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# FOIA MARKER

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**Record Group/Collection:** George H.W. Bush Presidential Records
**Collection/Office of Origin:** Speechwriting, White House Office of
**Series:** Speech File Backup Files
**Subseries:** Chron File, 1989-1993

**OA/ID Number:** 13717
**Folder ID Number:** 13717-009

**Folder Title:**
Oklahoma State University 5/4/90 [OA 6898] [2]

| Stack: | Row: | Section: | Shelf: | Position: |
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OSU

Oklahoma State University

OFFICE OF THE PRESIDENT

STILLWATER, OKLAHOMA 74078-0001
WHITEHURST HALL
405-744-6384
~~FAX: 405-744-8871~~

# FAX COVER PAGE

**DATE:** April 27, 1990

**TO:** Peggy Dooley

President Bush's office

**OFFICE PHONE NO.:**

**FAX PHONE NO.:** 202-456-7750

**FROM:** President John Campbell's office

Linda Miesner

**OFFICE PHONE NO:** 405-744-6387

**FAX PHONE NO:** ~~405-744-6285~~ **(Note our new fax number)**

**NO. PAGES (INCLUDING COVER PAGE):** 28

**CALL FOR ASSISTANCE WITH FAX TRANSMISSION:** ~~405-744-6384~~

**NOTES:** If you need any further information, please call.

CENTENNIAL 1890 • 1990

Celebrating the Past . . . Preparing for the Future

Oklahoma's early territorial settlers had hardly staked out their homesteads after the run of '89 than they turned their thoughts toward educating their children. On Christmas Day, 1890, the First Legislative Assembly of Oklahoma Territory created an Agricultural and Mechanical College.

Work began immediately to get the new institution into operation. The first president, Robert J. Barker, took office on June 25, 1891, and the first classes began on December 14, 1891, in the Stillwater Congregational Church. Forty-five students, 22 men and 23 women, were enrolled. The first graduates, six men, received their diplomas at the commencement exercises in 1896.

Classes continued in the church while construction was pushed on a permanent building being built on the 200-acre campus at the northwest edge of the city. An assembly building, dedicated on June 15, 1894, remains today. Known affectionately by OSU's thousands of alumni as Old Central, the building now serves as the Oklahoma Museum of Higher Education.

Course offerings at the start were grouped by departments with the main emphasis on agriculture, but as early as the turn of the century there were classes in domestic science. A mechanical engineering department was formed in 1902, education courses began in 1909, and the first graduate studies were offered in 1910.

The institution grew steadily and more buildings were added, including the first women's and men's dormitories in 1910 and 1911. The student body passed the 1,000 mark in 1908. That same year provisions were made to offer a master of science degree, with the first one being awarded in 1912. In 1916, the North Central Association accredited the school's academic programs for the first time.

From its first year of existence, the new institution's mission included research and initiated off-campus efforts to assist the citizenry of the state before the century turned. Today, OSU expends some $57 million in research and has extension and public service programs in every county of the state.

In the 1920s and 1930s, growth and development of OSU was marked by advances and setbacks as the new state sought to gain political, financial and administrative stability. In its first ten years, OSU had four presidents, two in the second ten, and four in the third ten-year period. In 1928, Henry G. Bennett was appointed president and served until 1951. John R. Campbell is the fifth person to serve as president since 1928.

The economic problems of the 1930s hampered the physical and financial growth of OSU, although enrollment increased until it reached 5,000 in 1938. During that period, plans for the future were formulated that enabled substantial, well-organized growth to occur when resources became available.

During the World War II years, OSU conducted twelve programs for the military, bringing thousands of young men and women from all over the country to the campus.

***The charter of this "people's college" was approved by the First Territorial Legislature of Oklahoma. It followed legislation by the U.S. Congress in 1862, known as the Morrill Act, which provided for one or more people's colleges in each of the states and a gift of federal lands to support them. Thus, they became known as land-grant colleges.***

Post-World War II brought dramatic changes to OSU. A technical branch was established at Okmulgee in 1946; the main campus enrollment reached 10,000 in 1947, and the heart of the campus began to alter drastically in the early 1950s with the construction of the Edmon Low Library and the OSU Student Union.

On July 1, 1957, the institution's name became Oklahoma State University.

Growth of the institution continued steadily in the 1960s and 1970s. Another technical branch was formed in Oklahoma City in 1961 and the Stillwater campus enrollment topped 20,000 for the first time in 1975. Physical growth surged to the western portions of the campus with the 12- and 14-story residence halls dominating that architectural landscape.

In 1988, OSU continued its expansion. Oklahoma College of Osteopathic Medicine and Surgery became known as the College of Osteopathic Medicine of OSU.

Since 1896, the university has granted more than 143,000 degrees. Bachelors' degrees are offered in 170 fields, masters' degrees in 70 fields and Ph.D. and Ed.D. degrees in 45 fields. The research activities spring from seven major research units within the University, with researchers being involved in over 1200 different projects.

Today, Oklahoma State University continues to welcome opportunities and to embrace challenges of the future. Currently involved in a special Centennial effort, the University is seeking to accelerate growth and development at a rate not previously known. The University seeks to achieve excellence in steadily broadening areas of instruction, research and extension.

***The first residence halls on the OSU campus were the Women's Building, now Bartlett Center for the Studio Arts, and the Boys' Dormitory, now Crutchfield. Both were funded by the Legislature in 1907 and were completed in 1910 and 1911, respectively.***

Student Activities
405/744-5488
Kim McCoy
744-6500

OKLAHOMA STATE UNIVERSITY
UNIVERSITY TASK FORCE
VISIT OF PRESIDENT GEORGE BUSH

Mr. Marshall Allen, Director
Educational Television Services
Telecommunications Center
(405) 744-5960

Rhonda Lyon
Alum 5368

Dr. Harry W. Birdwell, Vice President
University Relations and Public Affairs
470 Student Union
(405) 744-5362

Mr. Everett H. Eaton
Director of Public Safety
104 USDA Building
(405) 744-6528

Dr. Ralph Hamilton, Director
University Information and Publication Services
219 Public Information Building
(405) 744-6260

Mrs. Sheila Harp, Administrative Assistant
President's Office
107 Whitehurst
(405) 744-6385

Dr. Paul Hummer, Associate Dean Head of Commencement Committee
College of Agriculture
136 Agricultural Hall
(405) 744-5395

Mrs. Christine Jackson, Associate Vice President
Planning and Budget
408 Whitehurst
(405) 744-5971

Mr. Don Shepherd, Director
Physical Plant Services
103 ASPPA Building
(405) 744-7147

870-3967

Union
Strip - bars Eskimo Joe's not on
Theta Pond - cross pond, frats + sor walkways circle it, ducks

Univ. OK game

add $230 million

April 24, 1990

**MEMORANDUM:**

TO: SPEECHWRITERS

FROM: KIM NEWSOM

RE: Big Happenings currently in Oklahoma

---

I contacted a good friend of mine who currently works for the Oklahoma State Legislature. His name is Mark Nash, a Republican, and you are welcome to contact him at his office, (405) 521-5769, if you need further information.

Some things he suggested that are "Hot" in Oklahoma:

1. The State Senate amended H.B. 1862, a bill to change quail season to allow hunters to "hunt" on Sundays.

2. In November of 1988, the Legislature Compensation Board voted to **increase** salaries for State Reps. from $20,000 to $32,000. Immediately after, they proceeded to **shorten** their session from 120 days to 4 consecutive calendar months (January to April).

   In June 1989 (after the first session that was affected my this law took place), Governor Bellmon asked for a special session starting August 1, 1989. Although the current session was supposed to start on Jan.1, 1990, they are still in the special session called by Gov. Bellmon last year. (In my opinion, the session that never ends.)

3. The State Senate amended S.B. 589 that would move the Oklahoma State Dept. of Commerce from OKC to Tulsa. Everyone soon decided to jump on the bandwagon and began introducing all sorts of bills to move other Depts. to their respective cities. (Only in Oklahoma!)

4. The University of Oklahoma has caught a lot of flack lately for deciding to cancel their Women's Basketball program in order to use the money elsewhere in their women's sports program. They caught so much heat that they were forced to reinstate women's B-ball despite the fact that only a few fans (average: 65) ever attend the games and they are losing a lot of money. People are making fun of the fact that they changed their minds.

5. It is being rumored that Billy Tubbs, University of Oklahoma Men's Basketball coach, is considering the head coach position of Los Angeles Clippers in the NBA. This is something he heavily denies.

6. Oklahoma State University just signed on Eddie Sutton from Kentucky as their new Men's Basketball Coach. Eddie is an OSU graduate who used to play for Hank Iba, former OSU Men's Basketball Coach and legend to most fans.

7. The economy in OK during the mid 1980s was terrible. The "bottom fell out" is a good way to put it. They are a proud and hard working people. One of the news stations a few years ago had an ad campaign that seemed to sum up the "never say die" attitude of the Oklahoma people. I have attached a copy of the ad. Look at the last 2 lines especially.

8. Football and basketball are "King" in Oklahoma. The rivalry between the two state schools, The Sooners of the University of Oklahoma and the Cowboys of the Oklahoma State University, is fierce. OSU is **very** well known for its wrestling team. The Sooners are famous (or infamous) for their football team that used to be under Head Coach Barrie Switzer but just finished their first season with Garry Gibbs.

9. The teachers strike is a very hot item. Most schoolteachers from across the state went on strike to protest the low wages. I understand that the national average for teachers is around $29,000 and in OK the average teacher makes $22,000. I know that my friends that are teachers in OK are not making anywhere where near that much. This would <u>not</u> be a good topic for jokes.

10. Bush has over 350 lakes to choose from to make fishing jokes. President Bush might be interested in going fishing in **Sooner Reservoir** that is just west of Stillwater. Keystone Lake is 15 minutes outside of Tulsa. Either Mr. Earl Groves or Mr. Gary Cannon, of the Oklahoma Corps of Engineers (918-581-7311), would be happy to answer your questions.

Please let me know if any of you have further questions on this fantastic state!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

# Student Activities

## Student Organizations

| Organization | Room |
|---|---|
| Afro-American Student Association | 029 |
| Allied Arts | 060 |
| Interfraternity Council (IFC) | 050 |
| International Student Organization | 027 |
| Native American Students | 064 |
| Off-Campus Student Association | 030 |
| Panhellenic (Sororities) | 050 |
| Renter's Advisory Council | 030 |
| Residence Hall Association | 040 |
| Student Government Association | 040 |
| Student Legal Assistance | 040 |
| Student Union Activities Board (SUAB) | 076 |

The **Student Activities Center** staff offers students and student organizations several specific services:

- using display cases in the Student Union
- trip insurance
- using Bennett Chapel
- registering new student organizations
- distributing mail for groups
- notary public
- copying
- registering posters/flyers/signs
- using campus grounds

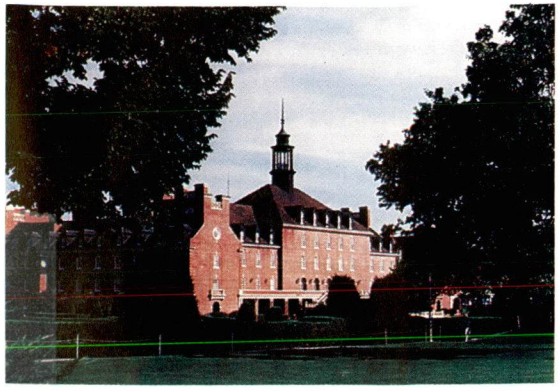
If you want additional information about any of these services, call **744-5488** or go by **Room 060** of the Student Union.

## Thank You for visiting the OSU Student Union♦

**For additional information on the OSU Student Union, contact the Student Union Information Desk, Room 242, (405) 744-5232.**

Oklahoma State University in compliance with Title VI of the Civil Rights Act of 1964 and Title IX of the Education Amendments of 1972 (Higher Education Act) does not discriminate on the basis of race, color, national origin, sex, qualified handicap or disability in any of its policies, practices, or procedures. This provision includes but is not limited to admissions, employment, financial aid, and educational services.

OKLAHOMA STATE UNIVERSITY
STUDENT UNION



The OSU Student Union opened in 1950 as the "Waldorf Astoria" of Unions. Located in the heart of the campus, it offers more programs and services under one roof than any other Union in the world. The Student Union serves as the community center for University students, faculty, staff, administration, alumni, and guests. Whether you are visiting the Union to eat, relax, shop or just visit friends . . . . we're glad you're here.

# SERVICES

### Athletic Tickets
(1st Floor, Room 121) **744-5745**

### Automatic Teller Machines
(2nd Floor, East Entrance)
Transfund, Cirrus, MPACT, CheckOKard, SCS
- BancFirst
- Stillwater National Bank

### Bakery - The Pastry Pantry
(1st Floor, North Food Mart) **744-5216**
- Fresh baked pastries and bread!
- Custom cake and cookie decorating

### Big Screen TV
- Student Union Food Mart, 1st Floor.

### Bookstore - Student Union
(1st Floor, Room 120) **744-5237**
- Textbook, tradebooks, supplies and OSU gifts

### Catering - Student Union
(2nd Floor, Room 242) **744-5216**
- Full service catering/banquet facilities—Plan your next event with us.
- Refreshments for your meetings

### Check Cashing
(3rd Floor, Outside Room 313)
- With a validated Student ID card cash up to $50 a day for only twenty cents.

### Conferences
(1st Floor, Room H-103) **744-7395**

The OSU Hotel and Conference Center's professional staff is willing to help you achieve your meeting objectives by offering the perfect type and size of facility.

### Copies/Fax
- **Cowboy Copy Center** **372-8124**
  (1st Floor, Room 148)
- Copy Machines located . . .
  (coin operated)
  2nd Floor, East Entrance
  Basement, Room 060
  3rd Floor, near escalator

### Hairstyling - For Men and Women
- **The Silver Clippers**
  (1st Floor, Room 182) **372-4182**
- **Student Union Style Shop**
  (1st Floor, Room 172) **377-4400**

### Hotel - OSU Student Union
(1st Floor, H-103) **744-6835**
- Newly renovated
- Cable TV
- Special rates

### Lounges - Come Relax!
- French Lounge (2nd Floor, Room 270)
- Alumni Centennial Lounge (3rd Floor, Room 300)

### Magazines and Paperbacks
- **The Nook** **744-5237**
  (1st Floor, Room 111)

### Meeting Rooms **744-5232**
- Available at no charge to student organizations.
  Reservations: (2nd Floor, Room 242)

### OSU Souvenirs and Apparel
- **The Student Store** **744-5237**
- The official OSU varsity shop!
- Gifts for all ages.

### Post Office (1st Floor, Room 140)
- Open 8:30 am - 4:30 pm

### Restaurants
- **Food Mart North:** (1st Floor)
  Cutting Board (Delicatessen)
  Pastry Pantry (Bakery)
  Big Dipper (Ice Cream)
- **Food Mart South:** (1st Floor)
  Armando's (Italian)
  Mamacita's (Mexican)
  Uncle Sam's (American)
  Entree, Etc. (Traditional)
  Yum Tree (Desserts)
- **Starlight Terrace** (4th Floor, Room 465)
- **State Room** (1st Floor, adjacent to Hotel)
  Fine dining for breakfast and lunch. Try our Sunday Brunch!

### Telephones
- Pay phones on each floor plus local courtesy phone at information Desk, Room 242

### Television
- (4th Floor, Terrace Room) (non-smoking)

### Travel Agency
(2nd Floor, east entrance)
- International Tours **744-6894**

### Video Games
(Lower level, Room 065)
- Student Union Games Room - for all the latest video games as well as billiards.

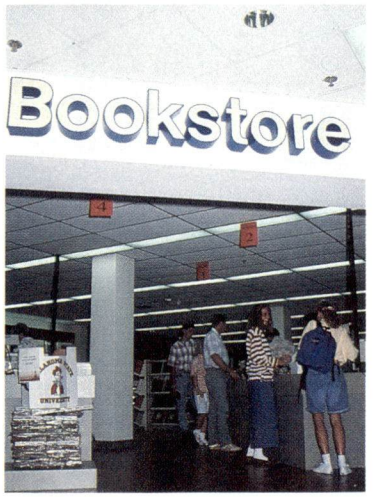
*We've got it all in the . . .*

## UNION PLAZA MALL

- Candies and Gifts
- Jewelry
- Magazines/Cards
- Clothing
- Novelties
- Men and Women's Hairstyling
- Copies/Fax Service
- Travel Agency
- Computers
- Video Games

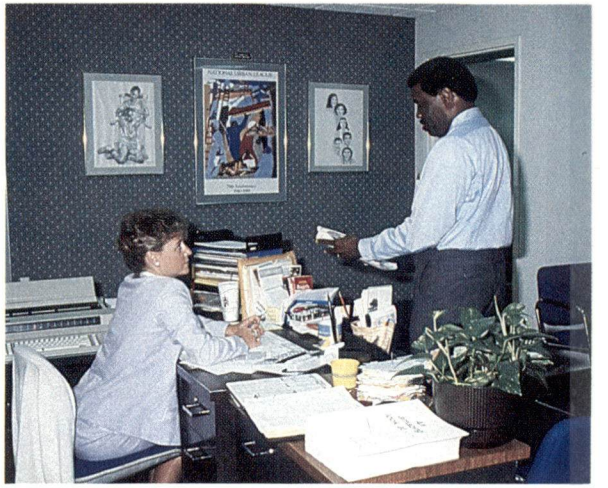
### The Student Store

The Student Store is OSU's only official outlet for Cowboy clothing and souvenirs. It is owned and operated by Oklahoma State University.



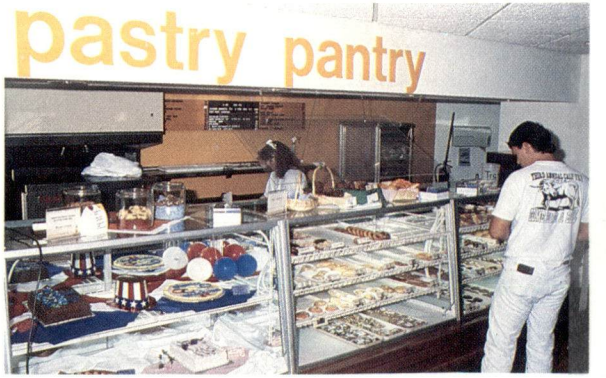

### Student Union Bookstore

The Student Union Bookstore offers a complete line of office and school supplies, as well as required textbooks. The Bookstore carries a wide variety of OSU gifts and novelty items.



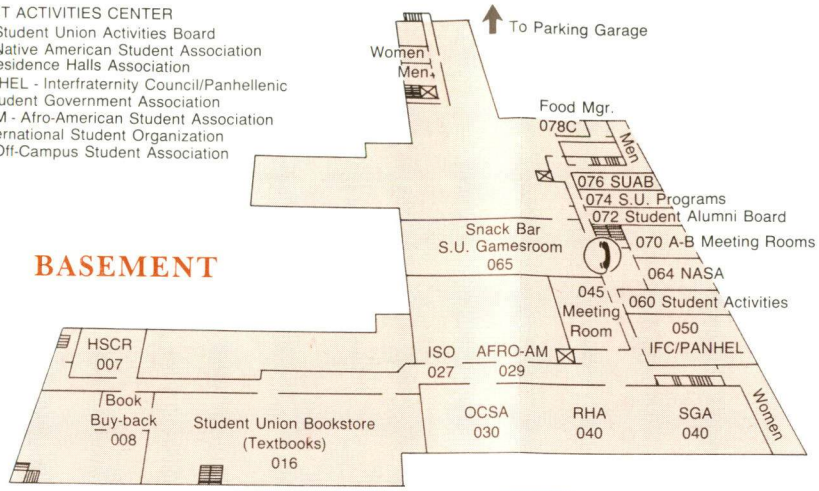
## OFFICES

| Office | Room |
|---|---|
| Alumni Association | 212 |
| Board of Regents - Legal Counsel | 220 |
| Credit Union | 350 |
| Counseling Services | 310 |
| OSU Foundation | H-100 |
| High School and College Relations | 210 |
| International Student Advisement | 316 |
| National University Teleconference Network | 332 |
| Placement Services | 360 |
| Registration/Sectioning | 440 |
| Student Loan Accounting and Collections | 319 |



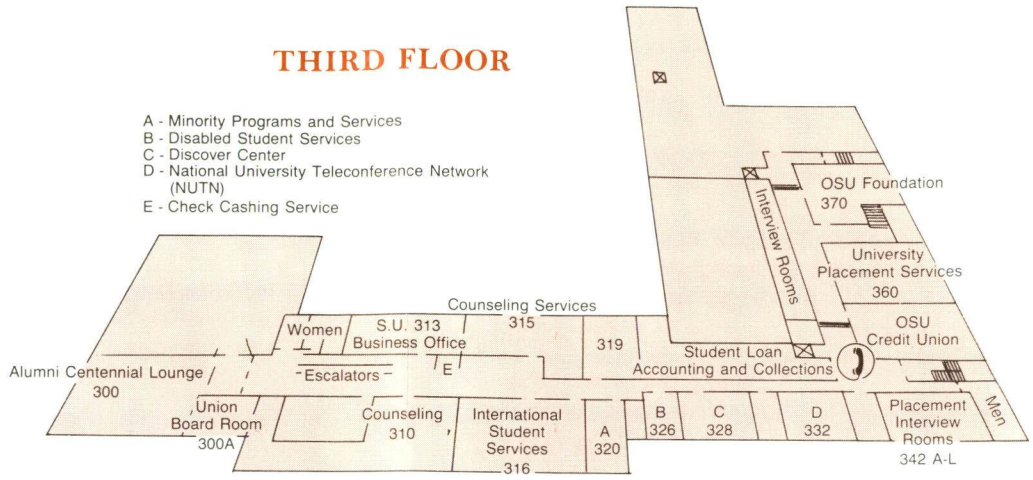
STUDENT ACTIVITIES CENTER
SUAB - Student Union Activities Board
NASA - Native American Student Association
RHA - Residence Halls Association
IFC/PANHEL - Interfraternity Council/Panhellenic
SGA - Student Government Association
AFRO-AM - Afro-American Student Association
ISO - International Student Organization
OCSA - Off-Campus Student Association

## BASEMENT



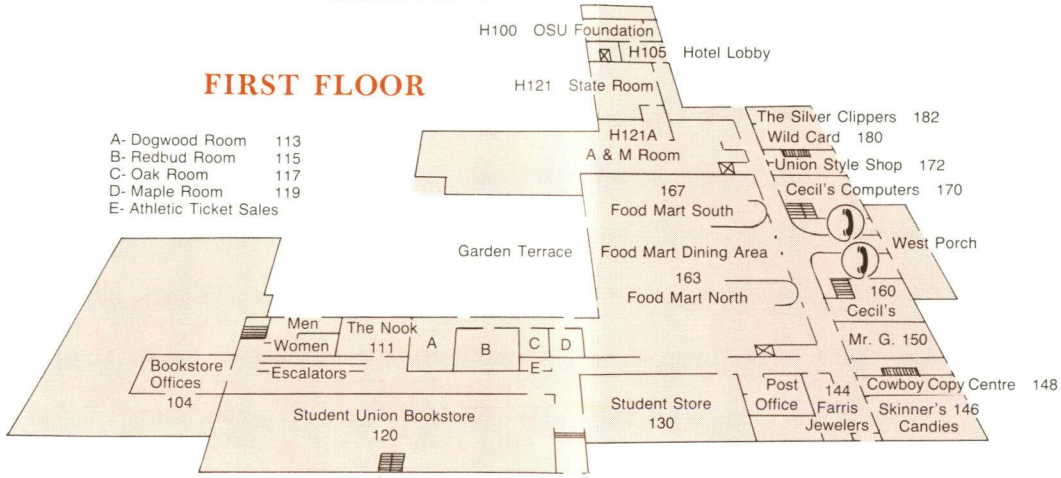

## THIRD FLOOR

A - Minority Programs and Services
B - Disabled Student Services
C - Discover Center
D - National University Teleconference Network (NUTN)
E - Check Cashing Service



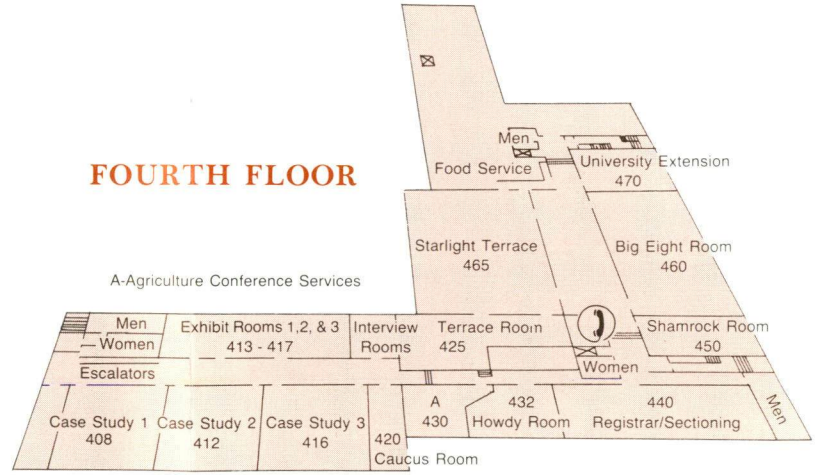

## FIRST FLOOR

A- Dogwood Room 113
B- Redbud Room 115
C- Oak Room 117
D- Maple Room 119
E- Athletic Ticket Sales

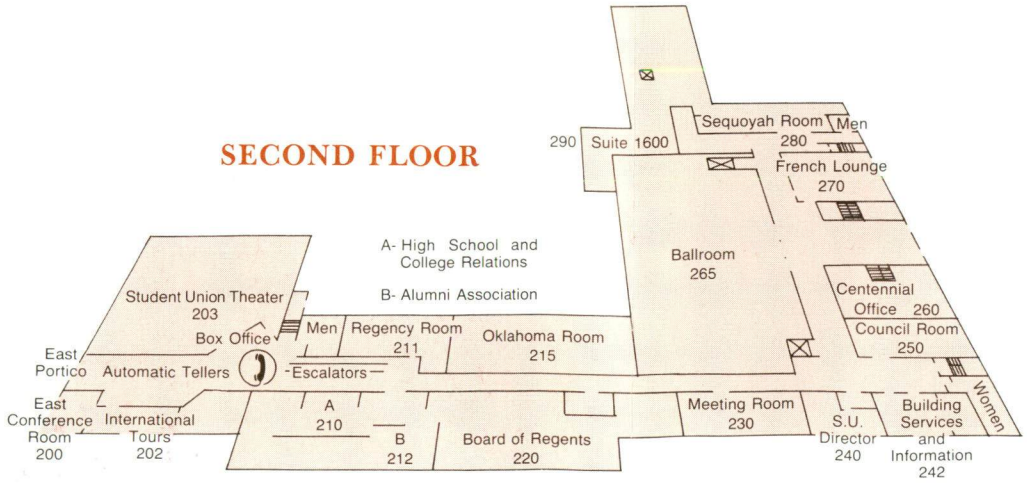



## FOURTH FLOOR

A-Agriculture Conference Services




## SECOND FLOOR

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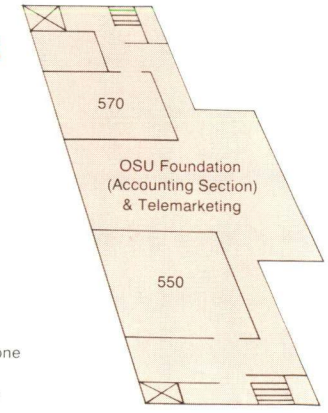
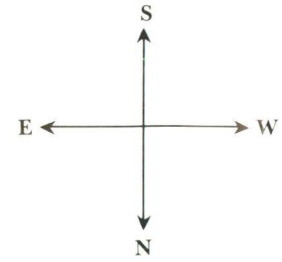



# LOCATOR MAPS

Pay Phone
Elevator

**National Journal Ratings**

| | 1988 LIB | 1988 CONS | 1987 LIB | 1987 CONS |
|---|---|---|---|---|
| Economic | 92% | 0% | 73% | 0% |
| Social | 86% | 0% | 78% | 0% |
| Foreign | 84% | 0% | 81% | 0% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | AGN | 5) Ban Drug Test | AGN | 9) SDI Research | AGN |
| 2) Gephardt Amdt | FOR | 6) Drug Death Pen | AGN | 10) Ban Chem Weaps | FOR |
| 3) Deficit Reduc | FOR | 7) Handgun Sales | AGN | 11) Aid to Contras | AGN |
| 4) Kill Plnt Clsng Notice | AGN | 8) Ban D.C. Abort $ | AGN | 12) Nuclear Testing | |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | Louis Stokes (D) | 148,388 | (86%) | ($173,534) |
| | Franklin H. Roski (R) | 24,804 | (14%) | |
| 1988 primary | Louis Stokes (D), unopposed | | | |
| 1986 general | Louis Stokes (D) | 99,878 | (82%) | ($164,171) |
| | Franklin H. Roski (R) | 22,594 | (18%) | |

# OKLAHOMA

No other state was hit as hard by the Depression of the 1930s as Oklahoma. A state which had grown from 1.5 million at statehood in 1907—well within the living memory of most adult Oklahomans then—to 2.4 million in 1930 suddenly found its way of life destroyed as farm prices plummeted and the farmland itself vanished in dust storms. "On a single day, I heard, 50 million tons of soil were blown away," John Gunther reported later. "People sat in Oklahoma City, with the sky invisible for three days in a row, holding dust masks over their faces and wet towels to protect their mouths at night, while the farms blew by." The famed Okies headed westward on U.S. 66 to the green land of California—the biggest internal migration of the 1930s—and Oklahoma's population sank to 2.3 million in 1940 and 2.2 million in 1950; it did not rise above the 1930 level again until the census of 1970.

The episode was not atypical. Boom and bust has been the history of Oklahoma, over and over again. This is a state with a history as short as any, and as tragic. It was home first to the Cherokee and other Civilized Tribes driven here by Andrew Jackson's troops over the Trail of Tears. Not until 1889 was even part of Oklahoma opened up to white settlement; then, on the morning of the great land rush memorialized in the Rodgers and Hammerstein musical, an Edna Ferber novel, and half a dozen Hollywood movies, thousands of would-be homesteaders drove their wagons across the territorial line, the most adventurous or unscrupulous of them jumping the gun—the Sooners. Of course, it wasn't such attractive land in the first place, or Jackson wouldn't have given it to the Indians. Interestingly, there are many Indians left: Oklahoma has the second largest Indian population of any state, not on reservations, but assimilated into the rest of the population.

Oklahoma boomed once again in the 1970s, as the oil shocks of 1973 and 1979 sent oil prices up; the population rose from 2.5 million in 1970 to 3 million in 1980 and 3.3 million in 1981. Then, with the collapse of oil prices and the collapse of Oklahoma's farm economy as well, it was bust again. Just as the dust cloud was the symbol of Oklahoma's 1930s bust, so the auction of oil drilling equipment might be the symbol of the 1980s calamity. Alongside Oklahoma highways in the middle 1980s you could see rows of drill rigs and tractors, their still bright paint flecked with rust; in muddy lots, you could see bidders watch as yet another oil man's derrick trailers, rig-up trucks, cranes, compressors and Mercedes were auctioned off.



To understand how sickening Oklahoma's fall has been, you need to understand how giddy was its rise. In January 1982, the rig count was 882; in February 1983, 232, and by 1986, 128. In parallel fashion, between 1980 and 1983, 186,000 people moved into the state; between 1983 and 1986, more than that moved out. In the early 1980s, it was the scene of feverish oil drilling in established fields and of deep-well gas exploration in the Anadarko Basin which promised to take care of America's energy needs for years. In the midst of national recession in 1982, Oklahoma had the nation's lowest unemployment rate, below 4%; by 1986, it was above 8%, after the state lost 59,000 oil and gas jobs. By April of 1989, the unemployment rate had fallen back to 5.7%, though this increase in jobs was due to improvements in the service and transportation economies. Oil and gas have continued to wither; by May 1989, the rig count was 93, the lowest level since 1973. Historians may record that Oklahoma ended up after the oil bust pretty much where it was headed before the oil boom, but that ignores the human cost. Thousands of Oklahomans, many from dirt-poor backgrounds, for a fleeting moment struck it rich—and then found themselves shorn of their money and their dreams.

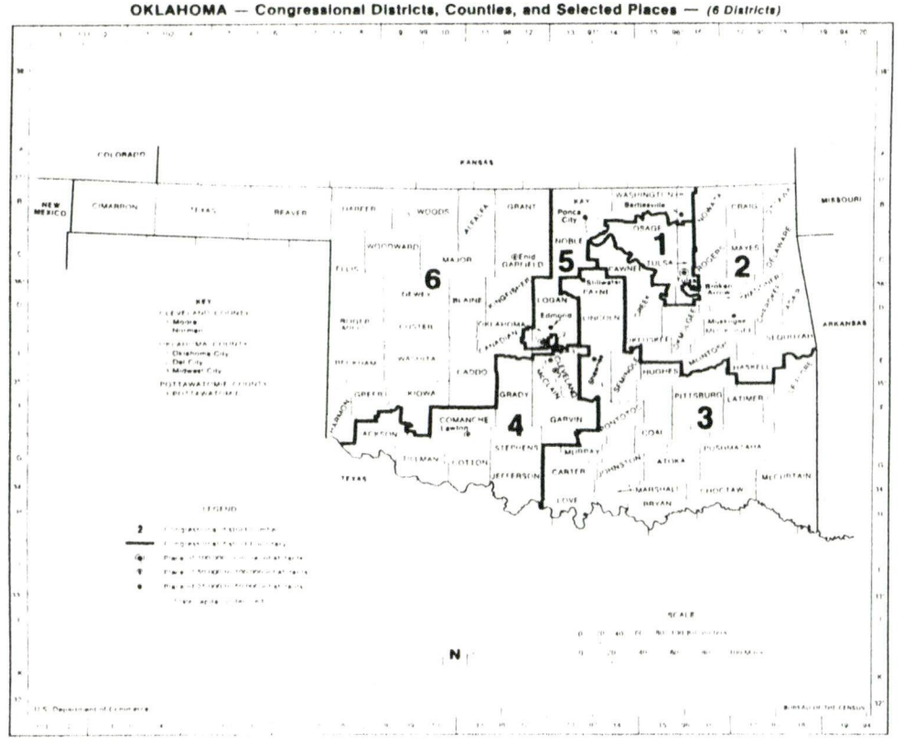
**Governor.** Governor Henry Bellmon is Oklahoma's most durable politician: he was elected governor in 1962, Senator in 1968 and 1974, and governor again as the state's economy languished in 1986. Bellmon is a taciturn wheat farmer who disliked Washington life and refuses to serve liquor in the governor's mansion, and an old-fashioned Republican who dislikes deficits and cultural conservatives. His policy has been austerity. Oil and gas revenues used to provide one-third of Oklahoma's budget, but these revenues are off by two-thirds; as a result, the sales and gas taxes have been doubled and the income tax left unadjusted after federal tax reform, but local property taxes are low (and county governments often overstaffed and corrupt) so the demand for state education spending is high. Bellmon wants to spend more for education, to insist on tobacco-free schools, to bar dropouts from getting driver's licenses, and to institute a no-pass-no-play rule for high school athletes.

