said.

“It’s a large machine and it’s a powerful machine,” he said. “It is possible to make an error in programming and have it result in an unexpected motion that can be violent.” But, there is an emergency stop button to prevent the robot from going too far, he said.

When there are no programming errors, the robot can do the work of a man. It does not work faster than a welder but works continuously with no sick days, vacations or breaks, increasing productivity, he said.

A robot takes persons out of less desirable, hazardous jobs — such as arc welding — and puts them into more desirable jobs, Richardson said.

The robot is programmed to do the same work repeatedly on the same area of each part. But the parts vary slightly, meaning the seams to be welded are no always in the same place. This causes the welds to be off, he said.

To solve this problem, the welding department is trying to find a way to give the robot the ability to “sense” the seam location with a TV camera system to help the robot do a better job, Richardson said.

The robot is on a three-year loan from the company. At the end of the three years, the company will either give or sell the robot to OSU, or replace it with another robot also to be on loan. Richardson said.
Welding research center is one of a kind

A new one-of-its-kind Center for Welding Research has been established at Ohio State University's College of Engineering.

Funded by a combination of federal grants from the National Science Foundation and matching monies from eight corporations, the center will do research useful to industry by linking its needs with the University.

Welding is associated with 40 percent of the gross national product, explains Roy B. McCauley, director of the new center and professor of welding engineering. Ohio State offers bachelor's and master's degrees in welding engineering in the only accredited degree programs in the United States.
A Cincinnati Millicron T3 Robot welds Script Ohlo for spectators at an open house sponsored by the Department of Welding Engineering. The robot is a recent addition to the department and represents contemporary innovations in the welding field.
Small computerized robot is capable of taking on large jobs

By Valerie Lynn Quillen
Lantern staff writer 2-17-83

The 4-foot-tall General Electric P5 robot sports a tan and an orange outfit and can lift 22 pounds.

Tim Metko, student chapter vice president of the American Welding Society, said the P5 robot takes up slightly more space than a person of average size. But its arm can reach more than six feet into the air.

This recent addition to Ohio State's campus exposes engineering students to robotic programming in welding operations, said Dick Richardson, assistant professor of welding engineering.

The General Electric P5 robot will be one of several displays in the 11th annual Welding Engineering Open House today, from 2-8 p.m. in the welding engineering laboratories at 190 W. 19th Ave.

The P5 is not what people may imagine it is, Richardson said. It is not a conventional walking, talking robot with two arms, two legs, or even a head.

Instead, P5 is an electrically driven, computer-controlled robot arm, Richardson said.

It resembles a human in its ability to simultaneously control five axis of motion similar to a swiveling waist, elbow, or shoulder. It also has two wrist motions that allow it to rotate its wrist and vertically move its hand, Richardson said.

Metko said, "The P5 robot has all the dexterity of a human arm to allow it access to those hard to reach locations that limit conventional machines."

Students can take courses to learn how to write programs and lead robots through a welding sequence for a particular object.

"General Electric P5 remembers everything it is taught and can repeat programmed movements within 0.008 of an inch," Metko said.

The robot was a gift from the General Electric Co. this quarter. Its operation is similar to that of a hydraulic robot donated to the welding engineering department two years ago by Cincinnati-Milacron.

Richardson said the two robots differ in that Cincinnati-Milacron, a hydraulically driven robot that can lift 100 pounds, is messier, noisier and much taller than the P5 robot.

"General Electric P5 operates electrically, which makes it smaller, neater in appearance and able to run smoothly without tubes," Richardson said.

"The popularity and desire of students to work with these robots is greater than the opportunity to provide robotic classes," said Karl F. Graff, chairman of the welding engineering department.

"The P5 robot is a nice user-friendly robot, meaning it is not too complicated for a student to become acquainted with its use," Graff said.

"We receive an average of approximately $100,000 in donated equipment from various companies each year," Graff said.

These donations give students real world application and exposure to operations popular in today's industry, Metko said.

The use of arc welding robots will become more common place in the years to come because of their ability to remove welding operators from a hazardous environment and put them in more desirable jobs that require less personal risk, Metko added.

But many mass welding jobs eventually will be filled by robots, Graff said. "These robots improve quality, increase productivity and reduce labor costs."

"Robots are able to inhabit places a human is unable to and they can work an eight-hour shift without taking a lunch break," said Marty Scott, a welding engineering student from Cleveland.

Bruce Madigan, a senior in Welding Engineering from Zanesville, operates the P5 robot in the Welding Engineering laboratory.
COLUMBUS, Ohio -- Ohio State University's Center for Welding Research has received $395,000 from 14 major industrial firms to continue sponsorship for the third year of research on problems in the welding industry.

The industrial sponsorship is supplemented by a $225,000 National Science Foundation grant for 1983.

Major areas of research currently underway include arc welding control, solid state welding and welding stress analysis, according to Roy B. McCauley, professor of welding engineering and center director.

The welding center award from the industrial firms, administered through the Engineering Experiment Station, was one of 107 January research agreements totaling some $8,754,980 reported Friday (3/4) to the university's Board of Trustees.

Largest was a $4,369,947 grant from the U.S. Department of Education for research in the National Center for Research in Vocational Education on problems and leadership development in vocational education.

Other large agreements:
-- $318,410 from the Ohio Office of Litter Control, for a litter control and recycling education program by the Ohio Cooperative Extension Service.
-- $252,780 from the National Institute of Education,
agreements -- 2

Washington, D.C., for continued support of the Educational Resources Information Center (ERIC) Clearinghouse on Science, Mathematics and Environmental Education, conducted by the academic faculty of science mathematics education.

-- $242,500 from the U.S. Department of Agriculture for continued support in the department of entomology of the North Central Region Special Studies Program for Pesticide Impact Assessment.

-- $220,523 from the National Cancer Institute, Bethesda, Md., for support of the Southwest Oncology Group by the departments of medicine, pathology, surgery and radiology.

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OSU only accredited welding school

Students weld bright future

By Janet Nickerson
Lantern staff writer 5-12-83

OSU’s Department of Welding Engineering is the only school in the United States accredited for that subject, according to William L. Green, assistant professor of welding engineering.

In comparison, the Soviet Union has forty such accredited schools because they have been successful in bringing together many different engineering concepts, Green said. He said such concepts as mechanical, civil, metal and electrical have been put together into one high level of schooling.

Only two of the eight professors in the department have welding engineering degrees—himself and William Baesslerak III, assistant professor, said Green.

OSU has the only accredited school in Welding Engineering because of budget problems.

During the 1960’s, welding engineering was not considered by the universities as “appropriately scientific”, said Karl F. Graff, professor and chairman of the Department of Welding Engineering, established in November of 1947.

“Now that there is a demand for welding, there isn’t any money or room to incorporate new programs. It’s a little late now,” said Graff.

There are three unaccredited schools for welding engineering in the United States, according to Graff. These schools include LeTourneau at Longview, Texas; Arizona State University at Tempe; and California Polytechnic State University at San Luis Obispo.

Students from all over the country have applied to OSU’s department and enrollment has increased significantly over the past ten years, said Green.

About 150 undergraduate and 30 graduate students are now enrolled. Over the past five to six years, the department has attracted women students in increasing numbers, Green said.

On the average, a person with a welding engineering degree can make about $25,000 in their first year. Green said a welding engineering degree puts the employee “in a different category right away.”

“It’s a promising field,” said Green. “The employment opportunities are exceptional because of a limited supply of welding engineers. The positions are increasing as industry increases.”

The unique background that a welding engineer student acquires at OSU brings him or her to the notice of employers, Green added.

“He (the student) is one of very few being hired at the same time as other engineers, and has better potential for advancement,” Green said.

Welding engineering employs a variety of processes, from laser and electrical conversion to heat. A student wanting to major in this area needs a thorough background in metallurgy (the science of metals), chemistry, physics and mathematics.

Earning a degree in welding engineering normally takes from 13 to 14 quarters to complete, said Green. This allows for practical experience such as summer internships with industries.

“We’ve had a couple of students go to England for their internships,” said Green. “We rely a considerable extent on alumni for placement.”

Industrial corporations aid welding center’s funding

5-12-83

A need for research in engineering prompted the creation of a special center, partially funded by major industrial corporations, said the chairman of the Department of Welding Engineering.

The Center for Welding Research, located in the Welding Engineering Building, 190 W. 19th Ave., was created to improve technology, said Karl F. Graff, who is also acting director for the center.

The center was established July 1, 1980, and is in the third year of a five-year funding program by the National Science Foundation. The foundation donated $1 million for research and financial assistance for graduate students in welding engineering.

Twelve industrial corporations are also funding the center, each donating $30,000 a year. Among these corporations are General Electric, Sohio, General Motors, Westinghouse, John Deere, Caterpillar, IBM and TRW.

The center is the base for “specific research projects defined both by faculty and industrial members,” said Graff.

Current projects deal with robotics, laser welding and non-destructive testing, which is the testing of items by ultrasonic waves, X-rays and electromagnetic processes to test these items for flaws in the materials without damaging the materials.

One project developed at the center and commercially marketed by General Electric is an arc-welding robot that can see and correct what it is working on.

The robot was invented by Richard W. Richardson, assistant professor of welding engineering. A solid-state camera is enclosed in the welding torch and is reflected in a mirror. This televised image of the weld is sent to the robot’s control computer so it can supervise and correct the weld.
Machine tool industry losing lead

By Robert Boyce  

Foreign competition is threatening the leadership of the American machine tool industry, warns the National Academy of Engineering, and an Ohio State engineer agrees.

But Hans Moltrecht, associate professor of industrial and systems engineering, differs with an NAE conclusion that technology in the United States sector of this basic industry has fallen "significantly below" the state of the art attained by leading international competitors.

"Although the machine tool industry stopped developing in this country in recent years because of lagging sales, I question whether it has yet lost its technological edge," says Moltrecht.

Machine tools are machines that cut, form and shape metal. Nearly every manufactured product in an industrialized society is either made by a machine tool or by a machine that was built by a machine tool.

The panel of authorities commissioned for the study by the National Academy of Engineering found that the American machine tool industry now claims only 8 percent of the world market, a decline from its leading 25 percent 20 years ago.

The panel also found that the United States now imports more machine tools than it exports and that the industry, in this country has fallen behind its foreign counterparts in computerized manufacturing and production technology.

Moltrecht, who has worked closely with the machine tool industry for about 40 years, including 20 years in the metal working industry, says Americans have to some extent abandoned the larger volume part of the machine tool market to the Japanese and instead have concentrated on smaller, specialized orders.

"Small machine tool companies have a distinct advantage — management can stay close to the product and follow all aspects of production and marketing," he says.

"On the other hand, the small company has the disadvantage of less capital to expand, modernize and keep abreast of engineering design and research." Moltrecht questions whether the industry needs to actively pursue high technology research as such, but he says it does need to carefully examine new developments in technology for selective application to machine tools and manufacturing systems.

One new technology is called the "flexible manufacturing system," or "FMS" — a computer-controlled, fully automatic production system designed to produce different parts having similar configuration and sizes, says Moltrecht.

"Some leading machine tool firms have been gobbled up by big companies in other industries, resulting in a loss of quality in their product, largely as a result of the remoteness of top management from the design of the product and the operation of the machine tool plant," says Moltrecht.

Lack of capitalization not only has hampered the machine tool industry's engineering and research, it has also slowed its plant modernization and its sales promotion, according to Moltrecht.

This economic pinch recently prompted the industry to ask for government support to maintain its leadership in the world market.

Moltrecht believes one solution would be closer ties between machine tool companies and universities.

"Universities could help the industry with basic research and the industry could in return supply universities with some machinery and on-the-job training for students," he says.
"Flexible" systems let metal industry specialize

By Robert Boyle 26 May 1983

The Department of Industrial and Systems Engineering is planning a University-industry center for a joint attack on some of industry's biggest manufacturing problems.

