

# HUPDATE

A PUBLICATION OF THE  
DEPARTMENT OF MECHANICAL ENGINEERING  
IOWA STATE UNIVERSITY • AMES, IOWA

## MECHANICAL ENGINEERING

November 1988

**Leading the Way to the 21st Century**

# INDUSTRIAL ADVISORY BOARD

### **ADVISORY BOARD MEMBERS**

In the Fall of 1987, an Industrial Advisory Board was formed for the Department of Mechanical Engineering. A list of Board Members is presented on Page 2.

The main purpose of the Board, which meets once each semester, is to bring an industrial perspective to departmental planning. At the most recent meeting, on October

6, 1988, the Board met the new Engineering Dean, discussed progress in the Engel Laboratory, and formulated plans for future fund raising efforts.

### **WELCOME BY DEAN KAO**

The Dean of the College of Engineering, David Kao, welcomed the Board and expressed his appreciation for the Board's support.

Dean Kao joined Iowa State University in July 1988. "Being

new at this university, I was pleased to find that the Mechanical Engineering Department has such a supportive and experienced resource as the Advisory Board."

He discussed his view of engineering education, stressing the importance of faculty involvement in research. He emphasized that research should not be at the expense of teaching. "As technology advances, research and teaching must be a joint effort. In years to come, we wish to move in the direction which stresses the basics in scientific methods rather than devoting too many classroom hours to computational procedures. This is necessary to assure that students won't graduate with too narrow a focus. It is our responsibility to prepare students to study on their own with a lifelong commitment to education," said Kao.

Dean Kao pointed out that no engineering problem is as well defined as textbooks would lead one to believe, therefore, students must be able to recognize and define problems. They must then have the ability to visualize not one, but many feasible solutions. Students also need to realize that



*David Kao welcomes the Industrial Advisory Board.*

**Continued on Page 2**



## FACILITIES PRESENTED TO ADVISORY BOARD

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technological factors are not the sole consideration for solutions. Social, environmental, and economic factors also affect problem solving. Kao feels these areas are of vital importance and it must be the commitment of the College to include them in the curriculum.

### PRESENTATION OF MECHANICAL ENGINEERING FACILITIES

Professor Jerry Hall, leader of the Design and Manufacturing Group and director of the Engel Laboratory, presented information concerning the new additions of equipment for the Department of Mechanical Engineering. "We were fortunate to be recipients of the Engel Grant. The equipment purchased through this grant will support significant advances in our teaching and our research."

Traditionally, in the Department of Mechanical Engineering there has been one group that teaches design courses and another that teaches materials and manufacturing courses. This is changing so that the faculty with manufacturing interests will become increasingly involved with teaching design and vice versa. "It is an area that is crucial for the United States. We need to teach our students that design and manufacturing are very closely related parts of the same overall task."

In the past, the department has not had the equipment suitable for demonstrating this point of view. "Through the Engel grant, we have purchased equipment which has

### Industrial Advisory Board Members

**Allen M. Acheson**, President, Black and Veatch International; **Jim Anderson**, Retired Chief Engineer, The Boeing Company; **Dave Arnold**, President and CEO, EMD Associates, Inc.; **Bill Binger**, Retired from Shell Oil Co.; **Dan Button**, Director of Technology FCS, Fisher Controls; **Roger Heimbuch**, Executive Engineer, General Motors Technical Center; **Pete Hilstrom**, Founder/Chairman of Driv-Lok, Inc.; **Ken Huebner**, Manager, CAE Department, Ford Motor Company; **Dale Johnson**, Operations Director, Consumer Products Group, 3M; **Mike Mack**, Retired Director, John Deere Product Engineering Center; **David MacMorris**, Corporate Executive Vice President, Sundstrand; **Fred Rixe**, Retired from Williams Brothers Engineering Company; **Vern Schrimper**, Executive Vice President, Cedarapids, Inc. (A Raytheon Company); and **Ron Vander Weerd**, Manager, Quality Technology, Pella Rolscreen.

allowed us to initiate the integration of computer aided design and computer aided manufacturing."

There are now several senior level design courses which are using AutoCAD, a computer-aided drafting package. This software has been implemented for student design projects on 12 IBM PS/2 work stations. "We hope to add more work stations in the design labs as more funding becomes available," said Hall. "We would like every design student to have access to this advanced equipment."

The department has also purchased a large machining center with automatic tool changing along with a small conveyer line, an assembly robot and a small milling machine. These are coupled together in a flexible manufacturing cell. The conveyer line, robot and mill interact under computer control, facilitating fabrication of student designs implemented on the

PS/2 work stations.

Planned future acquisitions include a computer controlled turning center, to be purchased with the assistance of the National Science Foundation, and a robot to facilitate loading and unloading of the machining center.