In April 1989 Bellmon unexpectedly announced he would retire in 1990, stimulating long lists of candidates for the office. Republicans include current or former legislators Mike Fair, Tim Leonard and Tom Cole; Transportation department head Neal McCaleb; former Human Services chairman V. Burns Hargis and U.S. attorney Bill Price. Democrats include Congressman Wes Watkins, former Governor George Nigh, 1986 nominee and narrow loser (47%–45%) David Walters, Lieutenant Governor Robert Kerr II, Treasurer Ellis Edwards, and state Speaker Steve Lewis.

**Senators.** Oklahoma's Senator David Boren has become, in his second term, an important national figure. When he entered the Senate he seemed to be one of its most conservative young Democrats, a supporter of the Kemp-Roth tax cut before 1980 and a resolute backer of decontrol of oil and gas prices. He snagged a seat on the Finance Committee, where Oklahoma's Robert Kerr once reigned, and he has had considerable success in his original objectives: taxes have been cut and energy prices mostly decontrolled. But in the process of achieving these objectives, Boren has become popular with his fellow Democrats, partly because he has voted with them more often than they anticipated, partly because he is pleasant and competent. He is capable of sharp partisan maneuver: he led a filibuster of Edwin Meese's nomination for Attorney General in early 1985 until Republican leaders agreed to consideration of his farm credit proposals. He played a more nonpartisan role shaping the 1987 farm credit bill.

In the late 1980s, he has concentrated on two new issues. One was campaign finance reform. He has never accepted PAC contributions himself, and the Boren bill which he introduced with Barry Goldwater in 1985 would have limited the total amount of PAC money candidates could receive and provide the option of federal financing which would be conditioned on accepting

**OKLAHOMA — Congressional Districts, Counties, and Selected Places — *(6 Districts)***




limits on campaign and personal spending. Boren had to struggle to get a vote on it, but finally succeeded and saw 69 Senators agree — although the number might have been inflated because it was clear it would not pass the House.

The other major area for Boren's attention is foreign policy, now that he is chairman of the Senate Intelligence Committee. Boren seems likely to be a quieter chairman than David Durenberger was, less prone to go to the press with complaints and disclosures, more willing to work with the CIA which has itself seemed more willing to work with Congress. He played a part in strengthening the verification provisions of the INF Treaty but has otherwise been quiet—perhaps a sign of success in that job.

Boren has been the most popular politician in recent Oklahoma history. He has long experience in politics: his father was a congressman, and after Yale and a Rhodes scholarship he returned to Oklahoma for law school, was elected to the legislature, and was elected governor in 1974. In the Democratic primary he beat an incumbent who later went to jail; Boren's symbol was a broom. Boren was an early Carter supporter, but was disappointed when Carter didn't back total decontrol of energy prices. He ran for the Senate when Republican Dewey Bartlett retired in 1978 and won reelection easily in 1984. He has been mentioned locally as a possible favorite son candidate for President; when Oklahoma's Robert Kerr ran as a favorite son at the 1952 national convention, Boren, then 11, was a page for him. He is up for reelection in 1990,



and by early 1989 no credible opponent had surfaced.

Oklahoma's other Senator, Don Nickles, turns out to have a safer seat than many Washington observers thought. Nickles was one of the real surprise winners in 1980, a 31-year-old state senator with little command of national issues and a Catholic whose strongest support came from Protestant fundamentalists. But that is an asset here: if polls could measure intensity of religious feeling, Oklahoma would probably rank near the top of the nation. This is Southern Baptist and evangelical country: Oklahoma only recently has allowed liquor by the drink, and Tulsa is the headquarters of evangelist and Pentecostal faith healer Oral Roberts. With that support, Nickles won typically light-turnout Republican primary and runoff contests and prevailed over a not very well-known Democrat in the general. In Washington, Nickles was one of the least visible of the Republican freshmen, not coming forward with venturesome legislation or constitutional amendments, not denouncing colleagues for backing conventional policy.

This may have been shrewder than it looked. Certainly the Democrats seemed to underestimate Nickles going into 1986. His opponent was Tulsa Congressman Jim Jones, chairman of the House Budget Committee for the first four Reagan years, 14-year House incumbent from a basically Republican district, an aide when a very young man to President Lyndon Johnson. By any measure of legislative competence or raw ability, Jones was the superior candidate, but he had some liabilities which Nickles shrewdly exploited. To Oklahomans, Nickles seemed the patently sincere and plausible candidate.

Nickles has been more active legislatively than expected in the Democratic Senate, and had the satisfaction of finally seeing the 55-mile-per-hour speed limit and the windfall profits tax repealed in 1988. He serves on the Appropriations and Budget Committees—assignments that could give him real leverage in a Republican Senate—and he was chosen to chair the Republican Senate campaign committee in 1989 and 1990.

This is a tough assignment: Republicans go into the cycle behind 55–45; the Democrats probably have more obvious targets; and the early retirements of Bill Armstrong and Gordon Humphrey make holding their two seats considerably iffier. Nevertheless, Democrats who scoff at Nickles's skills should recall how he did against Jim Jones. The Republicans have long had a fine fundraising operation, and they have often done brilliantly at sending the money in the right directions. The harder part is to frame the issues in a way that works for their candidates. Nickles seems to have done that in Oklahoma better than anyone expected, or at least better than most of the Republican Senators of the class of 1980, and it will be interesting to see if he surprises the pundits once again in 1990.

**Presidential politics.** Curiously, neither the dust bowl nor the oil bust vastly changed Oklahoma's party politics. Historically, party preference was determined by where you came from: southern Oklahoma's Little Dixie was Democratic; the wheat country in the northwest, settled from Kansas, was Republican. Southerners and Democrats were more numerous, and Oklahoma was mostly Democratic, and became a bit more so in the bust of the 1930s. The same split remains today, in different proportions. In the close presidential race of 1976, Gerald Ford carried almost every county north of Interstate 40 and west of Tulsa and lost almost every one on the other side of that line; Republican Henry Bellmon did the same in the close gubernatorial contest of 1986. The balance favors the Republicans, however, because of their strength in the two big cities, Oklahoma City and Tulsa, which have long been Republican, and among people in the oil business, who believe they prosper from free markets and were hurt by regulation—except for regulations and tax preferences that helped them, of course.

That Republican trend in the two metropolitan areas, which between them cast 47% of the state's votes, kept Oklahoma solidly Republican despite the oil bust of the 1980s. It favored Ronald Reagan over Walter Mondale 69%–31%, and in 1986, when most of the country trended mildly Democratic, Oklahoma reelected a Republican Senator who had a strong opponent and, like its Oil Patch neighbor Texas (known here sometimes as Baja Oklahoma), replaced a

Democratic governor with a Republican. In 1988, however, it moved toward the Democrats; Oklahoma, outside the two metropolitan areas, (though nothing like Brookline, Massachusetts in its cultural attitudes) gave George Bush no better than his national margin of 53%–46%. He still carried the state smartly by winning 64% and 63% in greater Oklahoma City and Tulsa.

**Congressional districting.** Oklahoma's congressional districting plan is, to put it bluntly, a Democratic gerrymander. It was designed to safeguard the seats of the state's five Democratic congressmen and to place the maximum number of Republican voters in the seat of its one Republican House Member. It succeeded through 1986, when Jim Jones's decision to run for the Senate enabled the Republicans to take the Tulsa-based 1st District that always seemed likely to be theirs if Jones were not a candidate—though they didn't win it by a large margin in 1988 and it may be seriously contested in 1990.

**The People:** Est. Pop. 1988: 3,263,000; Pop. 1980: 3,025,290, up 7.9% 1980–88 and 18.2% 1970–80; 1.37% of U.S. total, 26th largest. 16% with 1–3 yrs. col., 16% with 4+ yrs. col.; 13.4% below poverty level. Single ancestry: 13% English, 6% German, 5% Irish, 1% French, Dutch. Households (1980): 74% family, 40% with children, 63% married couples; 29.3% housing units rented; median monthly rent: $164; median house value: $35,600. Voting age pop. (1980): 2,170,406; 6% Black, 5% American Indian, 2% Spanish origin, 1% Asian origin. Registered voters (1988): 2,199,014; 1,436,147 D (65%), 704,901 R (32%), 57,966 unaffiliated and minor parties (3%).

**1988 Share of Federal Tax Burden:** $9,219,000,000; 1.04% of U.S. total, 27th largest.

**1988 Share of Federal Expenditures**

| | Total | | Non-Defense | | Defense | |
|---|---|---|---|---|---|---|
| Total Expend | $10,762m | (1.22%) | $8,434m | (1.29%) | $2,665m | (1.17%) |
| St/Lcl Grants | 1,406m | (1.23%) | 1,405m | (1.23%) | 1m | (0.97%) |
| Salary/Wages | 2,232m | (1.66%) | 747m | (1.11%) | 1,485m | (1.11%) |
| Pymnts to Indiv | 5,640m | (1.38%) | 5,332m | (1.37%) | 308m | (1.65%) |
| Procurement | 870m | (0.46%) | 336m | (0.72%) | 870m | (0.46%) |
| Research/Other | 614m | (1.65%) | 614m | (1.66%) | 1m | (1.66%) |

**Political Lineup:** Governor, Henry Bellmon (R); Lt. Gov., Robert S. Kerr, II (D); Secy. of State, Hannah Atkins (D); Atty. Gen., Robert Henry (D); Treasurer, Ellis Edwards; Controller, Clifton H. Scott (D). State Senate, 48 (33 D and 15 R); State House of Representatives, 101 (69 D and 32 R). Senators, David Lyle Boren (D) and Don Nickles (R). Representatives, 6 (4 D and 2 R).

**1988 Presidential Vote**

| | | |
|---|---|---|
| Bush (R) | 678,367 | (58%) |
| Dukakis (D) | 483,423 | (41%) |

**1988 Democratic Presidential Primary**

| | | |
|---|---|---|
| Gore | 162,584 | (41%) |
| Gephardt | 82,596 | (21%) |
| Dukakis | 66,278 | (17%) |
| Jackson | 52,417 | (13%) |
| Hart | 14,336 | (4%) |
| Simon | 6,901 | (2%) |

**1984 Presidential Vote**

| | | |
|---|---|---|
| Reagan (R) | 861,530 | (69%) |
| Mondale (D) | 385,080 | (31%) |

**1988 Republican Presidential Primary**

| | | |
|---|---|---|
| Bush | 78,224 | (38%) |
| Dole | 73,016 | (35%) |
| Robertson | 44,067 | (21%) |
| Kemp | 11,439 | (6%) |



## GOVERNOR

**Gov. Henry Bellmon (R)**

Elected 1986, term expires Jan. 1991; b. Sept. 3, 1921, Tonkawa; home, Red Rock; OK St. U., B.S. 1942; Presbyterian; married (Shirley).

**Career:** USMC, WWII; Farmer; OK House of Reps., 1946–48; Gov. of OK, 1962–66; U.S. Senate, 1968–80.

**Office:** State Capitol Bldg., Rm. 212, Oklahoma City 73105, 405-521-2342.

**Election Results**

| | | | |
|---|---|---|---|
| 1986 gen. | Henry Bellmon (R) | 431,762 | (47%) |
| | David Walters (D) | 405,295 | (45%) |
| | Jerry Brown (I) | 60,115 | (7%) |
| 1986 prim. | Henry Bellmon (R) | 111,665 | (70%) |
| | Mike Fair (R) | 33,266 | (21%) |
| | Three others (R) | 13,968 | (7%) |
| 1982 gen. | George P. Nigh (D) | 548,159 | (62%) |
| | Tom Daxon (R) | 332,207 | (38%) |

## SENATORS

**Sen. David Lyle Boren (D)**

Elected 1978, seat up 1990; b. Apr. 21, 1941, Washington, D.C.; home, Seminole; Yale U., B.A. 1963, Rhodes Scholar, Oxford U., 1965, U. of OK, J.D. 1968; United Methodist; married (Molly).

**Career:** OK House of Reps., 1968–74; Prof. and Chmn., Dept. of Govt., OK Baptist U., 1968–74; Practicing atty.; Gov. of OK, 1975–79.

**Offices:** 453 RSOB 20510, 202-224-4721. Also 621 N. Robinson, Rm. 350, Oklahoma City 73102, 405-231-4381; 440 S. Houston, Tulsa 74127, 918-581-7785; and Municipal Bldg., Seminole 74868, 405-382-6480.

**Committees:** *Agriculture, Nutrition, and Forestry* (3d of 10 D). Subcommittees: Agricultural Credit; Agricultural Production and Stabilization of Prices; Domestic and Foreign Marketing and Product Promotion (Chairman). *Finance* (5th of 11 D). Subcommittees: Energy and Agricultural Taxation (Chairman); International Trade; Taxation and Debt Management. *Small Business* (6th of 10 D). Subcommittees: Government Contracting and Paperwork Reduction; Rural Economy and Family Farming. *Select Committee on Intelligence* (Chairman of 8 D).

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 25 | 41 | 41 | 58 | 20 | 48 | 33 | 90 | 58 | 17 |
| 1987 | 35 | — | 39 | 42 | — | 63 | — | — | 50 | 33 |

**National Journal Ratings**

| | 1988 LIB — 1988 CONS | | 1987 LIB — 1987 CONS | |
|---|---|---|---|---|
| Economic | 35% | 63% | 41% | 58% |
| Social | 40% | 59% | 29% | 70% |
| Foreign | 48% | 51% | 40% | 59% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Cut Aged Housing $ | AGN | 5) Bork Nomination | FOR | 9) SDI Funding | FOR |
| 2) Override Hwy Veto | FOR | 6) Ban Plastic Guns | AGN | 10) Ban Chem Weaps | FOR |
| 3) Kill Plnt Clsng Notice | FOR | 7) Deny Abortions | FOR | 11) Aid To Contras | FOR |
| 4) Min Wage Increase | AGN | 8) Japanese Reparations | FOR | 12) Reagan Defense $ | AGN |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1984 general | David Lyle Boren (D) | 906,131 | (76%) | ($1,192,026) |
| | William F. (Bill) Crozier (R) | 280,638 | (23%) | ($6,925) |
| 1984 primary | David Lyle Boren (D) | 432,534 | (90%) | |
| | Marshall Luse (D) | 48,761 | (10%) | |
| 1978 general | David Lyle Boren (D) | 493,953 | (65%) | ($751,286) |
| | Robert B. Kamm (R) | 247,857 | (33%) | ($443,712) |

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**Sen. Don Nickles (R)**

Elected 1980, seat up 1992; b. Dec. 6, 1948, Ponca City; home, Ponca City; OK St. U., B.A. 1971; Roman Catholic; married (Linda).

**Career:** Natl. Guard, 1970-76; Vice Pres. and Gen. Mgr., Nickles Machine Co., 1976-80; OK Senate, 1979-80.

**Offices:** 713 HSOB, 202-224-5754. Also 215 Dean McGee Ave., Rm. 820, Oklahoma City 73102, 405-231-4941; 3310 Mid-Continent Tower, 401 S. Boston, Tulsa 74103, 918-581-7651; 1916 Lake Rd., Ponca City 74601, 405-767-1270; and 106 Fed. Bldg., 5th and F Ave., Rm. 115, Lawton 73501, 405-357-9878.

**Committees:** *Appropriations* (12th of 13 R). Subcommittees: Foreign Operations; Interior; Legislative Branch (Ranking Member); VA, HUD, and Independent Agencies. *Budget* (7th of 10 R). *Energy and Natural Resources* (6th of 9 R). Subcommittees: Energy Regulation and Conservation (Ranking Member); Energy Research and Development; Mineral Resources Development and Production.

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 0 | 4 | 3 | 17 | 0 | 92 | 73 | 100 | 86 | 71 |
| 1987 | 5 | | 3 | 8 | | 100 | | | 94 | 87 |

**National Journal Ratings**

| | 1988 LIB — 1988 CONS | | 1987 LIB — 1987 CONS | |
|---|---|---|---|---|
| Economic | 25% | 73% | 6% | 87% |
| Social | 0% | 89% | 6% | 89% |
| Foreign | 0% | 92% | 0% | 76% |



**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Cut Aged Housing $ | AGN | 5) Bork Nomination | FOR | 9) SDI Funding | FOR |
| 2) Override Hwy Veto | AGN | 6) Ban Plastic Guns | FOR | 10) Ban Chem Weaps | FOR |
| 3) Kill Plnt Clsng Notice | FOR | 7) Deny Abortions | FOR | 11) Aid To Contras | FOR |
| 4) Min Wage Increase | AGN | 8) Japanese Reparations | AGN | 12) Reagan Defense $ | FOR |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1986 general | Don Nickles (R) | 493,436 | (55%) | ($3,252,965) |
| | James R. Jones (D) | 400,230 | (45%) | ($2,564,982) |
| 1986 primary | Don Nickles (R), unopposed | | | |
| 1980 general | Don Nickles (R) | 587,252 | (53%) | ($828,346) |
| | Andy Coats (D) | 478,283 | (44%) | ($996,447) |

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## FIRST DISTRICT

"A dramatic view of Tulsa from the southwest," wrote the *WPA Guide* 50 years ago, "across the vast refinery dominated by West Tulsa and the wide sand-carpeted bed of the river, shows tall, smoke-stained stacks giving way, on the skyline, to the taller modern-city group of skyscrapers that serve the office and hotel needs of its hundreds of oil companies. It is a visual summary of the city's description of itself as the oil capital of the world." The label was grandiose, but Tulsa, almost spanking new in the 1920s and 1930s (it was Indian country not long before that, within living memory) already had the character it still shows today. Its buildings may not have been air-conditioned, but its economy was based on oil; Oral Roberts had not yet built his church headquarters, his university, or his 60-story City of Faith hospital, but Tulsa was already a city inspired by the tradition of enthusiastic religion; its leading citizens did not shop then in gallerias, but they already had pretentions for culture and looked down on the mud-on-their-boots sorts in Oklahoma City.

Politically, Tulsa was then and is now one of America's most conservative cities—which means, paradoxically, that it wants to change the way a lot of things are going. Despite the collapse of oil prices in the 1980s, Tulsa is still full of a contagious enthusiasm for new business enterprises and innovations. Ordinary people here do not resent or attack the oil companies or the new rich; they identify with them. They see not class conflict, but a coincidence of economic interests. They see government as interfering with efforts to produce goods and services people want and are ready to pay for—although Tulsans are pleased that the federal government built the McClellan-Kerr Waterway that has made the Tulsa suburb of Catoosa a seaport. They are only mildly embarrassed by Oral Roberts's declaration that "God would call him home" unless he raised $4.5 million by April 1, 1987 for his plans for medical programs. (He was saved at the last minute when a Florida dog track owner gave him $1.3 million.)

Oklahoma's 1st Congressional District consists of most of Tulsa County, plus parts of several of the surrounding counties, into which Tulsa's suburban growth has just been starting to pour in the 1970s and 1980s. By all odds it should be a solidly Republican district. It has voted for nothing but Republican presidential candidates over the last 50 years. Yet the 1st was represented by a Democrat, Jim Jones, for most of the 1970s and 1980s, and its current Republican congressman, Jim Inhofe, seems in weak political shape. This can be explained partly by political skills. Jones, a onetime aide to President Lyndon Johnson, has a subtle political mind and had a successful House career, serving on the Ways and Means Committee (important always to oil interests) and serving for four years as chairman of the Budget Committee. Inhofe, in contrast, has had a rocky political (and business) career; an insurance company of which he was president left debts of $2 million, and he was hurt during the 1988

campaign by reports that in 1986 he took out a $20,000 personal loan and immediately donated it to the campaign—an end run, it seemed, around campaign finance law restrictions. He was beaten for reelection to the Oklahoma Senate in 1978 and as mayor of Tulsa in 1983; he lost the governor's race to David Boren in 1974 and the 1st District race to Jim Jones in 1976.

But Inhofe came back and won the House seat in 1986 against weak opposition in the primary and general, when Jones ran unsuccessfully for the Senate. Inhofe takes pride in being outspoken and a staunch conservative, criticizing colleagues George Crockett for supporting the Communist party line and Barney Frank for being homosexual. In 1988, he had tougher opposition from 33-year-old Kurt Glassco, who had been an aide to former Governor George Nigh. Glassco was for contra aid, against gun control, for silent school prayer and the death penalty; he said he knew people's problems from being a prosecutor while Inhofe had been on the public payroll too long. If he seemed to be singing a Republican tune, he may have been doing it more harmoniously than the incumbent Republican, who was dogged by a lawsuit brought by his brother over a family estate, which generated unfavorable publicity about the congressman's business practices, and by charges that in 1987 his campaign borrowed $20,000 from the same supporter who had illegally contributed to his 1986 campaign. Inhofe won reelection by the weak margin of 52%–48%. This may stimulate serious competition from Glassco or someone else in 1990, or after redistricting in 1992.

**The People:** Est. Pop. 1986: 552,400, up 9.7% 1980–86; Pop. 1980: 503,739, up 14.1% 1970–80. Households (1980): 71% family, 38% with children, 59% married couples; 34.3% housing units rented; median monthly rent: $204; median house value: $42,500. Voting age pop. (1980): 365,006; 8% Black, 4% American Indian, 1% Spanish origin, 1% Asian origin.

| **1988 Presidential Vote:** | | | |
|---|---|---|---|
| | Bush (R) | 120,873 | (61%) |
| | Dukakis (D) | 76,349 | (38%) |

**Rep. James M. Inhofe (R)**

Elected 1986; b. Nov. 17, 1934, Des Moines, IA; home, Tulsa; U. of Tulsa, B.A. 1961; Presbyterian; married (Kay).

**Career:** OK House of Reps., 1968–69; OK Senate, 1969–77, Repub. Ldr., 1975–77; Mayor of Tulsa, 1978–84.

**Offices:** 408 CHOB 20515, 202-225-2211. Also 201 W. 5th St., Tulsa 74103, 918-581-7111.

**Committees:** *Merchant Marine and Fisheries* (16th of 17 R). Subcommittees: Coast Guard and Navigation; Merchant Marine. *Public Works and Transportation* (12th of 20 R). Subcommittees: Aviation; Investigations and Oversight; Water Resources. *Select Committee on Narcotics Abuse and Control* (8th of 12 R).

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 10 | 13 | 17 | 27 | 19 | 92 | 87 | 100 | 92 | 68 |
| 1987 | 4 | -- | 0 | 7 | -- | 100 | -- | -- | 100 | 83 |



**National Journal Ratings**

| | 1988 LIB | — | 1988 CONS | 1987 LIB | — | 1987 CONS |
|---|---|---|---|---|---|---|
| Economic | 21% | — | 77% | 0 | — | 89% |
| Social | 0% | — | 95% | 0 | — | 90% |
| Foreign | 0% | — | 84% | 0 | — | 80% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | -- | 5) Ban Drug Test | FOR | 9) SDI Research | FOR |
| 2) Gephardt Amdt | AGN | 6) Drug Death Pen | FOR | 10) Ban Chem Weaps | AGN |
| 3) Deficit Reduc | AGN | 7) Handgun Sales | FOR | 11) Aid to Contras | FOR |
| 4) Kill Plnt Clsng Notice | FOR | 8) Ban D.C. Abort $ | FOR | 12) Nuclear Testing | AGN |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | James M. Inhofe (R) | 103,458 | (52%) | ($484,585) |
| | Kurt Glassco (D) | 93,101 | (48%) | ($253,585) |
| 1988 primary | James M. Inhofe (R), unopposed | | | |
| 1986 general | James M. Inhofe (R) | 78,919 | (55%) | ($410,286) |
| | Gary D. Allison (D) | 61,663 | (43%) | ($119,550) |

## SECOND DISTRICT

Indian Territory—that was, literally, what northeast Oklahoma was, from the time in the 1830s the Five Civilized Tribes were driven here from Georgia and Alabama over the Trail of Tears. Oklahoma was not open to white settlement until 1889, and today 12% of the people in this part of Oklahoma report their race as American Indian; many more claim some percentage of Indian blood. The Indian percentage is highest in the hilly counties just west of the Ozarks of Arkansas, where the county names—Cherokee, Delaware, Sequoyah—recall what were called the Civilized Tribes. "Steadily there is being woven into the fabric of Oklahoma's citizenship this red thread of Indian," wrote the *WPA Guide* 50 years ago. "Through intermarriage, Indian blood in Oklahoma is becoming more widely diffused. The time may come when an Indian recognizable as such will be hard to find within the state, but perhaps through wider dissemination the influences of Indian blood may be greater in the future than they have ever been in the past." Much attention nationally is focused on the problems of Indians in states where there are large reservations. But no one seems to be asking whether the experience of the Indians in Oklahoma—where they are now relatively prosperous, assimilated and living comfortably with the white population—has any useful lessons for Indians and whites in other parts of the country.

Most of northeastern Oklahoma, minus most of Tulsa and its immediate surroundings, makes up the 2d Congressional District of Oklahoma. It is represented by a man from Muskogee, Mike Synar, who is not an ordinary Oklahoma politician. Synar is aggressive, pushy, independent to the point of cussedness, yet possessed of a self-effacing sense of humor. His record on the issues is about as liberal as that of any Oklahoma congressman, and his energy is not concentrated on parochial issues. He made headlines in 1985 when he brought a lawsuit challenging the constitutionality of Gramm-Rudman—after several colleagues who said they'd join him ducked out—and more headlines in 1986 when the Supreme Court ruled that Gramm-Rudman's trigger mechanism was indeed unconstitutional. He has fought for years to ban all forms of tobacco advertising. With David Obey of Wisconsin, he is the lead House sponsor of the campaign finance reform to limit PAC contributions, and he takes no PAC money himself. Synar sometimes seems to be a fly in every well-entrenched group's ointment—which occasionally costs him. He ran for Democratic caucus chairman in 1988, and was unwilling to make

campaign contributions to colleagues, as William Gray did, or to politick much for support; he ran far behind Gray and Mary Rose Oakar.

But he is not a down-the-line liberal either. He worked hard on the bankruptcy law in 1986 and on some issues supported the views advanced by big creditors. He has worked out compromises on such sticky issues as who should pay for state and local costs imposed by the immigration reform bill and family farm bankruptcy procedures. He was a vitriolic opponent of the Synthetic Fuels Corporation, despite its strong support from Jim Wright. On the Energy and Commerce Committee, he pushed for natural gas deregulation against the never-to-be-underestimated opposition of Chairman John Dingell. He supports the seven-day waiting period for gun purchases opposed by the National Rifle Association. In his first term, as a young member of the Judiciary Committee, he sponsored a key amendment strengthening the fair housing law the House passed in 1980, which passed by a 205-204 vote. More recently, he has been pushing for a mandatory parental leave law.

Synar has managed to combine this record of positions which are not always popular, and priorities which are not always shared in his district, with impressive popularity among the voters. He first won the seat in a fluke, beating in the 1978 Democratic primary an incumbent who had recently been divorced and was rumored to have a heart-shaped waterbed, and winning reelection by a lesser margin in 1980. After winning more than 70% against weak opponents in suceeding elections, he got stronger primary opposition in 1988. Frank Shurden, a state senator whose seat was not up, challenged him in the primary, swearing that he would vote for contra aid and against all tax increases and deficits, and boasting of his bill requiring castration of convicted sex offenders. But Synar, who returned most weekends to the district and took care to have a strong constituency service operation, won 70%–30%. In the general, Republican businessman Ira Phillips, though not very articulate, made the standard Republican case against liberalism. Synar replied, "If fighting for senior citizens, veterans, farmers and ranchers, families and the future of children is liberal, I claim proudly to be one." In a year when Michael Dukakis ran even with George Bush in most of the district, Synar carried every county in the district but Tulsa and won 65%–35%. These victories pretty well dispose of the notion that Synar is vulnerable, and as he enters his forties he has the prospect of a long House career ahead of him.

**The People:** Est. Pop. 1986: 559,400, up 10.7% 1980-86; Pop. 1980: 505,149, up 33.6% 1970-80. Households (1980): 78% family, 42% with children, 68% married couples; 23.0% housing units rented; median monthly rent: $118; median house value: $31,500. Voting age pop. (1980): 353,938; 10% American Indian, 4% Black, 1% Spanish origin.

| **1988 Presidential Vote:** | | | |
|---|---|---|---|
| | Bush (R) | 110,246 | (53%) |
| | Dukakis (D) | 97,194 | (47%) |



**Rep. Michael L. (Mike) Synar (D)**

Elected 1978; b. Oct. 17, 1950, Vinita; home, Muskogee; U. of OK, B.A. 1972, J.D. 1977, Northwestern U., M.S. 1973, U. of Edinburgh, Rotary Intl. Scholar, 1974; Episcopalian; single.

**Career:** Rancher, practicing atty., real estate broker.

**Offices:** 2441 RHOB 20515, 202-225-2701. Also Fed. Bldg., 125 S. Main, Rm. 2B22, Muskogee 74401, 918-687-2533.

**Committees:** *Energy and Commerce* (12th of 26 D). Subcommittees: Energy and Power; Health and the Environment; Telecommunications and Finance. *Government Operations* (6th of 24 D). Subcommittee: Environment, Energy, and Natural Resources (Chairman). *Judiciary* (7th of 21 D). Subcommittees: Courts, Intellectual Property, and the Administration of Justice; Economic and Commercial Law. *Select Committee on Aging* (11th of 39 D). Subcommittees: Health and Long-Term Care; Retirement Income and Employment.

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 100 | 91 | 62 | 91 | 69 | 0 | 17 | 10 | 38 | 20 |
| 1987 | 84 | — | 60 | 86 | — | 13 | — | — | 13 | 13 |

**National Journal Ratings**

| | 1988 LIB — 1988 CONS | 1987 LIB — 1987 CONS |
|---|---|---|
| Economic | 65% — 34% | 55% — 43% |
| Social | 86% — 0% | 78% — 0% |
| Foreign | 68% — 28% | 71% — 27% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | AGN | 5) Ban Drug Test | AGN | 9) SDI Research | AGN |
| 2) Gephardt Amdt | AGN | 6) Drug Death Pen | AGN | 10) Ban Chem Weaps | FOR |
| 3) Deficit Reduc | FOR | 7) Handgun Sales | AGN | 11) Aid to Contras | AGN |
| 4) Kill Plnt Clsng Notice | AGN | 8) Ban D.C. Abort $ | AGN | 12) Nuclear Testing | FOR |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | Michael L. (Mike) Synar (D) | 136,009 | (65%) | ($358,705) |
| | Ira Phillips (R) | 73,659 | (35%) | ($81,634) |
| 1988 primary | Michael L. (Mike) Synar (D) | 62,936 | (70%) | |
| | Frank Shurden (D) | 27,604 | (30%) | |
| 1986 general | Michael L. (Mike) Synar (D) | 114,543 | (73%) | ($268,187) |
| | Gary K. Rice (R) | 41,795 | (27%) | ($11,276) |

## THIRD DISTRICT

Fifty years ago, Little Dixie was the most backward part of Oklahoma. This southeast part of the state was settled between 1889 and 1907 by white southerners, most of them dirt poor; some county names here (Leflore, Pontotoc) were taken directly from Mississippi. The politics, too, was from the old one-party South: Little Dixie remains the most Democratic part of Oklahoma, giving even Michael Dukakis a near victory in 1988. The 3d Congressional District of Oklahoma includes most of the Little Dixie counties, and juts up into the center of the state, into the old university town of Stillwater, which is Republican territory, to include enough people to meet

the population standard.

This is the district that for 30 years elected Carl Albert to the House of Representatives. Albert was chosen by Speaker Sam Rayburn early in his career, in 1955, to be majority whip, but he did not get to be Speaker until 1971, when he seemed tired; he deferred to committee chairmen and had trouble relating to the younger Members who were potential allies for a strong Speaker. Nonetheless, as a national leader of the area's historic party, he was widely popular in Little Dixie.

The current congressman from Little Dixie succeeded Carl Albert and has a different approach. Rather than seek a national leadership post, Congressman Wes Watkins has concentrated on getting projects for the district. He is a member of the Appropriations Committee, and of two subcommittees which can do his district a lot of good: Agriculture and Energy and Water Development. He devotes much time, energy and ingenuity in snaring more water projects for Little Dixie; and he has been active as a promoter of rural areas generally, and was for three terms chairman of a Rural Caucus. He has taken a role on national issues with implications for rural America, like the farm credit bill of 1987. But he seems to devote most of his attention to local projects. He was proud to have helped create the Winding Stair Mountain National Recreation and Wilderness Area and the Robert S. Kerr Memorial Arboretum, named after the Senator who, in the 1950s and early 1960s, brought plenty of pork to Oklahoma. These projects may have done some good, too. At least the economy of Little Dixie has been growing more robustly than that of the rest of the state in the 1980s; it is less dependent on oil and more on leisure time activities, and in 1986 and 1987 it generated more than one-third of the state's new jobs.

On other issues, Watkins voted a very conservative line in his first four years in the House and since Ronald Reagan came in has been much closer to other Democrats. This probably reflects a shrewd appreciation of how the increasingly partisan House does business. Committee and subcommittee chairmen are elected by secret ballot by their fellow Democrats, and conservatives who buck the party too often lose these contests. Watkins has not caused party leaders any trouble, and in return they are happy to help him with what he cares about the most. This has proved a winning formula in 3d District elections, which have not been seriously contested since 1976, when Watkins beat Albert's longtime administrative assistant, Charles Ward, in the primary.

But Watkins may leave the 3d to run for governor. In April 1989 when Governor Henry Bellmon announced his retirement, Watkins emerged as one of the leading Democratic contenders for the office, and seemed poised to run. If he does the favorite in this district that almost voted for Michael Dukakis will be the next Democratic nominee. The most prominent early possibility was state Attorney General Robert Henry.

**The People:** Est. Pop. 1986: 536,800, up 6.5% 1980-86; Pop. 1980: 504,268, up 20.1% 1970-80. Households (1980): 74% family, 39% with children, 64% married couples; 27.6% housing units rented; median monthly rent: $113; median house value: $25,100. Voting age pop. (1980): 365,865; 6% American Indian, 4% Black, 1% Spanish origin.

**1988 Presidential Vote:**

| | | |
|---|---|---|
| Bush (R) | 95,225 | (50%) |
| Dukakis (D) | 94,615 | (49%) |



**Rep. Wes Watkins (D)**

Elected 1976; b. Dec. 15, 1938, DeQueen, AR; home, Ada; OK St. U., B.S. 1960, U. of MD, M.S. 1961; Presbyterian; married (Lou).

**Career:** USDA, 1963; Asst. Dir. of Admissions, OK St. U., 1963-66; Exec. Dir., Kiamichi Econ. Develop. Dist. of OK, 1966-68; Realtor and homebuilder, 1968-76; OK Senate, 1975-76.

**Offices:** 2348 RHOB 20515, 202-225-4565. Also 232 P. O. Bldg., Ada 74820, 405-436-1980; 118 Fed. Bldg., McAlester 74501, 918-423-5951; and 720 S. Husband, Stillwater 74074, 405-743-1400.

**Committees:** *Appropriations* (24th of 35 D). Subcommittees: Energy and Water Development; Rural Development, Agriculture and Related Agencies.