George L. Smith Jr., professor and chairperson, says the proposed center for the design and operation of flexible manufacturing systems could be established as early as autumn quarter, pending University approval.

The center would be structured like the Center for Welding Research in the Department of Welding Engineering but without the initial support of the National Science Foundation to get the operation under way, according to Smith.

"We anticipate some 20 industries pledging $30,000 annual support each, and sharing in research results," says Smith.

Smith's department recently held a workshop at which manufacturing-research executives from several industries spent the day "telling us the critical questions to be addressed."

On May 19 the department met with its alumni advisory committee to discuss ways to encourage industry participation.

Smith explains that most manufacturing problems today involve the need for flexible manufacturing — the ability to switch a production line from one specific product to another.

"Today, 75 percent of all metal items manufactured in this country are made in batches of 50 items or less, so much of the production should be set up on a flexible basis.

"Even the auto industry doesn't run a thousand identical units. Orders come in for five trucks of a certain kind, or seven trucks, and they must be built to individual specifications."

Smith says to be economically feasible, this type of manufacturing requires a rapid changeover between product runs and a minimum of inventory.

"FMS attacks all manufacturing costs, whereas automation attacks direct labor costs, which are only 12 percent of manufacturing costs. Since manufacturing costs comprise about 40 percent of the cost of batch-manufactured products, direct labor accounts for less than 5 percent of the total."

Smith explains that batch products are such items as car parts, bearings and printed circuit boards, whereas things like soap, gasoline or chemicals are continuously manufactured products.

Two problems industry representatives brought to the workshop's attention were the need to design machines that could hold different sized parts for processing, and a need for information on production alternatives when equipment breaks down.

"Even a flexible manufacturing system is ultimately controlled by a human operator who needs information to decide what to do if a machine needs repair or if production is stopped by a key worker not showing up," says Smith.

"At the University we have a diverse faculty for FMS research. The industrial and systems engineering faculty can be supplemented by experts from mechanical, electrical and welding engineering, and computer and information science.

"By combining their expertise with that which industry representatives bring to the center we could work on solutions to a great variety of problems at a level which a single company could not afford."

He says the new center would serve as a neutral ground where member industries could come to share problems and have them addressed by a neutral agency.

"We would provide objectivity and they would get immediate access to research while it was being done, in addition to royalty-free use of any patents developed at the center."

Smith adds that a University-industry relationship should speed up the technology transfer process — reducing the time from inception of a concept until its ultimate application in the consumer market.

There currently are 100 graduate students working with his department. Up to 15 of them could be working at the center at any time, in addition to five or six faculty members from his department alone.
Center breeds vital life into welding industry

By Robert Boyce

There's a sign in a small Kentucky community bearing the message: "If you lived here you'd be home now."

That's the message Karl Graff would like to spread about Ohio State Center for Welding Research, and industries belonging to the center have immediate access to its research developments.

The center's biggest achievement since it started two years ago is what Graff calls "a generic solution to a wide class of arc welding problems in sensory-based applications."

In other words, it is a vision system attached to a welding robot so it can "see" its work.

Patent application for the development is pending, and one corporate member of the center, General Electric, has applied the principle to a new robot welder, says Graff, professor and chairman of the welding engineering department.

"Members of the center are free to develop applications of such research results for their own companies, whereas outside firms must apply for a license," he says.

Thirty-five faculty, graduate students and staff researchers currently work at the center on eight basic problems in the multi-billion-dollar-a-year welding industry. The projects are chosen by the center's 12 member industries.

According to Graff, the pressures of short-term profit and loss operate to the disadvantage of basic research.

"Most private firms want to do basic research, but the fact of the matter is that very few have been able to do it in recent years because of economic conditions," he says.

"Many of the company laboratories that were established for research now are reverting to testing and development. They have become 'firefighters,' bent on solving immediate production problems."

In this climate, says Graff, "the center can provide the means for getting industry back again to a long-term philosophy of basic research which is essential to technological advancement."

Some industries draw their research budgets from operating divisions, according to Graff, and the corporate heads tell their research arm that it must become profit-making, too.

"The result has been that, in the past few years, research efforts by industry have been hurt, and some leading companies have fallen victim to competition, including some of industry's major research contributors of the past."

Graff says that new, highly successful, high-technology firms, such as those in robotics, risk falling by the wayside if they fail to come up with new developments.

He points out that welding is a major fabrication technology with applications in the production of everything from bridges, buildings, ships and automobiles to space vehicles and microcircuits.

"Some $2 billion a year is spent by industry for welding equipment and more than $20 billion for welding labor," says Graff.

"It's apparent that research and development is essential to such an industry that contributes to 30 percent of the gross national product in the form of fabricating manufactured goods."

The Center for Welding Research was begun in 1980 with a National Science Foundation startup grant of $1 million through Ohio State's department of welding engineering.

Since its establishment in 1947, the department has been the only accredited, degree-granting department in this field in the United States, and offers both the bachelor of science and graduate degrees in welding engineering.

Research center facilities include two laser welders, two robot welders, an inertia welder, friction welder, 20 arc welding systems, and equipment for ultrasonic welding and microbonding, as well as laboratories for testing, microprocessor control, materials processing and nondestructive evaluation.

A recent grant from the Department of Defense will add a $100,000 programmable thermo-mechanical testing system to center facilities.

Besides the robotic visual system, the center's research covers projects in welding design, laser welding, thick section welding, solidification of welds, welding discontinuity analysis, resistance welding control, and microjoining.
Robot to cut its own metal ribbon in ceremony

Open house will highlight new laser

By Valerie Lynn Quillen
Lantern staff writer

Lasers can be used for more than a light show.
Laserdyne 410, which is a new robot at the Department of Welding Engineering, can modify surfaces, process material, heat, melt and vaporize metal.

Charles E. Albright, professor of welding engineering, said, "The laser is just a big flashlight that works by focusing its light on small areas."

Laserdyne is not a conventional robot, it is a robot of sorts, Albright said.
The laser robot does not have arms, legs or a head.

Instead, it is a computer-controlled system where the laser works over a moving table, he said.

The robot operates so precisely that it could divide the tip of a human hair into 30 parts, he said.

"Another beauty of the laser is that it can be beamed to various locations without it spreading or losing its power," Albright said.

Randy K. Keller, student chapter vice chairman for the American Welding Society, said the laser robot will be the highlight of the department's 12th annual open house today, from 2-8 p.m. in the Welding Engineering Laboratories, 190 W. 19th Ave.

At 2 p.m. there will be a ribbon cutting ceremony where the laser will burn through a metal ribbon, he said.

Albright said if people expect a light show they may be disappointed.

"But, there will be interesting visual effects. Demonstrations of laser welding and the robot will be personalizing a few metal tags for key chains," he said.

Keller said another high spot of the show will feature robots performing arc welding to form replicas of script Ohio.

Arc welding is used to fuse two pieces of metal, he said.

There are two-year programs in welding, but OSU is the only four-year welding engineering department in the United States, he said.

Keller said there is a big difference between a welder who graduates from a technical school and a welding engineer who graduates from OSU.

"A welder learns how to weld, but a welding engineer learns why you weld in conjunction with learning how," he said.

The department wants people to realize welding engineering can boost industry, Keller said.

"We are trying to break away from our old stigma and emphasize the high technology of welding such as robots and lasers," he said.

The student chapter of the American Welding Society, which is sponsoring the open house, has invited Gov. Richard F. Celeste, Mayor Dana G. Rinehart, President Edward H. Jennings, and other university officials, but the entire campus is invited, Keller said.
Ph.D. program sought

By Beth Baldridge

Ohio State may be the first university in the country to offer a Ph.D. program in welding engineering.

The Council on Academic Affairs approved a proposal for the program last week. The program must also be approved by the University Senate, the Board of Trustees, and the Ohio Board of Regents before it can be established.

"We have the only welding engineering department in the United States," Karl Graff, chairman of the Department of Engineering, said. He said that OSU also has the only recognized bachelor's and master's degrees programs in that area.

"Given that basis, it seems logical that if a Ph.D. is offered in welding engineering, this is the likely place to have it," Graff said.

OSU's Department of Welding Engineering has been aiming toward a Ph.D. proposal for several years, Graff said. The department has been expanding and upgrading its faculty and facilities, he said.

Currently, there are nine faculty members, 140 undergraduates and 40 students in the master's program, he said.

If approved, Graff said he expects to have 12 to 15 students enrolled at the Ph.D. level.

The proposal states that three new faculty members and six new graduate courses are required for the new Ph.D. program.

Donald Glower, dean of the College of Engineering, said he thinks that the department can have a fine Ph.D. program with just the nine faculty members it currently has.

There is an industrial need for welding engineers, he said. The Ph.D. program would help students advance in welding engineering and enable them to get better jobs, Graff said.

Welding engineers work with automobiles, or help construct bridges, airplanes and spacecrafts, he said.

Graff said welding is a form of manufacturing, an industry that has declined over the past 20 to 30 years. Engineering went through a technical period and there was a strong emphasis on science and computers. Welding didn't have much appeal, he said.

In the past few years, there has been an increased interest in manufacturing, Graff said. Now that there is a need, most universities don't have the funds available for welding engineering programs.
COLUMBUS, Ohio -- The Ohio State University Board of Trustees Friday (10/2) authorized the university to participate in two new ventures under the Ohio Department of Development's Thomas Alva Edison Partnership Program.

Trustees authorized university membership in the Applied Information Technologies Research Center and the proposed Edison Welding Institute Inc. The trustees also authorized the president to appoint university representatives to serve on the organizations' governing boards.

The university president and the vice president for business and finance were authorized to negotiate the university's participation in the agreements with the Ohio Department of Development. The agreements will provide some $4.1 million in state matching funds for each organization.

Both organizations are designed as not-for-profit corporations in partnership with the business and industrial community and Ohio educational institutions. Their purpose is to "stimulate the development of new technologies that can be used by private sector organizations to improve existing products and create opportunities for pursuing new commercial products and ventures."
The Applied Information Technologies Research Center has been formed to conduct applied research and development in information technologies, including artificial intelligence, information processing, microelectronics, software and systems engineering, and telecommunications.

The Edison Welding Institute Inc. is being formed to conduct programs of research, development, applications, education, training, and technology transfer in the fields of welding and allied technologies that can be used by private sector organizations to improve existing products and create opportunities for pursuing new commercial products and ventures.

Creation of the new organizations was first announced last July 11 by Gov. Richard Celeste. Four other new organizations involving other state universities under the Edison Partnership Program were announced at the same time.

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University to receive $7 million for welding research

By Bill Boggess
Lantern staff writer

During the next five years, Ohio State will receive at least $7 million from the new Edison Welding Institute, for welding research done by faculty and graduate students.

Gov. Richard F. Celeste and Pres. Edward H. Jennings were among those who witnessed the signing Wednesday of the agreement that makes OSU part of the new international welding research organization.

The Edison Welding Institute, which will be located at OSU's new research park on Kinnear Road, is part of Celeste's Thomas Alva Edison Partnership Program designed to provide Ohio businesses with access to advanced technology and research.

The agreement is between the Edison Institute and The Welding Institute of England. It is a partnership arrangement that gives each organization access to the other's research and equipment.

The agreement was signed Wednesday by officials of each institute via satellite from the Fawcett Center for Tomorrow in London.

Celeste called The Welding Institute of England "the premier welding institute in the world."

Ron Reeve, executive director of the Edison Institute, said OSU's welding faculty will become part of the staff available to the institute.

He said the institute is now organizing and will begin operating in January.

Both Celeste and Reeve emphasized the importance of welding to Ohio's economy.

"About everything you can think of has some kind of welding involved in it," Reeve said.

All the big companies that have gotten involved in welding are located near Columbus, he said.

Reeve said the institute will help the industry become more productive and efficient in using welding technology.

Ohio provided $4.1 million for the institute. OSU and businesses matched the funds.