"We have components in the Engel Laboratory which allow us to teach and do research in areas of national importance, and we will strive to continue to improve. The mechanical engineering students leaving Iowa State will now have hands-on experience in a modern design and manufacturing environment," said Hall.

### THE BLACK-HILSTROM FUND

Henry M. "Prof" Black, Department Head from 1946 to 1972, and Hollis R. "Pete" Hilstrom were present for the Advisory Board meeting. The two offered a bit of

Continued on Page 3



## EXTRAS BECOME ESSENTIALS FOR BLACK-HILSTROM FUND

Continued from Page 2

history concerning the founding of The Black-Hilstrom Fund.

Black and Hilstrom became acquainted in 1930 when Hilstrom was a freshman in a class that Black was teaching at Iowa State. The two kept in touch and after World War II, Hilstrom, who was successfully leading his company, Driv-Lok, welcomed Black back to Iowa State.

"Pete used to visit with me when he would come to campus. One day he asked me what I would do if he gave me some money for my department. I told him I would spend it on faculty rather than students because students had funds available to them, but the faculty did not," said Black.

At that time, Black felt he was losing the ability to hire good instructors because he didn't have the money to pay for extras such as moving expenses. Further, the department did not have funds to support other necessities such as travel to conferences, which enhance instructors' teaching abilities.

"At first, Pete was the only individual who donated to the department, so I suggested that our 4,000 other alumni should have the opportunity," said Black. The Black-Hilstrom fund was established in 1955 for alumni contributions.

The purpose of the Black-Hilstrom Fund was to establish an interest bearing account to support faculty development. "We wanted



*Pete Hilstrom (left) and Henry Black at the Advisory Board meeting.*

to have money available to improve the faculty," said Hilstrom. "The fund now helps professors by providing a variety of things from equipment acquisitions and maintenance to travel to technical conferences."

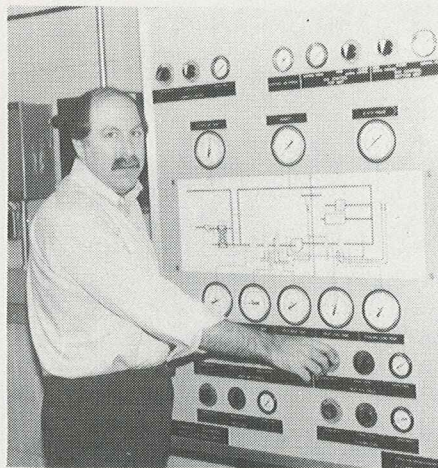
The Mechanical Engineering

Department was the first department to have a faculty development fund at Iowa State. "I'm impressed because we initially wanted to reach a goal of \$100,000. The Black-Hilstrom Fund has surpassed that now, and has become a key to the success of the department," said Black.



*Pete Hilstrom addresses the Board.*





**H**oward Shapiro, Associate Professor, is in his fourteenth year on the faculty of the Mechanical Engineering Department. He teaches thermodynamics at both the undergraduate and graduate levels, and he has recently been involved in the senior course in experimental engineering. He had the special honor of receiving the Superior Engineering Teacher Award for the College of Engineering in 1988.

His research is in the area of

## Shapiro Writes ME Text

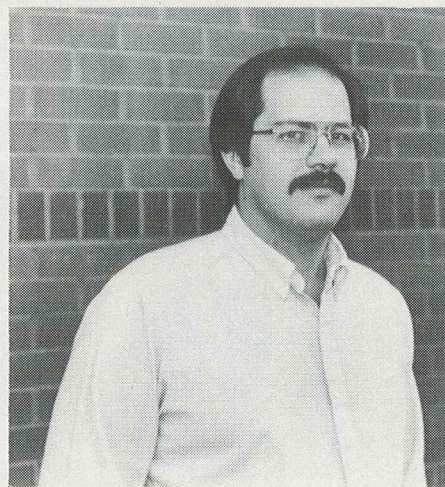
applied thermodynamics dealing with energy utilization in buildings. A current experimental study is looking at the control of chilled water coils in heating, ventilating and air conditioning systems. Shapiro has studied the dynamic simulation of air flow and water flow in order to get a better understanding of their control and to improve energy utilization.

Shapiro is also leading the design and implementation of an environmental control laboratory which is currently under construction with the financial assistance of Black and Veatch. The laboratory consists of two side-by-side rooms, each with complete environmental control systems so that temperature and humidity can be controlled independently. Researchers can then simulate the conditions that would be surrounding pieces of equipment and then evaluate the performance of the equipment. "There are not many facilities like

this at the university level. This gives us the capability to study equipment efficiency in a laboratory setting."

A major part of Shapiro's efforts in the last five years has been devoted to developing the textbook, "Fundamentals of Engineering Thermodynamics" which he co-authored with Michael J. Moran of Ohio State University. This fall, approximately 50 universities are using the text. "We wrote the book to help students develop an engineering approach to problem solving. Through it we hope to reach many future engineers."