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 50 | 64 | 46 | 73 | 38 | 46 | 19 | 60 | 57 | 25 |
| 1987 | 64 | --- | 44 | 43 | --- | 17 | --- | --- | 21 | 22 |

**National Journal Ratings**

| | 1988 LIB — 1988 CONS | 1987 LIB — 1987 CONS |
|---|---|---|
| Economic | 45% — 54% | 57% — 40% |
| Social | 40% — 58% | 58% — 41% |
| Foreign | 50% — 49% | 49% — 51% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | FOR | 5) Ban Drug Test | AGN | 9) SDI Research | AGN |
| 2) Gephardt Amdt | FOR | 6) Drug Death Pen | FOR | 10) Ban Chem Weaps | AGN |
| 3) Deficit Reduc | FOR | 7) Handgun Sales | FOR | 11) Aid to Contras | FOR |
| 4) Kill Plnt Clsng Notice | FOR | 8) Ban D.C. Abort $ | AGN | 12) Nuclear Testing | AGN |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | Wes Watkins (D), unopposed | | | ($174,437) |
| 1988 primary | Wes Watkins (D), unopposed | | | |
| 1986 general | Wes Watkins (D) | 114,008 | (78%) | ($210,936) |
| | Patrick K. Miller (R) | 31,913 | (22%) | |

## FOURTH DISTRICT

The 4th Congressional District of Oklahoma starts out within a few miles of the oil-derrick-surrounded state Capitol in Oklahoma City, smack dab in the middle of the state, and proceeds south and west to cover half of Oklahoma's Red River Valley. It includes Lawton, a small city whose major industries are Goodyear and the Army's Fort Sill; Norman, home of the University of Oklahoma; and some mostly blue-collar parts of Oklahoma City itself and its suburbs of Midwest City and Moore. But the predominant tone, demographically and politically, is rural. Even in the cities and towns, the red or brown dust gets tracked indoors by your boots, and the entree of choice is still chicken-fried steak. Politically, this country is ancestrally Democratic, although Republicans, helped by Republican trends in the parts of the district with population growth like Norman, Lawton and the Oklahoma City suburbs, have carried it in recent national

elections.

The congressman from the 4th District, Dave McCurdy, has emerged as one of the national leaders of his party on several defense and foreign policy issues, even though he was first elected only in 1980, and then by a narrow margin. He occupies that position partly because of his expertise and committee assignments, but even more because he is poised at the fulcrum of opinion in the House: with a few other like-minded members, he can determine the outcome of votes on bitterly contested issues like contra aid and the MX missile. This he has gone out and done, with an adroitness hailed by his admirers or (take your choice) an opportunism denounced by his detractors.

He embarked on this course by getting a seat in his first term on Armed Services, a natural assignment for a Member from a hawkish district laden with military bases (Fort Sill, Oklahoma City's Tinker Air Force Base, Altus Air Force Base). While generally supporting increased military spending, he sparked the movement to oust the elderly Mel Price as Armed Services chairman and install Les Aspin in his place, a move that succeeded in 1984 despite the opposition of Speaker Tip O'Neill. He worked with Aspin in 1985 to fashion a compromise on the MX missile which was opposed by most House Democrats but accepted by the Administration and adopted by Congress. He also became a player on contra aid in 1985, as the lead sponsor of the proposal to give the contras $27 million in "humanitarian" aid, but no military aid. All this was premised on progress in negotiations and continuing review by Congress - and also, in practical terms, on acts of the Sandinistas; McCurdy switched to a tougher position at one point when Daniel Ortega flew off to Moscow after the House voted down military aid. McCurdy supported the Arias plan and Speaker Jim Wright's policy on the contras, and seemed pleased when the contra movement seemed to surrender in early 1988. He insists he doesn't like the Sandinistas, but clearly the Republicans are correct when they say that his first priority was blocking American military aid and they are probably right in saying that the various amendments and changes in policy he has helped to produce have weakened pressure on the Sandinistas to honor human rights.

McCurdy wanted to become chairman of the Intelligence Committee in 1989, and in December 1987 resigned from it for a year so that he would not be subject to the six-year limit on consecutive service. Jim Wright appointed him to another six-year term, but named Anthony Beilenson of California, a liberal but not a political deal-maker, to be chairman. Beilenson, however, must rotate off the committee when he reaches the six-year limit in 1990, and McCurdy, as the second ranking Democrat, is in line to become chairman. He could keep that potentially powerful position for five years, provided that he has the favor of Speaker Tom Foley and that (as everyone expects) the Democrats retain control of the House. He was also prominent in 1989 as the lead House sponsor of the Democratic Leadership Council's national service plan. Volunteers could serve in the military or in civilian service jobs and earn vouchers that could be used for college expenses or down payments on a house. McCurdy does more mundane things as well. He got himself a seat in 1987 on an Armed Services subcommittee handling military bases - obviously of importance in the 4th District.

In the midst of all this involvement in foreign and defense policy, McCurdy has transformed the 4th District from the most marginal of districts to a safe seat. In 1988, he won 83% in the primary and was unopposed in the general. He has made no move to run for the Senate and is one congressman who would have greater power if he stayed in the House.

**The People:** Est. Pop. 1986: 563,200, up 11.3% 1980 86; Pop. 1980: 505,869, up 24.3% 1970 80. Households (1980): 77% family, 44% with children, 67% married couples; 30.6% housing units rented; median monthly rent: $181; median house value: $37,200. Voting age pop. (1980): 356,658; 6% Black, 3% Spanish origin, 3% American Indian, 1% Asian origin.



**1988 Presidential Vote:**

| | | |
|---|---|---|
| Bush (R) | 105,170 | (58%) |
| Dukakis (D) | 74,429 | (41%) |

**Rep. Dave McCurdy (D)**

Elected 1980; b. Mar. 30, 1950, Canadian, TX; home, Norman; U. of OK, B.A. 1972, J.D. 1975, U. of Edinburgh, Scotland, Rotary Fellow, 1977-78; Lutheran; married (Pam).

**Career:** OK Asst. Atty. Gen., 1975–77; Practicing atty., 1978–80.

**Offices:** 2344 RHOB 20515, 202-225-6165. Also P.O. Box 1265, Norman 73070, 405-329-6500; 103 Fed. Bldg., Lawton 73501, 405-357-2131; and P.O. Box 1051, Duncan 73534, 405-252-1434.

**Committees:** *Armed Services* (11th of 31 D). Subcommittees: Military Installations and Facilities; Research and Development. *Science, Space and Technology* (11th of 30 D). Subcommittees: Natural Resources, Agriculture Research and Environment; Transportation, Aviation and Materials. *Permanent Select Committee on Intelligence* (2d of 12 D). Subcommittees: Oversight and Evaluation (Chairman); Program and Budget Authorization.

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 60 | 78 | 44 | 82 | 56 | 30 | 31 | 70 | 64 | 31 |
| 1987 | 44 | — | 41 | 50 | — | 27 | — | — | 40 | 25 |

**National Journal Ratings**

| | 1988 LIB — 1988 CONS | 1987 LIB — 1987 CONS |
|---|---|---|
| Economic | 46% — 52% | 45% — 54% |
| Social | 55% — 45% | 57% — 43% |
| Foreign | 50% — 50% | 48% — 52% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | AGN | 5) Ban Drug Test | AGN | 9) SDI Research | FOR |
| 2) Gephardt Amdt | AGN | 6) Drug Death Pen | — | 10) Ban Chem Weaps | AGN |
| 3) Deficit Reduc | FOR | 7) Handgun Sales | FOR | 11) Aid to Contras | AGN |
| 4) Kill Plnt Clsng Notice | FOR | 8) Ban D.C. Abort $ | AGN | 12) Nuclear Testing | AGN |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | Dave McCurdy (D), unopposed | | | ($251,956) |
| 1988 primary | Dave McCurdy (D) | 52,366 | (83%) | |
| | Howard Bell (D) | 10,728 | (17%) | |
| 1986 general | Dave McCurdy (D) | 94,984 | (76%) | ($176,096) |
| | Larry Humphreys (R) | 29,697 | (24%) | |

## FIFTH DISTRICT

Oklahoma City, created within the memory of many then living, had an unfinished, hastily assembled look to the *WPA Guide* 50 years ago. "Downtown, on the streets, in the stores, and in lodging places that range from 25 cents a night to the luxury of fine hotel suites, fur coats and overalls, oil-field workers and clerks, farmers and their families, and sophisticates who know Europe and South America as well as they know the playgrounds of the United States — all these mingle and make Oklahoma City a truly American metropolis." Truly Oklahoman, certainly:

situated almost precisely in the middle of the state and the middle of the continent, with the oil derrick outside the state Capitol still pumping some oil, Oklahoma City is the metropolis of Oklahoma. Like many state capitals, it was not the spontaneous creation of commerce but the deliberate creation of government, built on land that is browner and more eroded by creeks than the greener, rolling Oklahoma farther east. During the 1960s, the city fathers decided that they would not let the old city limits fence them in, so Oklahoma City, unlike most American central cities, started annexing land, so that it now spills over into five counties and four congressional districts, and includes hundreds of acres which even today are farms or grazing land.

The 5th Congressional District of Oklahoma includes most of Oklahoma City, but it is a carefully chosen part: the most Democratic sections of the city, including its black areas, are chopped off and included in Democratic districts. The 5th is intended to be Republican. Besides the prosperous parts of Oklahoma City, which are heavily Republican as only prosperous parts of oil cities are, it includes wheat-growing counties to the north, and the market town of Ponca City, which is as Republican as any similar-sized town in nearby Kansas. Connected by a strip of mostly uninhabited Osage County is the well-to-do oil town of Bartlesville, headquarters of Phillips Petroleum, whose management, allied with the equally worried townspeople-employees, succeeded in warding off T. Boone Pickens, but only after saddling the firm with huge debt. The 5th District is a collection of urban Republican voting precincts stitched together by swaths of thinly populated rural territory.

The congressman from the 5th District is Mickey Edwards, a Republican regarded as far outside the national consensus when he was first elected in 1976 but today one of the leaders of his party in the House—and one of the more originally thoughtful members of either party. Edwards believes in market economics and has long believed in deregulating energy markets; he also, as one expects in the Oil Patch, favors a higher oil depletion allowance and other incentives for production, plus an oil import fee. On foreign policy, he was one of the leading and most vehement backers of military aid to the Nicaraguan contras; he is proud that he helped push through contra aid in June 1986, and he seems disgusted with the group of swing votes, evidently including his Oklahoma neighbor Dave McCurdy, who withdrew their support of military aid and, as he sees it, insured the contras' defeat in return for promises the Sandinistas are certain not to keep. The ranking Republican on the Appropriations subcommittee on Foreign Operations, he opposes giving assistance to countries like Mozambique and Peru. But he seems open to evidence of possible change in the Soviet Union, though skeptical. Will Gorbachev and perestroika produce real progress in human rights and market economics? "They're trying, but they still don't quite get it," he says.

After the 1988 election, Edwards was elected chairman of the House Republican Policy Committee, the number four position in the leadership. It was an impressive victory, all the more so because Edwards is not associated with either of the two groups symbolized by the two contenders in the 1989 contest for whip. He has little affection for the guerrilla tactics of the young Members around Newt Gingrich, and he has criticized both parties in the House for not doing more constructive legislating. His senior position on Appropriations clearly has influenced him here. Yet at the same time he is not one of the "old bulls" like Edward Madigan, devoted to getting along with the Democrats in fashioning legislation and temperamentally averse to publicizing new ideas. Edwards was chairman of the American Conservative Union for five years, and he has advanced some unorthodoxies of his own. He opposed the line-item veto, for example, after it had become a campaign staple of Republicans, because it would increase the power of the Executive Branch and diminish that of Congress; he asked his fellow conservatives how they would like it if a Democratic President could zero out weapons systems if he had the support of the one-third-plus-one of one house needed to prevent an overriding of his veto.

Edwards is now the oldest member of the youngish Oklahoma delegation and one of the most senior; he is also one of the politically most secure. He passed up his chance to run for the Senate and seems committed to a career in the House, just as his constituents seem committed to keeping him there.



**The People:** Est. Pop. 1986: 560,700, up 11.5% 1980–86; Pop. 1980: 502,974, up 17.1% 1970–80. Households (1980): 71% family, 37% with children, 61% married couples; 30.8% housing units rented; median monthly rent: $199; median house value: $43,600. Voting age pop. (1980): 367,630; 5% Black, 3% American Indian, 2% Spanish origin, 1% Asian origin.

**1988 Presidential Vote:**

| | | |
|---|---|---|
| Bush (R) | 145,247 | (67%) |
| Dukakis (D) | 68,735 | (32%) |

**Rep. Mickey Edwards (R)**

Elected 1976; b. July 12, 1937, Cleveland, OH; home, Oklahoma City; U. of OK, B.A. 1958, OK City U., J.D. 1969; Presbyterian; married (Lisa).

**Career:** Practicing atty.; Editor, *Private Practice* magazine; Asst. City Editor, *Oklahoma City Times*; Instr., OK City U.

**Offices:** 2330 RHOB 20515, 202-225-2132. Also 900 N.W. 63d St., Ste. 105, Oklahoma City 73116, 405-231-4541; 1200 S.E. Frank Phillips Blvd., Ste. 102, Bartlesville 74003, 918-336-5436; and 102 S. 5th, Ponca City 74601, 405-762-8121.

**Committees:** *Appropriations* (10th of 22 R). Subcommittees: Foreign Operations, Export Financing and Related Programs (Ranking Member); Military Construction.

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 10 | 26 | 10 | 45 | 25 | 92 | 72 | 100 | 93 | 61 |
| 1987 | 12 | -- | 8 | 14 | -- | 90 | -- | --- | 100 | 77 |

**National Journal Ratings**

| | 1988 LIB | 1988 CONS | 1987 LIB | 1987 CONS |
|---|---|---|---|---|
| Economic | 24% | 74% | 0% | 89% |
| Social | 13% | 84% | 27% | 73% |
| Foreign | 16% | 78% | 0% | 80% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | FOR | 5) Ban Drug Test | FOR | 9) SDI Research | FOR |
| 2) Gephardt Amdt | AGN | 6) Drug Death Pen | FOR | 10) Ban Chem Weaps | AGN |
| 3) Deficit Reduc | AGN | 7) Handgun Sales | FOR | 11) Aid to Contras | FOR |
| 4) Kill Plnt Clsng Notice | FOR | 8) Ban D.C. Abort $ | FOR | 12) Nuclear Testing | AGN |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | Mickey Edwards (R) | 139,182 | (72%) | ($318,822) |
| | Terry J. Montgomery (D) | 53,668 | (28%) | ($302) |
| 1988 primary | Mickey Edwards (R) | 25,311 | (83%) | |
| | Bill Maguire (R) | 5,142 | (17%) | |
| 1986 general | Mickey Edwards (R) | 108,774 | (71%) | ($289,552) |
| | Donna Compton (D) | 45,256 | (29%) | ($16,217) |

## SIXTH DISTRICT

Western Oklahoma 50 years ago was "fertile, but the crops are at the mercy of the elements. Wheat, broomcorn, and forage yields are large when drought and wind temper their fury. Many of the acres, particularly the broad plateaus with their terraced canyons, are used as grazing land for cattle. The flat, even terrain creates mirages on a wavering horizon. Inhabitants tell of standing in the open and being able to see towns many miles away. Tumbleweeds, which grow profusely here, are blown about by the wind and pile against houses and outbuildings. On especially windy days,"—and this is one of the windiest parts of America—"sand swirls over the fields, burying seeds and young plants deeply, and justifying the term 'dust bowl'." The western plains of Oklahoma are a demanding land, scorching hot under the summer sun, snow-blown in winter. The rural counties today have far fewer people than before the dust bowl of the 1930s (in the counties wholly within the 6th District, the population dropped from 423,000 to 282,000), and the once booming oil and natural gas exploration here in the Anadarko Basin and other fields has not done much for the region now that it has gone bust.

The western plains of Oklahoma, plus the blue-collar and black neighborhoods in Oklahoma City form Oklahoma's 6th Congressional District. Most of its acreage has long been Republican: it was settled by farmers moving south from Kansas, starting when (or a little before) the gun went off the morning of the great land rush in 1889. A few of its counties in the south are heavily Democratic, and always have been; most of the rest are heavily Republican, and always have been: these divisions are as permanent as if Oklahoma had been split down the middle during the Civil War, except that of course there were no white people settled in the state at all at that time.

Yet the 6th District elects and reelects a Democratic congressman, Glenn English. He was helped in the 1980s by redistricting, which carefully included a part of Oklahoma City which is 25% black and contains most of the city's white working-class areas; but he is by no means dependent on these votes. English was once an aide to liberal Democrats in the California Assembly, but you wouldn't know it from his voting record, which tends toward the conservative. His Oklahoma credentials are in order: he grew up here and served as executive director of the state Democratic Party before he ran for Congress in 1974. Perhaps his greatest political achievement so far was to seize a propitious moment—just four days before the showdown on the 1981 Reagan tax cut—and extract from Ronald Reagan, in a letter in his own handwriting, a commitment to veto "with pleasure" any windfall profits tax on natural gas. That promise effectively protected that otherwise vulnerable revenue source in 1982, when Republicans were scrambling around looking for politically painless ways to, in the phrase of the day, enhance revenues.

English serves on the Agriculture Committee, which of course is of great interest to this wheat-growing district, and chairs the Subcommittee on Conservation, Credit and Rural Development. In this capacity he has oversight over the commodities markets, and in early 1989 was planning an in-depth investigation in the wake of revelations of fraud. A fiscal conservative on most issues, he makes exceptions for local pork barrel projects and especially for wheat programs; a free trader generally, he is a hawk when it comes to restricting meat imports. He wants to stimulate U.S. farm exports and advocates an oil import fee. He also serves on Government Operations, which he has used to concentrate on the difficult and important, but not at all parochial, problems of government computers, individual privacy, and the Freedom of Information Act. He has also been, to the surprise and delight of many of his fellow Democrats, a tiger in preventing relaxation of the FOIA. He is one of several congressmen who have tried to reduce the federal expenditure on presidential libraries, and has authored legislation that would require private endowments to pay for their upkeep. (In early 1985, he discovered that the Administration supported his initiative, but only if it exempted the Reagan library.) National Republicans, apparently respectful of English's strength, have never targeted him, and he has won reelection by huge margins most years; in 1988 he beat a hapless Republican 73%–27%.



**The People:** Est. Pop. 1986: 532,900, up 5.9% 1980–86; Pop. 1980: 503,291, up 4.1% 1970–80. Households (1980): 73% family, 38% with children, 62% married couples; 29.1% housing units rented; median monthly rent: $152; median house value: $32,500. Voting age pop. (1980): 361,309; 9% Black, 3% American Indian, 2% Spanish origin.

**1988 Presidential Vote:**

| | | |
|---|---|---|
| Bush (R) | 101,606 | (58%) |
| Dukakis (D) | 72,101 | (41%) |

**Rep. Glenn English (D)**

Elected 1974; b. Nov. 30, 1940, Cordell; home, Cordell; Southwestern St. Col., B.A. 1964; United Methodist; married (Jan).

**Career:** Chf. Asst., Major. Caucus, CA Assembly; Exec. Dir., OK Dem. Party, 1969–73; Petroleum leasing business.

**Offices:** 2206 RHOB 20515, 202-225-5565. Also 264 Old P.O. Bldg., 215 Dean A. McGee Ave., Oklahoma City 73102, 405-231-5511; Fed. Bldg., P.O. Box 3612, Enid 73702, 405-233-9224; and 1120 9th St., Woodward 73801, 405-256-5752.

**Committees:** *Agriculture* (5th of 27 D). Subcommittees: Conservation, Credit and Rural Development (Chairman); Tobacco and Peanuts; Wheat, Soybeans, and Feed Grains. *Government Operations* (3d of 24 D). Subcommittees: Government Information, Justice, and Agriculture; Legislation and National Security.

**Group Ratings**

| | ADA | ACLU | COPE | CFA | LCV | ACU | NTLC | NSI | COC | CEI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 40 | 52 | 32 | 73 | 44 | 60 | 40 | 90 | 71 | 35 |
| 1987 | 44 | -- | 30 | 50 | — | 39 | — | — | 73 | 39 |

**National Journal Ratings**

| | 1988 LIB — 1988 CONS | 1987 LIB — 1987 CONS |
|---|---|---|
| Economic | 39% — 60% | 40% — 60% |
| Social | 26% — 73% | 47% — 53% |
| Foreign | 43% — 56% | 43% — 57% |

**Key Votes**

| | | | | | |
|---|---|---|---|---|---|
| 1) Homeless $ | FOR | 5) Ban Drug Test | AGN | 9) SDI Research | AGN |
| 2) Gephardt Amdt | AGN | 6) Drug Death Pen | FOR | 10) Ban Chem Weaps | AGN |
| 3) Deficit Reduc | AGN | 7) Handgun Sales | FOR | 11) Aid to Contras | FOR |
| 4) Kill Plnt Clsng Notice | FOR | 8) Ban D.C. Abort $ | FOR | 12) Nuclear Testing | AGN |

**Election Results**

| | | | | |
|---|---|---|---|---|
| 1988 general | Glenn English (D) | 122,887 | (73%) | ($306,600) |
| | Mike Brown (R) | 45,239 | (27%) | ($85,059) |
| 1988 primary | Glenn English (D) | 51,733 | (84%) | |
| | Butch Batchelder (D) | 9,490 | (16%) | |
| 1986 general | Glenn English (D) unopposed | | | ($149,998) |

## *The Cuyahoga River:*

"Until the mid-19th century the Cuyahoga was a clear stream winding through marsh grass and wildflowers, but in 1880 it was lined with sawmills, coal docks, blast furnaces, and overhung with smoke."

Walter Havighurst
*Ohio*
1976

* * *

"The Cuyahoga River at Cleveland, once the host to the ebullient sturgeon, actually caught fire one day. It burned fiercely and threatened to destroy that city."

Franklyn Russell
*American Heritage*
April, 1971

## *Dayton:*

"*The Almanac of American Politics* tells us that Dayton is the home of Richard Nixon's vision of the typical United States voter: a housewife whose husband works in a factory and whose brother-in-law is a cop."

Joel Garreau
*The Nine Nations of North America*
1981

* * *

"Dayton is bad and glad of it; 'we hope to be as "good" as Cincinnati some day,' one of its rulers told me."

Lincoln Steffens
*McClure's*
July, 1905

## *Hudson:*

"Perhaps when a town such as Hudson becomes so enisled, so encapsulated, so inverted, so smugly proud of its architecture and unusual history, it loses all sight of reality. While maintaining its dreamlike 'character,' it begins to live the dream. . . . Is it possible that living in a community that is too perfect, too controlled, can inflict a kind of paranoia on its citizens?"

Stephen Birmingham
*The Golden Dream*
1978

## *The Mahonigh River:*

"This Mahonigh River which looks as if the poisonous bile of all humanity had been poured into it."

Henry Miller
*The Air-Conditioned Nightmare*
1945

## *Marietta:*

"The old soldiers on the flatboat *Mayflower* drifting down the Ohio River, beneath silent buffs, to found their fort-town of Marietta with its streets named from a Latin text."

Richard Lingeman
*Small Town America*
1980

## *The Maumee River:*

"The Maumee is more a soggy, weed-encrusted drainage ditch than a river."

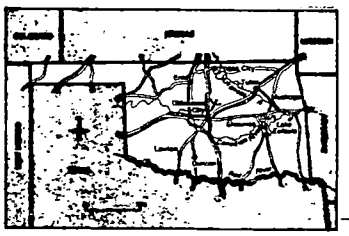
Douglas Waitley
*Portrait of the Midwest*
1963

## *Toledo:*

"Toledo was very beautiful, and the way that the city towers rise out of the dead level northwestern plains was marvelous. . . ."

Gertrude Stein
*Everybody's Autobiography*
1937

# *OKLAHOMA*



Capital: Oklahoma City
Became a territory: May 2, 1890
Entered the union (with rank): Nov. 16, 1907 (46)
State motto: *Labor omnia vincit* (Labor conquers all things)
State flower: Mistletoe
State bird: Scissortailed flycatcher

State song: "Oklahoma"
State tree: Redbud
Nickname: Sooner State
Origin of state name: From two Choctaw Indian words meaning "red people"

What immediately comes to mind when someone mentions Oklahoma is oil. But, in reality, oil is just one small part of the state's makeup. In the northeastern corner, Oklahoma is an extension of the Ozark Plateau, and the land is densely treed and hilly. A southward bulge of the Kansas plain covers much of central Oklahoma. The southern rim of the state looks southward at Texas and shares some of that state's dust and truck farming. The west slopes up toward the Rocky Mountains, and that is where most of the oil is found.

Until April 12, 1889, Oklahoma was basically an empty place on the road between other places. It didn't offer much in the way of good plowable land or the abundant water that settlers wanted. But on that day the federal government threw the entire Oklahoma Territory open to homesteaders. In one stampede 50,000 people galloped across the land to stake their claims to free property. The state's nickname comes from the derisive term "sooner" applied to those who tried to beat the noon starting gun.

Modern Oklahoma mixes its oil business with meat packing, food processing and equipment manufacturing. The combination of all this industry with Oklahoma's cattle and farming yields makes it one of the most prosperous states in the nation. Tulsa, where the oil business is centered, has one of the highest per capita incomes in the world.

Oklahoma is a tough, sinewy state where getting work done and plain fundamental values are the hallmarks of life.

## THE STATE

"Anything can have happened in Oklahoma. Practically everything has."

Edna Ferber
*Cimarron*
1930

* * *

"We spoiled the best Territory in the world to make a state."

Will Rogers
Quoted by Richard T. Ketchum
*Will Rogers, His Life and Times*
1973

## THE LANDSCAPE

"[Oklahoma soil is] rich and black and soft, and looks like chocolate where the plow has turned the sod."

Richard Harding Davis
*The West Through a Car-Window*
1892

* * *

"Tall tales come out of Oklahoma just as out of Texas; one favorite describes the 'crowbar hole.' This is a hole through the wall that many houses have, designed to check the weather. You shove a crowbar through the hole; if it bends, the wind velocity outside is normal; if the bar breaks off, 'it is better to stay in the house.' "

John Gunther
*Inside USA*
1947

* * *

"I'm not ashamed of the state I come from, Oklahoma, and Oklahoma's real soul is not ashamed to have me come from sandy hills and stickery weeds."

Woody Guthrie
"Born to Win"
1965

* * *

I first remember the scrub oak sand hills
Back down across Oklahoma
And all of the sticker weeds and grasses. . . ."

Woody Guthrie
"Born to Win"
1965

* * *

"[Oklahoma] is the biggest theater in the world . . . some of the girls who have been in Oklahoma already, say that there are almost no limits to it."

Franz Kafka
*Amerika*
1927

* * *

"There is no better country in the west than this, you can picture any kind of land and location for homes and find it here. Rich loamy prairie or timbered bottoms and black limestone valleys and uplands . . . well watered and timbered."

Anonymous letter, c. 1880, to Chief Bushyhead of the Cherokees
Quoted by Richard T. Ketchum
*Will Rogers, His Life and Times*
1973

* * *

"Some of the flowers still survive in pasture land but others are gone. Locoweed was beautiful, but as soon as its effect on cattle and horses became known, it was ruthlessly rooted out. The pink and blue starflowers and the spreading lapis spiderworts were trampled down and grazed over and vanished."

Alice Marriot and Carol Rachlin
*Oklahoma: The Forty-sixth State*
1973

* * *

"When the Arkansas, Red River, Salt Fork, Verdigris, Caney, Cat Creek, Possum Creek, Dog Creek, and Skunk Branch all are up after a rain, we got more seacoast than Australia."

Will Rogers
Quoted by Neal R. Peirce
*The Mountain States of America*
1972

* * *

"To the red country and part of the gray country of Oklahoma, the last rains came gently, and they did not cut the scarred earth."

John Steinbeck
*The Grapes of Wrath*
1939

* * *

"The dawn came, but no day. In the gray sky a red sun appeared, a dim red circle that gave a little light, like dusk; and as that day advanced, the dusk slipped back toward darkness, and the wind cried and whimpered over the fallen corn.

Men and women huddled in their houses, and they tied handkerchiefs over their noses when they went out, and wore goggles to protect their eyes."

John Steinbeck
*The Grapes of Wrath*
1939

# PEOPLE

"I just heard about a man in Oklahoma who went to a theatre where, for fifteen cents, he got two feature pictures, a Mickey Mouse, a newsreel, and two sets of dishes, and then demanded his money back because he didn't strike oil under his seat."

Howard Dietz
Quoted by Clifton Fadiman
*American Treasury 1455–1955*
1955

* * *

"The most persistently and mercilessly exploited human being in the country, he [the Oklahoma sharecropper] is the most zealous and intractable upholder of the politico-economic system that exploits him. Let him hear that some other sharecropper as illiterate as himself has been converted to socialistic doctrines and he will help his fellow Ku Klux Klanners that night give the poor wretch a tar bath and a coat of chicken feathers. He will not suffer for a moment anything that threatens his privilege of being mulcted."

Burton Rascoe
*These United States*
1924

* * *

"An Oklahoman knows, if he keeps his eyes open at all, everything that is going on about him and he knows that it is not conducive to respect and solicitude for his fellow men. It is the worst possible place for an idealist and, since most people of normal intelligence and decent instincts are weighted in adolescence with the impediment of illusions, they either shed their burden and become Oklahomans or shake the state's dust from their feet at the first opportunity."

Burton Rascoe
*These United States*
1924

* * *

"Only those who are anchored by real estate and resignation remain. The reason is fairly obvious. Oklahoma has been, from the first, a boomer state, even before it was a state—when old Oklahoma territory was first thrown open to settlers. It was peopled largely by land gamblers instead of home seekers."

Burton Rascoe
*These United States*
1924

* * *

"Here [in Oklahoma] the representatives of nearly every civilized nation on the globe are to be found—the sturdy Norseman from the 'Land of the Midnight Sun,' the industrious German, the Englishman who has had his eye-teeth cut, the excitable Frenchman, the 'Wild Irishman,' the carefree son of Italy, the polite scion of the Montezumas, and the patient laborer from the Isles of Greece. All are here animated by a common desire—to capture and sequester the Great American Dollar."

Carl Coke Rister
*Oil! Titan of the Southwest*
1949

* * *

"I am pretty much American Indian. Most folks in Oklahoma are."

Will Rogers
Quoted by Pearl S. Buck
*America*
1971

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Will Rogers
Quoted by Pearl S. Buck
*America*
1971

* * *

"I knowed you wasn't Oklahomy folks. You talk queer kinda—that ain't no blame, you understan'."

John Steinbeck
*The Grapes of Wrath*
1939

* * *

"Okie use'ta mean you was from Oklahoma. Now it means you're scum. Don't mean nothing itself, it's the way they say it."

John Steinbeck
*The Grapes of Wrath*
1939

* * *

"Every time they have an earthquake or a hippie rebellion in California, another handful of Okies comes back home. . . ."

Local resident
Quoted in *Time*
Jan. 26, 1970

## WAY OF LIFE

"Oil wells are to Oklahoma farmers what cows' teats are to Wisconsin dairymen. We milk them every day."

Richard Lloyd Jones, owner of the *Tulsa Tribune*
Quoted in *National Geographic*
March, 1941

* * *

"No . . . snobbishness can alter the fact that Oklahoma has diminished for lack of invididual opportunity."

Jonston Murray
*Saturday Evening Post*
April 30, 1955

* * *

"The oil and gas in the Oklahoma nature easily takes fire."

Editorial
*New York Times*
Jan. 10, 1923

## HISTORY AND POLITICS

"Any man who can afford a hall bedroom and a gas-stove in New York City is better off than he would be as the owner of one hundred and sixty acres on the prairie, or in one of these small so-called cities."

Richard Harding Davis
*The West from a Car-Window*
1892

* * *

"At each newly discovered [oil] pool there followed the rush and scramble. Another Bret Harte town sprang up on the prairie; fields oozed slimy black; oil rigs clanked; false-front wooden shacks lined a one-street village. Dance halls. Brothels. Gunmen. Brawls. Heat. Flies. Dirt. Crime. The clank of machinery. . . ."

Edna Ferber
*Cimarron*
1930

* * *

[A comment on the harshness of pioneer life]: "A part of the richness of this Oklahoma soil must be derived from the sweet bodies of our babies who lie buried there."

Mrs. Thompson B. Ferguson
Taken from a pioneer-era letter
*The Ferguson Papers* at the University of Oklahoma

* * *

"No state has more explosive politics than Oklahoma . . . its political behavior can be positively Balkanesque. 'Knock 'em, sock 'em, rock 'em,' is the rule."

John Gunther
*Inside USA*
1947

* * *

"To leave [Oklahoma during the Dust Bowl years] voluntarily—to break all those closely knit ties for the sake of a possibly greater comfort elsewhere—seems like defaulting on our task. We may *have* to leave. . . . But I think I can never go willingly or without pain that as yet seems unendurable."

Caroline A. Henderson
*Atlantic Monthly*
May, 1936

* * *

"Oklahoma! Well watered, well timbered, rich in soil, a most enchanting clime, may in the near future be your home."

A.P. Jackson and E.C. Cole
*Oklahoma! Politically and Topographically Described, History and Guide to Indian Territory*
1885

* * *

"Oklahoma has scarcely any history beyond the memory of living man . . . yet Coronado left his trail across Oklahoma before the Pilgrim Fathers were so much as conceived. . . . A hundred years ago Oklahoma was turned into a vast concentration camp for Red Indians, because it was such worthless land. Fifty years ago, white people from every state

swarmed in to dispossess the banished Indians, because it was such valuable land."

George Milburn
Quoted by John Gunther
*Inside USA*
1947

* * *

"Oklahoma is to sociology what Australia is to zoology. It is the place where the trials and errors of men, instead of nature, have been made only yesterday, and the results are as egregious as a duckbill or kangaroo. Oklahoma is full of man-made contradictions, perversities, and monstrosities."

George Milburn
Quoted by John Gunther
*Inside USA*
1947

* * *

"Chinch-bugged in Illinois, Bald-knobbed in Mizzouri, Prohibited in Kansas, Oklihonny or Bust!"

Sign on pioneer wagon
Noted by George Milburn
*Yale Review*
March, 1946

* * *

"It was only two generations [from late 19th century to early 20th] from stalwart Boomer to unwanted and despised Okie, less than half a century from verdant Indian territory to parched red-brown Oklahoma, from blue prairie skies to towering dust clouds. . . ."

Richard O'Connor
*Iron Men and Broken Wheels*
1973

* * *

"We [Oklahomans] have a subsidized and exporting economy. Oklahoma has always exported its people, oil, timber, farm products. If you take away the federal subsidies for lead, zinc, petroleum, welfare, agriculture and defense, you have nothing left—take these things out of Oklahoma and you don't even have a corpse."

Oklahoma businessman and politician
Quoted by Neal R. Peirce
*The Great Plains States of America*
1973

* * *

"A generous national government reserved the most fertile sections of the country for those Indians which it had hopes of making over into good and industrious citizens. It had been unable to tame the Apaches, Comanches, and Arapahoes, so it permitted them to die out of boredom in great numbers, under the armed surveillance of federal troops in the arid regions of the southwest part of the state."