Battelle Memorial Institute joined OSU and The Welding Institute of England in becoming a founding member of the Edison Institute.

Reeve said undergraduates will have part-time job opportunities at the institute and graduate students will be able to do advanced research and will be exposed to a variety of ideas for theses.

Jennings said OSU is the only university in the nation to offer degrees in welding engineering.

He said the institute will benefit students by exposing them to the most advanced welding technology.

"The best welding technology in the world will be located in Columbus," he said.

Reeve said companies will pay an annual membership fee to the institute, which entitles them to consulting and any research at the institute.

He said under the agreement, about 100 members of The Welding Institute of England will automatically become members of the Edison Institute.

The English institute will temporarily send some of its personnel to OSU to help the Edison Institute get established.

Karl F. Graff, chairman of OSU's welding department, was in London to witness the signing of the agreement.
COLUMBUS, Ohio -- Ohio State University's Board of Trustees Friday (3/1) approved establishment of the nation's first Ph.D. program in welding engineering.

The new degree will be offered in the College of Engineering's department of welding engineering, established in 1947 as the only department of its kind in the country and offering both the bachelor's and master's degree.

The Ph.D. program was developed in response to the strong demand for welding engineers and the growing research needs in this complex field.

The department has undergone rapid development in recent years, adding new faculty and equipment, revising courses and expanding its continuing education program.

Graduate student enrollment has increased to over 40 this year and sponsored research now totals over $1.2 million annually, conducted in the Center for Welding Research, which is sponsored by the National Science Foundation and industry.

The department is a partner with Battelle Memorial Institute and the Welding Institute of England for the exchange of programs, staff and research in the Edison Welding Institute. Recently established under Ohio's Thomas Alva Edison Partnership (more)
Welding Ph.D. -- 2

Program, the Edison Welding Institute has more than 120 U.S. member companies.

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Contact: Karl Graff, (614) 422-6841
Welding engineers to get Ph.D. program

By Michael A. Kucera
Lantern staff writer

3-8-85

The nation's first doctorate program in welding engineering has been approved by the Board of Trustees.

OSU's department of welding engineering, which was established in 1947, is the only one in the nation, said Karl Graff, chairperson and professor of welding engineering.

William Green, assistant professor of welding engineering, said the new program would improve the department's ability to conduct high quality research as well as attract quality faculty and students.

Presently, there is a great demand for people with a doctorate in welding engineering, he said.

With rapid improvements in technology, people with doctorates in welding engineering are needed in welding manufacturing, government research laboratories and to teach. Graff said.

"All the aspects of advanced manufacturing, robots and computers are causing a tremendous demand for these types of people," Graff said.

"Currently, welding engineering lags behind certain other areas of manufacturing in terms of productivity. People with this type of a degree would help," he said.

William Baeslack, assistant professor of welding engineering said, "In the past, if a company wanted someone with a Ph.D. level in welding engineering, they would have to take a metallurgical or mechanical engineer and transform him into a welding engineer."

Baeslack said people interested in a doctorate in welding engineering could not pursue a course of study in the area and were forced to pursue a doctorate degree in another area of engineering.

"Hopefully, we'll be able to attract these types of students to OSU for a Ph.D. in welding engineering," he said.

The program was approved by the Board of Trustees at its March 1 meeting. It must now be approved by the Board of Regents before being implemented at OSU, and Graff said the department hopes to offer courses by next autumn.

Graff said course work for a doctorate in welding education would involve attention to automated welding systems (robots) and computer-assisted welding design as well as additional advanced course work and a dissertation.
OSU to start nation’s first doctoral welding program

By Pat Hampton
Dispatch Staff Reporter

The first American welding engineering doctoral program, the third in the world, was approved Friday for Ohio State University by the Ohio Board of Regents.

Increasing the number of people with doctorates who do research in welding is America’s first step toward catching up with Soviet and Japanese welding technology, said David W. Dickinson, an OSU welding engineering professor.

“About 10 years ago several surveys were done by the White House and the Department of Defense that showed the U.S. was lagging behind the rest of the world in welding technology,” he said.

"We need 15 to 20 (doctoral) graduates a year to fill the gap. We’re expecting to graduate five to eight a year at first. It’s not enough, but it’s a start.”

OSU’s department of welding engineering is about 40 years old and is the only accredited welding program in the United States.

It has about 40 students in its masters program and 150 undergraduate students, Dickinson said. The doctoral program is set to begin with the 1985-86 school year, he said.

Since 1978, the size of OSU’s welding engineering program has increased significantly — growing to 10 professors, from three. Nine members of the faculty have doctorates, and graduate student enrollment has risen 400 percent, he said.

OSU’s department is tied to both research and manufacturing, Dickinson said, as more than 50 percent of the welding in the United States is done within 300 miles of Columbus.

Six months ago, the department joined with the British Welding Institute in Cambridge, England, Battelle Memorial Institute and the state of Ohio to form the only welding research and development organization in the free world — the Thomas Alva Edison Welding Institute.
Board ratifies program for Ph.D in engineering

A new program offering a Ph.D. in welding engineering was approved for Ohio State Friday by the Ohio Board of Regents.

In an unusual move, the board gave final approval to the program without a probationary period normally required when offering a new degree, said William J. Napier, vice chancellor for external affairs.

Students receiving the degree will be prepared to work as faculty members in colleges of engineering and in supervisory positions in industry, according to a board memo.
Welding department

to sponsor open house

The Ohio State University Department of Welding Engineering, the only unit of its kind in the nation, will be demonstrating robotic welders and other advanced technology during a Feb. 20 open house at the campus laboratories, 190 W. 19th Ave. The open house, from 2 to 8 p.m., will include equipment demonstrations and a tour of the laboratories.
Welding engineering to show robotics, lasers in open house

By Ingrida Sautins
Lantern staff writer

A laser ribbon-cutting ceremony will kickoff the 14th annual Department of Welding Engineering's open house at 2 p.m. Thursday at the Welding Engineering Building, 190 W. 19th Ave.

James Colburn, a representative of Governor Richard F. Celeste and the Edison Welding Institute, will be on hand for the opening.

The open house is held to show faculty, staff, students and industries working displays of equipment used in the only accredited welding engineering department in the United States, said Timothy Lamantia, chairman of the open house, and a senior from Toronto, Ohio.

Students also have a chance to show companies who have donated machines to the department what they are doing with the equipment, said Martin Wilkerson, a junior from Louisville and junior class vice-chairman of the American Welding Society student chapter.

Seniors in welding will conduct tours every 15 minutes, and juniors will demonstrate the equipment, Wilkerson said.

People attending the open house will be able to visit the Center of Welding Research, located within the department. The center conducts research on trends and developments in welding engineering.

Representatives of the Edison Welding Institute, an affiliate of the Welding Institute of England, will be at the open house to answer questions, Lamantia said. The institute recently moved its headquarters to Columbus. It is partially funded by a $4.1 million appropriation granted to Ohio State, Battelle Memorial Institute and Edison by the governor, Lamantia said.

The equipment demonstrated includes the new, state-of-the-art vision-controlled welding robot, three other robotic devices, and lasers, Wilkerson said.
COLUMBUS, Ohio -- A new computer program to analyze the cause of train derailments has been developed by Ohio State University engineers.

Over the past few years, derailments have cost railroads more than any other kind of accident. Of the estimated $448 million that railroad accidents cost in 1978, derailments accounted for 80 percent, according to the Association of American Railroads (AAR).

The Federal Railroad Administration (FRA), one of the federal agencies monitoring railroads, has identified over 200 different causes for derailments.

The computer program is believed to be the first such expert system. It was compiled from responses to hundreds of questions which Ohio State investigators asked derailment experts about specific accidents.

"We have tried to capture all the knowledge of the gray-haired guys who investigate derailments," says Thomas H. Rockwell, referring to experienced railroad investigators. Rockwell is a professor of industrial and systems engineering at Ohio State.

If such a system were already in use it might have prevented accidents such as the recent derailment of a freight train near Miamisburg, Ohio, which led to a massive white phosphorus fire and
explosion, forcing the evacuation of thousands of nearby residents, says Rockwell.

"The whole idea behind the expert system is accident prevention. Any accident points up the need to get to the root cause so you don't have a repeat."

He emphasized that the system is not a statistical analysis. "What we did in developing this system was to get the best wisdom from the senior railroad investigators. The system now can be shared to bring new derailment investigators up to speed," he says.

"We can bring in a rookie and make him look like an expert right off the bat with this system, so we emphasize the training side of its application first. Later it might be used as a trackside aid."

Rockwell calls the system CADI, which stands for Computer-Aided Derailment Investigation.

"We tried to get the computer to act like the best of professional investigators." Although Rockwell doubts it will ever be possible to endow the computer with the insights of an experienced investigator, he believes it can come close.

Currently being reviewed by several major railroads, the program was developed for a master's thesis by John Hoag over one and a half years. It was funded by the AAR.

"We don't know yet what the railroads will want to do with it," says Rockwell. "They will probably be able to use it in training new investigators, and they might also apply it to solve some actual accident causes."

In any case, he says, the program constitutes a valuable pool
of knowledge which is at risk of being lost as older investigators retire.

According to Rockwell, railroads basically have three kinds of people who investigate derailments. "There is the man in the operations division concerned with the train crew; there is the track engineer looking at broken ties or rails, and there is the equipment man involved with axles and wheels."

Any accident involves complex interactions and investigators who are at the scene asking questions before any equipment is moved or before crewmen leave.

"Before they tear things off the track they hold the crew for debriefing," he says.

"Marks on the rails are important indicators of the type of derailment. Short marks suggest large lateral forces such as overspeeding on a curve. Long marks mean a wheel rides on top of the rail. A broken wheel hits the rail about every eight feet."

Any time a derailment involves hazardous material it is serious, Rockwell says.

The AAR reported that some 4 percent of train accidents from 1975 to 1981 resulted in damaged or derailed hazardous materials cars. And about 1 percent of the train accidents resulted in a release of hazardous materials.

The report shows that accidents involving derailment of cars carrying hazardous materials increased 31 percent from 1975 to 1978. Of the total of 447 such accidents in 1978, 126 involved a release of hazardous material, then declined by 42 percent to a total of 73 such occurrences in 1981.

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Computer program averts derailments

By Crystal Benzies
Lantern staff writer

A computer program to prevent and analyze the cause of train derailments has been developed by OSU engineers.

Thomas Rockwell, professor of industrial and systems engineering, hopes the program is the answer to derailment problems. He sees it as part of the trend in using computerized expert systems to diagnose all types of problems.

"This program was spawned by the program used in the medical community called Mycin," Rockwell said.

Mycin is a computer program in which a patient's symptoms are placed into a computer which makes conclusions about the illness.

Rockwell, one of the two program developers, said the program "is kind of like 20 questions, the computer asks questions about the accident until it is satisfied that it either knows the derailment cause or admits it can't figure out the cause from the information you've given it."

The system was designed to represent known causes of derailments and to allow the study of them, he said.

The program can also be used as a training aid if a training derailment investigator follows the logic the computer used to pinpoint a derailment cause.

The derailment program was adapted from Mycin, a medical computer that analyzes a patient's symptoms to determine an illness.

Rockwell and graduate student John Hogue compiled hundreds of answers from derailment experts about specific accidents to develop the program.

"What we are trying to do is take the wisdom of the best derailment investigators in the country," Rockwell said.

"Two things should always be done when trying to prevent accidents," Rockwell said. "You make sure you train your crews and maintain your track and equipment."

He said this preparation is not always enough and when an accident does occur, a railroad should make sure it doesn't happen again.

"When we have a serious accident, we have to find the cause, because it may be something critical that may happen again," Rockwell said.

When the cause can be found more quickly and more efficiently, the probability of preventing further accidents is increased, he said.

He said the program is still being evaluated and he is now sending the program to various railroads.