All of Shapiro's research involves graduate students. "Doing research with graduate students helps to stimulate my own creativity. The one-on-one interactions are of great value. I also believe that research and teaching complement each other."



**R**ees Fullmer was educated at the University of Utah where he received his Ph.D. degree in 1983. He began teaching at Iowa

## Fullmer Praises Undergraduate Quality

State University in 1984. He currently teaches classes in system dynamics, instrumentation, and measurement and controls. His special role in the department is teaching and research in modern controls.

"I am impressed by the quality of our undergraduates. I think their ability in engineering is very high." He emphasizes that facilities such as the Engel Laboratory will have a significant impact on the department's educational program. "We're a fortunate department due to the quality of the faculty and the

equipment available."

Fullmer is working on several research projects. One project concentrates on the control of fluidized bed combustors using both classical control and "fuzzy logic" approaches. He is also involved in robotic control work. He spent the last two summers at the Kennedy Space Center working in the robotic application laboratory. His work with NASA concentrates on force feedback control. The goal is to use a robot to link umbilical lines to the space shuttle ground services.



## Lund Receives Software Development Grant

**Y**vonne Lund received her undergraduate degrees at the University of Iowa, earning a B.A. in general science and a B.S. in biomedical engineering. She received her Master of Science degree in Mechanical Engineering from Iowa State University in 1987 and is currently working on her Ph.D. Her dissertation emphasis is vehicle dynamics and controls.

She is currently an adjunct Assistant Professor in Freshman Engineering where she teaches computer fundamentals. "The students want to learn and I think they're getting a very good education here because we concentrate on im-

proving our teaching methods. The work itself is very methodical and thorough and it prepares students for the engineering thought process."

Last year, Lund received a grant from the College of Engineering to develop software which engineering students will use in their introductory courses. The software will help students visualize objects in three dimensions and understand principles of descriptive geometry.

A native of Elma, Iowa, Lund is an active member of Tau Beta Pi, Omicron Delta Kappa, ASME, the Society of Automotive Engineers



and the American Society of Engineering Education. She looks forward to continuing teaching and research. "I really like it here and I don't believe I would have this kind of opportunity elsewhere."

## Baumgarten's International Perspective

**J**oseph Baumgarten is a firm believer in striving to improve teaching and professional competence. In the course of a faculty improvement leave in 1975, he completed research at Technical University Warsaw on impacting machine members and on analysis of crimping machines.

In 1981, Baumgarten spent a year in The Netherlands teaching third year students CAD of mechanisms and completed research on finite element analysis of mechanisms and machines. Research was also conducted on CADOM, the Technische Hogeschool Delft algorithms for computer aided design of mechanisms.

During a leave of absence in 1986, he had a six month appointment to complete a preliminary design of a 2-stage constant

diameter light gas gun for Sandia National Labs. Then in 1987 he went to Belgium for a year to teach Kinematics and Machinery Dynamics. While at Katholieke Universiteit Leuven, he also conducted research on robotics.

Currently, Baumgarten is involved in a funded research project for the Air Force Office of Scientific Research. He is investigating liquid sloshing in spin-stabilized satellites. The challenge is to suppress coning motion without using excess fluid stores in the process.

Professor Baumgarten's primary teaching assignments are in design science and machinery dynamics. With his extensive experience with many students from various cultures, he is impressed with the computer capability of ISU

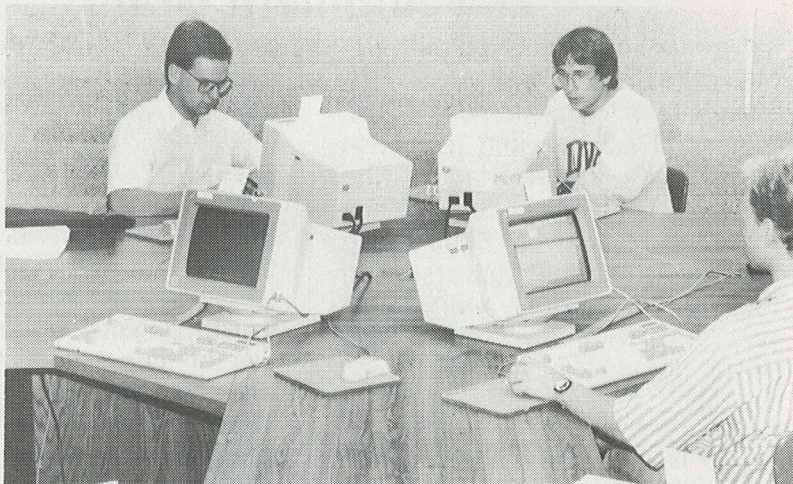


graduates. "I feel our students rank very well nationally in computer literacy. My teaching experience away from the Iowa State campus has let me compare the Mechanical Engineering students at ISU to students of other curricula, and I must say that ISU graduates excel."