Burton Rascoe
*These United States*
1924

* * *

"The state has been from the first one vast roulette wheel played by adventurers from other states."

Burton Rascoe
*These United States*
1924

* * *

"Did you read where my hometown of Claremore, Oklahoma, just opened an Indian hospital? Just think, Columbus discovered America a little over 400 years ago, and here they are building us a hospital. Just imagine what us Indians got to look forward to in the next 400 years. Why, they might even build us a cemetery."

Will Rogers
*The Best of Will Rogers*
1979

* * *

"[Route] 66 is the path of a people in flight, refugees from dust and shrinking land, from the thunder of tractors and shrinking ownership, from the desert's slow northward invasion, from the twisting winds that howl up out of Texas, from the floods that bring no richness to the land and steal what little richness is there."

John Steinbeck
*The Grapes of Wrath*
1939

* * *

"Oklahoma was agrarian, conservative, against federal bureaucracy, Democratic with a strong tincture of populism at statehood. It is now tending toward a conservative side, but really just against the existing order of things. In a showdown on domestic issues the majority will be more liberal than conservative. At statehood, the voter was independent, even ornery, and he didn't bow to authority or worship the man in high position. He was quick to be against, and the attitude was reflected in the near impeachment by the House of Representatives of a governor in 1920, and in the impeachment and ouster of two governors by the House and Senate in 1923 and 1929."

Otis Sullivant, Oklahoma newspaper man
Quoted by Neal R. Peirce
*The Great Plains States of America*
1973

* * *

"[Oklahoma's legislature is] a zoological garden of cranks."

William Howard Taft, secretary of war
Quoted by L.J. Abbott
*Independent*
Oct. 20, 1910

# CITIES, TOWNS AND REGIONS

## Oklahoma City

"... Oklahoma City stole
the Capital and government whole
From Guthrie, and to keep it sound
Put threescore oil-wells gushing round.
State where strong men get there sooner
Than expected! Prairie schooner
Was too slow for your swift words,
So you took to bright steel birds."

Robert P. Tristram Coffin
*Primer for America*
1942

* * *

"One thing is certain, ours was a chaotic community [Oklahoma City], still characterized by frontier attitudes and by that strange mixture of the naive and sophisticated, the benign and malignant, which makes the American past so puzzling and its present so confusing."

Ralph Ellison
*Shadow and Act*
1964

* * *

"Oklahoma City... is the first American city of consequence to ask every citizen, even proud ladies of southern descent, to submit to a test for venereal disease."

John Gunther
*Inside USA*
1947

* * *

"On a single day [in Dust Bowl era], I heard, 50 million *tons* of soil were blown away. People sat in Oklahoma City, with the sky invisible for three days in a row, holding dust masks over their faces and wet towels to protect their mouths at night, while the farms blew by."

John Gunther
*Inside USA*
1947

* * *

"... a fit ornament for the Capital might well be a derrick, its base set deep in the rotunda and its functional, girderlike top jutting up through the center of the building, so that everyone could see who was boss in Oklahoma City."

Philip Hamburger
*An American Notebook*
1965

* * *

"Oklahoma City is restless, beset with mighty longings; it is contrary, a maverick that refuses to fit a pattern; it is typically Oklahoman in that if it likes something, it likes it. If it doesn't, duck!"

Debs Myers
*American Panorama: West of the Mississippi*
1960

* * *

"Oklahoma City with its towers that is its skyscrapers coming right up out of the flat oil country was as exciting as when going to Alsace just after the armistice we first saw the Strasbourg Cathedral. They do come up wonderfully out of that flat country and it was exciting and seeing the oil wells and the funny shapes they made the round things as well as the Eiffel Tower ones...."

Gertrude Stein
*Everybody's Autobiography*
1937

## Tulsa

[Tulsa is]: "The Oil Capital of the World, not content with one grandiose claim, goes further and declares itself also to be America's Most Beautiful City and, that still not being renown enough, The Best Livable City in the United States."

Erskine Caldwell
*Afternoons in Mid-America*
1976

* * *

"There are only two absolutely sure ways of securing a living in Tulsa. Of the two, the first and most comforting one is to have ownership of a lease in a producing oil field, and the other is to manage somehow to get on the Oral Roberts University payroll, in any capacity ranging from professor to janitor, and thereafter pray assiduously."

Erskine Caldwell
*Afternoons in Mid-America*
1976

* * *

"Tulsa, Oklahoma . . . would have been a real town even if its people weren't greasy rich with oil, for it is founded on the spirit of its people."

Will Rogers, 1923
Quoted in *Travel/Holiday*
August, 1981

## Other Cities and Places

### *Claremore:*

[When a six-story hotel in Claremore, Okla., was named after him]: "I know now how proud Christopher Columbus must have felt when he heard they had named Columbus, Ohio after him."

Will Rogers
*The Best of Will Rogers*
1979

### *Muskogee:*

"We don't smoke marijuana in Muskogee
We don't take our trips on LSD
And we don't burn our draft cards down at the courthouse
Like those hippies out in San Francisco do,
I'm proud to be an Okie from Muskogee!

And I'm proud to be an Okie from Muskogee;
A place where even squares can have a ball.
We still wave Ol' Glory down at the Court House,
White lightning's still the biggest thrill of all.
In Muskogee, Oklahoma, U.S.A."

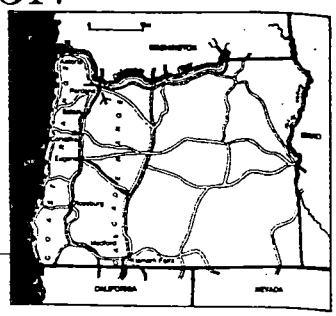
Merle Haggard and Roy Edward Burris
"Okie from Muskogee"
1969

* * *

"This Muskogee is really a parking space for cars entering Claremore. Of course, if you want to drive on into the town of Claremore proper, it's only 60 miles through the suburbs from here."

Will Rogers
*The Illiterate Digest*
1924

# *OREGON*



Capital: Salem
Became a territory: Aug. 14, 1848
Entered the union (with rank): Feb. 14, 1859 (33)
State motto: The Union
State flower: Oregon grape
State bird: Western meadowlark
State song: "Oregon, My Oregon"
State tree: Douglas fir
Nickname: Beaver State
Origin of state name: No one is certain; it was first used by Jonathan Carver in 1778, and most authorities believe it comes from the writings of Major Robert Rogers, an English army officer

Oregon was among the first areas of America sighted and explored. Spanish and English seamen are thought to have been there in the 1500s and 1600s. Capt. James Cook charted the coast in his quest for the mythical Northwest Passage across the continent. And Capt. Robert Gray discovered a torrential river there in 1792 and named it after his ship, the *Columbia.*

But Oregon's remoteness from the East Coast heart of early American civilization kept development out until Lewis and Clark brought back glowing tales of the territory after their 1805 visit. John Jacob Astor set up a fur depot here in 1811, and in 1846 the United States resolved all British claims to the area and made it a U.S. territory.

At the same time, the Oregon Trail began shuttling settlers into the moist, richly forested area, which soon became a major population center.

Today Oregon prides itself on having the largest reserve of standing timber in the country, supporting a lumber processing industry whose annual revenues exceed $5 billion. It also sports one of the world's largest salmon fishing centers around Astoria on the Columbia River.

The state's huge supply of fast-moving water has provided for highly successful agriculture, particularly orchards, and permitted a huge supply of hydro-

OSU

Oklahoma State University

STILLWATER, OKLAHOMA 74078
STUDENT UNION 470
(405) 744-5362

OFFICE OF THE VICE PRESIDENT FOR
UNIVERSITY RELATIONS AND PUBLIC AFFAIRS
AND
EXECUTIVE DIRECTOR OF THE INSTITUTE FOR
INTERNATIONAL TRADE AND ECONOMIC DEVELOPMENT

March 22, 1990

Mr. Judd Swift, Deputy Director
Presidential Advance Office
The White House
1600 Pennsylvania, N.W.
Washington, D.C. 20500

Dear Mr. Swift:

Per our conversation this morning, the attached information is provided to describe Oklahoma State University and to indicate our interest in your support for a series of teleconferences emenating from OSU highlighting on the President's education goals.

We propose to hold a series of teleconferences dealing with education issues and sharing with other colleges and universities as well as secondary education institutions across the country.

Our first teleconference would involve live broadcast feeds of the President's addresses at both the OSU Commencement and later May 4th to the Oklahoma Foundation for Excellence. (Our assumption is that the President will highlight the importance of education and indicate administration goals in his speeches. Assuming he does further define his education objectives, we believe the message would be well received at many additional sites.) At the conclusion of the President's speeches, we would have reaction to his comments by key educational leaders indicating support for the President's initiatives. On dates scheduled subsequent to May 4, we would hold at least two other live interactive video teleconferences featuring educational leaders and state governors sharing innovative programs that have been successful in their respective states. We would ask governors to share the education initiatives that they have begun since the Education Summit in Williamsburg.

It should be noted that Oklahoma State University is a national leader in distance learning and satellite transmission of educational programming and coursework. The National University Teleconference Network is headquartered at OSU and has membership of more than 300 institutions nationwide. We believe these teleconferences will make for an extremely useful

dialogue among education leaders throughout the country, utilizing the President's remarks in our first proposed teleconference to set the framework for national exchange of ideas in subsequent teleconferences.

Attachments related to the Educational Television and teleconferencing capabilities of Oklahoma State University and the National University Teleconference Network are attached for your review. We would appreciate your response to our proposal as soon as possible so that our programming and scheduling can proceed.

I look forward to seeing you next Tuesday.

Sincerely,

Harry W. Birdwell
Vice President

HWB:skc

Attachments

cc: President Campbell

OSU
OKLAHOMA STATE

Office of the Vice President for
University Relations and Public Affairs
and Executive Director of the Institute
for International Trade and Economic Development
Student Union 470, Extension 45362

# MEMORANDUM

CONFIDENTIAL

Date: March 22, 1990

To: Chris Jackson
Paul Hummer
Everett Eaton
Ralph Hamilton
Marshall Allen
Don Shepherd
Sheila Harp

From: Harry W. Birdwell

Subject: Preliminary Advance Team Visit

We have been notified by the White House that the preliminary advance team will be in Stillwater on the 27th of March at 11:30 a.m. We will meet briefly in my office and will go at noon to Suite 1600 for lunch. After a working lunch, we will move to the Council Room of the Student Union. This will be an opportunity to answer many of the questions that we have, to get to know the appropriate contact people at the White House, and to go over the logistical arrangements for the activity. Please come prepared with any questions you may have for which answers are needed.

We have been asked to keep our group small so that productive work can occur.

HWB:skc

cc: President Campbell

FAX: Mr. Judd Swift, Deputy Director
Presidential Advance Office
(202)456-2820

# The University

Oklahoma State University was founded on December 25, 1890, as Oklahoma Agricultural and Mechanical College, just twenty months after the Land Run of 1889.

When the first students assembled for class on December 14, 1891, there were no buildings, no books, and no curriculum.

In 1894, two and one-half years after classes began in local churches, 144 students moved into the first academic building, later known as Old Central, on the southeast corner of campus.

In 1896, Oklahoma A&M held its first commencement with six male graduates.

On July 1, 1957, Oklahoma A&M College became Oklahoma State University. Technical branches were established in Okmulgee in 1946 and in Oklahoma City in 1961. In July 1988, the Oklahoma College of Osteopathic Medicine and Surgery became the College of Osteopathic Medicine of OSU.

As one of Oklahoma's land-grant institutions, OSU has three goals: instruction, research and [illegible]ension.

OSU is located in north central Oklahoma in Stillwater, a town of over 42,000, which is almost equally distant from Tulsa and Oklahoma City. The University is coeducational and has an enrollment of over 26,683 students on its four campuses.

The University offers bachelor's, master's and doctor's degrees in a large number of fields, as well as the professional Doctor of Osteopathy and Doctor of Veterinary Medicine degrees. Specialist degrees are also offered in selected fields.

Although OSU is a large, comprehensive university, its size does not minimize the personal attention given to each student. The individual is more than just a number at this university. OSU encourages all students, when they first enroll, to identify the college in which they wish to major. Once the student has identified his or her major department, he or she becomes a very important individual to the faculty and advisers of that department. Because the average number of students majoring in any one department is less than 150, the student can count on personal attention in a friendly environment.

The largeness of the University has many distinct advantages. OSU's 1.5 million volume library, its vast research laboratories and equipment, excellent physical education-recreation and student union facilities, nationally-recognized residence halls programs, outstanding cultural events, and 37 nationally-affiliated fraternities sororities, all provide a stimulating educational and social experience.

## [illegible]e Mission

The mission of Oklahoma State University is to provide an environment in which its constituents can discover, examine, preserve, and transmit knowledge, wisdom, and values that will help ensure the survival of present and future generations, with enrichment in the quality of life.

## Student Profile

OSU has a diverse student body. Students come not only from Oklahoma, but from across the nation and world. Of OSU's 26,683 students, more than 20,500 are on the Stillwater campus, 2,100 at Okmulgee and 3,500 at Oklahoma City, as well as nearly 700 students at the University Center at Tulsa and 800 students at the College of Osteopathic Medicine in Tulsa. Eighty-nine percent of the undergraduate enrollment is from Oklahoma; six percent from other states, and five percent from more than 25 foreign countries. Of the undergraduate population, 55 percent are men and 45 percent are women. Minorities make up eight percent of the undergraduate student body.

The graduate student enrollment totals 4,165. Of these students, approximately 600 enroll through the University Center at Tulsa. Seventy-one percent are from Oklahoma; 12 percent from other states; and 17 percent from foreign countries. Of the graduate population, 56 percent are men and 44 percent are women. Minorities make up eight percent of the graduate student body.

## Facilities

The OSU campus is one of exceptional beauty with modified Georgian style architecture in all of the new buildings. The main campus encompasses 415 acres and 200 permanent buildings. These facilities include one of the largest libraries in the entire Southwest, a large Student Union complete with hotel facilities, the Colvin Physical Education Center, the Bartlett Center for the Studio Arts, and the Seretean Center for the Performing Arts.

The Lake Carl Blackwell area, eight miles west of Stillwater, is also owned by OSU. The area includes approximately 21,655 acres, including the 3,000-acre Lake Carl Blackwell which provides the water supply for OSU, and is also used for research activities, in addition to being a popular regional recreational area.

Additional properties include approximately 1,900 acres in farm land and facilities in Payne County, as well as 2,900 acres and various structures devoted to research stations around the state.

## General Education

Oklahoma State University is committed to producing graduates who have both a depth of knowledge in their major fields of study and a breadth of knowledge outside their majors, the best graduate being one with a mastery of a specific subject matter and a solid and diversified general education. As a result of this commitment to breadth and general education, the following philosophy of general education was adopted in 1978:

The role of General Education at Oklahoma State University is to assist the student in the pursuit of general knowledge and in the development of skills and attitudes conducive to a lifetime of enlightenment. It must stimulate intellectual curiosity, original thought and expression, the capacity for critical analysis and problem solving and the ability to make conscious value judgments consistent with both personal needs and the public interest. It must be a blend of the timely and the timeless and assist the graduate to live and function in a rapidly changing, complex and cosmopolitan world.

## Accreditation

Oklahoma State University has been continuously accredited by the North Central Association of Colleges and Secondary Schools as a degree-granting institution since 1916. It is also a member of the National Association of State Universities and Land-Grant Colleges, the Association of American Colleges and the American Council on Education. The University is on the approved list of colleges and universities of the American Association of University Women. All Teacher Education programs are fully accredited by the National Council for Accreditation of Teacher Education. Many of the colleges and programs are accredited through their professional organizations. These accreditations include the American Historical Association, the Accrediting Council on Education for Journalism and Mass Communication, the National Association of Schools of Music, the American Speech-Language-Hearing Association, the American Assembly of Collegiate Schools of Business, the National Council for Accreditation of Teacher Education, the Accreditation Board for Engineering and Technology, the Associated Collegiate Schools of Architecture, the National Architectural Accrediting Board, the American Home Economics Association, and the Council on Education of the American Veterinary Medical Association. Refer to the appropriate college sections in this *Catalog* for information on accreditation of specific programs.

## Affirmative Action Program

OSU's Affirmative Action Program reflects the commitment of the University to equal opportunity and outlines the procedures necessary to fulfill this commitment. OSU is committed by policy of its Board of Regents to promote equal opportunity in all phases of university life for all persons within its constituency. The Affirmative Action Program complies with the legal requirements for federal and state civil rights laws and implements directives. Members of ethnic minority groups, women, the handicapped, disabled veterans and veterans of the Vietnam era, and the aged in society have faced many complex barriers to equal opportu-

OKLAHOMA STATE news

OKLAHOMA STATE UNIVERSITY CENTENNIAL 1890 • 1990

Vol. 20, No. 7

March 19, 1990

# Four multicultural activities planned

The OSU Planning Committee for Multicultural Awareness Programs has announced four activities to be held during the remainder of the Spring Semester.

On Mar. 26, the spotlight will be on Native Americans in a program to be presented by Rayna Green of the Smithsonian Institution. The topic "Re-Interpreting American Indian History and Culture: A New Museum for the Next 500 Years." The program will begin at 7:30 p.m. in the Student Union Theater. A reception will follow in the French Lounge.

Green will present another program on the following day, Mar. 27, 3:30 p.m. in 101 Classroom Building. Her topic then will be "American Indian programs and Opportunities at the Smithsonian."

On Apr. 11, the program spotlight will be on African, Hispanic and Native Americans. "Men of Color" is the topic for two videotaped presentations and a panel discussion, all slated for the Student Union Theater. The first videotaped presentation is scheduled for 1:30 p.m. to 3:30 p.m., the panel discussion from 5:30 p.m. to 6:30 p.m. and the second video presentation from 6:30 p.m. to 8:30 p.m.

From Apr. 16-20, the spotlight will be on Hispanics in a photo exhibit, "New Spain: The Frontiers of Faith," in the Student Union Alumni Centennial Lounge.

Three activities were held earlier in the semester by the planning committee, spotlighting Asian Americans and African Americans.

The Planning Committee on Multicultural Awareness Programs was formed in 1989 by the Office of the Vice President for Student Services. Its objective is to develop and implement programs and activities to enhance organizational and individual awareness of and sensitivity to the value of ethnic diversity in the academic environment.

For more information about the committee and the scheduled activities, call x45328 or x46934.

# Sexual harassment panel available for seminars

Each year, the Sexual Harassment Advisory Panel conducts seminars for various groups around the campus. This is an effort to help students and staff understand the nature of sexual harassment and the proper procedures to handle inquiries or process complaints.

This year, several campus groups are expected to avail themselves of the opportunity to become better informed on the subject matter.

"At some point, each of us may be asked to answer an inquiry or process a sexual harassment complaint," said Ken Chance, director of affirmative action. "We want to assist you in any way we can to properly handle these situations, should they occur."

Chance encourages each supervisor or administrator to review the contents of OSU Policy Letter 1-0702 on sexual harassment. Various procedural and supervisory responsibilities are clearly outlined in the policy.

Additionally, staff from the affirmative action office or members of the advisory panel may be contacted to answer questions or conduct training seminars.

"An excellent video tape has been produced by OSU to assist in these training efforts," Chance said.

Sexual harassment hinders performance on the job or in the classroom and is strictly prohibited by University policy.

"If we can assist you in any way or you wish to schedule a seminar, please call myself, Lois Sharpton of our office, or any member of the advisory panel," Chance said. Members of the panel are: Ed Lawry, associate professor and head of philosophy, x46088; Janice Park, assistant professor of clothing, textiles, and merchandising, x45776; Linda Jamison, senior unit assistant, physical plant administration, x47147; Toni Connelly, financial assistant, electrical and computer engineering, x45153; Gail Martin, student; and Sharon Krueger, student.

# Four Phoenix Award winners announced

A professor and three outstanding students are recipients of this year's Phoenix Awards from OSU Graduate Student Council.

James Lawler, professor of political science, was named Outstanding Graduate Teacher. Runners-up in the teaching category were Barbara Stoecker, associate professor of food, nutrition and institutional administration, and Marvin Stone, associate professor of agricultural engineering.

Asha Hegde-Niezgoda, a doctoral student in housing, interior design and consumer studies; Susan Routh, a master's candidate in housing, interior design and consumer studies; and Paul Chapman, a master's candidate in forestry, were all presented awards at a recent ceremony.

Runners up in the doctoral category were Sarah Drummond and Tim Springer. There were no runners-up in the graduate category.

# Emeritus group hears about Soviet Union, research

The OSU Emeritus Association heard reports about the Soviet Union and OSU research programs at its January and February meetings.

### January

In January, three OSU emeritus professors related experiences and observations from recent travels in the Soviet Union.

Lionel Arnold, emeritus professor of humanities, presented slides centered on Russian art, music, dance and architecture as he encountered it. He provided a historical context for the various art forms.

His slides included the palace at Yalta, the architectural treasures of the Kremlin, the cathedrals of Leningrad; and two modern structures in Moscow, the Exhibition of Economic Achievement and the Monument to Space. In relation to other arts, Arnold presented colorful slides of a professional dance troupe in various traditional and modern costumes.

Richard Leftwich, emeritus professor of economics, presented observations from an Elderhostel tour on which he and Maxine Leftwich visited Moscow, Leningrad, and parts of the Ukraine.

In their interactions with professors, students, and people on the street, the Leftwiches encountered more openness than they had expected. They saw glasnost in action in the cities, on a collective farm, and on trains.

Living standards were lower than they had expected—"almost at Third World levels," Leftwich said.

Beyond clothes, household goods, and cars, very little is owned personally under the Russian socialistic system. "Prices are set on all products and resources. There is a state monopoly on everything, and bureaucratic intrusion into everything," Leftwich said.

What the Soviet Union really needs is economic freedom. It needs to provide opportunity for entrepreneurs; and it needs free international trade. "Until they move away from a socialistic system, perestroika is doomed to failure."

Kyle Yates, emeritus professor of religion, along with his wife Jean, made a Russian tour in August which focused on religions.

Of the 70,000 to 80,000 Russian Orthodox churches in the country before the Revolution, only about one-tenth remained as active churches after Stalin. Most of the others were converted to museums. As many as 1,700 have been changed back to churches in the last 18 months, and the number is growing. In April of 1988, Gorbachev pledged full cooperation to the Russian Orthodox Church.

At one time there were one hundred synagogues in Kiev; now there is one. There is one each in Moscow and Leningrad. It is interesting to note, however, that a Jewish library and cultural center is now under construction in downtown Moscow.

In Lithuania, the Catholic Church has reopened. In Moscow, a Baptist seminary is to be built only three or four blocks from the Kremlin.

### February

At the February meeting, Karl Reid, dean of engineering, architecture and technology, described the origins, purposes and programs of the Oklahoma Center for the Advancement of Science and Technology (OCAST).

OCAST was established by the Oklahoma legislature in 1987 to stimulate the economy of Oklahoma by developing new ideas, methods and products in the state.

Reid explained the strategy set forth as a "sustained collaborative effort between college and university research talents and Oklahoma businesses to develop unique concepts with regional, national, and international market potential."

The expected outcomes of this effort, he said, is "new and expanded Oklahoma businesses, new jobs for Oklahomans and greater recognition of Oklahoma capabilities and achievements."

Two of the three OCAST Centers of Excellence are at OSU. These are the Integrated Design and Manufacturing Center, with $9.5 million funding, and the Laser Development and Applications Center, with $11.5 million funding. The third Center is in the Medical School at the University of Oklahoma.

Both OU and the University of Tulsa cooperate with OSU in the Integrated Design and Manufacturing Center. The unique feature of this Center, Reid explained, is the system integration of the design and manufacturing components.

Reid cited one OCAST success story in which a flight simulator was designed for the Air Force as the result of a $50,000 grant for one OSU faculty member and one graduate student. The simulator, now being built in Tulsa, has created one hundred new jobs.

A history of excellence and focus in the physics and chemistry departments laid a solid foundation for the Center for Laser Applications, Reid said, as he gave credit to both William Sibley and Richard Powell for their expertise and their efforts. The Center for Laser Application has provided a practical vehicle for transferring the basic research from physics and chemistry to engineering. But there is a need to transfer more laser information and technology to Oklahoma industry, Reid said.

The present focus is on industrial and medical applications of laser. One exciting development is opto-electronics, or the use of light, or photons, rather than electrons. Examples are electronic cameras and laser compact discs.

Reid concluded that as projects such as these flourish, we are "moving toward partnership of research and practical application in Oklahoma industry."

The March 28 meeting of the association will feature Wilton (Andy) Anderson, emeritus professor in the College of Business Administration, in a program on financial planning. Meeting time is 9:30 a.m. in Student Union Case Study III.

# Center sets brown bag lunch programs

The Stillwater Family Resource Center, 1207 W. McElroy, has announced the schedule for its Brown Bag Lunch schedule for the remainder of the Spring Semester.

The lunches are held every Wednesday from noon until 1 p.m. and are open to the public.

"The Dilemma of Peanut Butter and Steak Part Two" is the topic of the Mar. 21 lunch. Mike Hopkins, public service specialist with the home economics university extension, will be completing a presentation begun at the Mar. 14 luncheon.

"What You Heard May Not be What I Said" is the topic of the Mar. 28 lunch. Paul Harper, head of the speech communication, will be the featured speaker.

Hopkins will present "Honor Your Father and Mother" at the Apr. 4 lunch.

"Time Management" is the topic of the Apr. 11 lunch. Beulah Hirschlein, director of the home economics university extension, will be speaking.

"Changing Expectations: Pre-Marriage, Marriage, and Second Marriage" is the topic of the Apr. 18 luncheon. David Fournier, interim head of family relations and child development, will be the featured speaker.

"The Appropriate Role of the Stepparent" is the topic of the Apr. 26 lunch. Lois Mickle, assistant professor of family relations and child development, will be speaking.

"Living With Your Child's Temperament" is the topic of the May 2 lunch. Sherre Davidson, child development specialist of Payne County Guidance Clinic, will be the featured speaker.

Davidson will present "Power Struggles With Your Child" at the May 9 lunch.

"How to Get Out of Your Own Way" is the topic of the May 16 lunch. Anne Benes, coordinator of the Family Resources Center, will be speaking.

# 1990 census importance stressed by state group

The Oklahoma 100-member "Complete Count Committee" is stressing to Oklahomans the importance of answering and returning the 1990 Census questionnaire, according to the Oklahoma Department of Commerce.

The committee was created by Governor Henry Bellmon to promote awareness of census activities and is working in conjunction with the Oklahoma State Data Center, the State Department of Commerce and the Governor's Office. The Data Center is the state's official depository for census data.

Congressional representation and millions of dollars in annual fee funding are at stake, the Department of Commerce points out, and Oklahomans are urged to "stand up and be counted" during the 1990 U.S. Census.

In the 1979 Census, Oklahoma barely retained its sixth congressional seat. With recent outmigration trends, Oklahoma could be adversely affected in 1990.

In 1989 alone, $107 billion or 35 percent of all federal funds were allocated to municipalities based on census data. During the next 10 years, it is estimated that Oklahoma could lose $1,500 per person for each person that is not counted in the 1990 census.

The 1990 Oklahoma census count will be taken using three enumeration methods: mail out/mail back, update/leave and list/enumerate activities.

Because minorities have been undercounted in Oklahoma in the past decades, a special public awareness effort is being targeted toward those groups by the Complete Count Committee.

## Professional Notes

**John Hoover,** associate professor of veterinary medicine and surgery, has been honored by the Oklahoma Animal Disease Diagnostic Laboratory for his work in producing superior descriptive and accurate case histories which helped the laboratory serve him, his clients, and his patients better. Hoover is one of 12 veterinary practitioners being honored by the laboratory.

* * *

**Smith L. Holt,** professor of chemistry and dean of arts and sciences, has been elected as a Fellow of the American Association for the Advancement of Science.

A Fellow of the association is a member "whose efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." The association elected 310 individuals as Fellows this year.

* * *

**Robert Wicklein,** assistant professor of occupational and adult education, has been presented with the Outstanding Service Award from the Technology Education Division of the American Vocational Association.

The award is based on research that Wicklein completed for the division during the 1988-89 academic year.

* * *

**Leonard Leff,** associate professor of English and co-author of a history on movie censorship, was interviewed in early March in Washington D.C., on the Larry King Mutual Network radio show. Leff is author of The Dame in the Kimono: Hollywood Censorship, & the Production Code for the 1920s to the 1960s.

Leff wrote the book with Jerold L. Simmons of the University of Nebraska at Omaha.

While in Washington, Leff was also interviewed by radio station KAMU, by National Public Radio for its "Fresh Air" program, and by CBS Television News for its "Night Watch" late news program.

* * *

**Cecil Dugger,** associate professor of aviation and space education, has been named an "Honorary Colonel" in the Oklahoma National Guard in honor of his years of work in the Oklahoma Military Department in the development and teaching of education programs.

* * *

# Staff Council fills vacant positions

The OSU Staff Advisory Council has filled several vacated positions during the last few months.

Margaret Betts (Academic Affairs), Coy Jenkins (Business and Finance) and Kathryn Merrill (University Relations and Public Affairs) were presented certificates in appreciation of their hard work and support, while Patty Bible, Steve Gahagans and Jan Haley were appointed to fill their positions.

The new SAC brochure is in the process of being distributed to all classified and professional staff. If you have not received a copy, please contact Patty Bible at X46779.

SAC also will be distributing a spring newsletter within the next few months to update classified and professional staff on recent SAC concerns and actions.

Monthly meetings of the group are held on the second Wednesday at 1:15 p.m. in 250 Student Union.

If you have concerns you wish to share with the Council, please contact any member listed here.

## 1989-90 Staff Advisory Council

| | |
|---|---|
| Linda Amey | X45994 |
| Marie Basler (Chair, Policies and Benefits) | X45488 |
| Craig Beeby | X49973 |
| Patty Bible (Chair, Public Relations) | X46779 |
| Billie Blackburn | X45231 |
| Billy Joe Dobson | X47199 |
| Sandra Colasacco | X45737 |
| Steve Gahagans | X46523 |
| Jan Haley | X47693 |
| Eileen Kammerer | X43004 |
| Debbie Lane | X46384 |
| Kim Marotta (Secretary) | X46148 |
| Retta Gayle Meigs | X46606 |
| Ken Morris (SAC Chair) | X46787 |
| Cindy Ogilvie | X45524 |
| Kathy Phillips (Vice Chair) | X48171 |
| Dorothy Scarbrough (Chair, Awards/Recognition) | X46661 |
| Adrian Self | X47154 |
| Marilyn Verhalen | X46088 |
| Janice Walter (Chair, Rules and Procedures) | X46055 |
| Joe Weaver | X45663 |

## Architecture lecturer schedule is changed

Changes in the spring visiting lecturer schedule have been announced by the OSU School of Architecture.

Peter Q. Bohlin's lecture, originally scheduled for Mar. 15, has been rescheduled for Apr. 5, during the School's "Architecture Week."

A new lecture has been added for Apr. 24 at 8:00 p.m. in the Bartlett Center Auditorium to be given by Paul F. Downton. Downton is currently lecturer in architecture in the department of architecture at the South Australian Institute of Technology.


### NOTICE

When your Doctor recommends surgery or hospitalization

CALL

Health International
1-800-0448-9776

This new procedure applies to everyone covered by American Fidelity except retirees who are also covered by Medicare.


### March-April Videoconference Schedule

#### ASTS

| | | |
|---|---|---|
| American Government | M-W-F | 8:45a-9:45a |
| German I by Satellite | M-W | 9:45a-10:45a |
| German II by Satellite | M-W | 10:45a-11:45a |
| AP Chemistry by Satellite | M-W-F | 10:45a-11:45a |
| Basic English and Reading | T-Th | 8:45a-9:45a |
| Analytical Geometry | T-Th-F | 9:45a-10:45a |
| AP Calculus by Satellite | T-Th-F | 9:45a-10:45a |
| AP Physics by Satellite | T-Th | 10:45a-11:45a |
| Russian By Satellite | T-Th | 10:45a-11:45a |

All of the ASTS programming may be viewed on campus channels 10 and some shows may be be available on Stillwater Cable channel 30.

#### Other Programming:

| | | | |
|---|---|---|---|
| 3/20 | 3:15p-6:15p | Contemporary Issues #11 | Education Extension |
| 3/22 | 3:15p-4:45p | Microcomputers and Science Education | Education Extension |
| 3/27 | 1:00p-3:00p | Robotics in Space | NASA |
| 3/27 | 3:15p-6:15p | Contemporary Issues #12 | Education Extension |
| 3/28 | 12:30p-3:00p | Europe 1992: The New American Challenge | College of Business |
| 3/29 | 3:15p-4:45p | Microcomputers and Science Education | Education Extension |
| 4/3 | 3:15p-6:15p | Contemporary Issues #13 | Education Extension |
| 4/4 | 3:45p-6:00p | Keep Oklahoma Running | Economic Education |
| 4/4 | 3:15p-5:45p | Improving Teaching at a Distance #1 | Education Extension |
| 4/10 | 3:15p-6:15p | Contemporary Issues #14 | Education Extension |

The above programs can be viewed on campus channels 10 or 12 and will be available on Stillwater Cable 30.

For further information, call Rose Delano at x45960.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**Stillwater, OK 74078**

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OKLAHOMA CITY, OKLAHOMA 73105

March 20, 1990

RECEIVED
MAR 23 1990
PRESIDENT'S OFFICE

Mrs. George Bush
First Lady
The White House
Washington, D.C. 20500

Dear Mrs. Bush:

Each year Oklahoma State University presents the Henry G. Bennett Distinguished Service Award to individuals who have truly rendered outstanding and unselfish service to our fellow human beings. The Award is named as a lasting tribute to a former President of Oklahoma State University, Henry G. Bennett, who, along with his wife, lost their lives in a plane crash in Ethiopia during an American educational mission related to the Point Four project.

Because of your continuing service to promote literacy and the cause of education, Oklahoma State University and its governing Board of Regents wishes to honor you by presenting you with the Henry G. Bennett Distinguished Service Award during Commencement exercises on May 4, 1990. Dr. Bennett had a vision for the University that enabled OSU to follow through even after his untimely death. It seems to the world, Mrs. Bush, that you are sharing in the vision your husband has for this great country of ours. You seem to have been able to strike the perfect balance of being completely supportive of President Bush's mission without becoming embroiled in political debate.

To millions of American families you have shown that there are values in life which are not outmoded or outdated such as being a loving help mate and an understanding mother and grandmother and still be able to take time in your life for people and causes in which you believe.

President Bush has agreed to honor the University by giving the Commencement address at Oklahoma State University on May 4, 1990. To have you accompany the President and let us honor you would please us beyond measure.

(Continued on page two)

As First Lady of the United States of America, you have brought great dignity and new appreciation to the position you hold. To be very candid, you have won the hearts of all Oklahomans as well as all Americans, and it would give us great pleasure to have you visit our campus on such a happy occasion.

OSU will be 100 years old on December 25, 1990, which means we are in the midst of celebrating many memorable events this year. Having the President visit the campus during OSU's Centennial Year is an occasion to which thousands of Oklahomans are looking forward with great anticipation. To have the Presidential couple visit the campus would be a historical first in our 100-year history. I respectfully ask you to consider the trip to OSU with the President on May 4.