"Some are sending it back saying, 'You did a nice job but you forgot this cause,' and 'you didn't ask these questions,' so we're getting the railroads to look this (program) over to see if they can improve it, and see whether or not it's advantageous for them to use it."

The Association of American Railroads supported the program by providing funding for Hogue.
OSU engineers find

By Mary Jo Mostowy
Lantern staff writer

OSU engineers have developed a computer program that will help determine the cause of train derailments.

The Computer-Aided Derailment Investigation (CAD1) system was the result of derailment investigative experts giving details about specific train accidents.

A $20,000 grant from the Association of American Railroads helped fund the project.

The system helps derailment experts decide the cause of the accidents faster and also helps train new investigative officers.

"We tried to get the logic (that) railroad derailment officers used when they approached the scene of a derailment. The computer mimics the expert's opinion," said Thomas F. Rockwell, professor of industrial and systems engineering.

Determining the cause of a train derailment is a complicated process because there are over 200 possible causes for the accidents, said David Erickson, of the Public Utilities Commission of Ohio Railroad Freight Safety Division.

The three basic divisions of derailment causes are track failure, broken ties or rails, and equipment failure — usually with axles, wheels and crew failure, Rockwell said.

The computer uses the basic information found by the investigators and expands upon it to determine the causes of the derailment. For example, marks left on rails are important indicators of the type of force that caused the derailment. A short mark is caused by a strong, lateral force that drives the freight car off the track. Large marks indicate a gentle force has caused a wheel to ride on top of the rail, Rockwell said.

However, the system will not take the place of the derailment investigative officer, according to Rockwell.

"A computer can only do things we already know. If you come across a new cause for a derailment, the computer would never find the cause, but a human could use intuition to help explain the cause," he said.

Accidents involving freight trains carrying hazardous cargo are a major problem for railroads. Rockwell said if the system had been in use, it might have prevented such accidents as the recent freight train derailment near Miamisburg.

"Once you understand the cause, it's up to the railroad to put preventive measures in action to make sure these causes don't appear again," Rockwell said. "That's the whole purpose behind accident prevention."

The computer program is currently being tested by the Federal Railroad Administration Research Department.
Metal plates give strength
to wet joints

By Robert Boyce

The Department of Welding Engineering and Arcair Co. of Lancaster have teamed up to overcome a problem that has long plagued structures with underwater welds.

"Wet" welds made under water are inherently weaker than those made in the air. Consequently, the engineers have created a method in which part of the welding is done in the air. Also, the new design does not put the full weight of a structure on underwater joints.

Chon L. Tsai, associate professor of welding engineering, and graduate student Larry R. Zirker developed a design that cushions the stress on joints by welding a metal pad between two structural members. Formerly, the members would have been joined directly.

They compare it to the role of springs on an automobile, pointing out that driving a car without springs to cushion road shocks soon would break the car's axle.

"The new design principle can save up to 50 percent of current costs of underwater welding," says Tsai, who worked at Arcair some 15 years ago.

This concept can be applied to the assembly and repair of structures such as bridges, piers and offshore drilling platforms.

The concept was developed jointly and tested with funding by the Ohio Sea Grant Program through the University's Center for Lake Erie Area Research.

Tsai explains that a "wet" weld traditionally is weaker than a weld made in air because, among other factors, water quenches the weld quicker, thus reducing the time for hardening.

So, deep-water welding, where pressures are high, is done conventionally within air-filled enclosures built around the area to be joined. The assembly of such enclosures, however, is expensive and time-consuming, says Tsai.

"With the new design, a flexible intermediate connection pad - to be placed between the structural members to be joined - is welded outside the water," he explains. After all critical pieces are connected, the assembly is attached to the structure under water with wet welding.

Tsai compares the flexible weld concept to an auto bumper that absorbs most of the impact from a collision.

"A multi-layer pad design may be used for increased flexibility requirements. The energy dissipated in the connection pad before it reaches the welds made under water and the energy stress in the welds is minimized."

Tests have been conducted in the Arcair laboratories to demonstrate the effectiveness of the welds.

"We now believe we can fit a design to every problem," Tsai says.

Zirker, who returned to school after a career of teaching and welding in the oil fields of the Southwest, expects to earn his master's degree in welding engineering this June with research on the Arcair project.

A second phase of research will focus on the weld fatigue problem, or the life-span of a weld, says Zirker. "This concept will be tested in Lake Erie starting about September of this year."

Lance Soisson, Arcair manager of process development who works directly with Tsai and Zirker on the joint project, explains that safety for underwater welding is of the highest priority.

The underwater welder is relatively safe from electric shock if proper measures are taken," he says. "All underwater welders, and that includes those of us here at the plant, have at one time or another experienced some kind of mild shock, which points up the need for safety."

The diver's operation is monitored at all times by a tender who is in communication over an intercom and can hear the diver's breathing. He also controls the power to the diver's torch and turns it on only during actual welding or cutting.

The diver wears heavy insulated gloves and is careful to keep out of the path of the electric current while working. Before a dive, the welding team goes through an extensive checkout procedure of equipment. Direct current, rather than alternating current, is used, thus reducing the risk of shock.

Arcair's history goes back to World War II when a welding engineer at the Bremerton naval shipyard in Washington state hit upon a novel way to remove defective stainless steel welds in armor plate. He combined the arc and air in a single hand-held tool -- the first air carbon arc torch. It was patented in 1949.
Robotics study thrives on campus

By John McElfresh
Lantern staff writer

After 40 years, the Department of Welding Engineering remains unique.

The department, founded in 1947, has the only accredited welding engineering program in North America. This means an individual wishing to earn a bachelor's, master's, or doctorate degree in welding engineering, must attend Ohio State or study abroad.

"The fact that ours is the only accredited program offers a tremendous advantage to our graduates," said William L. Green, professor of welding engineering.

"In the job market, our engineers have no competition with graduates from other universities, which isn't the case in many other fields of study," he said.

Green said the high initial expenditure to purchase equipment is a major factor prohibiting other schools from starting a program like the one at Ohio State.

"For example, we have five industrial robots involved in welding projects at this time. The newest one cost approximately $200,000 to purchase and set up for operation," he said.

The robots used in the program are loaned to the university on a consignment basis, said Phillip K. Wadsworth, a graduate research associate in the department's robotics program.

"These are actual industrial robots, not toys designed for educational purposes," Wadsworth said.

Ohio State is the only university in the United States to offer as many industrial robots for training purposes, Wadsworth said. Very few schools have even one or two at their disposal.

The program operates on an annual budget of approximately $1 million, which is used to purchase materials used in research projects and to provide wages for graduate students who work on these projects.

"The interaction between industry and the university is very important and beneficial for both parties," Green said. "It allows our students to gain experience through hands-on training and the industry as a whole benefits, due to advancements in welding technology developed here at the university."

Ohio State is recognized as a leader in welding research, said Chris Anderson, of Hobart Robotics, a division of Hobart Brothers Welding, in Troy. He said the company is keeping tabs on some of the robotics work that is taking place at Ohio State.

Some current experiments involve operations in environments that are not usually associated with welding.

One experiment involves a technique to be used in the deep-sea that will allow a structure to flex instead of being so rigid it breaks when exposed to extreme stress.
Welding chairman to leave OSU post

By David Sours
Lantern staff writer

Karl F. Graff, chairman of the Department of Welding Engineering for eight years, will retire at the end of June to become the full-time executive director of the Edison Welding Institute, 1100 Kinneer Drive.

Edison Welding Institute is a nonprofit corporation that functions as an industrial research lab for private industry, Graff said. The institute uses the basic research of universities and applies it to research and development to directly help industry, he added.

Graff said the institute is housed in a building owned by Ohio State and has close ties with the university. A number of OSU students work at the institute.

Graff said he wants to maintain these close connections with the university.

The institute distributes research results to 165 companies throughout the country. The types of companies include producers of aerospace products, steel and automobiles.

William L. Green, professor of welding engineering who has been with the department since 1954, said one of the high points of Graff’s administration was the establishment of the Ph.D. program.

Graff said, “The quality level (required) to establish a Ph.D. program raised the quality of every part of the department’s program.”

He said one of the most important changes in the department was the establishment of the Center for Welding Research. The center was funded by the National Science Foundation in 1980 and caused increased enrollment in recent years, he said.

“Now the Department of Welding Engineering has the highest level of research funding per faculty member of the College of Engineering,” Graff said. He said the funding is greatest on an absolute dollar scale.

It’s a crummy building, but the equipment is excellent,” he said. “A task left undone as I move out is the fact that we don’t have a new building,” Graff said.

He said a proposed building is included on the university’s capital appropriations list and it stays on the list, the department should have a new building by 1991.

He said the new building will probably be very similar to present engineering buildings, except for slightly different electrical power requirements.

Graff does not take credit for the advancements made during his chairmanship. He said the role of a chairman is to create opportunities for faculty members and be supportive of their activities. “The faculty will take care of the job if given the right opportunities,” Graff said.

“I look at it very much like a racing shell. You've got people on the ears and then you've got some guy who gets to sit there and say ‘row hard!’ They (the faculty) are the ones that row hard,” he said.

Graff said he strongly believes this management style is the only way a university department can be successful.

He earned his bachelor's and master's degrees in engineering science at Purdue University and his doctorate in theoretical and applied mechanics at Cornell University.

Graff came to Ohio State as an assistant professor in the Department of Engineering Mechanics in 1964. He was chairman of that department from 1972 until 1979.

He was appointed chairman of the Department of Welding Engineering in 1979.

Even though his education and experience as a chairman was independent from welding engineering, he said it was beneficial for the department chairperson position.

“It gave me a perspective on what was necessary for the job, what we had to do to meet the level of requirements of quality at OSU, to bring the quality up,” said Graff.

“There was literally a rolling-up of one's sleeves aspect because . . . there was quite a backlog of accumulated and obsolete materials, junk and other things that had to be moved out of the building. There was a literal house cleaning,” he said.

Graff said the College of Engineering had to decide whether to “build the department or fold it because the number of faculty had gone down to three.”

“It was a serious situation. You either fold up a department under those circumstances or you make a commitment to rebuild it, but you can't go in between,” Graff said.

Karl Graff is leaving his position as chairman of the welding engineering department in June to become executive director of the Edison Welding Institute.

it was not my welding experience that made it happen. It's their (the faculty) drive that did it,” he said.

As he completes the last few weeks in term, Graff said he is optimistic about recruiting a new faculty member in the area of plastics composites. Avi Benetar, from the Massachusetts Institute of Technology.

“Being able to get him here when he could have gone to 500 other places in the U.S. (was something). I was pretty proud of it.”

“The key challenges in welding are the new materials. He's going to be the person who is going to take us into these new areas,” Graff said.

The department is becoming even more advanced than its counterparts around the country with the new non-destructive testing program, Graff said.

He said non-destructive testing allows a piece of equipment to be tested for a variety of characteristics without destroying it.

“I think the theme we've followed in the last few years is to move the whole field of welding into high-technology, whether it's robots, lasers, computers or non-destructive testing.”

“IT'd like to feel the new chairman has a job to do. The job ahead is still very large,” he said.
Roving robot

Adnan Qamar, a senior from Pakistan, scratches his head as Robert Adkins, a senior from Lancaster shows him how to move the arm of the robot welder in the Welding and Engineering Building. The lesson is part of the course work for Welding Engineering 656.
Open house reveals technology of engineering

By TODD A. SEDMAK
Lantern staff writer

Instead of a traditional snip of the scissors, the ribbon-cutting at the 16th annual Welding Engineering open house was done with the burning rays of a laser beam.

David W. Dickinson, chairman for the Department of Welding Engineering, said, "Welding engineering is not just arcs and sparks; welding engineering is not just the man with the mask and the torch — it's working with lasers, computers and robots."

The Department of Welding Engineering is celebrating its 40th anniversary. It is the only accredited welding engineering department in the country.

Anthony Anitomone, a senior from Mingo Junction, said, "All the equipment in the lab is donated and the companies want to see what we're doing with it. We want to stay on their good list."