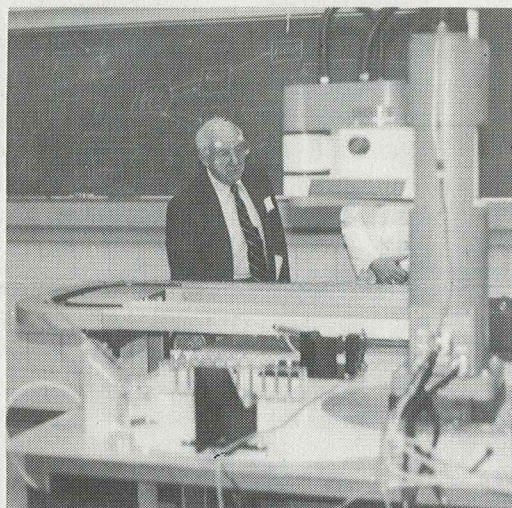


## TOUR of the ENGEL LABORATORY

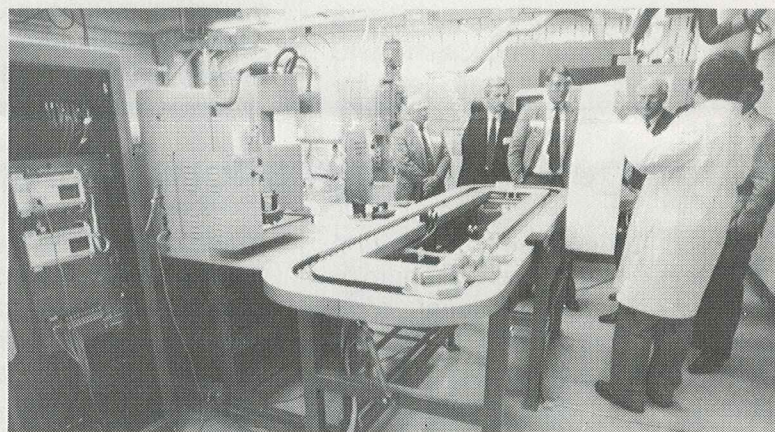
The Department of Mechanical Engineering is proud of the advanced technological equipment now operational in the Engel Laboratory. Pictures on these two pages were taken during the Industrial Advisory Board's tour of the facilities.