If you could let us know when your decision is made, we would be most appreciative.

Sincerely,

Carolyn Savage, Chairman
OSU Board of Regents

CS/cw

xc: Governor Henry Bellmon
U.S. Senator David Boren
U.S. Senator Don Nickles
OSU President John Campbell
Members of the OSU/A&M Board of Regents

Bridwell

OSU

Oklahoma State University

OFFICE OF THE PRESIDENT

STILLWATER, OKLAHOMA 74078-0001
WHITEHURST HALL
405-744-6384
FAX: 405-744-8871

March 16, 1990

Mrs. George Bush
The White House
Washington D.C. 20500

Dear Mrs. Bush:

It is a genuine pleasure to advise that the Board of Regents for Oklahoma State University (OSU) unanimously approved you as a recipient of the 1990 Henry G. Bennett Distinguished Service Award. We are hopeful that you can be on hand to accept this award at the May 4, 1990, Commencement commemorating the 100th birthday of OSU. The only caveat in receiving this high honor is to be present for the recognition.

Oklahoma State University annually recognizes unusually outstanding individuals with the Henry G. Bennett Distinguished Service Award. This year, in addition to your receiving the award, we will honor Wilma P. Mankiller, Principal Chief of the Cherokee Nation, and H. F. Donnelley, a distinguished native son of Stillwater, Oklahoma. Named in memory of the visionary leader who served this University with great distinction as President from 1928 to 1951, this award is the highest honor awarded by Oklahoma State University. Former recipients include crew members of the first Apollo lunar mission, Emperor Haile Selassie, United States Senator Henry Bellmon, Nobel laureate Norman Borlaug, Pennsylvania Supreme Court Justice Juanita Kidd Stout, newsman Paul Harvey, and other distinguished men and women.

Presentation of the award citation and medallion will be an important part of our Commencement program, which highlights the academic year at OSU. The Commencement exercises begin at 2:00 p.m. As you know, your husband, the Honorable George Bush, will deliver the Commencement address. We will be in touch with your staff regarding details of the schedule.

Meanwhile, we would appreciate receiving a biographical summary highlighting your distinguished record of public and private service, a photograph, and any additional information that might be useful in preparing appropriate publicity releases and printed materials for distribution.

CENTENNIAL
1890 • 1990

Celebrating the Past . . . Preparing for the Future

Mrs. Bush, you have brought great honor and distinction to this nation through your distinguished public service, and "down-to-earth" philosophies, and we are extremely proud and pleased to recognize your achievements with this highly coveted award.

Eunice and I look forward to welcoming you personally to campus on May 4. Meanwhile, we send our abundant best wishes to you and the President!

Sincerely,

John R. Campbell
President

JRC:SH

cc: Mr. H. J. Chesney
Dr. Jerry Gill
Mr. Charles Platt

**STILLWATER, OKLAHOMA - 4 MAY 1990** Scheduled to begin at 2pm

EVENT: Oklahoma State University (O.S.U.) Commencement

CONTACTS: See attached list

405/744-8531 GREAT! Contact

1. Harry Birdwell - VP for Univ. relations & public Affairs and past graduate of O.S.U.
2. Ralph Hamilton - Director Univ. Info. & publication Services

LOCAL COLOR: This is the largest school in the state

INTRODUCING THE PRESIDENT: Probably the Univ. President

BEFORE: White House

AFTER: Foundation for Excellence before that small GOP reception

TELEPROMPTER: (YES) NO Speech in Lewis Stadium #34 on Campus map

MASCOTS: Cowboy - "Pistol Pete" modeled after a real U.S. Marshal →

over * RECORDS OF TEAMS: #1 in Golf WRESTLING? 3/24 they won National Title in Wrestling

BARS: Eskimo Joes Yes - ESKIMO JOE'S? They have the 2nd largest mail order business only after Hard Rock Cafe of t-shirts sweatshirts, etc.! VERY POPULAR

ACTIVITIES:

(?) COMMENCEMENT THEMES: Centennial Commencement "Celebrating the past →

HISTORY: Land Grant University - they are opening the first Center for International Trade Dev. which they got $5 million from USDA for.

FAMOUS PAST GRADUATES: Governor Bellman, Senator Don Nickels not sure if they'll attend - probably yes.

PAST PRESIDENTS WHO VISITED: Nixon 1974 in one of his last appearances Also Ford in 12/89 and Carter is coming - check on date.

DOMESTIC AND FOREIGN POLICY INTERESTS - POSSIBLE PROTESTERS: not really a problem Harry didn't know of any off hand.

WEATHER: expected nice for event NATURAL DISASTERS? NO

SONGS: The college band will be there to play.

TRENDS: To come from Harry Birdwell

HUMOR: Book Store called - Cowboy Book Ltd. - off campus.

Maybe use Pistol Pete in a joke about the Drug war and our new Secret weapon is Pistol pete? Something like that.

OVER FOR MORE

- They are giving out the Henry G. Bennett Award, Bennett was a past President in the 40's & 50's big on the Part four program. He was killed in 1953 in a plane crash. The award is given for distinguished community service, they'd like to give it to Mrs. Bush.

They are also planning on giving The President an Honorary Doctorate degree in Economics. This will be The first honorary doctorate given in the history of Oklahoma. The reason is that the state has never allowed it up until now, and this will be the first given out. As well as the first given at the University. named Frank Eaton

* Teams - They have won more NCAA titles than any other school except two other schools, so they are 3rd in total NCAA TITLES.

Also they had the Heisman Trophy winner in '88 Barry Sanders - a big hero! He holds the single season rushing record of nearly 3,000 yrds. in one season.

and Preparing for the future" is the logo.

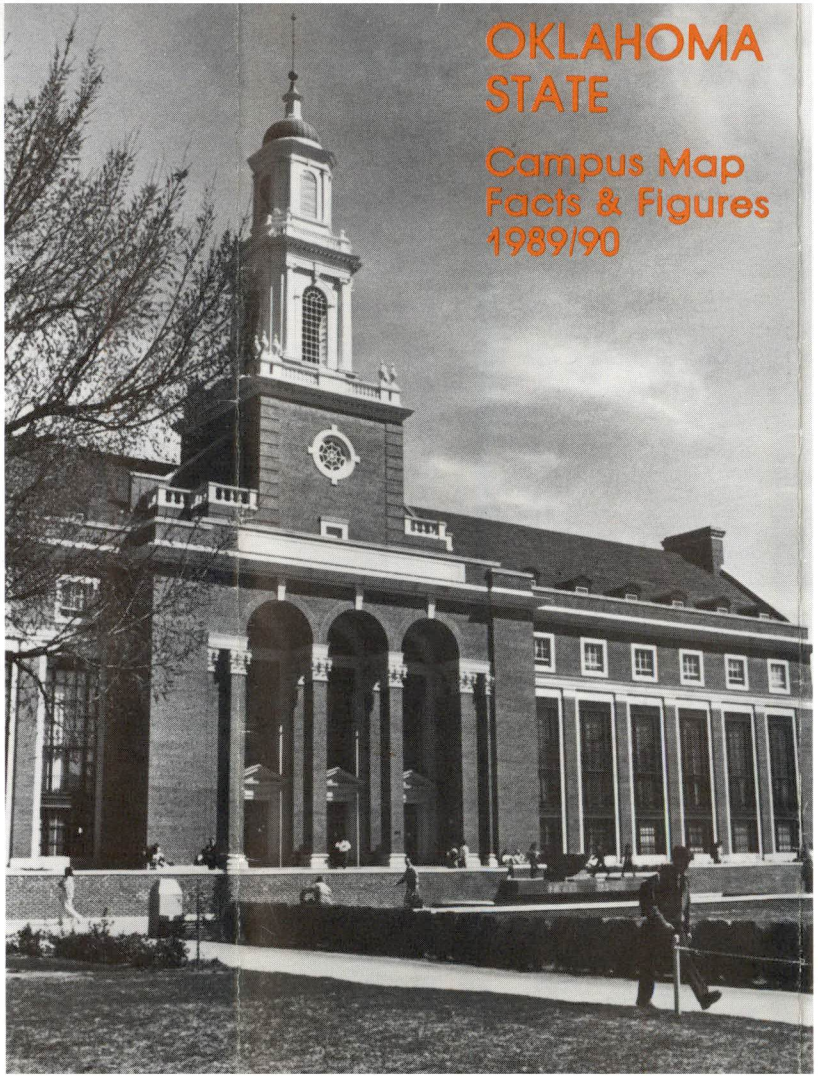
- They also have a big educational television program. They feed to over 500 high schools in 30 states college prep. courses in Languages, math, chemistry, physics ... etc.. They'd like to do a National teleconference with this commencement speech and feed it out to stations across the state, like the Education Summit.

- They plan to have one representative from each College on the dias with the President, I think 6 other people.

Contact Harry Birdwell for more info. - we had to leave early to catch our flight back on a commercial airline. Advance Stayed.

Oklahoma State University is an affirmative action/equal opportunity educational institution.
This publication is printed and issued by Oklahoma State University as authorized by the Director of University Information and Publication Services. 45M copies have been prepared and distributed at a cost of $2,576.16.

CENTENNIAL
1890 • 1990



# OKLAHOMA STATE

## Campus Map Facts & Figures 1989/90

## Facts & Figures 1989/90

### OKLAHOMA STATE UNIVERSITY
### Stillwater, Oklahoma 74078

OSU was founded December 25, 1890 as the Oklahoma Agricultural and Mechanical College. It became Oklahoma State University on July 1, 1957. Oklahoma's land-grant institution has three goals: to instruct, to do research and to offer educational assistance to the public through extension.

Technical branches were established in Okmulgee in 1946 and in Oklahoma City in 1961. In 1988, the Oklahoma College of Osteopathic Medicine and Surgery was merged with OSU to become the College of Osteopathic Medicine of OSU.

### Governing Board

The Board of Regents for Oklahoma State University and the Oklahoma Agricultural and Mechanical Colleges:

Carolyn Savage / Hominy
L.E. "Dean" Stringer / Oklahoma City
W.H. "Bill" Braum / Tuttle
Jack Craig / Leedey
Ed Malzahn / Perry
Dr. John Montgomery / Poteau
Robert Robbins / Altus
Jimmie Thomas / Ada
*Chief Executive Officer*
H. Jerrell Chesney / Oklahoma City

### Administration

PRESIDENT . . . . . John R. Campbell
VICE PRESIDENTS:
Academic Affairs & Research . . . James H. Boggs
Business-Finance (Interim) . . . . . Gene Satterfield
Student Services . . . . . Ronald S. Beer
University Relations and Public Affairs . . . . . Harry W. Birdwell
Director, OSU Technical Branch, Okmulgee and VP at OSU . . . . Robert Klabenes
Director, OSU Technical Branch, Oklahoma City and VP at OSU . . . . . James E. Hooper
President, College of Osteopathic Medicine of OSU . . . . . Clyde B. Jensen

### Teaching Staff

About 1,020 full-time equivalent teaching staff are employed on the main OSU campus.

### Enrollment (Fall 1989)

Main Campus, Stillwater . . . . . 19,354
Men 54% Women 46%
University Center at Tulsa . . . . . 746
University Center at Enid . . . . . 10
OSU Technical Branch, Okmulgee . . . . . 1,982
OSU Technical Branch, Oklahoma City . . . . 3,633
College of Osteopathic Medicine of OSU . . . . 265
TOTAL ALL BRANCHES . . . . . 25,990

**COLLEGES** (nearest whole % of total students on Main Campus):
Agriculture . . . . . 7%
Arts & Sciences . . . . . 24%
Business Administration . . . . . 29%
Education . . . . . 7%
Engineering . . . . . 13%
Freshman Programs . . . . . 6%
Graduate . . . . . 18%
Home Economics . . . . . 5%
Veterinary Medicine . . . . . 1%

### Number of Graduates

147,361 bachelor's, master's, doctor's, professional and associate degrees granted since the first six graduates in 1896. Degrees granted in 1988-89:

2,881 Bachelor
687 Master
210 Doctor
69 Veterinary Medicine
44 Associate
TOTAL = 3,891

### Degrees Offered

The University offers bachelor's, master's and doctor's degrees in a large number of fields, as well as the professional DVM and DO degrees. Specialist in Education degrees are also offered in selected fields.

### Operating Budget (All Agencies)

Total 1989-90 . . . . . $267.9 million
State Appropriations . . . . . $127.1 million
Other (federal funds, student fees, sales, services) . . . . . $140.8 million

## Fees

Fees vary dependent upon course level. All students pay $5.75 per credit hour for activity and facility fees. The Health Center fee is $36.00 (7 + hours) or $5.00 (1-6 hours) per semester. These charges are in addition to the ones listed below.

| | Lower Division | Upper Division | Graduate |
|---|---|---|---|
| *Oklahomans* | $ 41.30 | $ 44.30 | $ 58.20 |
| *Non-residents* | $133.00 | $149.70 | $187.10 |

## Colleges

AGRICULTURE . . . . . Dean C.B. Browning
139 Agricultural Hall, 744-5398
ARTS & SCIENCES . . . . . Dean Smith L. Holt
201 Life Sciences East, 744-5663
BUSINESS
ADMINISTRATION . . . . . Dean R.L. Sandmeyer
201 Business Administration, 744-5064
EDUCATION . . . . . Dean K.L. King
103 Gundersen, 744-9463
ENGINEERING . . . . . Dean K.N. Reid
111 Engineering North, 744-5140
GRADUATE . . . . . Dean N.N. Durham
202 Whitehurst, 744-6368
HOME ECONOMICS . . . . . Dean P.K. Knaub
106 Home Economics West, 744-5053
VETERINARY MEDICINE . . . Dean J.W. Alexander
205 Veterinary Medicine, 744-6648

## Extension

*University Extension and Public Service Programs* are provided by the academic colleges to assist those who wish to continue their education or update their skills through courses for credit, workshops, conferences and seminars at times and sites convenient to the working adult. — 470 Student Union, 744-6606.

*Cooperative Extension Service* programs in agriculture, home economics, 4-H and rural development are conducted on campus and through 77 county Extension Offices — 139 Agricultural Hall, 744-5398.

## Research

The needs of Oklahoma and the nation in the areas of food, water, materials, energy, and human resources are being emphasized in research at OSU. The research program is an integral part of graduate instruction and undergirds the undergraduate curriculum. Over 1,000 research projects are conducted annually by the research offices in each of the academic colleges - Agricultural Experiment Station, 139 Ag Hall, 744-5398 . . . . Arts & Sciences Research, 201 Life Sciences East, 744-5663 . . . . . Business Research, 345 Business, 744-5125 . . . . Education Research, 408 Classroom Bldg., 744-6508 . . . . . Engineering Research, 110 Engineering North, 744-5957 . . . . . Home Economics Research, 106 Home Economics, 744-5053 . . . . . Veterinary Medicine Research, 308 Veterinary Medicine, 744-6663 . . . . . Assistant VP Research, 744-6501.

## Noble Research Center for Agriculture and Renewable Natural Resources

The 178,000 square foot research and education facility is located north of the Edmon Low Library and the International Mall. Construction on the Center began in June 1985 and was substantially completed on November 1, 1988. Construction on Phase Two - Building C will begin in late 1989 with a completion date in mid-1991.

## Edmon Low Library

A nationally known major research library covering five acres of floor space, with more than 1.5 million volumes. Open 362 days a year, usually from 7:30 a.m. to 11:00 p.m. Information desk 744-9729. The Edmon Low Library is shown on the cover.

## Who To Contact For What

All offices maintain normal 8-5 hours Monday-Friday unless otherwise noted.

Campus information: (405) 744-5000.

- **Admissions** - First Floor Whitehurst, freshmen, 744-6858; transfers, 744-6861. Toll free number: 1-800-522-6809 (Oklahoma only).
- **Alumni Association** - Programs and services for students, former students and the University. 212 Student Union, 744-5368.
- **Campus Events Tickets** —
  *Allied Arts.* Student Activities. 060 Student Union, 744-7509.
  *Student Productions* contact sponsoring organization.
  *Athletic Tickets.* Ticket Manager, Gallagher-Iba Arena, 1-800-522-6858 (Oklahoma only) or 744-5745. Also ticket office, First Floor Student Union. *Athletic Promotions,* Gallagher-Iba Arena, 744-5938.
- **Campus Recreation** - Facilities for over 30 activities, including swimming, outdoor trips, camping equipment, fields and courts, group camping or meetings (Camp Redlands), sailing center. Two indoor facilities, Colvin Center and Annex, 744-5510.
- **Campus Visits** - High school student information and campus tours for prospective students. Contact *Office of High School and College Relations,* 210 Student Union, 1-800-522-6809 (Oklahoma only) or (405) 744-5358. Tours: Monday through Friday 11:00 a.m. and 1:30 p.m. Saturday tours at 11:00 a.m. except holidays and summer session.
- **Financial Aid** - Scholarships, loans, federal assistance - *Office of Student Financial Aid,* 1st Floor, Hanner, 744-6604.
- **Health Service** - Physical and emotional medical care. Emergency care 24 hours daily. Student Health Center, 744-7026.
- **Housing** —
  *University Apartments* - 713 apartments beginning at $292 per month. Apartments are available for all OSU families and a limited number for single graduate and upper division students. University Apartments Office, E-2 Brumley, 744-5353.
  *Residence Halls* - 11 halls (including one 12-month graduate hall) with developmental programming for approximately 5,000 students. Residence Halls Office, First Floor Iba Hall, 744-5592.
  *Fraternity-Sorority* - 23 men's national fraternities and 14 women's national sororities. Student Activities, 050 Student Union, 744-5490.
- **OSU Foundation** - Fostering private support for OSU programs, 370 Student Union, 744-7400.
- **Public Information** - Services to the mass media and publications about OSU. Public Information Building, 744-6260.
- **Student Union** - Student Activities, Conference Center and Shopping Mall, Director's Office, 744-5231; Information and Reservations, 744-5232; Hotel/Conference Center, 744-6835; Food Service, 744-5216; State Room Restaurant, 744-5220; Student Union Programs, 744-5214.
- **University Personnel Services** - Employment, Benefits, Payroll, 407 Whitehurst, 744-5373.
- **University Placement** - Placement services for graduates, 360 Student Union, Director, 744-5253.
- **University Police** - Police assistance on campus is provided 24 hours daily for visitors and the OSU community. To obtain parking or crime prevention information, as well as police assistance, call 744-6523. In emergencies, use the emergency telephones marked by the blue lights, or dial 911.

## Intercollegiate Athletics

Oklahoma State has one of the best all-around athletic programs in the country, ranking in the top ten in the national all-sports poll in each of the last 16 years. The Cowboys and the Cowgirls compete in the Big 8 Conference and the men rank third in the nation in the number of NCAA Championships won as a team and fourth in individual titles. Athletic Director, Gallagher-Iba Arena. 744-5733.

## Academic Calendar

SPRING SEMESTER 1990

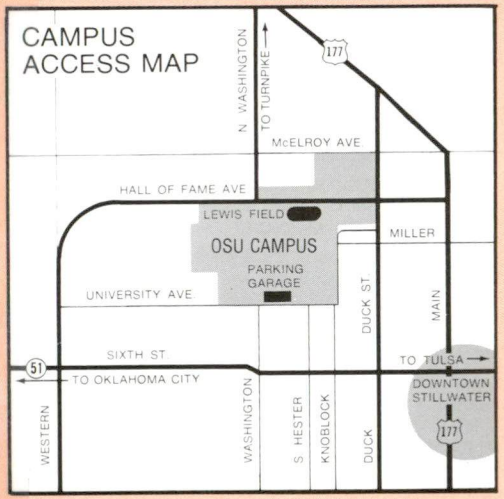
| | |
|---|---|
| January 8 | Class work begins |
| March 3-11 | Spring recess |
| May 5 | Commencement |

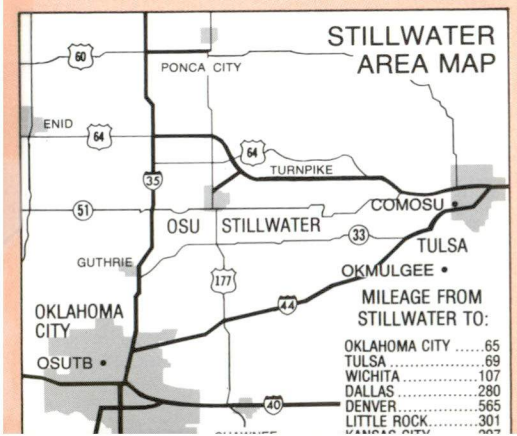
SUMMER SESSION 1990

| | |
|---|---|
| June 4 | Class work begins |
| July 30 | Semester closes |

FALL SEMESTER 1990

| | |
|---|---|
| August 27 | Class work begins |
| October 15,16 | Fall recess |
| December 21 | Class work ends |




# OSU Campus

©1989 Oklahoma State University

## Numerical Index

1 Old Central Museum of Higher Education
2 Fire Station No. 2
3 Performing Arts (Seretean Center)
4 Gundersen
5 Bennett Memorial Chapel
6 Journalism and Broadcasting (Miller)
7 Student Union
8 Studio Arts (Bartlett Center)
9 Morrill
10 Business Administration
11 Hanner
12 Thatcher
13 Classroom Building
14 Home Economics East
15 Civil Engineering
16 Engineering South
17 Engineering North
18 Library (Edmon Low)
19 Willard
20 Whitehurst
21 Mathematical Sciences
22 Life Sciences West
23 Life Sciences East
24 Physical Sciences
25 Dairy
26 Noble Research Center (under construction)
27 Power Plant
28 Cordell
29 Diesel Laboratory
30 Radiation Laboratory
31 Industrial Arts
32 Crutchfield
33 Architecture
34 Stadium (Lewis)
35 Football Offices
36 Gallagher-Iba Arena
37 Athletic Dressing Room
38 Wrestling Hall of Fame
45 Student Union Parking Garage
50 Motor Pool and Garage
51 Veterinary Medicine
53 Veterinary Medical Teaching Hospital (Boren)
54 Bovine Laboratory
55 Animal Disease Diagnostic Laboratory
56 Agricultural Center
57 USDA
58 Brumley Apartments
59 Colvin Center Annex
60 Colvin Physical Education Center
61 Headhouse and Greenhouse
62 Controlled Environment Laboratory
63 Agricultural Engineering Laboratory
64 Iba Hall
65 Willham Hall North
66 Willham Cafeteria
67 Willham Hall South
68 Drummond Hall
69 Kerr-Drummond Cafeteria
70 Kerr Hall
71 Wentz Hall
72 Scott Hall
73 Parker Hall
74 Scott-Parker-Wentz Cafeteria
75 Stout Hall
76 South Murray
77 North Murray
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79 Public Information
80 Home Economics West
81 Agriculture
82 Student Health Center
83 Meat Laboratory
84 Animal Sciences
85 Poultry
100 Physical Plant Services
101 Architectural Services and Physical Plant Administration
108 Plant Sciences and Water Conservation Laboratory
109 Vo-Tech Print Shop
110 Student Services Maintenance
111 Student Services Warehouse
112 Vo-Tech Education Warehouse
113 Construction Laboratory 1 - Fire Tech
114 Construction Laboratory 2 - Const. Tech
115 Fire Protection Publications Warehouse
116 Electronics Laboratory
117 Hazardous Reaction Laboratory
118 Petroleum Technology Classroom
119 Fluid Power Research Center
120 Petroleum Technology Warehouse
121 Fire Publications and Training
122 University Printing/Central Mailing
123-6 Family Housing
127 Driver's Training Range
129 Track and Field Center (Droke)
130 Ceramics/Sculpture
132 Bennett Hall
133 Baseball Stadium (Reynolds)
134 Mechanical Engineering Laboratory
135 President's Home

## Academic

81 Agriculture
23 Arts and Sciences
10 Business Administration
4 Education
17 Engineering, Architecture and Technology
80 Home Economics
20 Graduate College
51 Veterinary Medicine
18 Library

## Administration

20 Bursar
20 Budget
20 Controller
20 Enrollment Information
20 Grants and Contracts
20 Personnel Office
20 President's Office
20 Vice President, Academic Affairs and Research
20 Vice President, Business and Finance
20 Vice President, Student Services
7 Vice President, University Relations and Public Affairs
7 OSU Foundation

## Athletics

36 Athletic Ticket Office
133 Baseball Stadium
34 Football Stadium
36 Gallagher-Iba Arena
60 Physical Education Center
129 Track and Field Center

## Research Facilities

81 Agricultural Experiment Station
16 Bioenvironmental Engineering Laboratory
61 Cereal Insects Laboratory
15 Civil Engineering Laboratory
113 Construction Laboratory 1 - Fire
22 Entomology
119 Fluid Power Research Center
31 General Technology Laboratory
83 Meat Laboratory
134 Mechanical Engineering Laboratory
28 NASA/Aerospace Education Services Project
81 Oklahoma Crop Improvement Foundation
55 Oklahoma Animal Disease Diagnostic Laboratory
108 Plant Science Research
85 Poultry
102 Sheep Research
56 USDA
53 Veterinary Medical Teaching Hospital
1 Museum of Higher Education
57 OSU Museum

## Residence Halls

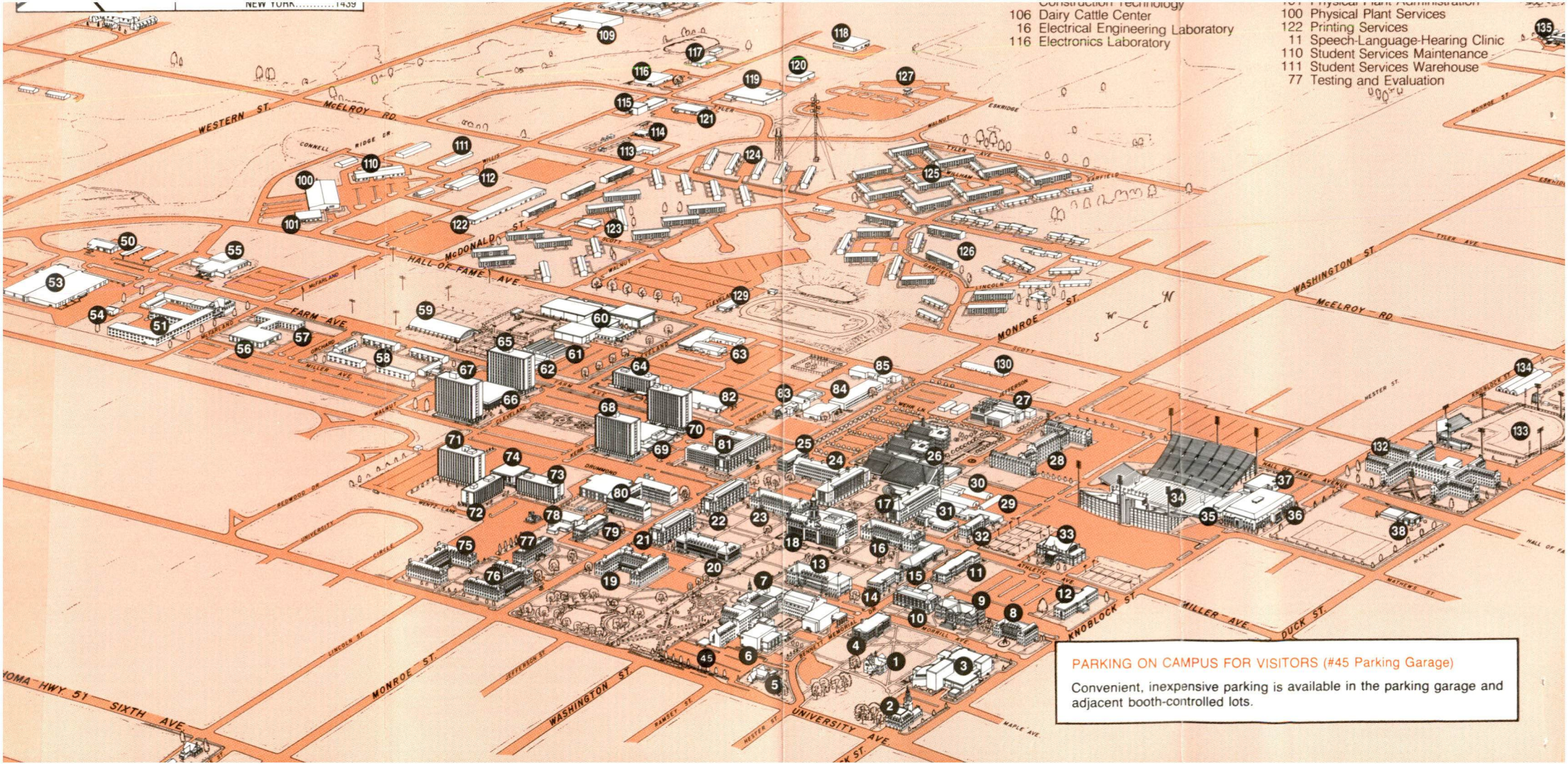
132 Bennett
58 Brumley
68 Drummond
64 Iba
70 Kerr
73 Parker
72 Scott
75 Stout
71 Wentz
65 Willham North
67 Willham South

## Student Services

20 Bursar
57 English Language Institute
11 Financial Aid
82 Health Center
7 International Students
7 Student Union
12 ROTC
57 Parking Permits

## University Services

101 Architectural Services
28 Audiovisual Center
57 Campus Police
7 Campus Post Office
122 Central Mailing Services
21 Computer Center
104 Food Service Center

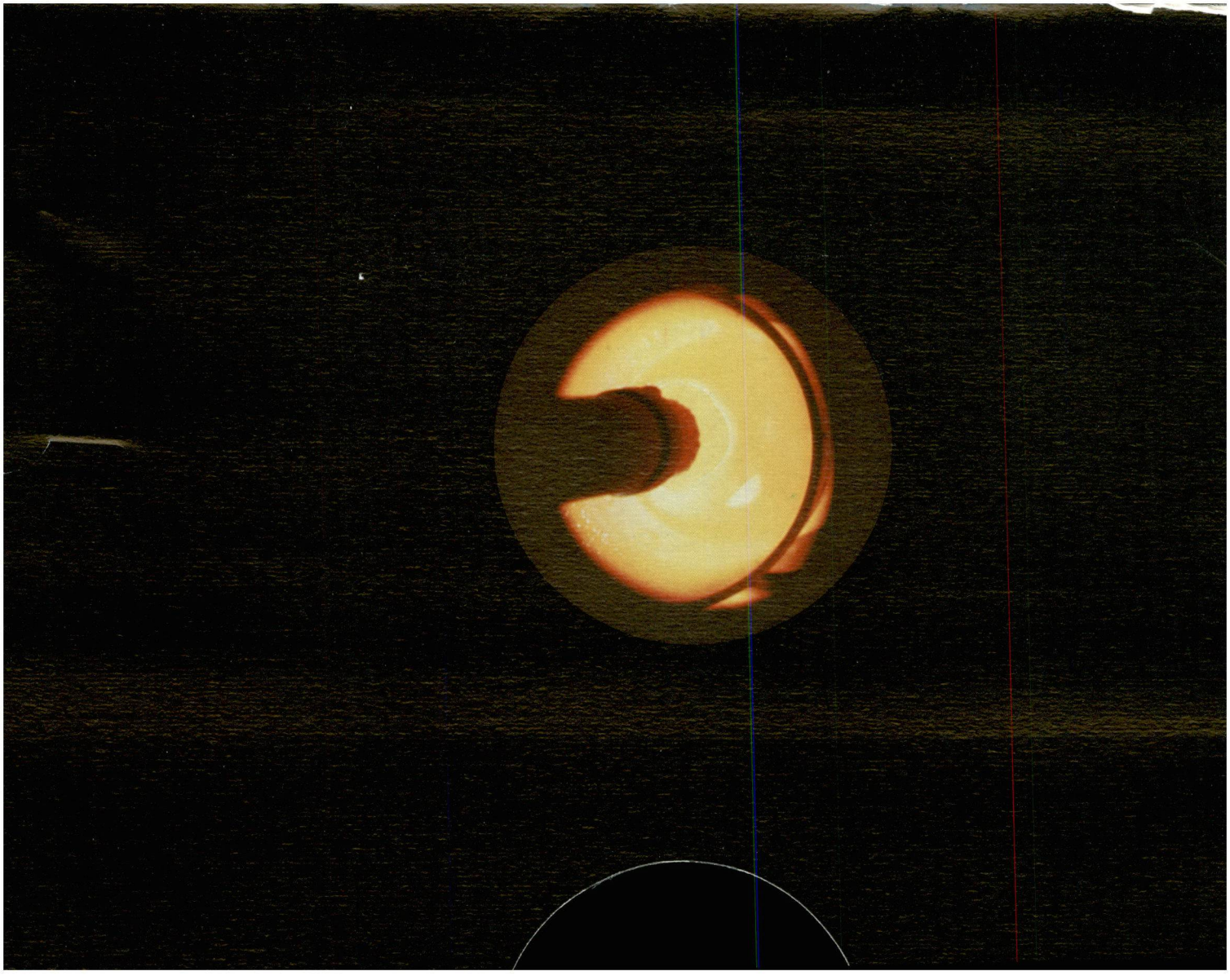


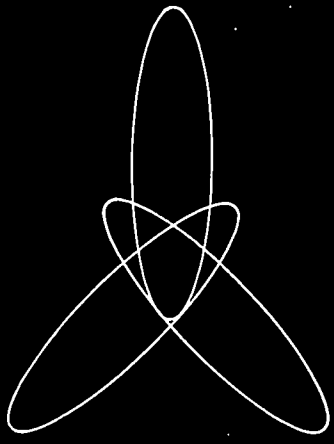

PARKING ON CAMPUS FOR VISITORS (#45 Parking Garage)

Convenient, inexpensive parking is available in the parking garage and adjacent booth-controlled lots.

MATERIALS RESEARCH CENTER

Oklahoma State University / Stillwater



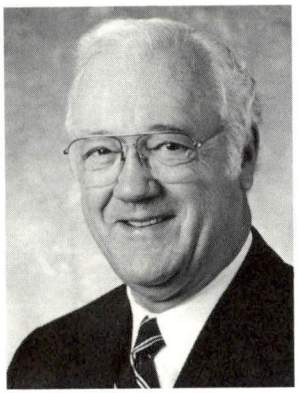


Crystal Growth

Sample Characterization

*Inside cover photos:*

Electro-optic and electro-acoustic materials for high technology applications.