One exhibit, the radiography lab, demonstrated the ability to evaluate welds using x-rays. The x-ray appears on a television monitor rather than on a piece of film.

Dickinson said radiography is used for the space shuttle and aerospace products. "You wouldn't use this to build a bridge."

He predicted that industry would be using radiography within three years. He provided an example of how radiography would assist industry.

"On the Alaskan pipeline, workers lost track of the x-ray photos of welds. With radiography, you examine the weld immediately."

"Industry says there is always time to do it a second time," Dickinson said. "In the Alaskan pipeline incident, they may have buried the pipe and moved 10 miles before realizing a problem. Then you may have to go back and plow the snow and dig up the pipe."

"The open house is a recruiting tool to prospective students," Dickinson said. More than 7,000 invitations were sent out to all Ohio high schools.

OSU student members of the American Welding Society performed all the demonstrations. Dickinson said, "The beauty is that high school students relate better with college students. They can't relate too well with us old guys."

Brian Finnigan, a senior from Indianapolis, demonstrates the Hobart Motoman welding robot. The Motoman is used commercially for mass production of carts on assembly lines.
GM, union ask OSU to study 'culture' inside Fisher Guide

By Ron Lietzke
Dispatch Business Reporter

Workplace relationships among 700 Fisher Guide employees will be scrutinized over the next three years as new production and team management techniques are implemented to increase productivity.

The Ohio State University, Fisher Guide Division of General Motors Corp. and United Auto Workers Local 969 have teamed up for a project aimed at "writing the book" on changes in the American workplace.

IN THE last two years, Fisher Guide has divided operations into four sections and is encouraging worker input to successfully increase productivity. But officials want to continue the process, to keep the plant world-competitive.

Business Unit 3, where approximately 700 workers make door locks for GM vehicles, has been selected for the studies.

On Jan. 4, GM, the UAW and OSU will sign a contract providing $500,000 from the company and $30,000 in union funds for wide-ranging investigations into what is being termed "culture in the workplace."

George L. Smith Jr., chairman of industrial and systems engineering at OSU, will administer the project.

"It already is a focus plant, where workers have developed a new relationship to the workplace," he said. "There is more participation, an emotional relationship.

The impact (of the studies) will be learning what takes place as a result of change in the workplace. The GM people are very interested in this."

IN ADDITION to business and industrial engineering, he said study proposals will be considered early next year from the university's full range of academics.

Plant Manager Harry Lambert approached OSU President Edward Jennings more than a year ago to utilize what he calls the university's vast research capabilities.

"We were exploring every possible means to get more competitive, primarily in the area of quality and cost," Lambert said. "We have a 40-year-old culture in our plant. ... We want to know who we are, where we are going."

Lambert, who came up with "cultural in the workplace" to encompass the scope of the project, said it will focus on creating a plant environment that encourages involvement, problem-solving and quality.

"THE BOOK really hasn't been written on this," he said. "We hope we are, in effect, writing a book with our kind of people and our kind of challenges. ... We also believe there have to be a lot of locations around the country in the same condition."

Fisher Guide will be GM's best manufacturing facility, predicted Don Deibel, president of UAW Local 969.

"In the last two years alone, you can see a lot of changes, getting people involved in making every-day decisions," he said.

George L. Smith Jr.

"Any time you deal with a great university like OSU, the prospects of changing things is very high."

The partnership also will benefit the university, said Simon Dinitz, OSU's advisory committee chairman for the project.

"It will create a place for graduate students to do research and test out (ideas) through cooperation with management and labor," he said. "It will be a place where we can study change in the workplace."
In it together

The relationship between workplace culture and productivity will be the focus of a three-year project planned by the Fisher Guide Division of General Motors Corp., The Ohio State University and United Automobile Workers Local 969. Yesterday, Robert Walker, UAW national administrative assistant, left, Edward H. Jennings, OSU president, center, and W. Blair Thompson, vice president and group executive of the automotive components group at GM, signed the $530,000 contract, which will involve research at the Columbus Fisher Guide plant.
Engineers design wet weld

OSU professor develops water welding project

By Kristin Sinding
Latern staff writer

Researchers from OSU’s Department of Welding Engineering have teamed up with the Arcair Company of Lancaster and developed a method for improving design and fabrication of underwater welding.

After more than three years of research, the department has designed, built and tested a flexible connection pad that will improve underwater wet weld durability.

These pad welds are used in the construction of offshore oil rigs, docks, dams and nuclear applications, said Jesse A. Grantham, graduate research associate in the welding department.

Chon L. Tsai, associate professor of chemistry, said underwater wet welds have problems that do not occur in welds produced out of water.

Tsai said a weld made in direct contact with water is brittle because the metal is immediately cooled by the surrounding water. Welds cannot withstand impact and therefore cannot endure a lot of stress.

“Even though an underwater wet weld is weak, as long as it’s never overstressed, the weld won’t fail,” he said.

Industry is interested in Tsai’s research, because a stronger wet weld would benefit underwater construction.

His research for improving the design and fabrication of wet welds began more than three years ago after his application to the Ohio and U.S. Sea Grant was approved. Sea Grants are given to universities located in states that border on an ocean or one of the Great Lakes.

The solution to the problem was the development of the flexible connection pad, said Tsai. Use of the pad takes the primary weld away from areas of high stress.

Tsai said the primary weld, located between a pipe and the pad, is made outside of water and is a strong weld. The pad is then welded to an underwater main pipe in areas of minimal stress.

There were four stages to the flexible connection pad project, Tsai said. The first two stages involved a computer rendered design and test of the pad, called the Finite Element Method.

The third stage of the project involved field testing.

Grantham and a team of divers and welders took the information, originally simulated from the Finite Element Method, to Stone Laboratory on Lake Erie, Grantham said.

After three days of doing field tests on the pad and the wet welds, he returned to Ohio State to compare his results with those produced on the computer.

The final stage of the project, involving the analysis and summarization of all the tests, should be completed by August, said Grantham. The project information will be published and made available to the offshore oil industry and the American Welding Society.

“The most valuable part of the experience was comparing the mechanical results of the field tests with those done in lab and verifying that the results were the same, meaning that the project was very successful,” said Grantham.

It was this underwater research program that lured Grantham from an consulting engineer position in the industry to Ohio State, he said.

Dickinson said underwater research has only been in existence for 10 years. The Department of Welding Engineering wants to continue underwater research and a proposal for improving an underwater electrode is in the works, he said. An electrode is the tool used for making the underwater welds.

In addition to underwater research, the department is offering a course in underwater engineering in the spring. The students will learn how to design and repair the wet welds and determine the proper conditions for underwater welding. This course is the only one of its kind offered in the United States.
Company invites studies of relationships at work

By Ruth Gerstner

It will take more than technology for American manufacturing plants to compete successfully in the world marketplace in the future. With that in mind, the management and union leaders at the Columbus plant of Fisher Guide Division of General Motors have invited Ohio State researchers to study human relationships in the manufacturing workplace.

On Jan. 4, President Jennings, GM Vice President W. Blair Thompson, and Bob Walker, representing the United Automobile Workers union, signed a three-year contract for a research partnership.

GM is providing $500,000 and the UAW is contributing $30,000 to fund a variety of research projects with the goal of improving production, product quality and working conditions at the local plant. Fisher Guide-Columbus employs about 2,500 workers and manufactures door frames, door locks, latches and aluminum moldings for the automotive industry. The research project will focus on the 700 employees who make door locks.

Ohio State researchers will study human relations issues, such as quality of life in the workplace, how people relate to each other as peers in unit production teams and as labor and management, human dimensions of technology, effects of management practices, and changes in employee behavior.

Plant manager Harry Lambert said, "Many of the scholars who have studied, researched and analyzed the reasons for success of world class manufacturers in the world marketplace are quick to point out that our competitors have cultivated a partnership among management, labor, government, academia, and the financial community with the single-minded objective of obtaining world leadership in everything they do."

Lambert, with the encouragement of Columbus Mayor Dana Rinehart, first approached Jennings over a year ago with a proposal for Ohio State to join in the work already underway to reorganize work at Fisher Guide.

Jennings said he was immediately enthusiastic about the opportunities offered by the partnership.

"This agreement is an important and unique example of what's possible when universities, businesses and government come together," the president said.

"There was vision in this decision to start such a program, and commitment in your willingness to allow University researchers to help you learn more about yourselves," he told the Fisher Guide workers and GM executives. "Vision and commitment to excellence are what built this country, its industries and its universities."

Ohio State researchers from any discipline are eligible to submit proposals for projects to the steering committee set up by the contract. The committee consists of two representatives from each of the signatory parties.

Simon Dinitz, professor of sociology, and Howard Gauthier, associate provost, represented the University in establishing the research contract and will serve on the steering committee. George L. Smith Jr., chairperson of industrial and systems engineering, is the program's administrator.

"We are trying to improve the atmosphere of the workplace to make it a more congenial place so people feel comfortable, feel they have a greater stake in it, and do not permit themselves the adversarial relationships that have characterized manufacturing in the United States for so long a period of time," Dinitz said.
ASTRONAUT TO SPEAK AT WELDING ENGINEERING EVENT

COLUMBUS -- Astronaut Jerry L. Ross will cut the ribbon with a high power laser for the 17th annual open house of The Ohio State University Department of Welding Engineering Feb. 23.

A lieutenant colonel in the Air Force, Ross was mission specialist on last November's military space shuttle flight.

The open house, sponsored by welding engineering students in the Welding Engineering Building, 190 W. 19th Ave., is aimed at encouraging high school students to enroll in welding engineering at Ohio State. However, the public is invited to attend as well.

The Ohio State students will demonstrate different welding procedures and answer visitors' questions at various workstations in the laboratory.

Ross will discuss missions of the National Aeronautics and Space Administration in a public address at noon in 100 Ives Hall, 2073 Neil Ave. In his presentation he will review progress of the space agency and project future missions.

At 2:30 p.m. in 214 Welding Engineering, he will conduct a roundtable for research faculty and graduate students interested in space construction and show a NASA film on space exploration and colonization. The roundtable will explore research ideas and

- more -
potential links between the College of Engineering and NASA's Astronaut Office.

The department's high power laser will be demonstrated at the open house to show how it is used to investigate welding procedures on many high performance materials for use in aerospace. It has also been used for some preliminary studies on the fusion of lunar rocks.

According to David W. Dickinson, chairperson of the welding engineering department, other open house demonstrations will cover robotic arc welding, seeing eye robots, inertia welding, computer-aided design, resistance welding, welding of plastics and composites and nondestructive evaluation.

Ohio State offered the first undergraduate program in welding engineering in the nation and has the only academic department offering a doctoral program in the subject.

Contact: David W. Dickinson, (614) 292-6841
Written by Robert Boyce (B203)

NOTE TO EDITORS: Information about opportunities to interview Ross individually will be provided about one week in advance of his visit.
Scissors eliminated, laser used to cut ribbon at annual ceremony

By Tomoko Kotaka
Lantern staff writer

Astronaut Jerry L. Ross performed the ribbon-cutting ceremonies Thursday morning at the 17th Annual Welding Engineering open house.

But he didn’t bring a pair of scissors. Instead, Ross used a carbon dioxide-powered laser.

Ross, Mission Specialist for the November 1986 shuttle expedition, is also chairman of the Astronaut Science Support Group. The group’s major focus is studying the feasability of space construction and repair.

Ross, a native of Crown Point, Ind., said he knew he wanted to be an astronaut early in life. When he was in the fourth grade he made model rockets, skipped school to watch space launches on television and kept scrapbooks about space exploration.

David W. Dickinson, chairman of the Department of Welding Engineering, said, “I specifically chose Ross to host the open house because the department he heads and the welding engineering department both have a commitment to exploring the possibilities of space construction.”

Ross participated in two, six-hour spacewalks demonstrating space station construction techniques. He was also on the 23rd and 27th shuttle flights and has made 108 orbits around the Earth.