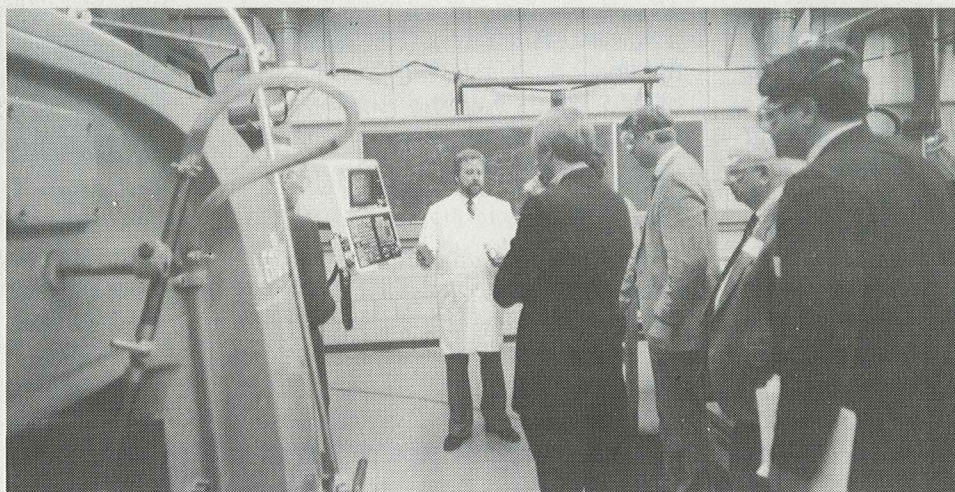
*Students using AutoCAD*



*Henry Black inspects the flexible manufacturing center*

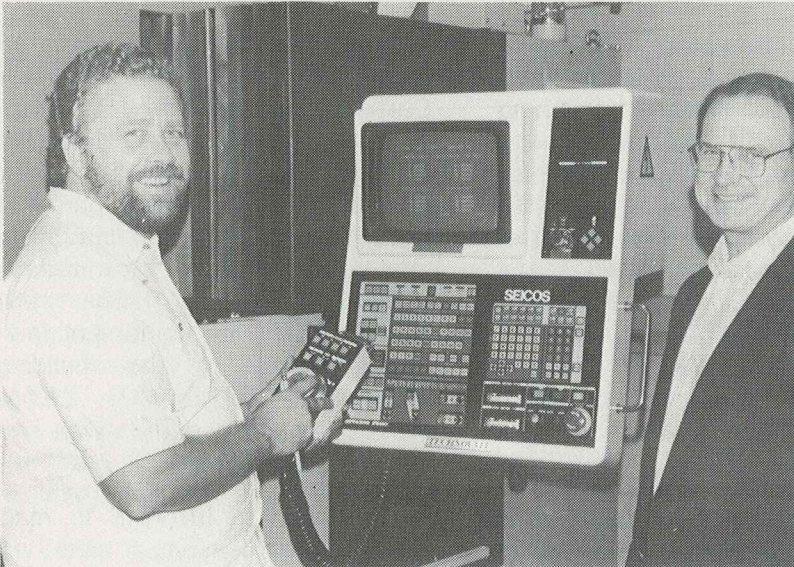


*(from left) Henry Black, Ron Vander Weerd, Dale Johnson and Bill Binger*



*Brian Espeland with (from left) Ron Vander Weerd, Dale Johnson, Vern Schrimper and Roger Heimbuch.*

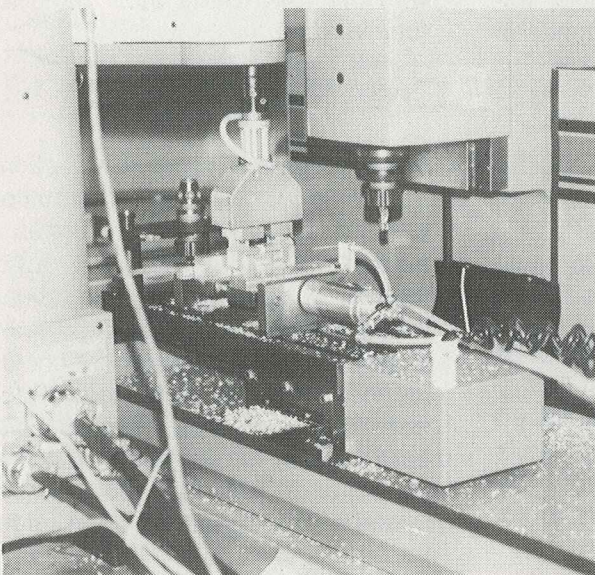




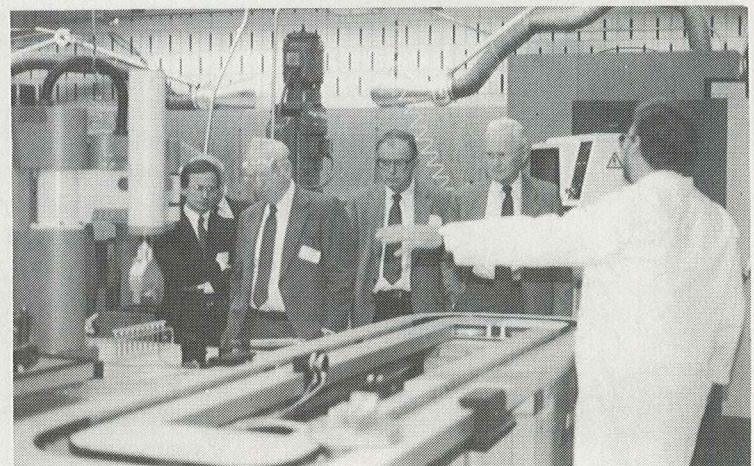
*Brian Espeland (left) and Jerry Hall with the control panel for the new machining center*



*The machining center being unloaded for placement in the Engel Laboratory*



*The precision assembly robot manipulator arm loading a part into the pneumatic vice of the milling machine*



*(from left) Dan Button, Mike Mack, Alan Acheson and Pete Hilstrom*



## Internships Contribute to Undergraduate Education



**R**ene Culberson grew up in Marshalltown, Iowa, graduating from high school in 1984. She is a senior who will be graduating in December of 1988 with her B.S. in Mechanical Engineering.

Since graduation is approach-

ing, Culberson is busy with the interviewing process. She is interested in project and manufacturing engineering and has taken many technical elective courses for preparation in the field. She attributes her well-rounded engineering education to the facilities and to the challenges posed by the faculty. "I'm impressed with the equipment available for student use. It's a challenging curriculum and the professors are very supportive."

During the past two summers, Culberson has had engineering internships. "I think the engineering experiences offered by internships are very important." In the summer of 1987, she had an internship with the Saginaw Division of GM when she worked in product engineering. Then in the Summer of

1988, Culberson was a project engineer at the Hoechst Celanese Corporation in Corpus Christi, Texas. During this internship, she recommended a work station expansion for the CAD department, gaining needed information by interviewing vendors and reading technical journals. She also worked on safety equipment for a new section of the building, modified a reactor for a new process, and worked with engineering scheduling.