*Materials represent the cornerstone of today's high-technology society. For the development of technologies of the future, new materials with well characterized properties will be required. Electro-optic and electro-acoustic devices form the basis of newly emerging technology with widespread applications in various industrial, military, and medical areas. This has generated the requirement for new materials which can be used as lasers, modulators, transmission lines, and detectors in these systems.*

*Oklahoma State University has established a Materials Research Center focusing on electro-optic and electro-acoustic materials to help advance this important area of technology through the generation of new knowledge and the education of students. The efficiency of technology transfer is significantly enhanced through close cooperation between the university Center and industrial laboratories.*

*This publication highlights some of the capabilities of the Center and its current research projects. The university-industry team effort coordinated through the Center is a key element in helping this nation maintain its leadership in this area of technology.*

L. L. Boger

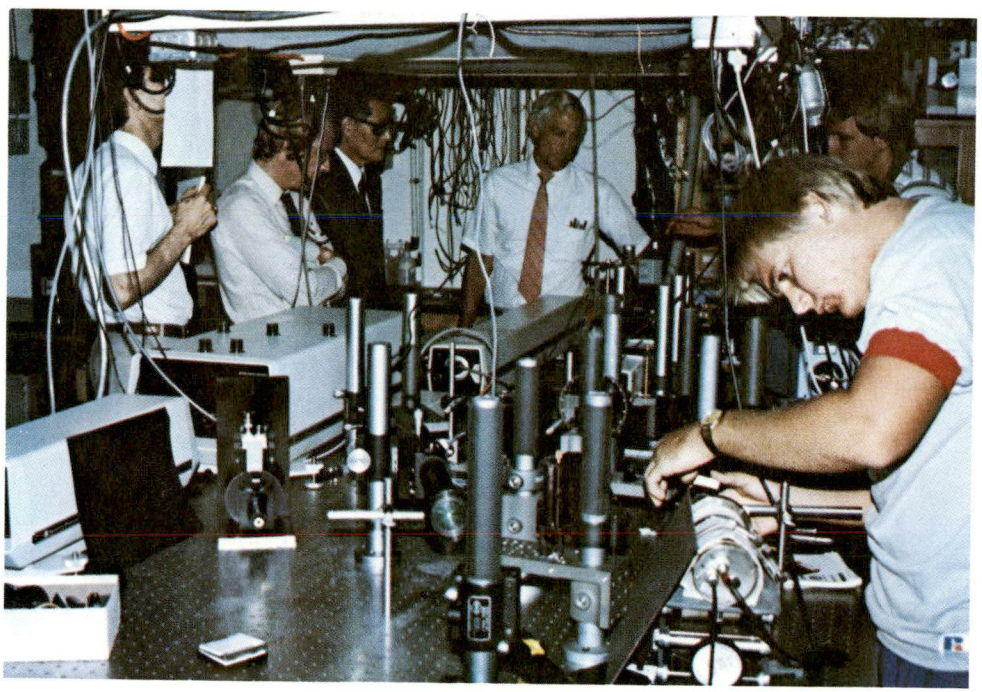
Lawrence L. Boger
President

# Goals

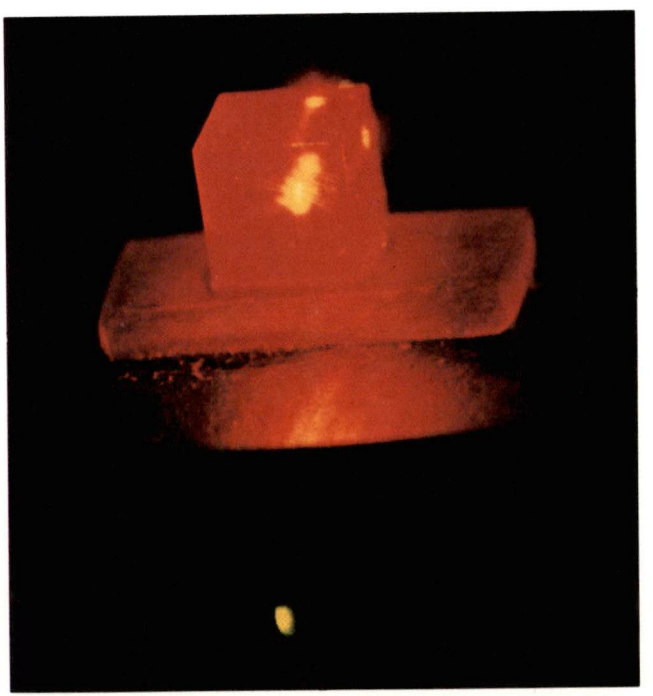
## OF THE OSU MATERIALS RESEARCH CENTER

- To develop an international center of excellence in research and development on materials for opto-electronic and acousto-electronic device applications.
- To educate students for jobs in high-technology industries.
- To provide a support base for industries dealing with opto-electronic and acousto-electronic materials.

*Close cooperation between universities and industries is of vital importance in ensuring the continued leadership of the United States in high-technology areas.*



# For
- LASERS
- FIBERS
- OPTICAL COMPUTERS



## Examples of Materials Being Investigated

- Rare Earth-Doped Laser Materials:
  $Y_3Al_5O_{12}$:Nd  Glass:Re
  $Nd_xLa_{1-x}P_5O_{14}$  $RbCaF_3$:Er

- Vibronic Laser Materials
  $BeAl_2O_4$:Cr  $Al_2O_3$:Ti
  KBr:Rh  $Mn_2SiO_4$

- Up-Conversion Materials:
  $RbMgF_3$:Eu,Mn  $LiYF_4$:Yb,Er
  $RbMnF_3$:Er  $KMgF_3$:Eu,Mn

- Photorefractive Materials:
  $LiNbO_3$  $Bi_{12}GeO_{20}$
  $LiTaO_3$  $Bi_{12}SiO_{20}$

- Nonlinear Optical Materials:
  $KTiOPO_4$  $CaMoO_4$:$LaNbO_4$

- Scintillator and Phosphor Materials:
  $CaF_2$  $CaWO_4$:Eu

- Acousto-Electric Materials:
  $SiO_2$  $AlPO_4$

# Materials

MUST BE FABRICATED AT HIGH TEMPERATURES

## Crystal Growth Laboratory

- 2 Platinum Wound Bridgman Furnaces
- Bridgman Furnace For Reactive Atmosphere Processing (RAP)
- Czochralski Furnace With Tungsten Heater
- R.F. Induction Czochralski Furnace
- Sweeping System
- Annealing Furnaces
- Cutting and Polishing Equipment

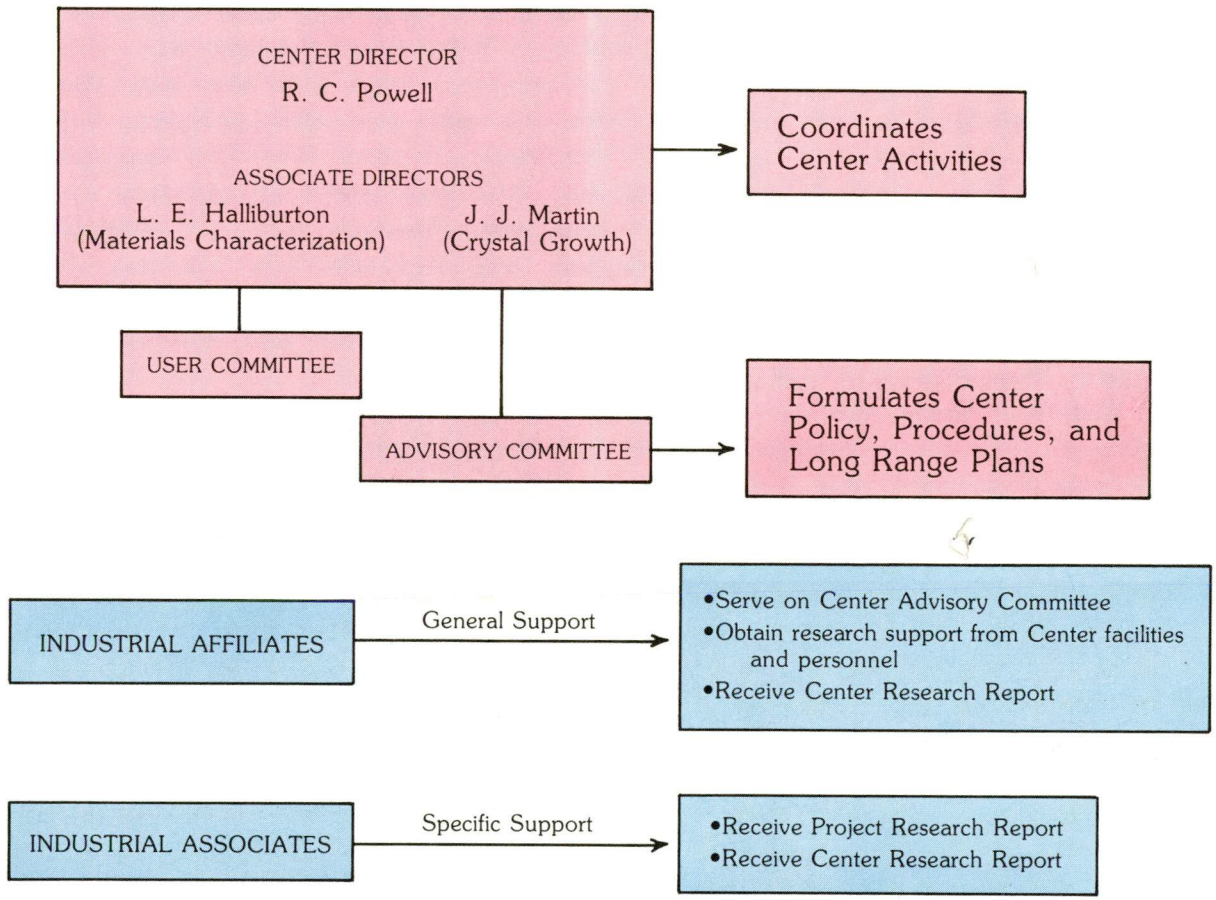
# How Do We Know THE MATERIAL IS GOOD?

## Materials Analysis Capabilities

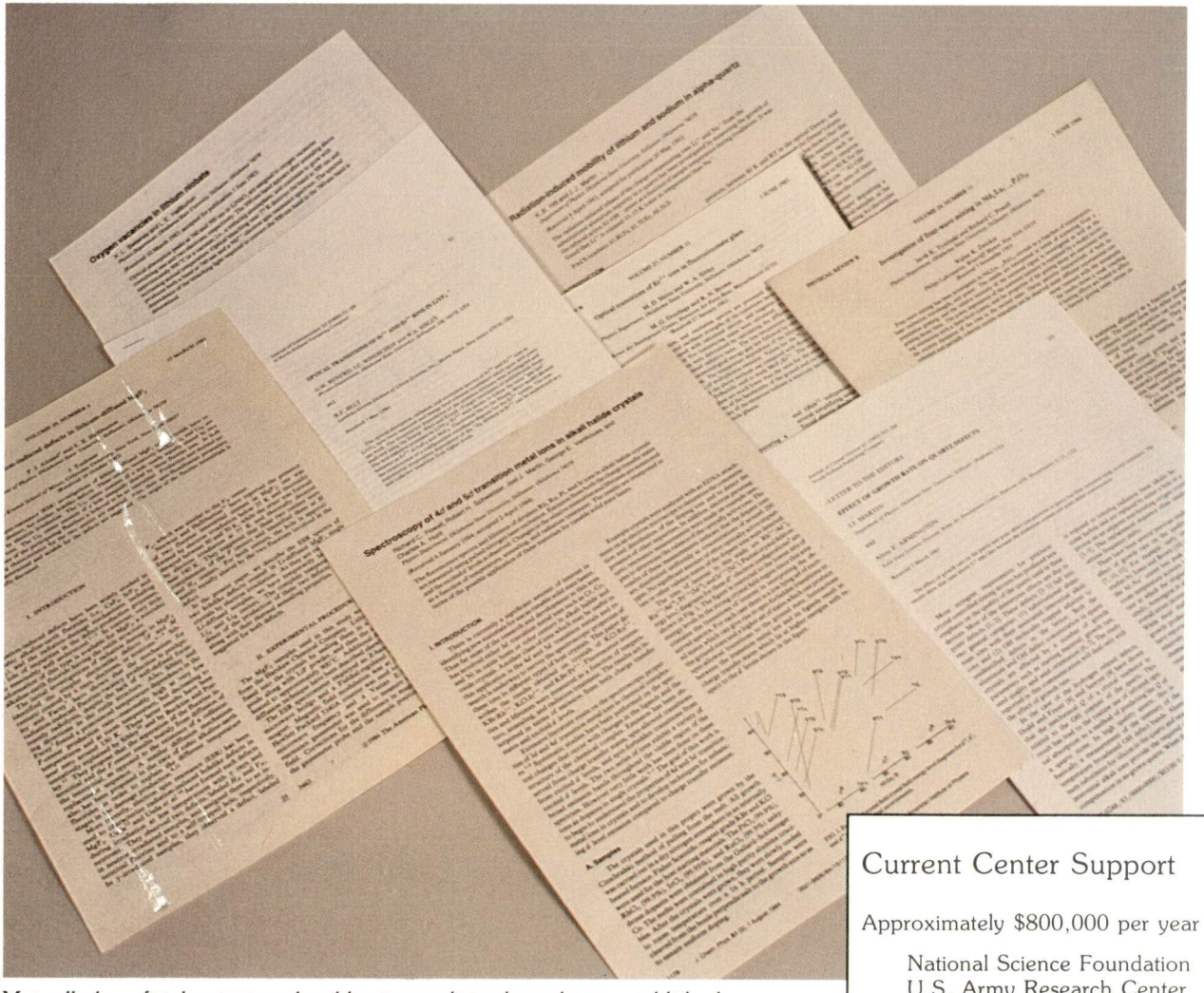
- Scanning Electron Microscope
- Energy Dispersive X-Ray Analyzer
- X-Ray Diffractometer
- X-Ray Fluorescence
- Atomic Absorption
- Laser Raman Microprobe
- Optical Spectroscopy
- Electron Paramagnetic Resonance

OSU MATERIALS RESEARCH CENTER

# Administrative Organization




# University/Industry Cooperation




Mutually beneficial patent and publication policies have been established.

## Current Center Support

Approximately $800,000 per year from:

National Science Foundation
U.S. Army Research Center
Rome Air Development Center
Naval Surface Weapons Laboratory
Office of Naval Research
Sandia National Laboratory
State of Oklahoma
Private Industries

MATERIALS RESEARCH CENTER

For Further Information, contact:

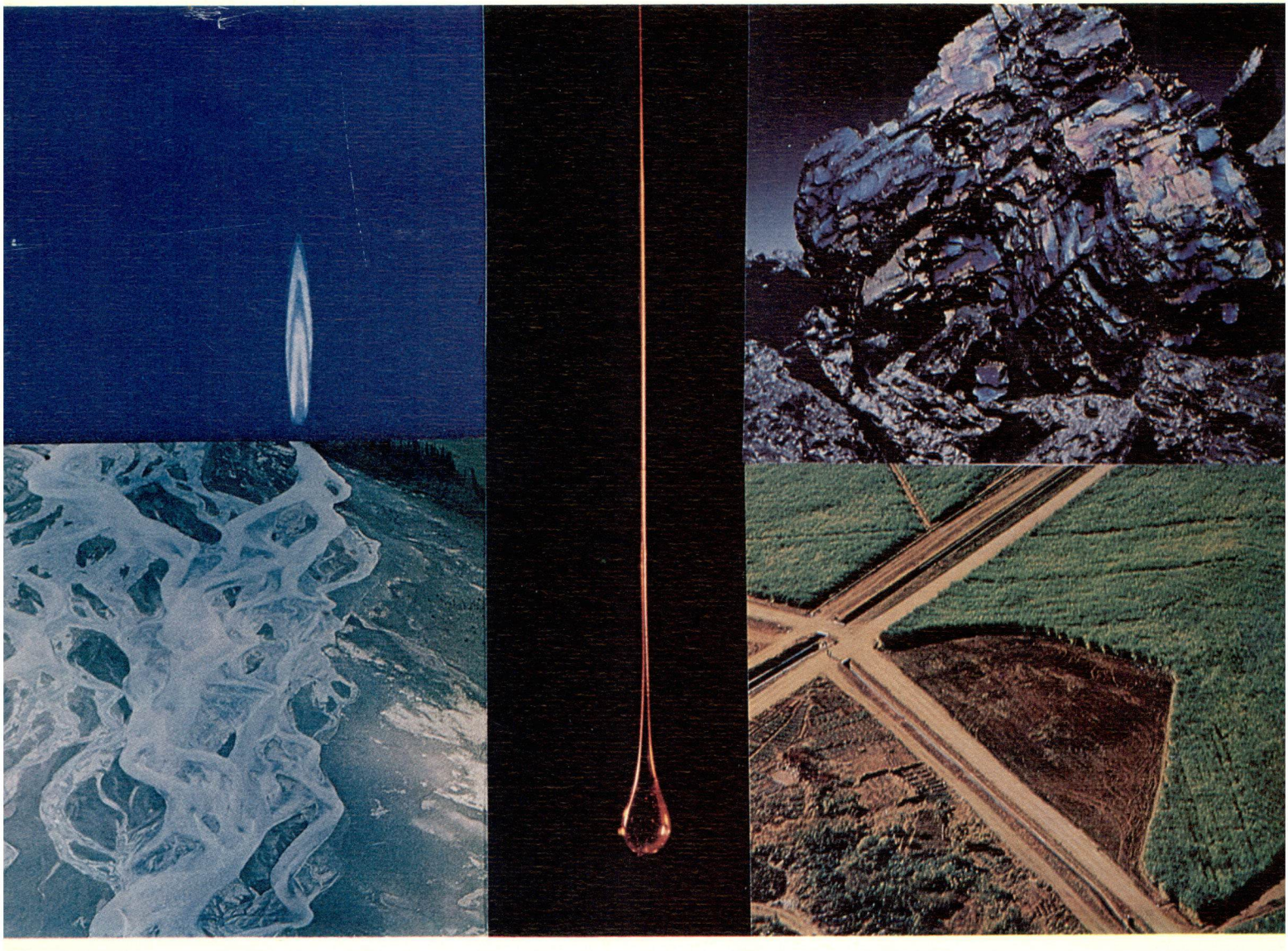
Professor R. C. Powell
(405) 624-6575

Professor L. E. Halliburton
(405) 624-5800

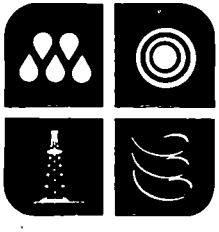
Professor J. J. Martin
(405) 624-5799

Department of Physics
Oklahoma State University
Stillwater, OK 74078

# Review of Oklahoma Energy Resources and Policy



OKLAHOMA STATE UNIVERSITY CENTER FOR ENERGY RESEARCH
JUNE 1985

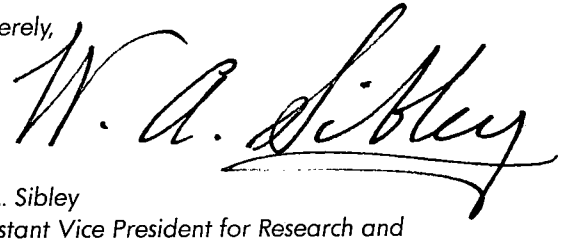


Edited by Dr. Joseph W. Westphal
Department of Political Science
Oklahoma State University

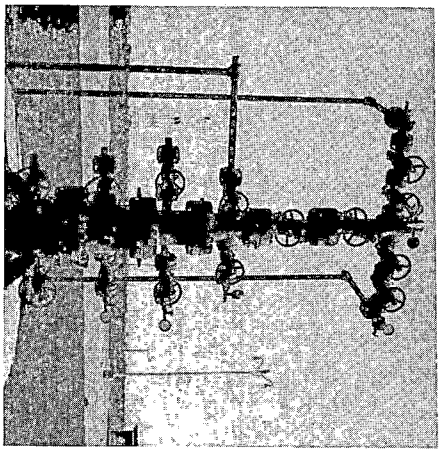
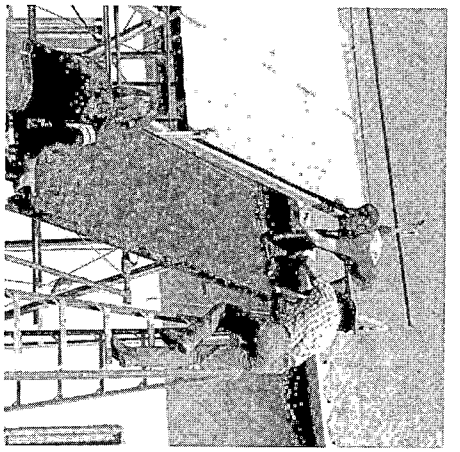
*The production and consumption of energy resources is of utmost importance to the people of Oklahoma. Our economy for a number of years has been based in a large part on the production and marketing of fossil fuels. In energy resources, uncertainty is a way of life. Recoverability of energy resources has an economic dimension. Resources often are potentially recoverable but only under very costly or complex conditions. Therefore, the evaluation of the energy resource base is difficult at best. For this reason it is important to have both a global and local assessment of the energy situation.*

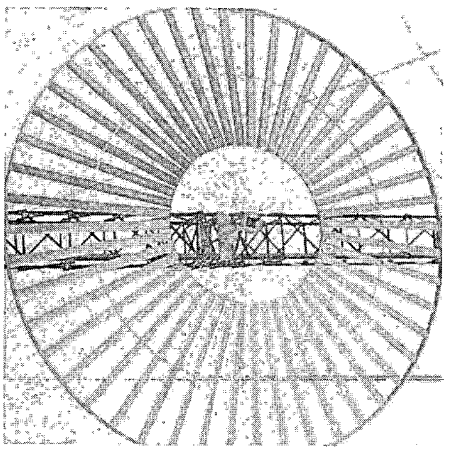
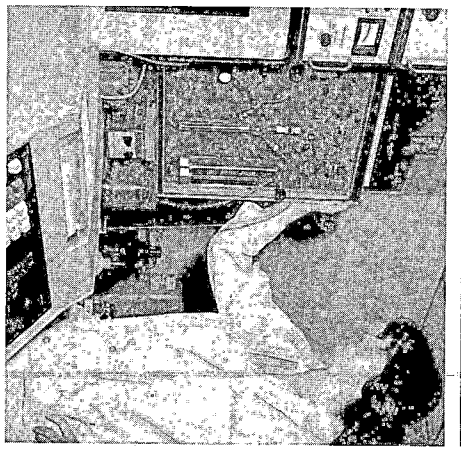
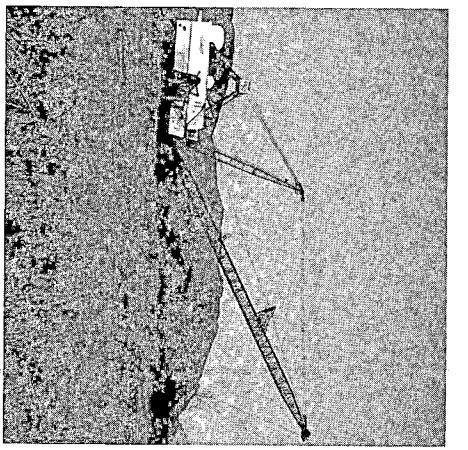
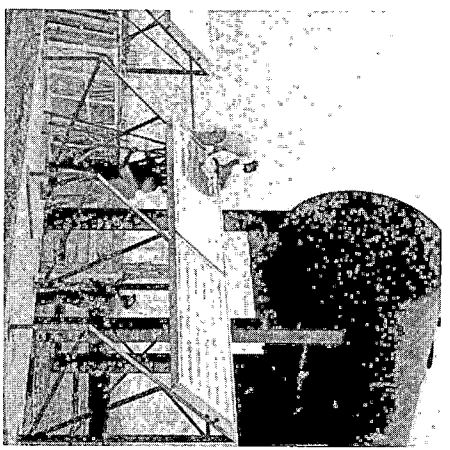
*This brochure, which contains a compilation of articles by senior professors at Oklahoma State University who are on the cutting edge of research in their various fields, should prove to be valuable. Leaders in the State of Oklahoma must know, for future planning, the status of our natural resources. The contributors to this brochure and the editor, Professor Joseph Westphal, have done a very fine job in presenting information which will be useful to Oklahoma leadership. This is a timely and readable presentation of the Oklahoma energy resource base. I certainly express my appreciation to those who took the time and effort to produce this presentation.*

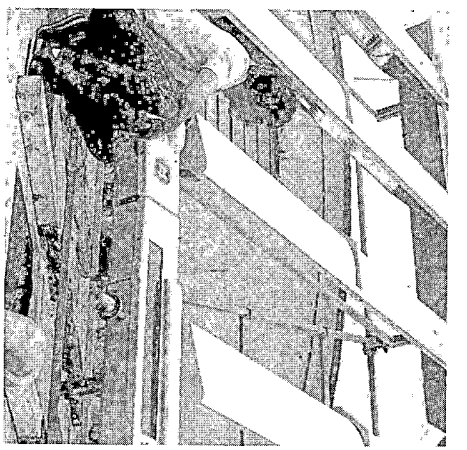
*Sincerely,*



*W.A. Sibley*
*Assistant Vice President for Research and*
*Director, University Center for Energy Research*



# Review of Oklahoma Energy Resources and Policy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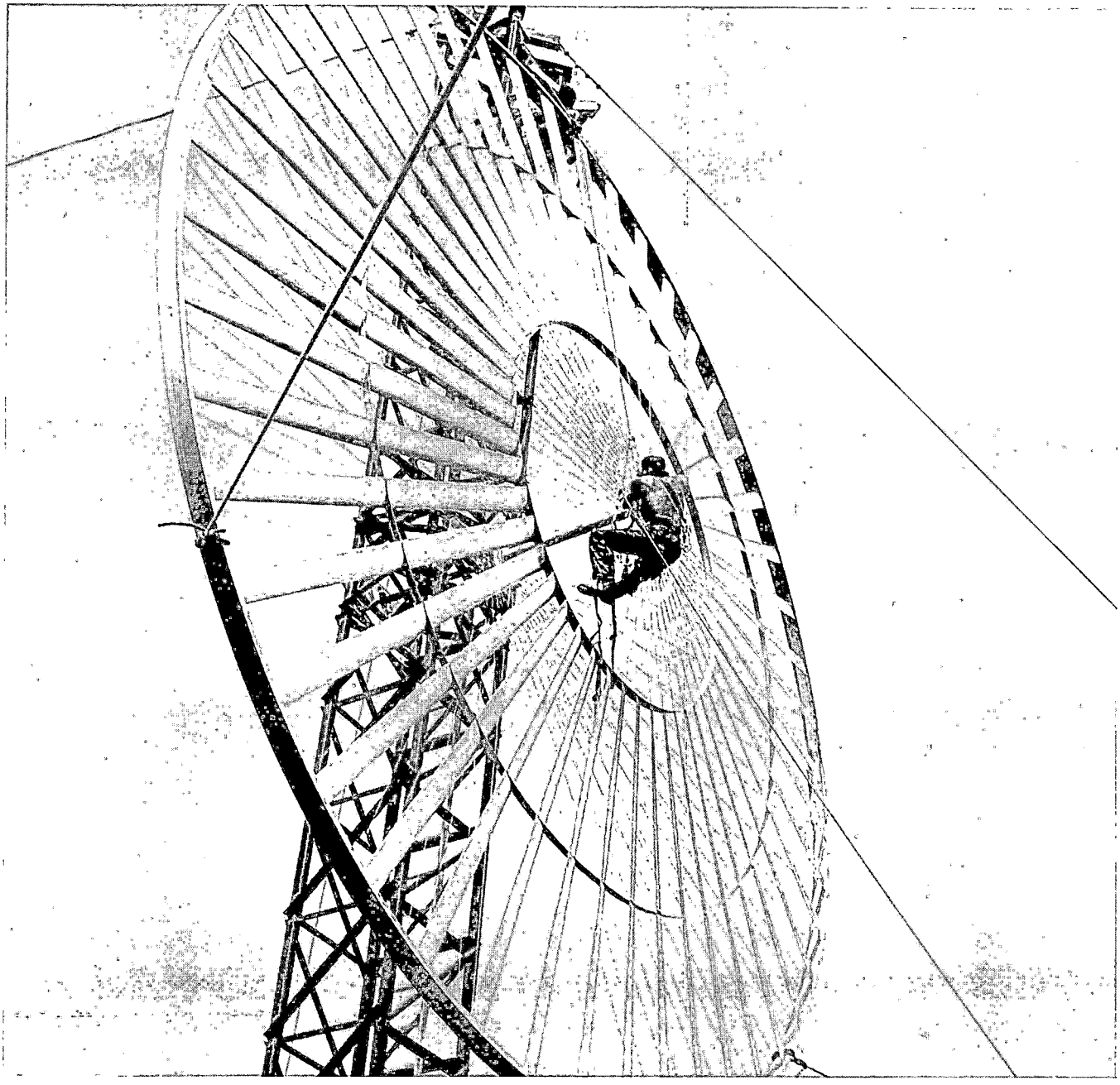


# INTRODUCTION

Despite the current "oil glut," the future of the United States and the future growth and development of Oklahoma depend on the availability and development of energy. In a recent interview in Oklahoma, Henry F. Keplinger, chairman of the Keplinger Companies, a Houston based energy consulting firm, stated that the international energy arena is on the verge of chaos and that the U.S. continues to be highly dependent on foreign oil mostly from the Middle East. He added that this region remains highly volatile with Soviet influence continuing to grow while the U.S. struggles to find solutions to the Mid East crisis.

This concern poses a fundamental question to U.S. policy-makers: How do we decrease dependency on foreign energy supply while achieving economic productivity in energy consumption? According to the Electric Power Research Institute (EPRI), one way is conservation.

> The ultimate objective of conservation research is to identify ways of using energy to increase the ratio of economic benefits to total costs.

The EPRI report suggests a re-examination of all aspects of production including labor, capital, energy and other resources. Research is necessary to improve productivity. We must improve both technology and consumer behavior. Innovative planning assumes that conservation is not limited to reducing energy use, but increases "total factor" productivity through technological transition into more productive and secure energy sources.

The energy research program at Oklahoma State University is based on the above premise. Basic research is conducted in a variety of fields concerned with energy use, availability, development and productivity. Current research at Oklahoma State University focuses on energy efficiency and planning in the following areas:

Fossil Fuels and Alternative Fossil Fuels
- Petroleum
- Coal liquefaction
- Upgrading of coal liquids
- Shale oil
- Cogeneration from stripper oil wells

Renewable Energy Sources
- Solar heating
- Thermal storage and heat pumps
- Development of equipment for minimum tillage operations
- Photovoltaics for utility applications
- Fuel cell systems

Policy Planning and Economic Productivity
- Electric power pooling and distribution policy
- Economic behavior of natural gas industry
- Peak load problems of public utilities
- Household energy conservation
- Industrial hazardous material management
- Natural gas deregulation

Energy productivity and development are essential components of Oklahoma's economic future. A state rich in fossil fuels such as coal, natural gas and oil, high in wind intensity and solar energy, and strong in its hydroelectric capacity, Oklahoma must continue to seek strategies and methods for energy productivity. Oklahoma must be conscious of the impact on agricultural and industrial development from conservation oriented strategies. The impact of energy productivity on the state's economy is highly leveraged. Recent developments in the price of fossil fuels such as oil and natural gas have produced significant revenue shortfalls for Oklahoma government. To avert future shocks, productivity must be maximized and alternatives evaluated.

The purpose of this report is to provide an overview of the energy sector in Oklahoma.

# THE ENERGY OUTLOOK

## THE OKLAHOMA ENERGY OUTLOOK

In 1973 the price of gasoline in the U.S. was $.39 per gallon. By 1983 the price had risen 67 percent to $1.26 per gallon. The Arab oil embargo of 1973, the decline in domestic production of oil, the continued surge in demand for oil and other energy sources, and the Iranian revolution in 1978 (the second energy crisis) all had serious effects on the U.S. economy and energy policy. These factors would heighten inflation, unemployment, and eventually lead to recession.

These events, along with the need to provide adequate energy supplies to power our industrial capacity, have placed Oklahoma in a critical position as an energy resource producer and supplier. Oklahoma is rich in such resources as oil, natural gas, coal, hydropower, solar, wind and biomass. Of these resources, oil and natural gas have the most impact on the State's economy. Today, Oklahoma is the third leading producer of natural gas and the fifth leading producer of petroleum among the fifty states. Oklahoma ranks fourth in reserves of natural gas and fifth in reserves of crude oil. It is second in the number of operating oil wells and fifth in the number of natural gas wells among the fifty states.

But Oklahoma is also a major energy consumer. It ranks among the top ten states in per capita energy use in the industrial, residential and transportation areas. It is the seventh highest per capita energy user among the fifty states. Thus, energy is important to Oklahoma not only from the production standpoint but also from the consumer's economic perspective. Table 1 depicts how Oklahoma ranks in various energy related categories.

The increasing consumption of energy, particularly in the natural gas areas, is depicted in Figure 1. For example, consumption of natural gas peaked in 1979 at 845 trillion BTU's and declined in 1981 to the 1975 level at under 700 trillion BTU's.

Between 1960 and 1981, the consumption of energy more than doubled from 537 trillion BTU's to over 1200 trillion BTU's.

## THE NATIONAL ENERGY OUTLOOK

The 1973 OPEC oil embargo and subsequent energy shortages brought considerable attention and focus to the significant dependence of the economy on energy consumption. Although petroleum was the major resource in controversy, the dramatic events leading to the energy crisis of 1973 drew attention to the inability of existing policies to curb consumption of both oil and gas as real prices continued to decline. Figure 2 shows the growth in U.S. energy consumption between 1960 and 1981.

Although consumption of energy increased significantly through the 1960's and 1970's, the distribution or share of consumption among the various sources of energy changed very little. The only significant change was the growth of nuclear power from less than 1 percent to more than 4 percent of the total energy consumed.

The greatest period of growth in energy consumption was between the early 1960's to 1970 when energy demand grew by over 5 percent per year. Between 1970 and 1978, when the second energy crisis developed, energy demand had been growing by only 1 percent per year. Estimates project that increases in energy demand will average 1.5 percent annually between 1980 and 1990. This projection is based on the assessment that prices will remain high and that conservation will continue to play a greater role.

On the supply side, projections indicate that fuel substitutes will be limited. Oil and gas will continue to provide the majority of the nation's energy supply to the 1990's. Other sources such as hydropower, solar, geothermal and wind are expected to grow but at a very limited pace as economics and government policy reduce research and development in these areas. Coal and nuclear power are expected to increase their contribution to the overall energy supply.

Assessing the future supply of energy resources is problematic due to the difficulty in predicting economic and

political conditions. U.S. government estimates show an increase in the areas of nuclear power and synthetic fuels, yet these programs have undergone significant reductions in funding in the 1980's. Coal and other renewable energy supplies are also predicted to grow. However, oil demand will require imports to meet future consumption.

The future of this nation's energy resources and their development is directly related to public policy decisions affecting economic stability and growth, distribution of income, allocation of resources, research and development strategies and regulation. Public policy is best defined by what it accomplishes rather than its intent. Thus it is important to examine changes in energy policy that affect current status as well as impact on long-term program development.