Dickinson said there is a need for advancements in space construction because of size and space limitations for items being transported into space. Welding is a reliable construction technique, Dickinson said.

Dickinson is currently researching and translating Russian texts with Stavislov L. Rohklin, an associate professor, and Kevin Watson, a graduate student.

Ross said although the explosion of the Challenger in January 1986 kept the program from flying for three years, there are many new developments to be launched in the future.

Ross said three important satellites will be launched this year. One will go to Venus, another to Jupiter and the third will be a space telescope.

“I think (the telescope) will be the most spectacular satellite we have ever launched,” Ross said. “It will give us an opportunity for the first time ever to see what many people believe to be the edge of the universe.”

Ross said NASA has a program called “Payload Specialist” which involves the use of people on a one-time space shuttle mission. These people have additional knowledge on a given experiment or piece of equipment, and use the experience and data they have gained to further their work on Earth.

He added there is a definite possibility a researcher from Ohio State may go up to a space center in the future.

“I’m not sure we’re to that stage yet,” Ross said. “But it’s certainly not something beyond the realm of possibility.

“We have a lot of folks (who are) graduates from other Big Ten schools that have flown or are preparing to fly in space.”

In the space program, Ross said there are about 90 to 95 people in the astronaut office who are in “training status” and preparing to fly. He said about 80 people are ready to be assigned missions right now.
Faculty studies productivity problems

By Traci Miller
Lantern staff writer

OSU faculty members were asked to submit their suggestions at a meeting Friday concerning research never before conducted at a university.

The purpose of the research is to study, review, examine, and perform research involving problems of productivity in the industrial workplace.

Howard Gauthier, associate provost for academic affairs, said the cooperative research project that joins Ohio State, GM and UAW as partners in research could set a precedent for the university's involvement in similar projects.

"The agreement is one we're quite proud of because it's unique. We (Ohio State) are the first to approach the problem of improving productivity by using the human element," he said.

The money for research, $530,000, was donated by the Columbus division of General Motors and a Columbus chapter of the United Auto Workers union.

GM and UAW were interested in conducting research on human relations issues vital to the future competitiveness of the plant, he said.

As soon as the faculty researchers submit their proposals, and are accepted, the actual studies will be underway, Gauthier said.

Researchers will focus on one section of the Fisher Guide manufacturing plant. Research on this section, business unit 3, where GM door-latches are made, will later be expanded to the rest of the plant.

Jerry Seiter, superintendent of the section, said, "We want to study the industrial culture, find out how people feel, try to get them involved, and then we'll look into what we can do differently to make their working environment better."

The research will focus on issues such as management-worker relations, workplace environment, changes in employee behavior and engineering questions.

John Bendekovic, associate professor in social work, said this agreement is important because it shows American industry is beginning to look at the workers' needs.

Friday's meeting was the first in a series of meetings to take place over the course of the three-year project, said George L. Smith, Jr., chairman of industrial and systems engineering and the project's executive director.

"The major objective of the meeting is to see how many people show up, to find out who is interested and try to get a sense of where they want to go with it," he said.

A steering committee, made up of two representatives from each of the three groups, would then take a look at all of the suggested proposals and decide which would be the best, Smith said.

He said he does not know how many of the proposals the committee will choose. The money will then be divided up and distributed to the chosen faculty members.
Just how far will space program go?

By Robert Gelchion

Imagine a Buckeye in orbit.

It could happen someday, according to astronaut Jerry Ross. After all, research and work being done at Ohio State may make it a necessity.

The Department of Welding Engineering is the only one of its type in the country and faculty here are examining space construction techniques. That knowledge might one day require that a researcher ride the shuttle, lending expertise as a payload specialist.

Ross’s visit to Ohio State Feb. 23 was part of a broad search to explore the best and most efficient way to construct America’s space station and other facilities in orbit. The station is scheduled for construction in the mid-1990s.

Ross, a veteran of two space shuttle flights and two space walks, attended the Department of Welding Engineering’s open house. “We at NASA are trying to understand what role welding might play in future space assemblies,” Ross said. “It probably won’t be used to build this space station, but we will use welding to make repairs and to build other structures.”

The department already has proposed several experiments to NASA for inclusion on future shuttle missions. This research is being aided by private industry, including Rocketdyne Corporation and McDonnell Douglas.

The space shuttle will be used to transport materials for the station into orbit. It will be up to astronauts to assemble the station.

The shuttle originally had been envisioned as a means to an end. But as a progression of presidents has declined to make firm space policy, the shuttle became an end in itself, Ross said.

With President Bush’s recent commitment to build a space station, America slowly may be moving toward some concrete goals in space exploration again.

“These national goals have to come from the top,” Ross said. “We have to lay the groundwork for some new commitments. We’ve got several commissions looking at it and there’s been some good homework done.”

But the shuttle, which had been sidelined by the Challenger accident in 1986, is struggling to meet a regular schedule. As the vehicle to ferry space station components into orbit, the shuttle is crucial to the project.

The shuttle has flown only twice in five months. “This system is never going to become a routine thing to fly,” Ross said. “We are going to try to do our best to keep it safe.”

As for Ross, he is hoping to get a chance to go into space again next year. He flew in November 1985 aboard Atlantis and took two space walks on that flight, testing construction methods in space. In November 1988, he flew on a classified military flight, again aboard Atlantis.

His current work focuses on the space station, the United States’ next great goal in space.

Ross, a graduate of Purdue University, said he has dreamed of going into space since the fourth grade. He wants the space program to go forward so others can, as he himself experienced on his spacewalks, get a “faceplate full of Earth.”
Welding sparks job offers

By Patricia Mroczek

For some people, the word "welding" brings to mind black smoke and white sparks. For graduates of Ohio State's welding engineering program, however, the term means high-paying jobs.

A bachelor's degree in welding engineering is worth just over $32,000 a year in the job market today—the highest starting salary among all engineering graduates. A master's degree is worth $36,000 annually, and a doctorate even more.

That's because Ohio State has cornered the market in welding engineering education, said David Dickinson, chair of the Department of Welding Engineering.

Ohio State is the only American university that grants degrees in welding engineering. "It's a very costly program for a college to get into," Dickinson said.

"When the program was founded in 1946, companies that manufactured equipment were looking for a department to train engineers. We were able to get equipment donations. We probably took the market away from all the other colleges," Dickinson said. "The exclusiveness paid off. Our students generally have more than one job offer when they graduate. They get to pick and choose from jobs all over the country or even the world."

Graduates are hired by a variety of industries, especially aerospace, power generation, petrochemical, construction, and shipbuilding. They work in design, procedure development, new equipment manufacturing, and metallurgical and materials sciences.

The department has 180 undergraduate and 75 graduate students and has room for a few more students, Dickinson said. About 30 percent of the enrollment is made up of international students.

Undergraduate students generally enter the program during their sophomore year and initially study math, calculus, physics, and chemistry. "The 'hands on' portion of the program begins with manual welding lessons so students can experience the practical application of welding," Dickinson said.

Students learn to program industrial robots before moving to advanced studies in four specialized areas: materials selection, design, process, and nondestructive evaluation.

Materials selection deals with technical knowledge of metals, plastics, ceramics, and high-tech materials. The study of design teaches strength qualities, fatigue resistance, and fracture properties of various materials.

Process involves the use of arc welding, lasers, electron beams, robots, friction, or ultrasound to bond materials together.

Nondestructive evaluation "makes sure you've done a good job," Dickinson said. It evaluates work without destroying or altering the sample by using ultrasound, X-rays, and holography (the use of lasers to produce three-dimensional images).

Dickinson said students benefit from the department's extensive collection of equipment.

"We have virtually every manufacturer's equipment represented here. I don't know of any place in the country that has that kind of diversity."

Dave Grewell, a senior from Lafayette, welds polystyrene samples on ultrasonic welding equipment at Edison Welding Institute.
THE LIFTOFF OF the space shuttle "Atlantis," along with the seven million pounds of thrust generated by its engines, gave Jerry L. Ross "a real kick in the pants." It also provided one of the most memorable moments of his career as an astronaut.

Watching earth from space was hard to describe and another highlight of Ross' two shuttle missions for the National Aeronautics and Space Administration, he said.

"It was amazing to get out of the shuttle for my space walk and see the earth some 200 miles below," said Ross, an Air Force Lt. Colonel. "The view was extraordinary—like seeing the prettiest rainbows and pictures from your vacations rolled into one."

Dissatisfied with simply strolling through space, however, Ross and a fellow astronaut built a truss shaped like an "inverted tetrahedron" during his 1985 shuttle mission, he said. Tethered to the shuttle and clad in space suits, the men put the structure together in about six hours by mechanically joining its components. "We wanted to learn what it really means to build something in space."

Ross, a mission specialist, also operated the shuttle's mechanical arm, conducted scientific experiments, and deployed satellites during the flight.

He made his comments during a recent open house held for the Ohio State department of welding engineering. The event attracted more than 5,000 high school students, industry representatives, and members of the public. Ross cut the ribbon opening the event with a high-power laser used to investigate welding procedures for high-performance aerospace materials.

"Working in a space suit is like trying to work inside a balloon and is really tiring, especially to the hands and fingers," he said. "I felt like I'd been in a hard summer football practice after we completed the truss."

As a result of Ross' mission four years ago, NASA changed its plans concerning the space station it wants to build in 1995, he said. Initially, the space agency hoped to take a "deployable" space station into orbit over the earth in the bay of the shuttle.

Upon reaching orbit, the shuttle would open its bay and the station would "spring out like a jack-in-the-box." But potentially serious technical problems caused NASA to drop the scheme.

Instead the agency will build the space station by manual assembly and save itself "several hundred million dollars," according to Ross, who has a master degree in mechanical engineering.

Ross said he and welding engineering chairperson Dr. David W. Dickinson have been in touch over the past two years to better understand the role of the discipline in future space construction projects. Although welding will not be used to build the NASA space station, the technology will be important for making equipment repairs and fabricating other structures in space, he said.

Ross and Dickinson also conducted a special roundtable for faculty, seniors, and graduate students to develop research ideas and a connection between the department and NASA's Astronaut Office. Dickinson has submitted a proposal to NASA to develop a center for welding in space which would develop new welding and bonding processes and procedures, he said. The center would help answer key questions such
—helps welding engineers stage open house

He also gives input as an astronaut to the people who design the equipment he uses in space, helping them do a better job.

Turning his thoughts to other matters, Ross said NASA has regained its confidence since the space shuttle "Challenger" blew up a few years ago, killing several astronauts.

"We feel good because the last two shuttle flights were successful," he said. "This year NASA will launch three scientific satellites, including one containing a space telescope which can see to the edge of the universe."

Because the shuttle is so complex, it will never be "routine" vehicle to fly, but NASA will make sure it stays as safe as possible, Ross said. The space agency recently discovered three pumps on the shuttle that didn't work properly and replaced them for the next flight, he added.

as how the solidification morphology of a weld is affected by the weightlessness and vacuum of space, he added.

"A firm recently has developed an arc welding process that produces good welds in a vacuum chamber," Dickinson said. "We would like to have a large vacuum chamber here to perform similar experiments."

Dickinson's department is currently interviewing sophomores who will be taught how to weld adequately and then learn how to do it while wearing "mock-up" space suits which will limit their maneuverability, he said. This research will help teach astronauts how to weld effectively and make repairs during long voyages in space.

Ross, who hopes to fly again in the shuttle, spends much of his time helping NASA plan for the space station. He also wants to develop a higher pressure suit that an astronaut can put on and immediately enter space without going through lengthy, elaborate preparations.

Visitors of all ages show interest in welding
OSU, UAW, GM unite

Ohio State researches auto workers' environment

By Megan Markey
Lantern campus reporter

Ohio State, General Motors and the United Automobile Workers Union have joined forces to improve workers' experiences, services and products at GM's Inland Fisher Guide Division in Columbus.