Culberson is involved in many college organizations. She was the Vice President of ASME last year and is currently serving as the Secretary for the group. She is the Social Vice President of the Off-Campus Board and has played with the Iowa State Jazz Band for four years.

## Recipient of NSF Creativity Award



**B**eing the recipient of the National Science Foundation's Creativity Award has encouraged Steve Koffman to continue his education in the field of engineer-

ing. Koffman is currently working on his Master of Science in Mechanical Engineering and plans to pursue a doctorate in Electrical Engineering.

Koffman is working on simulating and implementing a "fuzzy logic" control system for fluidized bed combustors. "Fluidized beds are rather difficult to control by conventional means but they are a nice application for fuzzy logic."

Fluidized bed combustion with a heat transfer bed is a process that is growing in popularity in commercial power generating facilities.

Typically, skilled operators are required for accurate control of fluidized beds. The fuzzy controller

has the ability to control actions not covered by the information base in a manner that emulates a human's actions; therefore, fuzzy logic is compatible with the human thought process. Fuzzy logic techniques prove to be the best choice for codifying the control policies from the operator. The special challenge of fuzzy logic is that the controller is only as good as the model of the operator's knowledge.

Koffman is active in many honorary organizations such as Pi Tau Sigma and Golden Key National Honoraries. He will represent the Department of Mechanical Engineering at this year's national ASME Old Guard Competition where he will discuss mechanism design and synthesis.



## Returning Student Studies Auto Steering Systems

**C**raig Weiss attended elementary school in Council Bluffs, Iowa. His family then moved to New Jersey where he graduated from high school. He attended Iowa State University and graduated in December 1987 with a Bachelor of Science degree in Mechanical Engineering. Weiss went on to work for a short time as a manufacturing engineer for AT&T. After deciding to continue his formal education, he returned to Iowa State for his Master of Science degree.

Weiss is now a Research Assistant working with Professor Martin Vanderploeg. He and Vanderploeg will be studying on-center feel for automobile steering systems.

Four major tasks will be accomplished in this study. First, tests will be performed to underpin the modeling of the power steering

system. These tests will relate steering wheel angle to force at the tie rods and will help determine the level of coulomb friction and lash in the steering system. Then the researchers will develop software to model the vehicle's front end, perform detailed sensitivity analysis and install the software on Chrysler's Cyber computer.

They plan to use the multibody dynamics program developed at ISU for modeling the chassis and the mechanical suspension and steering components. When the front end model is complete, it will provide the means to examine the complex relationship between the torque at the steering wheel and environmental, geometric, and system parameters.

The initial study will determine which components have the most



affect on the torque at the steering wheel. The final report will contain a description of the model, a summary of the sensitivity analysis, and a section which will serve as a user's manual for the Chrysler version of the software.

Upon completion of his Master of Science program, Weiss looks forward to joining the automobile industry where he hopes to continue his work in machine dynamics.

## Undergraduate Research Assistantship Program

**D**ean DeCock is currently a junior in the Department of Mechanical Engineering, where he is gaining experience from the Undergraduate Research Assistantship Program. The purpose of the program is to encourage undergraduate students to consider graduate school by matching them with faculty members to pursue shared research goals.

DeCock began working with Professor Robert Brown as a research assistant in June of 1988. Iowa State Minerals Mining Resource Institute is funding their project, which studies fluidized bed combustion as a method for reduc-

ing problems with acid rain. "I help out with the manual work in the laboratory and also help run combustors." He also worked on a model fluidized bed and changed the air intakes to measure moving air currents instead of the normal static air pressures. "We now use it for demonstrations for visiting high school students."

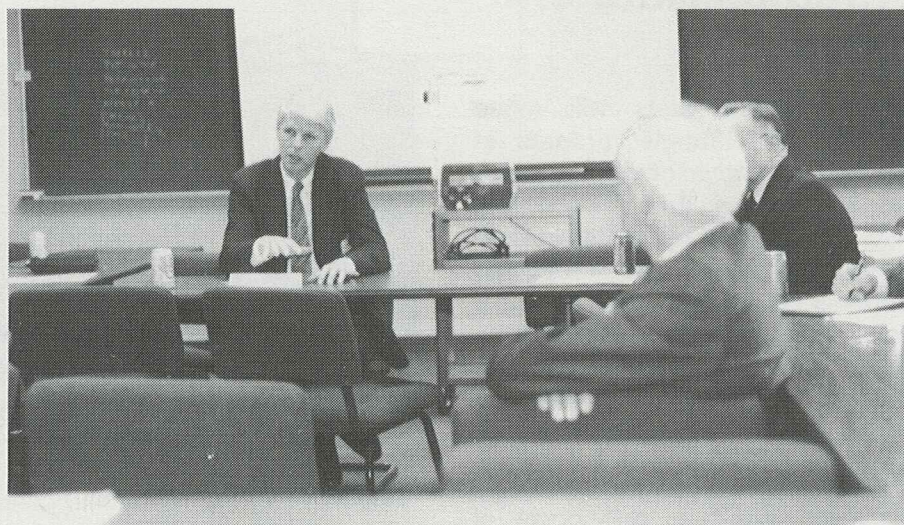
During his free time, DeCock works on his own project of cooling a computer chip with a miniaturized fluidized bed in order to prevent computer "hot spots". The majority of his summer was spent working on a prototype of the fluidized bed and computer chip.