Table 2 shows the major changes in energy programs since 1981. With the exception of two nuclear energy programs and funding for the Federal Energy Regulatory Commission, every program listed has suffered significant reductions in funding. Among the most significant reductions is the 86 percent reduction in funding for fossil energy research and development programs. These programs represent basic levels of government assistance in the coal, oil and natural gas resources areas. Along with significant reductions in the coal program and petroleum R & D, government

TABLE 1

OKLAHOMA ENERGY OVERVIEW, 1981

| | | Rank | | Percent of U.S. Total |
|---|---|---|---|---|
| Population, 1981 (thousands) | 3,104 | 26 | | 1.35 |
| Area (square miles) | 69,956 | 18 | | 1.93 |
| Normal Heating Degree-Days, 1951-1980 | 3,571 | 38 | | — |
| Normal Cooling Degree-Days, 1951-1980 | 2,010 | 6 | | — |
| Operating Coal Mines, 1981 | 55 | 12 | | 0.95 |
| Operating Oil Wells, 1981 | 82,639 | | 2 | 14.96 |
| Operating Natural Gas Wells, 1981 | 18,451 | 5 | | 9.28 |
| Operable Electrical Generating Plants, 1981 | 42 | 28 | | 1.37 |
| Per Capita Energy Use, 1981 (million Btu) | | | | |
| Residential | 75 | 7 | | — |
| Commercial | 55 | 11 | | — |
| Industrial | 170 | 10 | | — |
| Transportation | 106 | 10 | | — |
| Total | 405 | 7 | | — |
| Personal Income, 1981 (millions) | $31,753 | 25 | | 1.32 |
| Per Capita Personal Income, 1981 | $10,230 | 25 | | — |
| Nonagricultural Employment, 1981 (thousands) | 1,202 | 25 | | 1.31 |
| Manufacturing Employment, 1981 (thousands) | 200 | 30 | | 0.99 |
| Shipments by Manufacturers, 1981 (millions) | $25,311 | 27 | | 1.25 |
| Motor Vehicle Registrations, 1981 (thousands) | 2,746 | 23 | | 1.67 |
| Licensed Drivers, 1981 (thousands) | 1,953 | 29 | | 1.33 |
| Vehicle Miles of Highway Travel, 1981 (millions) | 28,780 | 19 | | 1.86 |

Source: Energy Information Administration, *State Energy Overview*, U.S. Department of Energy, Washington, D.C., 1983.

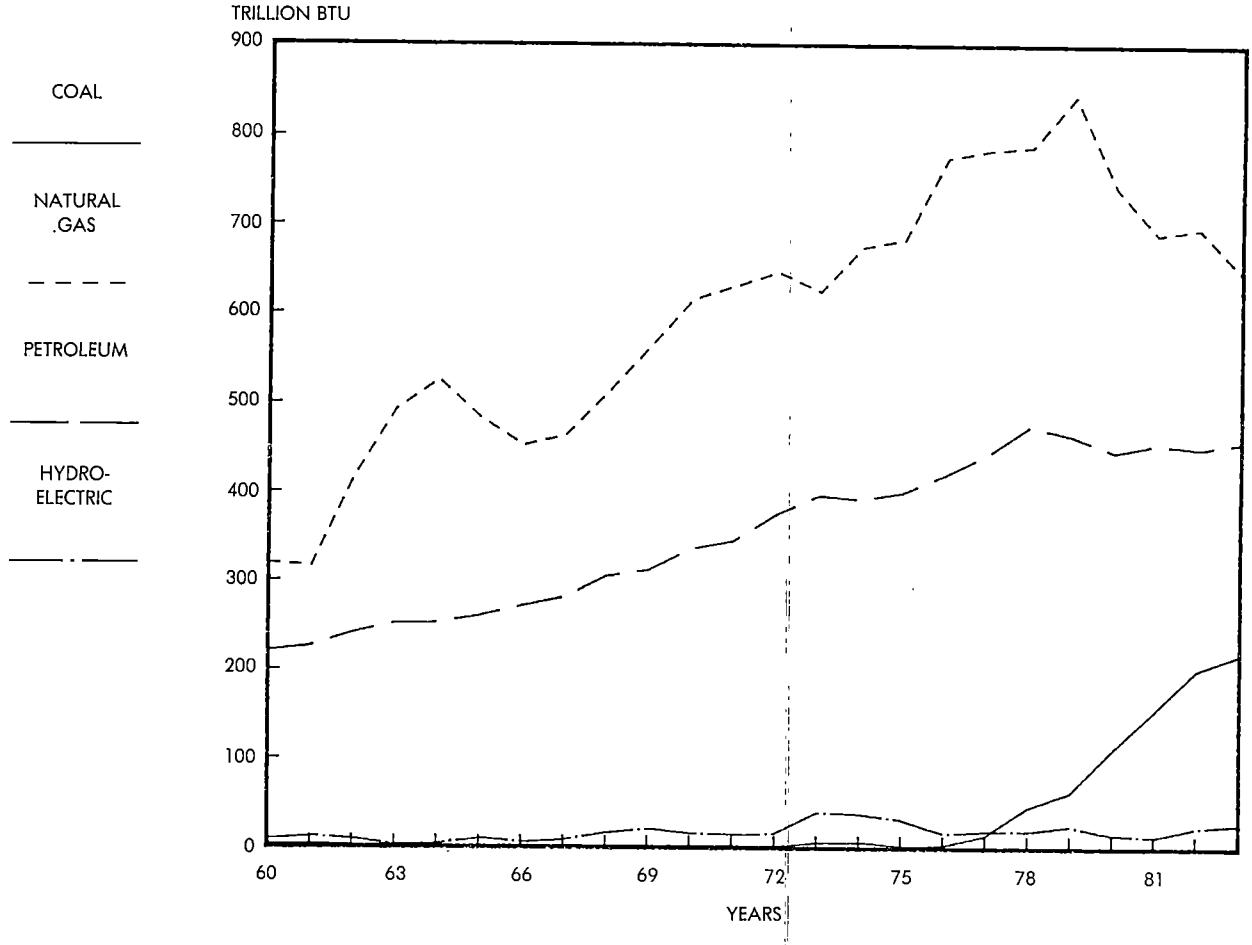



Figure 1. Consumption of Energy in Oklahoma by Source

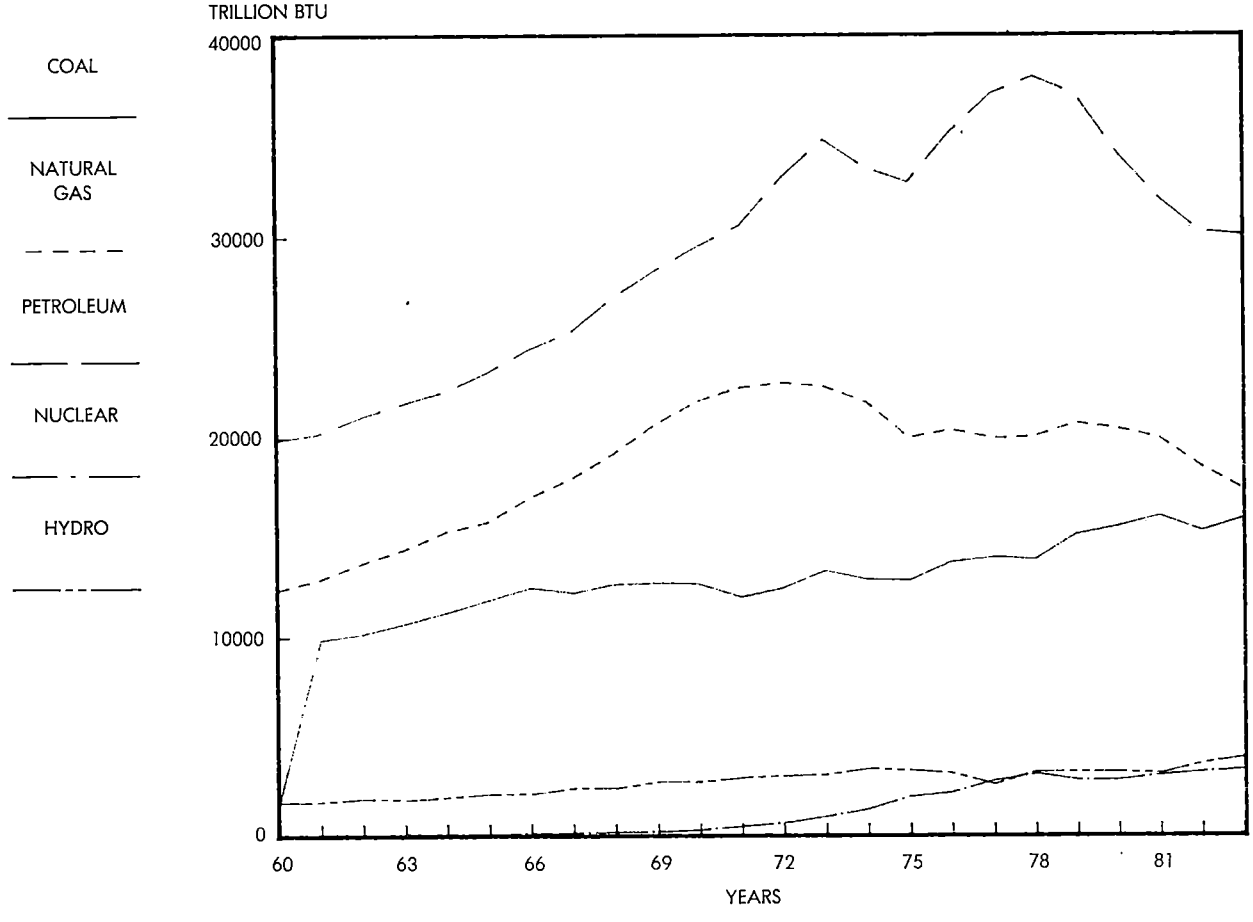



Figure 2. Consumption of Energy in U.S. by Source 1960-1981.

policy has resulted in a near cessation of research in the synfuels areas.

Energy conservation programs have also been substantially reduced as in the case of the Department of Energy's Energy Conservation Grants Program. The 99 percent reduction in funding will affect such areas as the low income weatherization, school and hospital energy conservation and state energy planning grant programs.

Nuclear fission programs, as a whole, have not grown since 1981. Given the reductions in other energy areas, the nuclear programs now represent a significant percentage of the overall energy program of the Federal Government.

Overall, in the areas of energy supply, conservation, emergency preparedness and information, policy and regulation funding levels which in 1980 were 6.3 billion were reduced to 3.3 billion in 1984. This represents a 48 percent reduction in spending. Budget Authority which in 1980 was 36.5 billion has been reduced to less than 3 billion, representing a 92 percent reduction.

The effect of this policy is to effectively reduce long-term production changes thereby having little effect on changes in patterns of consumption. This may result in the transfer of energy policy decision to the private sector. Such policy implications are the core of issues which relate to the

TABLE 2

MAJOR CHANGES IN ENERGY PROGRAMS*

(In millions of dollars of budget authority)

| | Actual FY 1981 | Actual FY 1982 | Current FY 1983 | President Reagan FY 1984 | Percentage change 1984/1983 | Percentage change 1984/1981 |
|---|---|---|---|---|---|---|
| Solar energy R&D | 549 | 268 | 202 | 87 | -57% | -84% |
| Energy conservation R&D | 292 | 152 | 133 | 71 | -47% | -76% |
| Conservation grants | 417 | 232 | 234 | 3 | -99% | -99% |
| Fossil energy R&D | 997 | 417 | 311 | 138 | -56% | -86% |
| Electric storage/systems | 112 | 60 | 43 | 27 | -37% | -76% |
| Geothermal energy R&D | 156 | 56 | 50 | 14 | -72% | -91% |
| Strategic Petroleum Reserve | | | | | | |
| Oil Acquisition | 3,205 | 3,684 | 2,074 | 583 | -72% | -82% |
| Clinch River Breeder | 172 | 194 | 194 | 270 | +39% | +57% |
| Other Breeder R&D | 439 | 482 | 385 | 333 | -14% | -24% |
| Uranium Enrichment | 1,495 | 1,834 | 1,843 | 2,240 | +22% | +50% |
| Federal Energy Regulatory | | | | | | |
| Commission | 75 | 77 | 77 | 95 | +23% | +27% |
| Energy Information | 90 | 79 | 57 | 51 | -11% | -43% |
| Rural Electrification | | | | | | |
| Administration (REA) | | | | | | |
| Insured Loans | 1,100 | 1,100 | 1,100 | 575 | -48% | -48% |
| REA Loan Guarantees | 5,145 | 5,145 | 4,745 | 3,360 | -29% | -35% |

Source: Committee on the Budget, *President Reagan's Fiscal Year 1984 Budget*, U.S. House of Representatives, February 1981.

*The percentage reductions in the table above do not reflect the effect of inflation on the "real" program level. If this inflation effect were taken into account, the "real" reductions would be seen to be even greater than displayed, since 1984 dollars are worth only 95 percent of their 1983 value, and only 84 percent of their 1981 value (according to OMB assumptions).

fundamental question of the appropriate role of government in energy policy.

There is uncertainty today concerning the world's energy situation. The instability in the Middle East, the weakness of OPEC and the tentative nature of U.S. energy policy have moved this country more and more to a high energy price economy. Many of the issues faced by the nation related to price and equity will impact on investment, capital formation needs, labor, transportation and regulatory requirements. These same conditions will impact Oklahoma's economy and future growth. Thus, the mission of a land grant university such as Oklahoma State University is to enhance the development of new technology that will provide a basis for a more stable foundation to meet future demand.

# *FOSSIL FUEL RESOURCES*

The long history of hydrocarbons in Oklahoma has been characterized by "boom and bust" periods which have had a drastic effect not only on the state's economy but on its cultural and social geography as well. The boomtowns of the past, such as Bartlesville, Drumright, and Cushing, have contemporary analogs in Elk City, Weatherford, and Clinton in Oklahoma's Anadarko Basin. The current "bust" period has undoubtedly impacted the approximately 92,500 people employed in Oklahoma by the oil industry and, unfortunately, added to the state's rise in unemployment. The implications of "boom and bust" cycles are felt in almost every aspect of Oklahoma life.

Beginning with the Arab oil embargo in 1973, Oklahoma experienced a "boom" time which culminated in 1981 with a softening in the market. A "bust" followed and continues today. The current cycle is perhaps unique in that it differs from the pattern of the past. Examination of the figures cited in the following pages indicates that while exploration expenditures and drilling activities were increasing, production and reserves of oil were decreasing at a steady rate since 1967. The combination of the economic recession and the international glut of oil has driven the price per barrel of oil down by more than $10 from the 1981 price.

On the other hand, data indicate a definite increase in natural gas production and reserves in Oklahoma in the 1980's. The market is now saturated with natural gas which resides mainly in deep reservoirs and, therefore, is deregulated. Many gas wells are "shut in" since few buyers can be found.

## CRUDE OIL AND LIQUID NATURAL GAS

Most of the giant oil fields in Oklahoma were discovered in the Central Oklahoma Platform before 1936. The first oil boom in Oklahoma history took place between 1900 and 1927, with an average rate of increase of almost 10 million barrels per year. Production reached a climax of 227 million barrels in 1927 — Oklahoma's peak production level. The depression years of the late 1920's and early 1930's were probably responsible for the accompanying decrease in crude oil production. The largest decline of 16.6 percent occurred in 1931. A sharp increase followed immediately until 1937 (approximately 9 billion barrels of crude oil were produced in 1936). Another decrease in crude oil production occurred between 1938 and 1943. During the period between 1945 and 1967, production increased at an average rate of 6 million barrels per year between 1945 and 1957 and 0.8 million barrels per year between 1958 and 1967. Production declined at a steady rate from 1968 and 1979, when the production curve began leveling off. In 1983, the estimated total production for the state was 150 million barrels.

Our knowledge of the geology of Oklahoma suggests that it is unlikely that production will ever approach the large amounts generated in the periods 1920-1945 and 1955-1970 (Figure 3). Moreover, it is believed that crude oil production will level off or decrease in the coming decade.

With respect to the price of oil, the 1981 price was ninety-four times higher than the 1908 price and ten times higher than the 1972 price. The rate of increase between

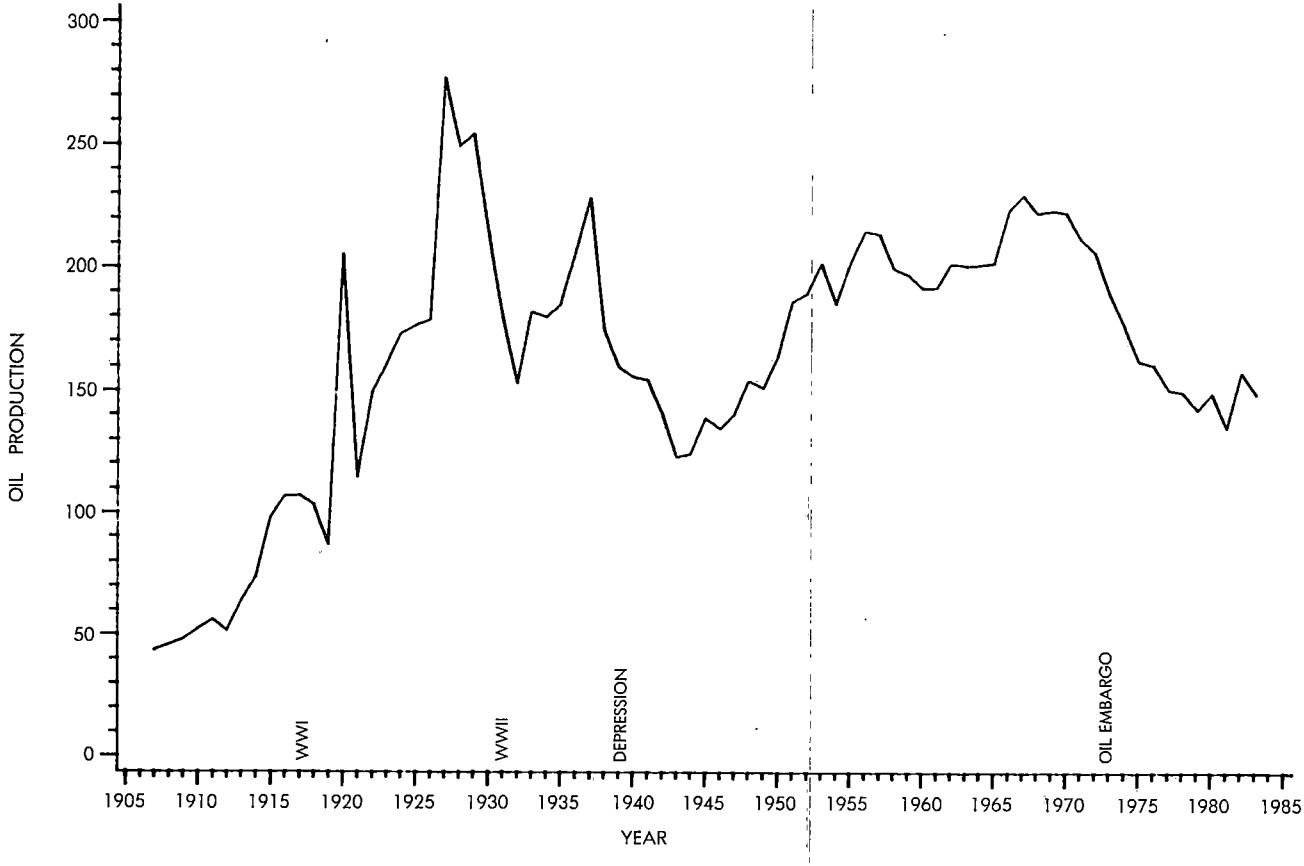



Figure 3. Oil Production in Oklahoma in Millions of BBLS, 1907-1983.

1908 and 1972 was relatively low, an average of 5¢ per year. However, following the oil embargo in 1973, the price of oil increased sharply.

The importance of oil revenues to Oklahoma can be seen in Figure 4. Beginning in 1973, gross revenues began to rise significantly reaching a peak $5.45 billion in 1983. Today, oil revenues stand closer to 1980 levels, having a significant effect on the Oklahoma economy.

With respect to liquid hydrocarbons, reserves peaked around 1955, with about 2.0 billion barrels of crude oil, and approximately 2.4 billion barrels total liquid hydrocarbons, respectively. Between 1955 and 1980, crude oil reserves steadily declined. Total liquid hydrocarbons show generally similar overall trends until 1979, when a slight increase occurred due to the production of liquid hydrocarbons associated with natural gas in the Anadarko Basin. In 1981, crude oil and total liquid hydrocarbon reserves reported by the Department of Energy were 950 million barrels and 1.58 billion barrels, respectively, which is similar to reserves in 1980.

## NATURAL GAS

Total production of natural gas in Oklahoma was approximately 55 TCF (trillion cubic feet) by the end of 1984. The major producing districts are the Anadarko and Arkoma Basins, and, to a lesser extent, the Central Oklahoma Platform district. In general, natural gas production shows an increase between 1907 and 1983, which is clearly different from the production pattern of crude oil. In 1907, Oklahoma produced only 4.87 BCF (billion cubic feet), while in 1983 natural gas production was reported to be approximately 1.8 TCF. As Figure 5 indicates, production trends of natural gas may be divided into three intervals: 1907 to 1941, 1942 to 1972, and 1973 to 1982. Production increased from 4.87 BCF in 1907 to .234 TCF in 1941, to 1.7 TCF in 1971, the sharpest rate of increase occurring during the second interval (1942-1972). In 1962, annual production broke the trillion cubic feet point, with 1.62 TCF produced.

Revenues from natural gas between 1907 and 1983 are shown in Figure 6. The impact of the price of natural gas was not significant until 1969, and by 1983, the gross revenue derived from natural gas was approximately $5.27 billion. The discovery of deep gas in the Anadarko Basin, and its subsequent deregulation in 1969, was an important catalyst in increasing exploration activities in Oklahoma. The price of deregulated deep gas (below 15,000 feet) ranges between $6 and $10 per thousand cubic feet. New shallow gas (above 15,000 feet) is still regulated, and the price ranges from $2 to $3 per thousand cubic feet. Some "old gas" (below 15,000 feet) is still sold at $2 per thousand cubic feet.

In 1965, natural gas reserves were the greatest, at approximately 21 TCF. Between 1965 and 1979, natural gas reserves declined at a steady rate, while a reversal of this trend was evident after 1979. The Department of Energy reported the reserves to be approximately 14.7 TCF in 1981. However, some estimates suggest that more than 130 TCF of gas may be found on the Anadarko Basin at depths shallower than 15,000 feet while 60 to 300 TCF may be found at depths between 15,000 and 40,000 feet.

## DRILLING ACTIVITY IN OKLAHOMA

In 1981, the Oklahoma Geology Survey reported 78,463 producing oil wells and 155,245 natural gas wells in the state of Oklahoma. Figure 7 shows the drilling activities in Oklahoma since 1907. These activities are the true barometer in evaluating the condition of the state's oil industry. "Boom" periods are characterized by a sharp increase in drilling activities, while "bust" periods show a sharp decline in drilling. Historically there have been at least three major cycles in the oil drilling industry in Oklahoma. The first cycle occurred between 1900 and 1932, when the major oil fields in Oklahoma were discovered. During the early 1900's, Cleveland, Red Fork, and Glenn Pool were some of the major discoveries, while the Cushing-Drumright Field was the most important discovery between 1912 and 1920. Some of the discoveries between 1921 and 1932 included the Marland, Three Sands, Seminole, and Oklahoma City fields. The second cycle, which climaxed in 1955, is represented by such discoveries as the West Edmond Field and the Sooner Trend. The third cycle in the Anadarko Basin attracted the lion's share of drilling activities. In 1981, 11,300 wells were drilled in Oklahoma, with 2,182 natural gas producers, 6,292 oil producers, and 2,826 dry holes. With the rise in drilling

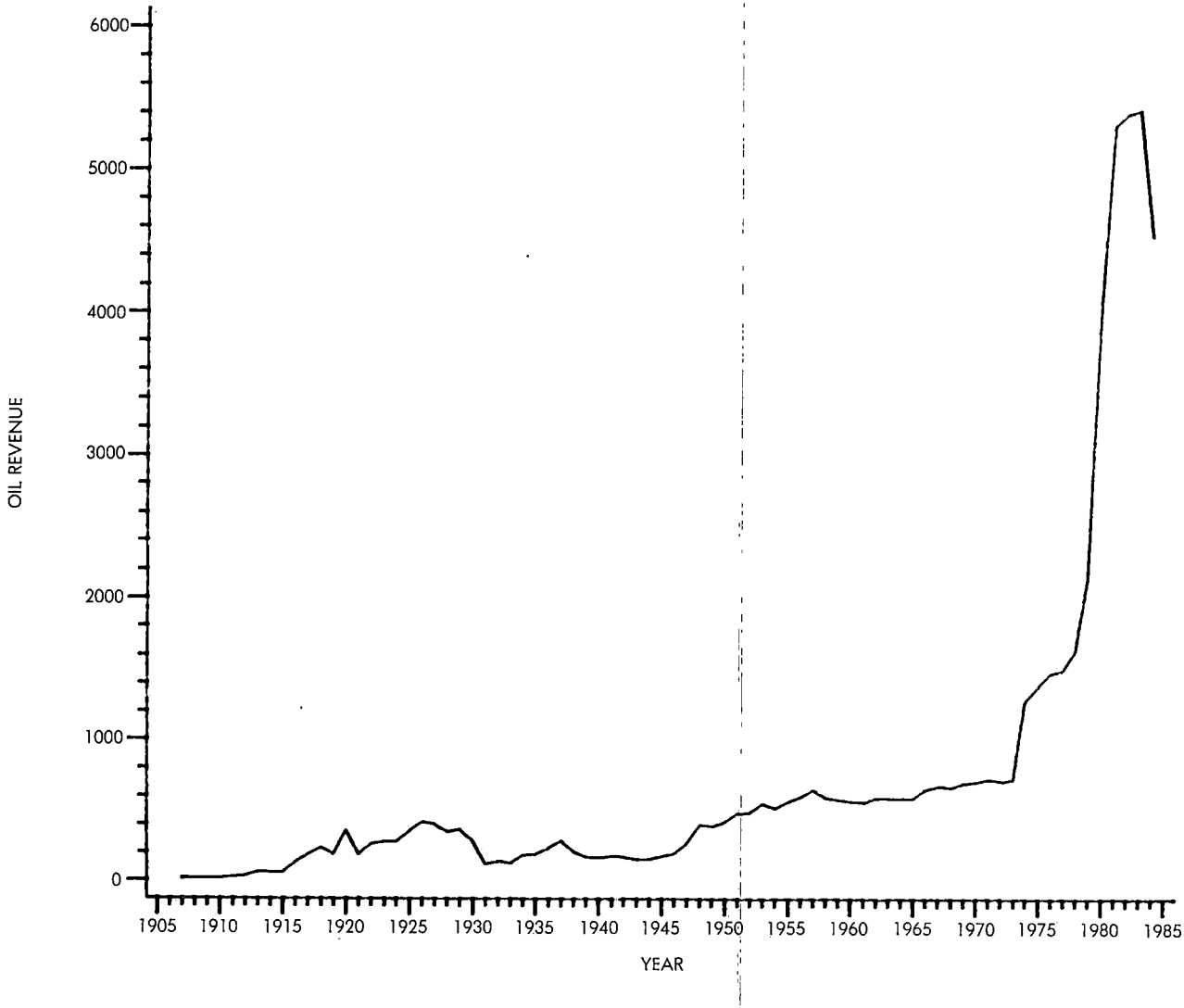



Figure 4. Oil Revenue in Oklahoma in Millions of Dollars, 1907-1984.

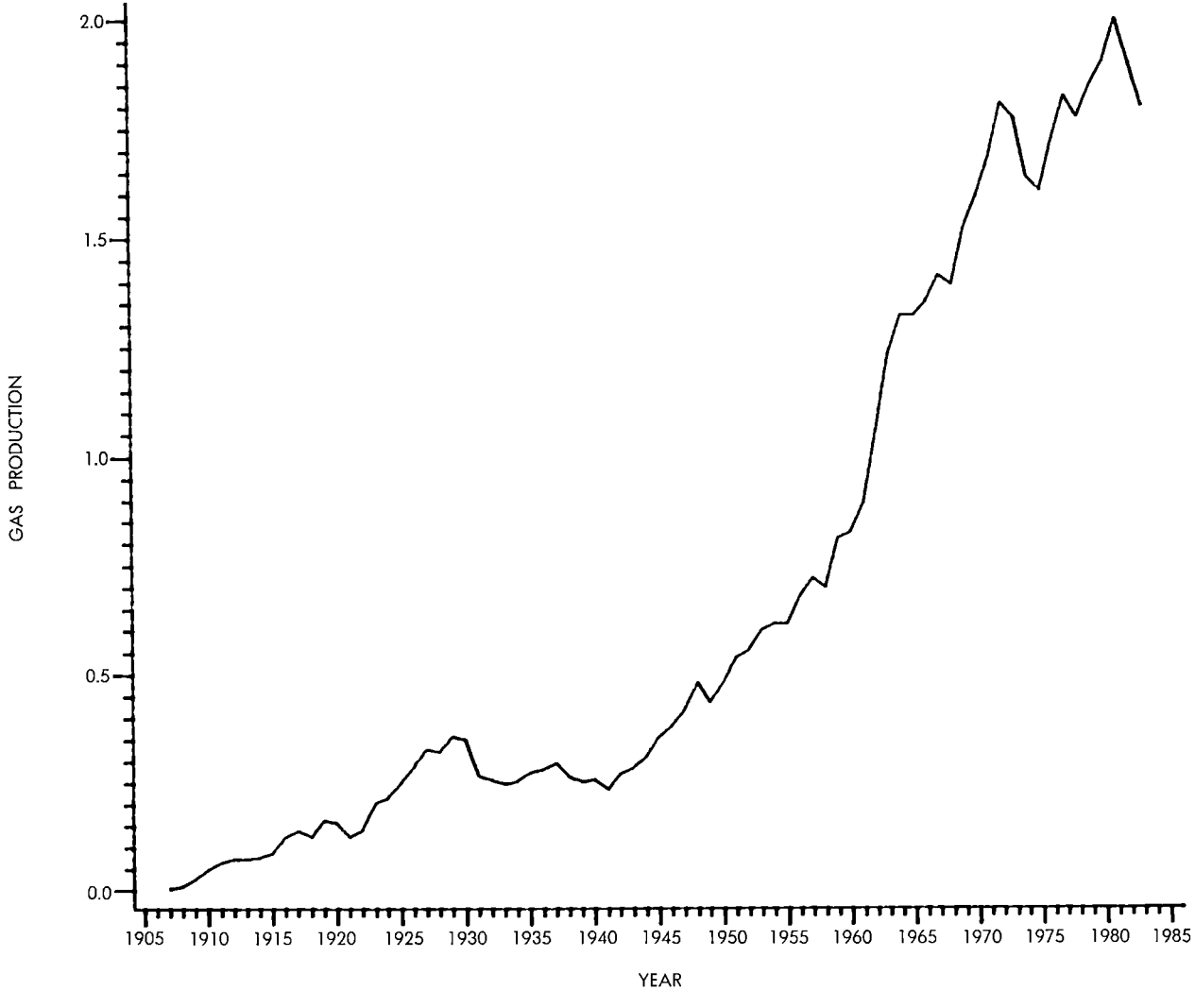



Figure 5. Natural Gas Production in Oklahoma in TCF, 1907-1983.

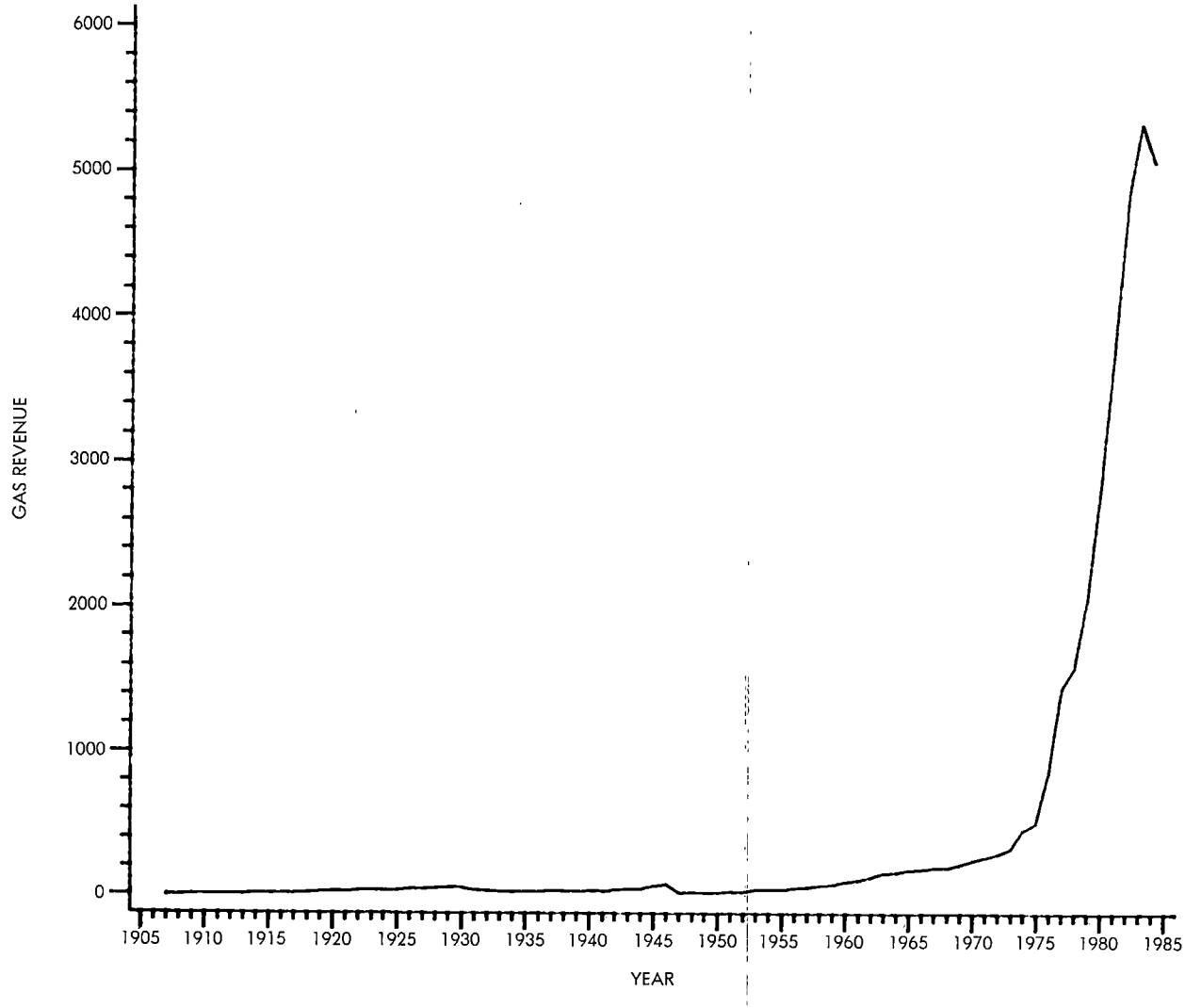



Figure 6. Natural Gas Revenue in Oklahoma in Millions of Dollars, 1907-1984

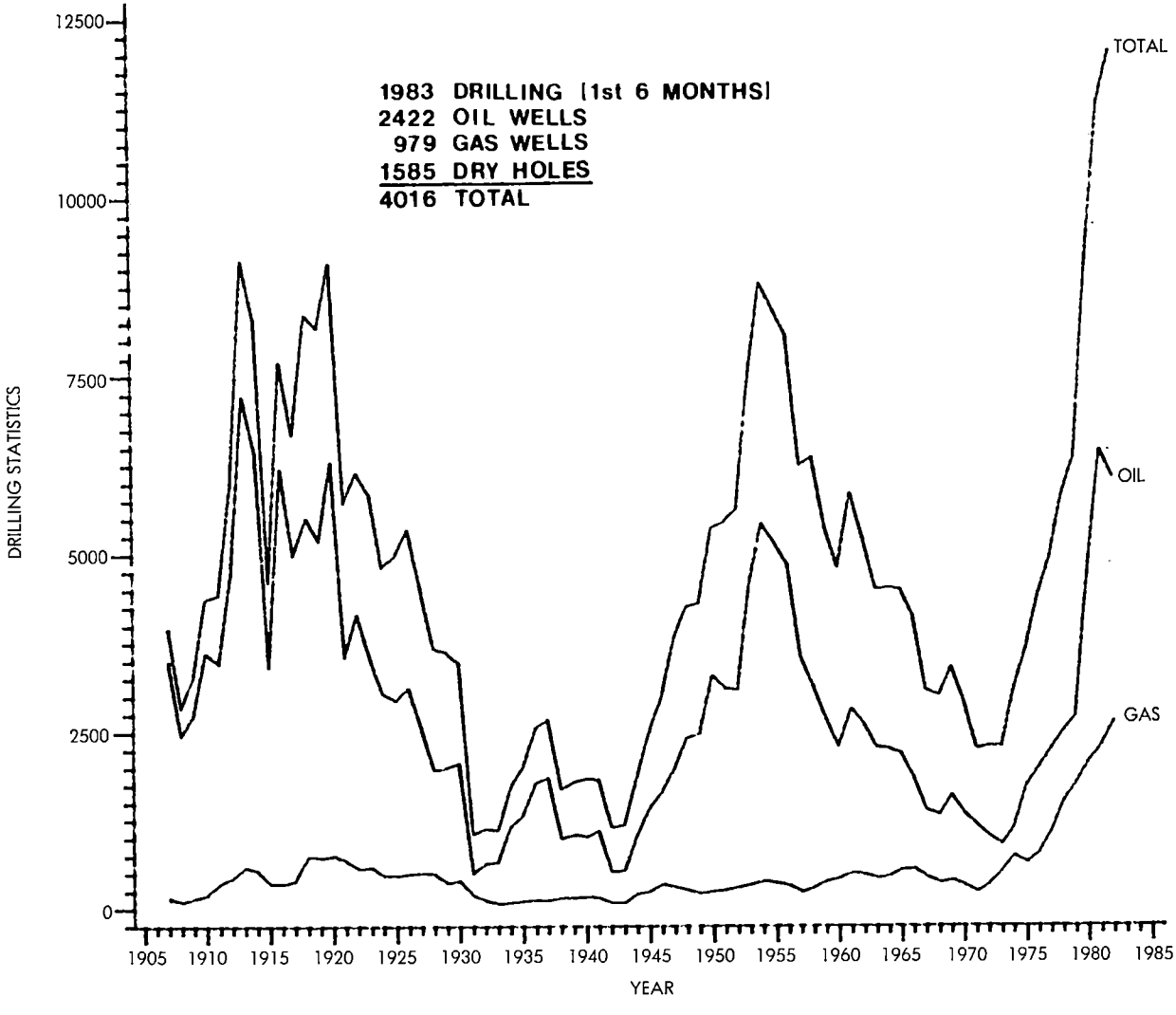



Figure 7. Oklahoma Oil and Gas Drilling Statistics, 1907-1983.

operations, the costs skyrocketed during 1980 and 1981. The cost of drilling and completing a 2,500 foot well was approximately $37 per foot, whereas the cost of drilling and completing deep holes in the Anadarko Basin was about $390 per foot. In 1983, only 4,016 wells were drilled. This shows a drastic decrease compared to the previous year. Due to the "bust" period during 1982 and 1983, drilling costs had been reduced significantly having a definite impact on the related industries and their economic stability.