Starting next year, an Ohio State research team will focus on working relationships among the 700 employees of GM's door latch unit.

"Our goal is to understand the dynamics of management-labor relations, then observe changing dynamics as the corporate culture changes, and finally participate in the change process in a way that will allow GM to be more competitive and effective," said George L. Smith Jr., executive project director and chairman of the OSU department of Industrial and Systems Engineering.

The door latch unit will begin manufacturing a new type of vehicle door latch later this year. This door latch is designed to capture a worldwide market, Smith said.

He said in 1990 new tools and equipment will be brought into the GM plant and there will be a significant change in how GM does business within itself.

"There's going to be an increase in the amount of employee participation," Smith said.

Some employees are very enthusiastic about the changes, others are threatened by the change because they aren't sure of the situation, he said.

Jerry Seiter, a superintendent of the door latch unit, said he hopes OSU's research will help to create an environment where all employees feel part of the GM team.

"We want employees to realize that the success or failure of the company depends on them. Employees need to feel as though they have input on solving problems," Seiter said.

With OSU's assistance, GM can begin to understand employees, especially those who are not sure about getting involved in the decision-making process, Seiter said.

Don Deibel, a president of UAW, is one of six members that will approve or disapprove the ideas OSU researchers come up with.

"So far the reports from OSU seem encouraging but we are only just starting," Deibel said.

In the next three to four months the local division is expecting many changes to take place, he said.

Deibel said he hopes to see various problems identified in order to make the plant better and more competitive.

"Most people in the world feel better and do a better job when they get a chance to be a part of the company's decision-making process," Deibel said.

The research idea began last year when Harry Lambert, manager of the plant, asked OSU President Edward H. Jennings if the university would be willing to do a study of the plant's corporate culture in order to improve competitiveness.

Jennings was very enthusiastic about the idea of the university cooperating with industry research, Smith said.

Lambert knew the technology at the local division that needed to be changed, but at the same time corporate culture needed to be change.

Smith said by joining all three of these very large organizations the results will benefit everyone involved.
Quality at risk
Will Ohio scholars make mark elsewhere?

Mark Harper, 33, is a perfect example of what is right with higher education in this state.
Harper was one of the three college students in the nation selected as outstanding young inventors in an annual BF Goodrich program.
A 1989 graduate of Ohio State University who soon will earn a doctorate there, Harper will be traveling to the University of

CON'T FROM PAGE 2

New South Wales in Sydney, Australia, on a Fulbright Scholarship to do additional research for a year.

OSU shares the honor with Harper, because another student from its campus also was selected last year by the BF Goodrich Collegiate Inventors Program.
Harper said he came to Columbus because of the university's nationally recognized welding engineering program, although he switched into metallurgical engineering later.

He is waiting for a patent on his invention, a process for depositing chromium and silicon as a diffusion coating on steels to improve their resistance to corrosion.

When Gordon Gee took over as president of OSU in 1990, he vowed to push academics and recruit promising scholars. He made remarkable progress, pushing the university in one year from 79th to ninth in the nation in the number of National Merit Scholars enrolled as freshman.

Unfortunately in April, undoubtedly as a consequence of impending cuts in state funding, OSU decided it would have to limit full-ride scholarships for National Merit Scholars coming in as freshmen in the fall.

There are 122 finalists in the program who have indicated the university as their first choice: 102 enrolled last year. In addition, about 160 high-school valedictorians and 380 University Scholars are headed to OSU in the fall.

The university is attracting high achievers, but the ability of it and other state-supported post-secondary schools to continue to provide for the best and the brightest is being threatened by the budget impasse in the Statehouse.

The governor has targeted state schools for more than their fair share of cuts, as he and the legislature failed to agree on how to raise additional revenues.

The state's priorities are horribly out of whack when it can't provide the money to help its fine colleges nurture the young people who hold the promise of becoming society's most productive citizens.

Truly, education of self-starters like Harper is the key to keeping this nation's economy healthy and growing.
Robo arm

Keith Skiddle, a senior welding engineering major from Amherst, Mass., shows Todd Eppert, a senior industrial and systems engineering major from Cincinnati, how to program the robotic arm to weld a piece of metal for welding engineering 656 in the Welding Engineering Building.
Wet and wild welding world will be wooed

By Jennifer Yance
Lantern staff writer

The Ohio Underwater Welding Center has asked the state to give $50,000 to fund the First International Underwater Welding Olympics.

The competition, which will be held at Battelle Memorial Institute in Columbus, will be between 12 teams. The teams would be part of a welding conference, said Chon Tsai, Ohio State professor of industrial welding and assistance engineering and the director of the welding center.

Nine faculty members from the CSU departments of welding and engineering constitute the center and work to make resources available to those who need underwater welding information, Tsai said.

The countries expected to be represented in the competition are the United States, Germany, Japan and England.

An exact date has not been scheduled, Tsai said.

“Creating an international event like this takes a remarkable amount of planning and that is why we are in the process of developing an international survey from which we will decide that most appropriate time to host the event,” he said.

The center is also asking for an endorsement by Ohio Governor George Voinovich.

The competition will be held in a large diving pool at Battelle and will be open to the public, Tsai said.

“A video camera will tape the underwater competition which will be shown to the audience on a large screen,” he said. “The teams will test each of the electrodes that they, the companies, have developed for underwater welding.”

The development of electrodes for “wet welding” has many benefits, Tsai said.

“Wet welding is more flexible and economical than dry welding,” he said. “The only problem with wet welding is that metal can become brittle quickly, as it cools rapidly in the water.”

The trick is “to make effective and efficient wet welds,” Tsai said.

The Underwater Welding Center helps identify markets, provide technical papers and publish materials for member companies, he said.

The center, which was started 2 1/2 years ago, was established to disseminate new underwater welding technology to industrial users, Tsai said.

The center receives funding through member companies, including two international companies, Tsai said.

Electrodes designed at the center have been used in a project to help the U.S. Navy National Coastal Resources Institute, Tsai said.

The OSU electrodes allow welders to make immediate repairs to naval ships, said Bill Bruce, principal research engineer in materials at the Edison Welding Institute.

Edison Welding operates the Navy Joining Center, which administers contracts for improving welding procedures for the Navy, Bruce said.

The electrodes developed enable the ships to continue their work until they can be dry-docked and complete replacements can be made, said Bruce, who helped with the technical oversight of the project.

The project saves both time and costs, he said.
INTRODUCTION

The Industrial Engineering Dept. began in 1925. The name was changed to Industrial and Systems Engineering in 1973. Later in 1995 the name was changed again to Industrial, Welding and Systems Engineering.

Any attempt to write a history of the dept. has many limitations. Historical information is sparse and perceptions are based on limited experiences. What one person sees as memorable events might not be the same as others. Not all might agree on memorable personalities. This history might best be viewed as a mechanism to invite reaction from other IE faculty and students and thus be an evolving document. There may also be archival documents around to enrich this history, especially the early years. Still, it seems important to catch history, as we know it now. Much of what follows comes from my experiences covering a period from 1951 until my retirement in 1988 (even though I continued to volunteer teach for another seven years and play racquetball with faculty today in the year 2000). I have also kept an annual newsletter to my former grad that cover the last 37 years. This newsletter includes departmental events, college news and university highlights. In addition, the author had interviews with Al Bishop, Dan Howland, Clarence James, Bill Morris, Don Moore, Don Kibbey and Frank Geyer after their retirement where I recorded their recollections. Jack Neuhardt also added three pages of his memories. More interviews are in the works.

The history is arbitrarily broken into decades with the exception being the formative years covering the inception of the dept in 1925 until 1950. Here there is little data, but we were fortunate to hear Frank Geyer’s memories as he entered the IE program in 1931 and to draw upon Don Moore’s experiences which began in 1941.

THE FORMATIVE YEARS—-1925—1950

The Dept began in 1925 under the leadership of its Chairman, John Younger who was formerly Chief Engineer at Pierce Arrow. He wanted to be addressed as “Chief”. Letterhead from 1933 revealed Professor Younger, Asst. Prof. O.D. Rickley and Instructors Denman, PatternMaking; Schneider, Foundry; Faust, Forging; Morrison, Machine Work, Paul Lehoczky, Production Control and Prof Emeritus W.A. Knight. Initial emphasis was on Mechanical Arts with courses on filing and scraping, machining (the shop had a central pulley system for its power which was converted to motor power in 1947) pattern making, casting, forging and welding. Production Control with economic lot sizes appears to be the first emphasis on modeling processes.
Geyer's fee card of fall 1930 shows chemistry, engineering drawing, gym and a cost of $46.00. Math classes met at 7AM. The OSU Glider Club was housed above IE in the old brick building on Woodruff. Prof Edwin Stanton joined the Dept. in 1945 and initiated the first chapter of the AIIE in 1948. Being a Col. in the Army, he preferred to be addressed as "Colonel". Lehoczky being the first Ph.D. on the faculty, liked to be called "Doc". He became Chair in 1944 and fired Stanton in the late 40's. Moore recalls an emphasis on scientific management (ala Fredrick Taylor) in the 40's. The faculty in the early 40's included Cooper, Faust (a blacksmith) and Poole. After an MS in ME, Moore joined the faculty in 1946 and supervised 14 undergrad assistants in the shop. Kibbey began his BS in 1945. James and Huffer joined Walker in the shop as technicians in 1947 and 1946. In the late 40's Jay Edmondson (Navy Gauge Lab), Gene Richmond (Plant Layout) and Doug Williams (Foundry) were part of the faculty. Hal Davidson (48-53) taught in work measurement before he left for a consulting career.

THE 50'S----GROWTH AND NEW HORIZONS

The 50's saw the introduction of five new faculty who together put in 150 years of professional service in the dept. Bill Morris (with a ME background) and Don Kibbey began in 1952 as instructors. Al Bishop and Tom Rockwell started MS work in 1951 in the Wright Field program as 2nd Lts. and were introduced to Hal Davidson and Jack Mitten who had joined the faculty in the late 40s. Bishop was an EE and Rockwell a ChemE. They finished their MS program under Mitten and went to work in industry until called back to OSU by Mitten to work on their PhD's and join the faculty in 54-55. As instructors we were workaholics but the environment was fun and we were given the chance to be self-directed. Dr. Paul Fitts of Psychology used to invite famous researchers to his home for discussions and included the IE grads. Morris and Kibbey finished their PhD programs in 56 and were invited to stay on. Bishop, Baker and Rockwell finished in 57 and also joined the department as Assistant Professors. The idea of in breeding was considered less important than the need for faculty with doctorates. Few IE PhD's were created in universities in those days to meet the demand. In-breeding ended with Giffin, Lewis and Clark in the next 15 years.

Dan Howland (53-65) joined the faculty with a combined degree (ISE and Psychology) and with Mitten (47-58) developed the Systems Research Group (SRG) (formerly the Operations Research Group). These two personalities had a great influence on dept. research. Mitten probably did more to shape the dept. than any one before or after him. He brought Operations Research (OR) into the program with math models that had the respect of other depts. Mitten came with a MS. from MIT and got his PH.D. in ISE from OSU. Jack was a character—dressed for class often in slippers and looked like he just got out of bed. He gave wild parties and invited the grad students—made stiff martinis—yet was the quality control of all dissertations. He was a genius in math models—teaching linear programming before a text was written. It was amazing that he got along with Lehoczky who tolerated his idiosyncratic behavior.
Lehoczky was a completely humorless person who took pride in being gruff and unapproachable. Morris opined he was a most insecure person. Howland remembers him as a bully. He once chided an Assoc. Prof. that Secretaries were harder to find than faculty. Ironically, this person was known for his expertise in arbitration (hundreds of cases including the US Steel strike) Yet, despite his total lack of rapport! with his faculty, Lehoczky led the department during this time of expansion and he expedited tenure and promotion for the junior faculty (eight years to Full Prof from Asst. Prof). He had no use for research and left SRG to researchers and he tolerated consulting probably because he did so much of it himself. Only Dave Baker and later George Smith could work with Doc and both assisted him in arbitration cases. Doc mellowed after his stepdown as Chair in 1965.