"We're reassessing the prototype right now and I'm doing a literature review for the redesign process."

DeCock hopes to further his education with a masters program at Iowa State. "The Research Assistantship has been a good preparation for graduate school."





*Department Chairman Jim Bernard with the Industrial Advisory Board.*

### From the Chairman

## FLEXIBLE SUPPORT ENHANCES DEPARTMENT'S FUTURE

This issue of the *Update* explains a new development for the department, the emergence of our Industrial Advisory Board. The Board has met three times, once each semester for the last three semesters, and we are looking forward to their continued twice-yearly meetings.

The Board is valuable to the department in several ways. Perhaps most important, they offer practical advice on setting near term goals and following up. As a consequence, we focus on our Board meetings for benchmarks on getting things done.

This has been particularly true with our efforts in the Engel Laboratory - we pushed our vendors and ourselves as hard as we could to have the equipment installed in time for our Board meeting last October 6. We were successful with at least eight hours to spare, and progress continues.

The pictures in the center pages of the *Update* show some of the hardware we had on display and operational for the Board's tour through the facilities.

We also look to the Board for advice in developing a longer term view. In particular, at our October 6 meeting we discussed asking for further assistance from you, our alumni. The discussion dealt with the common perception that Iowa State University is not a private institution, that it is supported by taxes as well as tuition and thus should not challenge its alumni to help it grow and prosper.

My response is this: The department currently uses about \$2.5 million of state funds for salary and fringe benefits. This supports thirty-two faculty, four secretaries, three technicians, and seven teaching assistants. Last year we spent about \$290,000 of discretionary funds. The sources of this support

are illustrated in the pie chart on Page 11. Note that more than half comes from private sources, principally the Black-Hilstrom fund and the Engel endowment.

The Engel endowment supports the Engel Laboratory, which is the cornerstone of our efforts to integrate design and manufacturing. The capital items to be supported currently include twelve IBM PS/2 systems equipped with AutoCAD, which are used by students in design classes, and a wide variety of manufacturing hardware including a large Haitachi-Seiki numerically controlled milling machine, a small conveying system, and a mill with a robot in a flexible manufacturing cell.

In addition, the Engel Endowment supports the salary of our newest technician, Brian Espeland, who has the responsibility for the care and embellishment of the Laboratory. (Brian is pictured in our "centerfold" with Jerry Hall alongside the input controller for the N/C mill.)

The Black-Hilstrom Fund supports almost all the other "flexible" activities in the department. These include:

- Most travel not billable to research accounts
- Many new equipment purchases
- Short courses for our faculty members (three faculty took multi-day courses last summer to improve their skills)
- Moving expenses for new faculty,
- Seed money for the initiation of new research projects, and
- The ME *Update*

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## Contributions Are A Critical Ingredient