Dan Howland landed large scale interdisciplinary research projects in tank warfare, submarine systems, freight operations and the Red Cross. He promoted "systems research" One million-dollar effort involved the measurement of hospital patient care. We even had a philosopher/logician on the SRG staff, Jay Minus, to check on our methodology. Dan's philosophy of research ran contrary to Mitten. It was a classic case of formalism (Mitten) vs empiricism (Howland). Sadly their disputes led Mitten to take the Chair of IE at Northwestern in 1958. Dan eventually left the dept for the OSU Business School in 1965, but his legacy for contract research was made in the 50's and 60's.

Bill Morris taught decision theory and engineering economy and was to write some 7-8 texts in his field. He later became Chair after Baker died in a plane crash. Bishop followed Mitten in math models and followed Morris as Chair. Rockwell introduced human factors subjects and emphasized sponsored research especially in driver behavior. Kibbey worked in manufacturing and Baker in work measurement.

Some of the grads who were remembered in these days were Paul Torgerson who after his PhD was not encouraged to stay. He later went on to be Dean and President of Virginia Tech. Bob Brown took his Ph.D. to Alabama, Huntsville. Edmondson left for the Bu. of Standards in Colorado and Richmond (to USC). The emphasis was on youth.

In the 50's every faculty member was expected to teach in several areas. All instructors were expected to teach the shop courses regardless of the hazard this presented to the students. Our students in those days were often Korean vets who were as old as the young faculty and insisted on hard work in learning IE skills. What began in the late 50's and carried on through the 70's was a "genuine mutual admiration and respect among the faculty" Everyone respected the skills and work ethic of their colleagues. Later, visiting faculty was amazed at the lack of cliques in the dept. Jack Neuhardt confirmed this when he interviewed in 1967, as did Chuck Reilly later.
The 60's---Emphasis on Research, a New Name and A New Building

In the early 60's the dept added Walt Giffin (62-87)(Operations Research), George Smith (human factors, work measurement) Dick Francis (66-71)(math programming), Chuck Overby (65-67)(methods and time study) and Vic Bond (65-74)(production control) Vic was an outstanding teacher with little interest in research outside of teaching. Yet, the dept. was able to get him tenure on the basis of his teaching contribution. But Vics departure in 1974 reflected his unease with the three criteria of performance for faculty, i.e.: teaching, research and publications. Overby left us for Ohio U. Tom Hoover got his Ph.D. in ISE, taught for a brief period, consulted at the Presidents office and went into OR consulting.

1965 saw the retirement of Doc Lehozky as Chair. He did so only if Dave Baker would succeed him. Dave aspired for the job and had the philosophy that a strong faculty needed a Chair to give them freedom to perform. Rockwell and Bishop found themselves on the bus to Wright Field---this time as teachers and not students. We introduced the combined degree program in the early '60's which gave the student the chance to get a BS and MS in five years. This was essential in getting enough grads for human subject testing in human factors research. In the early 60's Morris, Bishop and Rockwell organized a short course in OR which was given for four years at WPAFB and at Nationwide and North American.

Research was heavy in those days with the Tank project, studies for Suburban Freight, North American, the Red Cross, the hospital project, Warner-Swazey ceramic tool, Ohio Dept. of Highways and the US Public Health Service. One of our famous grads was Seth Bonder who joined U. of Michigan and later left UM to set up a well-known military O.R. group. Some of the notable grads that we remember (some in the 70's) included John Snider, John White, Bill Stewart, Dick Yantis, Bob Safford, Larry Cade, Dick Lawrence, George Jones, Alan Pritsker, Greg Butterworth, Don Henry, Ron Mourant, Vivek Bhise, Earl Wiener, Bob Williams, Helmet Zwahlen, Jim Knight, Gary Herrin, G Yum just to name a few. A great many went into academia which could be viewed as one measure of the quality of our program. The emphasis on sponsored research provided opportunity to attract and support top notch grad students like the aforementioned. It also made expensive hardware possible in the human factors research area; eg eye movement equipment.

In 1967 we began the TARGET program---a five-year interdisciplinary program on traffic accident research that included grad students from engineering, law and medicine. In that year faculty were allowed alcohol in the Faculty Club after 4 PM. Jack Neuhardt joined us, giving much needed skills in statistics and experimental design.

1968 saw ISE move into its new building on Neil Av. Many of us recall the foundry fumes which permeated our offices in the old brick building and were glad to get larger, clean, well-lighted space. There were few tears shed in leaving the old brick building. We finally had space for labs and grad students. Dave and Don Moore made the decision to limit foundry operations to aluminum in the new building.

We hired Larry Tracewell as our instrument man to support human factors projects (He later left us in 1976 to start his own company--Tracewell Enclosures - a very successful enterprise today)
NC machines were introduced into the shop and students constructed the famous red drill presses (for the next 12 years). 1968 also involved a student riot and the lock-in of Vice President Corbarly which would presage more serious riots in 1970. 1969 ended with the suicide of Prof. Bob Miller.

The 70's---Tragedy, Continued Growth and Collegiality

1970 began with the untimely death of Chairman Dave Baker in a plane crash in Long Island Sound. The pilot of a Commuter flight ran out of gas rather than declare an emergency. As an accomplished pilot, Dave probably was aware of this error at the end. We still honor Dave by using his doctoral gown for faculty participation in commencement exercises. Bill Morris succeeded Dave as Chair. Riots closed the university for five days—a sad time for all of us. The causes were mixed—some legitimate black student concern, a concern for military research on campus, a reaction to the Kent State shooting and the Vietnam war and a bunch of non student thugs on a tear. Some of us conducted classes in our homes.

The early 1970's brought four new professors, Clark Mount-Campbell, Al Miller, Ralph Swain and Rich Wendell (71-73). Francis, Bishop, Bond and Rockwell conducted a projected 7 year planning review of the dept. to set goals and programs. At this time we instituted exit interviews with graduating seniors to get feedback on the quality of instruction.

1972 saw the loss of Francis to Florida State and the addition of Will Wilhelm. We implemented the Plan B Masters program—a non-thesis program over the objections of Rockwell and Bishop. Rockwell had the dubious honor of reviewing the Deans office to make it more efficient. Harold Enarson became President.

The early 70's marked a new Chair, Al Bishop (1974), the departure of Wendell and Bond (to Allis Chalmers), the death of Doc Lehoczky and the retirement of Don Moore. In 1975, Jay Black joined the faculty. In 1976 Ralph Swain left, Subhash Sarin joined us, and Don Glower became Dean. Cedric Sze replaced Tracewell. The late 70's saw the firing of Coach Hayes, the addition of our first female Prof. in Gayle Berry, the retirement of Morris and Kibbey and our first female provost, Ann Reynolds.

The above factual data says little about the vigor of the dept in this decade—the concern was for constant improvement as indicated by the biennial two day retreats at Ohio State Parks where we shared research ideas and got consensus on dept. policies. We had informal brown bag lunches to share ideas and the famous pizza parties before football games hosted by Don Kibbey, using the foundry as ovens. We also instituted the two-light graduate program in this decade and supported the local OR group meetings in central Ohio. There was a sense of enthusiasm in our undergraduate and graduate program and there was a great demand for our graduates in both industry and academia. Despite the psychological jolt at the beginning of the decade, quality and growth seemed to epitomize the dept.
One of the activities that was indicative of the collegiality of the dept. were the regular poker games which began in the 70's and carried through the 90's. Here, with a few beers and a lot of kidding around, the faculty got to know each other better and had the chance to talk over dept. issues in a relaxed atmosphere. Eight to ten played regularly, rotating through individual homes. Who could forget "two-card monte", Mount-Campbell's "San El Defonzio" and other wild games? Al and Louise Bishop invited new faculty as their houseguests until they could get settled. Walt Giffin took prospective faculty and wives on rides in his airplane and Tom Rockwell did likewise with his boat.

Our relations with our students went far beyond the classroom. Casual beer parties at the "library", spring picnics where the effect of age was obvious in the student-faculty softball games, AIE and Alpha Pi Mu events and the dept. racquetball tournament each spring (which was usually won by the faculty).

The decade saw faculty recognition with new textbooks, outstanding teaching and research awards at college, university and national levels, large-scale research efforts and a patient statistician in Neuhardt to help design experiments and make sense of the data. SRG was given great support from Lois Graber and her staff.

Some of our illustrious graduates included Jim Rucker, Chris Mitchell, Debbie Seifert, Ken Funk, Jim Major, Mark Schwabero, Alec Kurlic, Brad Aston, Don Byrkett, Jo Ellen Force to name a few.

The 80's----Manufacturing Research, Faculty Changes and More Growth

The 80's began with new faculty, Alhawalia, Phil Smith and Hans Moltrecht. Phil doubled our human factors capability and Hans brought his industrial experience to the dept. Emphasis on computer graphics, Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) were initiated. Giffen and Rockwell added research on pilot error for NASA. Class sizes continued to increase.

In 1981, our new president Ed Jennings initiated more belt-tightening. We lost Berry and Black but gained the addition of Gary Maul. In 5 years our enrollments had tripled---31% of our undergrads were now women. Al Bishop guided us through accreditation. A search began for a new chair. In 1982, George Smith replaced Al Bishop after his 8-year term. We gave Al a sendoff with a large dinner celebration.

Bill Marras joined us to further strengthen the ergonomics program. We began an emphasis on flexible manufacturing. Our capstone course ISE 508, which sent out teams of seniors to solve industry problems, required considerable industrial sponsorship with the large enrollments. 1983 saw the last case of faculty inbreeding with the addition of Ron Lewis to our faculty and the beginning of another curriculum review. We began to introduce selective enrollments to limit class sizes. Sarin went to VPI and Moltrecht died of cancer. Hans was a wonderful person and a real loss to our program.
In 1983 and 1984 we secured Chuck Reilly (math programming) and Barry Nelson (simulation) from Purdue and later Jane Fraser (engr.econ), also from Purdue. PC's were provided to all faculty and a shift to more math was reflected in the curriculum. Clarence James retired 1984 after 27 years of service in the shop area. When he built special equipment for the road research program, it was virtually indestructible, like the electric motor which fed out 600 feet of steel wire to measure headway in driver car-following or the instrumented railroad spike. Marras and Rockwell had a research project with the Bu.of Mines. Thus, began the explosion of research in physical ergonomics under Bill's leadership. Sometime in the mid 80's, Jack Neuhardt led an intensive review of the dept's goals, policies, curriculum etc to focus our resources in the future.

In 1985 Tylan Altan joined the dept. from Battelle and later secured a 17 million-dollar research effort in Net Shape Manufacturing. A floor of the Baker building was devoted to this effort. This almost had the effect of a dept. within a dept. The ergonomic faculty—Rockwell, Phil Smith, George Smith and Bill Marras put together an Ergonomic Short Course for Ford Engineers, which has endured for some 15 years.

In 1986, we put a limit on new ISE majors to 45 students. Marc Posner joined the faculty in the math models area and Walt Giffin took retirement to be chair at Southern Colorado and build yet another airplane. The Biomechanics lab was born. In 1988 Tom Rockwell took early retirement to devote time to his consulting company but taught one to two quarters each year for the next 7 years in ISE 508 and graduate seminars on a volunteer basis. He was roasted in a retirement party at the golf course attended by some 70 faculty, staff and former students.

Dave Woods from Westinghouse replaced Rockwell and Don Lucca joined us in the Manufacturing area. Industrial support came from Honda, Fisher Body and Ameritech. The decade ended with the departure of Lewis and Lucca and the addition of Shivpuri and Minaie in the manufacturing area. Reilly became Vice Chair and the dept engaged in more introspection as to its goals and activities.

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