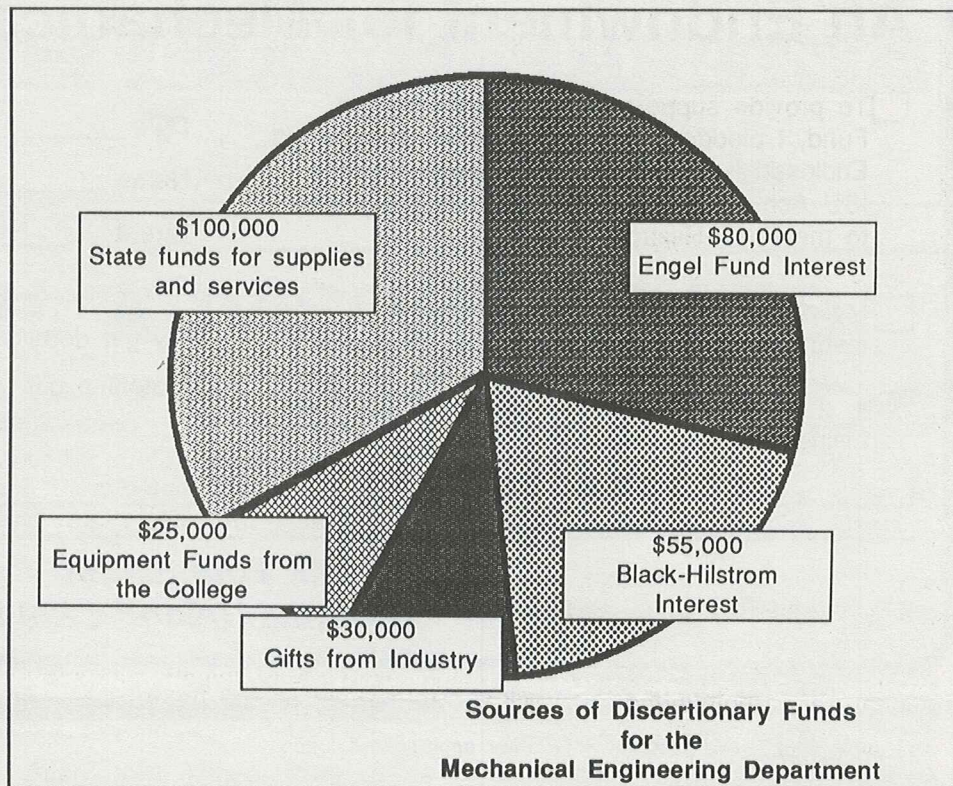
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As we look toward the future we see the need for more flexible support. For example, we hope to double the number of work stations available to students for their design courses, an initial expense of about \$60,000 with continuing maintenance bills for the foreseeable future. The prospects for funding this acquisition through state funds are not good, yet I'm convinced it is the right thing to do.

Another example - we have asked the College to fund the purchase of five data acquisition systems each year for three years to bring our laboratories up to modern standards. This request was well received, but there will be maintenance to consider, and, as time goes on, additional data acquisition cards and better sensors to measure the data. These additions are ideal uses of our flexible funds.

After detailed discussions of these matters, our Industrial Advisory Board has urged us to intensify our fundraising efforts, with a goal of bringing the Black-Hilstrom Fund from its present level of \$585 thousand to \$1 million, thus yielding, at today's rates, a total of about \$100,000 each year for flexible funds in the department. (We do not spend any of the capital.)

The Board has agreed to provide leadership in this effort, so you will be hearing from one of the Board members sometime next spring with a request for your help. I hope you'll take the point of view held by me and by the Board that it is appropriate for you to choose to help your department continue



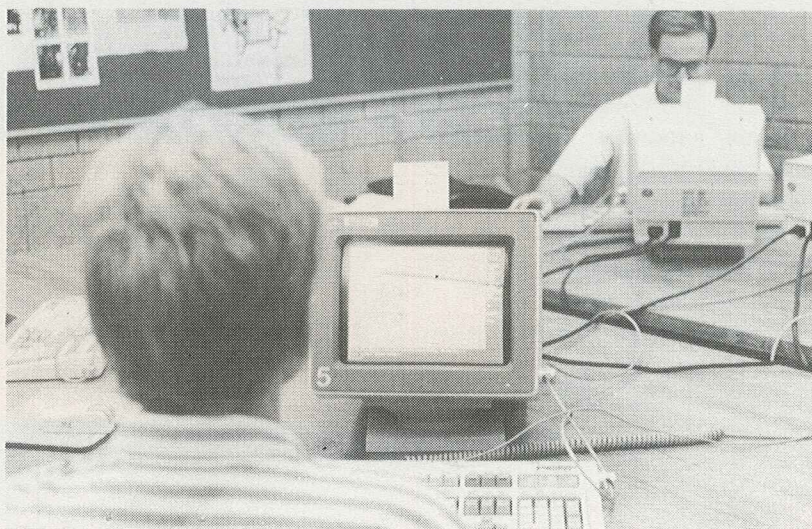
to improve. I can assure you on behalf of all our faculty that we will do our best to use our resources wisely.

Of course, we are delighted to have the help of those of you who continue to contribute regularly to the Black-Hilstrom Fund, and we encourage new contributors who

would like to think of giving something back to the department by helping tomorrow's students and faculty. The last page of this *Update* will facilitate your gift.

**On behalf of all our students and faculty, thank you for your help.**

*Jim Bernard*





# The Black-Hilstrom Fund

## An Endowment for Mechanical Engineering

☐ To provide support for the Black-Hilstrom Fund, I pledge \$\_\_\_\_\_. This is an outright gift. Enclosed is my check made payable to the ISU Achievement Foundation, but designated to the Black-Hilstrom Fund.

☐ My pledge of \$\_\_\_\_\_ will be paid in \_\_\_\_\_ installments. Enclosed is my first check for \$\_\_\_\_\_. Please bill me annually for the next 1, 2, 3, 4, 5 years (circle one). I would prefer billing in \_\_\_\_\_ (month).

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