## REVENUES FROM OIL AND GAS

Taxes collected from hydrocarbon production have been important sources of revenue to Oklahoma since 1916. However, in 1973, these revenues became the essential component of the state treasury. Taxes collected between 1916 and 1983 are shown in Figure 8. Although the rate of taxes collected shows a progressive increase with time, this rate clearly shows the sharpest increase between 1973 and 1983. This abrupt increase during the past decade resulted in improvement of the quality of education. Moreover, for a period of time it helped to shield Oklahoma from the effects of the recession that plagued most of the other states in the nation. At the peak of the boom period, $767 million in taxes were collected. This constitutes approximately 28 percent of total tax revenues. Reduction of this important source of income to the state has had significant impact on the state's economy. This impact has been felt by institutions of higher education as well as other public agencies.

## COAL RESERVES

The main coal region of Oklahoma is a part of the Western Interior Coal Province and is located in the northeastern and east central parts of the state. (See Figure 9) The coal bearing rocks are of Pennsylvanian (Des Moinesian and Missourian) Age. Coal underlies an area which basically has a north-south extent of 185 miles and an east-west extent of about 110 miles. This is slightly over one-fifth of the total area of the state and approximately 21 percent of the state. Presently coal is being mined in Oklahoma at the surface in seventeen counties. Workable coal beds range in thickness from two-six feet, and from seven-eight feet in certain localities, with the major portion of the coal beds having an average thickness of four feet. There are approximately seven beds of economic importance in the state, along with a number of beds too thin to be profitable under present conditions. As of 1980, it had been estimated that 7.8 billion tons of coal were still in reserve.

Of the remaining coal, slightly over one-half of the total amount is technically recoverable and less than one-half would be economically recoverable at current prices. Approximately 58 percent of the total remaining reserves are found at a depth of 1,000 feet below the surface, 25 percent are between 1,000-2,000 feet, and 17 percent are found between 2,000-3,000 feet interval. Reserves are distributed unequally among the twenty-five named beds, some of which are correlatives. Most reserves are concentrated in the Lower and Upper Hartshorne, McAlester and Henryetta beds, particularly the Hartshorne, which are the most extensively mined. About one-half of the reserves are located in LeFlore and Pittsburg Counties and an additional one-third are concentrated in Latimer, Haskell, and Coal Counties. Small deposits of coal have been found in Carter and Cimarron Counties, but they are not commercially profitable.

## COAL PRODUCTION

Oklahoma coal increases markedly in rank from high-volatile bituminous in the western part of the coal fields to low-volatile bituminous in the extreme eastern fields, thereby providing a wide range of useful properties. The estimated reserves are distributed unequally among three major ranks of coal as follows:

| | |
|---|---|
| high-volatile bituminous | 65% |
| medium-volatile bituminous | 13% |
| low-volatile bituminous | 22% |
| | 100% |

Oklahoma coal ranges in sulfur content from 0.8 percent in Rogers County to 5.0 percent in Coal County, with an average of 2.2 percent for the original and remaining coal reserves and 2.9 percent for the remaining strippable coal deposits. Sulfur content is an important criterion in determining certain uses of bituminous coal. Low and medium

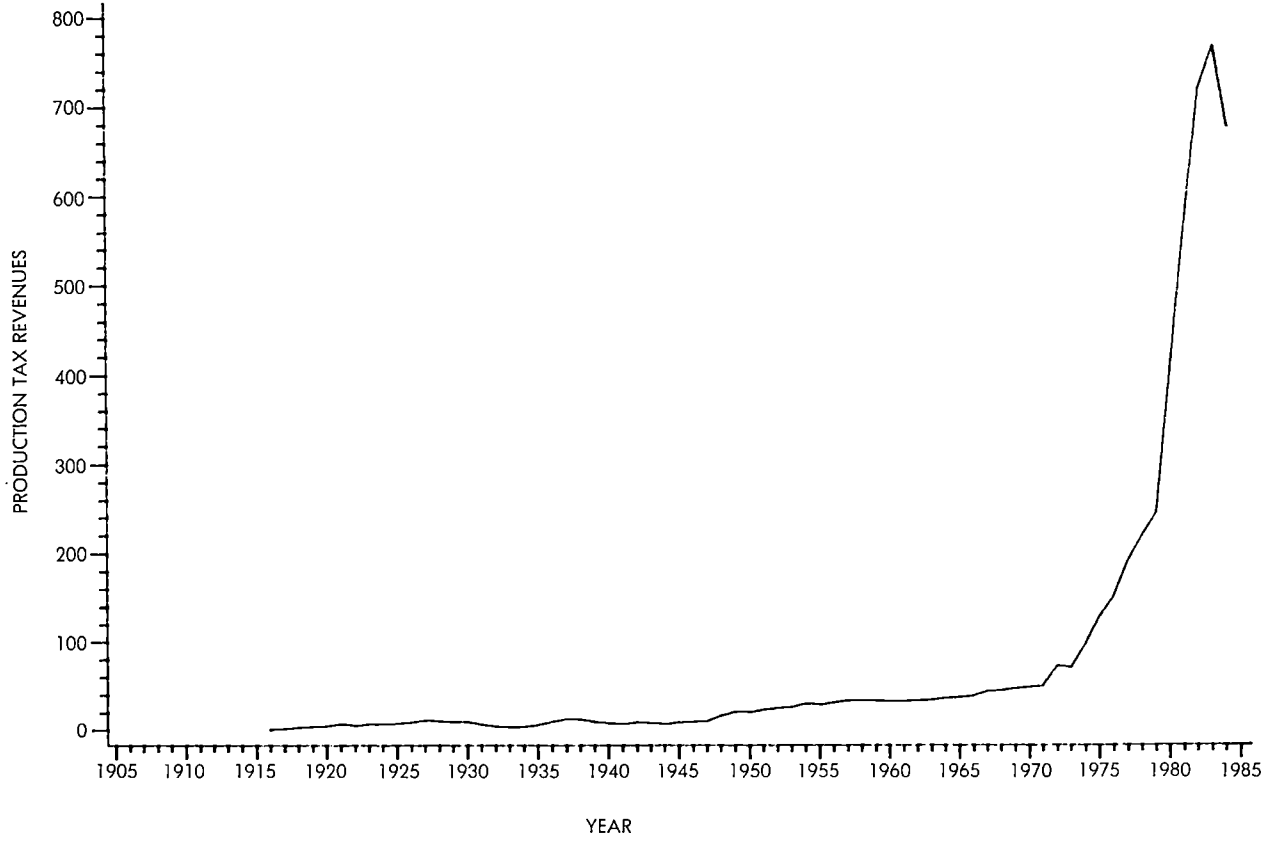



Figure 8. Gross Production Tax Revenues in Oklahoma from Oil & Gas in Millions of Dollars, 1916-1984.

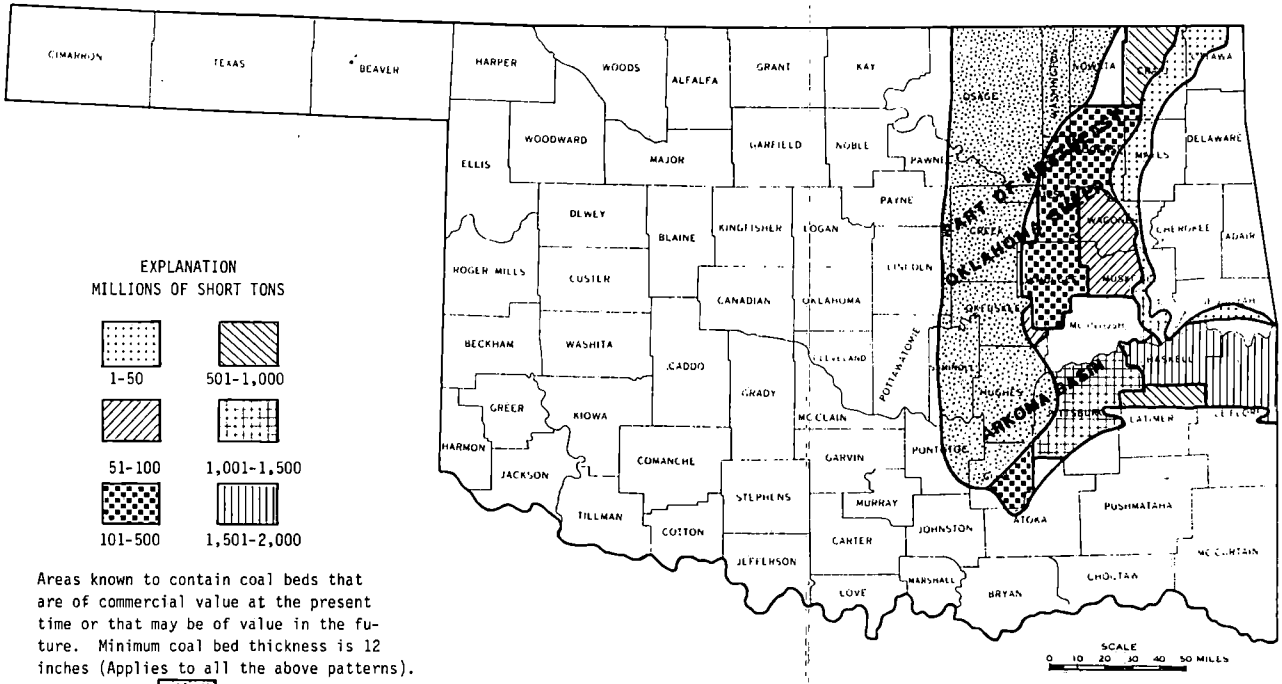



Figure 9. Distribution of Coal in Oklahoma, 1981.

Source: 1981 Keystone Industry Manual; Coal Seams and Fields Section
Oklahoma Report by S.A. Friedman and L.A. Hemish - Page 587.

volatile bituminous coal is best suited for coke, metallurgical and other industrial uses, whereas high-volatile bituminous coal is best suited for electric power generation. Oklahoma coal with a medium sulfur and ash content is best suited for gasification and liquefaction. Coal with a high sulfur and ash content is utilized for cement manufacture. At present, environmental regulations in Oklahoma prohibit utilities from using high-sulfur coal. Oklahoma coal companies can make more money by selling their low-sulfur coal for specialized purposes or by transporting high-sulfur coal to other states.

As mentioned earlier, commercial production of coal in Oklahoma did not begin until the year 1880, when approximately 100,000 tons of coal were mined. Thereafter, production increased steadily, when in 1920 nearly 5 million tons were mined, setting a record for that time period. Figure 10 shows the coal production between 1885 and 1981.

The depression caused the coal industry to fall to just over 1.2 million tons, a forty-year low, in 1934. No dramatic increases were recorded until 1976, when the total of 3.6 million tons was the highest since 1929 (Oklahoma Dept. of Mines, 1981). Record outputs were recorded at 5,346,654 tons and 5,428,678 tons for the years 1977 and 1978, respectively. In 1981, however, fifty-three surface mines and two underground mines combined, for a total of fifty-five mines, to produce a record 5,723,312 tons of coal. Since mining operations began in the state, approximately 230 million tons of coal have been recovered. The price of coal per ton has generally increased throughout the industry's growth, starting at $2.11 per ton in 1932 and building up to as much as $18.00 or more per ton for coal sold to other states in recent times.

During the early years, underground coal mining in Oklahoma was predominant. However, surface mining gradually and steadily increased its share of production during the 1930's, overtaking underground production for the first time in 1945. Since then, the amount of coal produced underground has annually diminished to a minute fraction of the state's total output. During the past twenty-six years, the leading coal producing counties have been Pittsburg, Okmulgee, Coal, LeFlore, Latimer and Rogers Counties.

In terms of labor productivity, there has been a steady incease in the number of tons of coal produced per employee throughout the coal industry's growth due to improved methods and working conditions. For example, in 1932, 2.45 tons of coal were produced per employee per day as compared with the 17.14 tons per man per day in 1976. Employment has fluctuated widely throughout the years. In 1932, 3,063 men were employed, but the number of men declined annually to an all-time low of 205 in 1965. Thereafter, the number of men employed gradually increased to its present level in 1981 of 1,468 men employed by the fifty-three surface mines and two underground mines.

## COAL MINING OPERATIONS COSTS

The cost of mining coal primarily depends on the depth of the coal. At some sites, the coal outcrops at the surface, at others, the land must be stripped quite deep to recover the coal. The deeper the operators must go, the more production costs rise.

Surface or open-pit mining has accounted for approximately 60 percent of all mining since coal extraction began, but significant tonnages have been mined by stripping methods only since 1920. From 1960 to 1976, surface mining has accounted for more than 90 percent of the total coal production, although only 15 percent of the total coal reserves are surface-minable. The U.S. Bureau of Mines estimated the average cost per ton of production of Oklahoma coal at a typical strip surface mine in northeast Oklahoma to be $5.27 in 1969. The cost was estimated at $6.95 for 1973, indicating a 7 percent annual increase in the interval between 1970-1973. Thus, in four years, these costs increased by 31 percent. This percentage increase would have made the cost in 1976 around $10 per ton.

All types of underground mines are, or have been, represented in Oklahoma coal mining. In the early history of Oklahoma, vertical-shaft mines were more numerous. Perhaps this reflected a national tendency at that time, as well as the fact that the area in which most coal mining was done could not be mined practically by other means. Slope and drift mines followed, although the word "drift" is rarely used in Oklahoma coal-mining circles. Underground, the room and pillar system has been most widely used; however, the panel and longwall systems have also been employed. Despite the fact that 91 percent of Oklahoma's coal resources are potentially recoverable by underground mining methods, surface mining has remained the dominant method. The

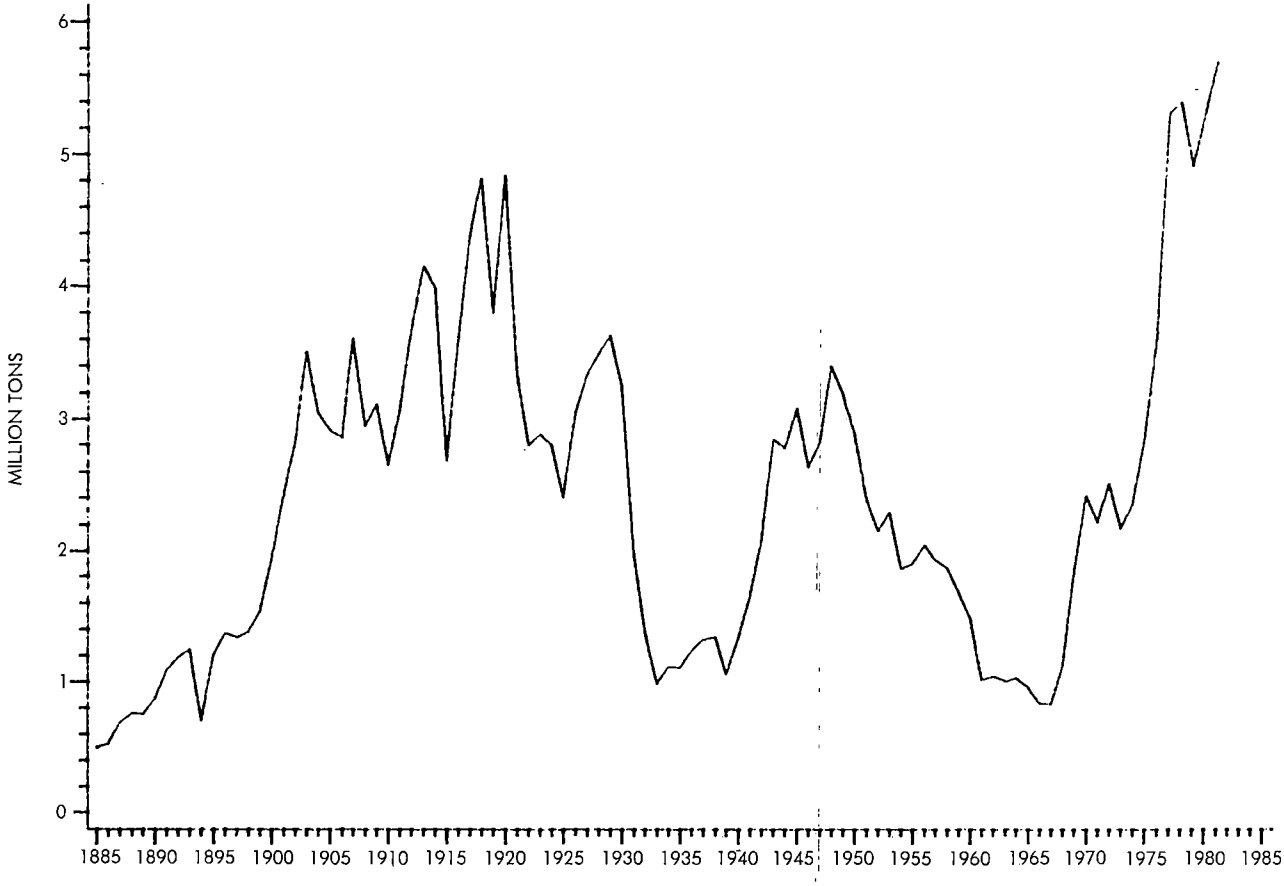



Figure 10. Production of Coal in Oklahoma, 1885-1981.

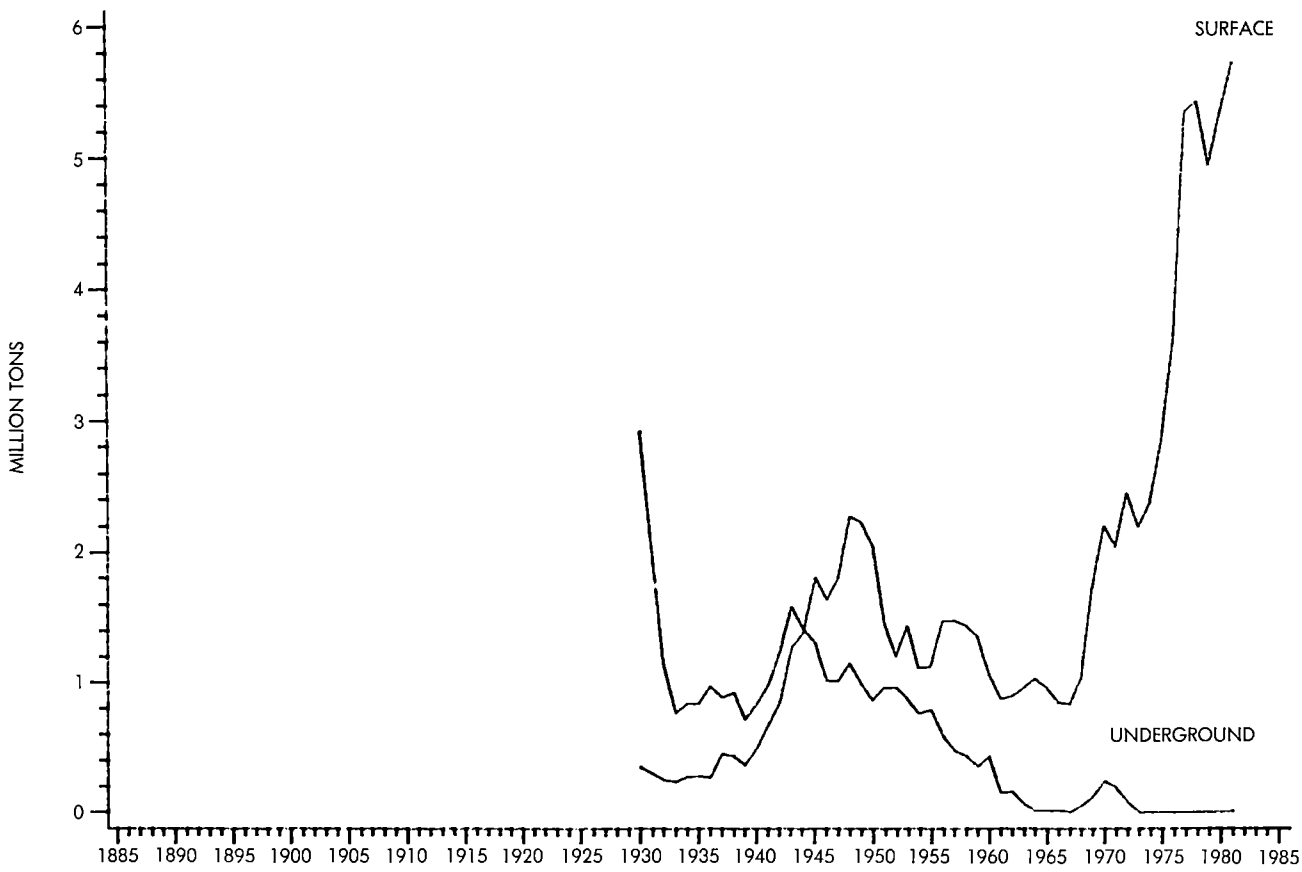



Figure 11. Comparison of Surface and Underground Coal Production In Oklahoma, 1930-1981

Bureau of Mines estimated that in 1973, the cost to produce a ton of coal by underground methods was approximately $11.17, an additional $4.22 per ton as compared with surface costs. Thus, in 1976, the cost of underground mining would theoretically be $14.22 per ton. Figure 11 shows surface and underground coal production between 1930-1981.

# SYNTHETIC FUELS

Synfuels in the broadest sense consist of the production of gas and liquid fuels from coal, tar sands, oil shale, heavy oil and tar deposits (more of a petroleum nature), solid wastes and biomaterials such as living plants or plant products (grains). These forms of gaseous and liquid products may be synthetic crude suitable for processing in a typical petroleum refinery, a low to high BTU gas, methanol or ethanol fuel, hydrogen gasoline or any distillate fuel.

In the past, interest in synthetic fuels in the U.S. came from supply and market factors. Now there are other related considerations that suggest the use of synfuels. There is an abundant supply of coal, shale and tar sands widely distributed throughout the United States (indeed throughout the world). There are significantly greater sources of fuel in these three forms than in petroleum or natural gas. Furthermore, the population on this earth creates huge quantities of solid waste which in themselves have fuel value. There are natural incentives to convert these sources into preferred forms. Of course, these preferred forms must: 1) have a competitive price, 2) be widely available, 3) be clean or non-polluting, and 4) be in a fluid form, that is as a gas or liquid. The predominant fossil fuel distribution network in the United States, excluding coal, of course, is through pipes and across the highways in tanks of trucks and automobiles. The only way this transportation system can be utilized is by gases and liquids. In 1980, 72 percent of the total energy used in the United States came from gases and liquids. We are unlikely to change this pattern.

At any given time in the United States there is incentive to convert our most abundant fossil fuel sources into forms that are priced competitively, clean and easily distributed. Ten years ago the incentive was near panic state; at the present, there is but a whimper of the original enthusiasm for synfuels.

## NATIONAL OVERVIEW

In the latter forties, a number of activities initiated enthusiasm for synfuels. In 1948 the United States became a net importer of oil. At that time nearly 6 million barrels daily were produced in the United States with another 500,000 barrels made available through imports. The latter forties and early fifties brought the first love affair with synfuels in what was called the Synfuels Act. During this period the United States was actually involved in the production of synfuels from oil shales, tar sands and coal. Most of this production was on a research and pilot plant stage. In fact, at Louisiana and Missouri, a 300 ton per day coal liquefaction plant was actually in operation.

The *New York Times*, September 12, 1948, enthusiastically proclaimed;

> The United States is on the threshold of a profound chemical revolution. The next ten or fifteen years will see the rise of a massive new industry which will free us from dependence on foreign sources of oil. Gasoline will be produced from coal, air and water on a scale so huge that it will dwarf even the gigantic synthetic rubber industry born in desperation during World War II.

Unfortunately, the enthusiasm from this earlier effort quickly dissipated with the increased identification and production of oil and gas reserves. The renewal of interest in synfuels did not reappear until the 1973-1974 Mid-East embargo.

This latest wave, over the past ten years, brought us to research and development states unprecedented at any other time in our history. Even Oklahoma could consider a synfuels industry. A detailed report by the Oklahoma Energy Advisory Council (1974) stated that synfuels were expected to help meet Oklahoma's future energy needs. The feasibility study of a coal gasification plant in eastern Oklahoma was being conducted and there were suggestions

for the use of hydrogen as an alternate fuel by as early as 1998 in Oklahoma.

On a national scale the enthusiasm reached an all-time high with the proclamation of President Nixon's "Project Independence" and President Carter's "Moral Equivalent of War." President Carter suggested that by 1992, the United States would be producing the equivalent of 2 million barrels per day of synfuels.

The legislatures were equally enthusiastic. As one editor stated, to relieve the gas pains of angry constituents back home, elected officials managed to work up forty different bills to stimulate production of synthetic fuels from coals, shales, sands, grain, and other sources.

The efforts in development of synfuels did bring us to pilot plant production stage wherein plants operating between 5 to 100 tons per day were constructed and tested. The Synthetic Fuels Corporation was created and funded to the level of about $17 billion through 1984.

All of these activities have gradually come to a close. The Synfuels Corporation has been drastically reduced in its funding with serious attempts to eliminate it completely. All major coal liquefaction plants in the United States have been closed. In May 1982, the Exxon Corporation abandoned its $6 million Colony Shale Oil project just two days after investors eliminated a $13 billion venture to win synfuels from Canadian tar sands.

In October 1984, a California coal gasification plant processing only 100 tons per day of coal to yield a medium of BTU gas was commissioned. There is still interest in the development of private plants to process tar sands to extract fuel. Coal gasification for low and medium BTU gas still has some interest and companies supported through the Synfuels Corporation are still moving toward operation of a sizeable gasification plant in the Great Plains area.

In general, there are no new major programs directed toward commercialization of synthetic fuels in the United States. The conservation efforts demonstrated by consumers and industry in the United States and throughout the world, the disintegration of the OPEC power base and other less significant activities such as the Strategic Petroleum Reserve, have dampened the drive toward production of synfuels. This policy can be dangerous since we are still vulnerable to political upheaval throughout the world, and most certainly in the Mid-East and South America.

## OKLAHOMA OVERVIEW

In 1973 and 1974 a study was conducted for Oklahoma to evaluate the merits of establishing a synfuels plant. Sites were evaluated and economics was assessed. This plant was to be a large, complex facility incorporating gasification and liquefaction of coal with nuclear power sources. Such a plant was found to be feasible.

In the past ten years at least four major energy companies within the state have been actively involved in the evaluation and actual pilot plant operation for synfuels production. Most of these facilities were coal-related plants of small scale. At present, no active facility is operational.

## FUTURE PROSPECTS

In essence both the state of Oklahoma, and the United States by present actions have agreed to "bank" our primary sources of fossil energy for future use, most likely well beyond the year 2000. This is certainly a reasonable position considering the so-called world glut of oil, the abundance of gas in Oklahoma and declining prices.

The entire price structure and development of synfuels are directly related to the price of a barrel of oil. In a recent publication by the Electric Power Research Institute the vice president of the National Economic Research Association, Incorporated, predicted that oil prices will remain stable or increase by not more than 1 percent per year through the end of this century. On the other hand, there are those who warn that production of oil in the United States by the year 2000 is expected to fall by 17-29 percent. Another warning by the president of the Institute of Gas Technology stated that the world energy system is very sensitive and a mere 2 million barrels per day or only 3.5 percent of the world consumption is sufficient to convert from a seller to a buyer's market. Indeed for every antagonist of synthetic fuels there is a protagonist who is concerned about imports, higher vulnerability to political and religious issues in the Mid-East, imbalance of payments and similar issues.

In no case can synfuels of any form be brought to the production stage quickly. A minimum of five to seven years would be necessary. The special economics of the synfuels industry are unique. The size of the capital is great. Multi-billion dollar plants are usually considered necessary for

commercial production, this being especially true in synfuels derived from coal. Clearly the business of synfuels is very capital intensive, and therefore, directly relates to the ability to raise risk capital. Incentives are always needed from the government for underwriting projects, fast amortization, debt equity financing, or even waiver of income tax. Regardless of what synfuel is being considered, the price is not likely to be at parity with present oil prices. The price of petroleum fully determines the price of all other fuels including synfuels and the rate of inflation of petroleum prices relative to other inflationary factors (material, labor, etc.) determine both the time and price of parity for any synfuel.

## SYNTHETIC FUELS IN OKLAHOMA

Even though Oklahoma has an abundant supply of fossil energy, especially liquid and gaseous forms, there are sufficient supplies of coal, tar sands and heavy oils which could lend themselves to the development of a synfuels industry. Solid waste collection from the two major urban centers can also serve as a source of energy through direct incineration or pyrolysis yielding low BTU gases and liquid fuels. Oklahoma has about 6-10 billion barrels of heavy oil present in the Kansas-Missouri-Oklahoma area. Heavy oil deposits in the south central area have been estimated at 1.8 billion barrels. These tar sands and heavy oil reserves are much too viscous and difficult to process through normal refining operations, and therefore, would lend themselves to upgrading and utilization by some alternate of synfuels process.

In the original study by the Oklahoma Energy Advisory Council, appropriate coals were identified for synfuel conversion in the counties of Coal, Latimer, Okmulgee, and Pittsburg. The total reserves from this area if mined to the extent of 40 percent recovery could yield an ample supply for conversion purposes.

In summary, Oklahoma does have a resource base that could support synthetic fuels development. Clearly, the coal reserves are not as great, as rich, nor as deep veined as those of the eastern and western fields. Nor are Oklahoma's tar sands as abundant in bitumen as can be found in those of Utah and Canada. The asphaltic rocks are in no way comparable to the hydrocarbon content of those shales in Colorado and Wyoming.

In spite of these relative measures, there is sufficient quality to dictate an ongoing investigation of synfuels production in Oklahoma. More detailed information should be collected on availability, abundance and general geological distribution of coal, tar sands and the heavy oils. Basic research should be conducted to determine properties and processing characteristics in general and those that might be unique to the fossil fuels in Oklahoma. Most certainly the major research institutions in Oklahoma, by right of their energy heritage, must contribute research toward the ultimate development of a synfuels industry in the United States. Few forecasters, experts or politicians will dispute that a new energy crisis of some magnitude will occur. However, no group can agree when. Clearly, there will be a limit to what we can extract from our natural fossil fuels. In order to prepare for the future of synfuels, basic research and development activities need to be funded and conducted now, not when pressures are generated by situations like the Mid-East embargo, the Iran-Iraq war, and others that limit the supply and drive prices of oil up.

A significant advancement of information and technology has resulted over the past ten years. The massive synfuel plants, the questions in technology and the environmental and social issues cannot be resolved, constructed and brought to production in a few months — years are needed. The immediate price of oil should not dictate our basic research and development policies for synfuels. These efforts should be dictated only by our perception of when this new industry is needed.

# RENEWABLE ENERGY RESOURCES

Renewable energy resources are perhaps the most abundant sources for future energy demand, yet are also the least used. Renewable energy resources include solar, biomass, wind, geothermal, tidal and hydropower. They do not include fossil fuels and nuclear fuels. Renewables are viewed as the future energy sources due mainly to their economically inexhaustible stock and the potential for technically efficient methods of storage, conversion and transportation.

Despite their inexhaustible supply, renewable energy resources do not exist or occur in forms that correspond to patterns of energy demand and consumption. The compatability with structure of energy use is imperative and research is currently focusing on this important area.

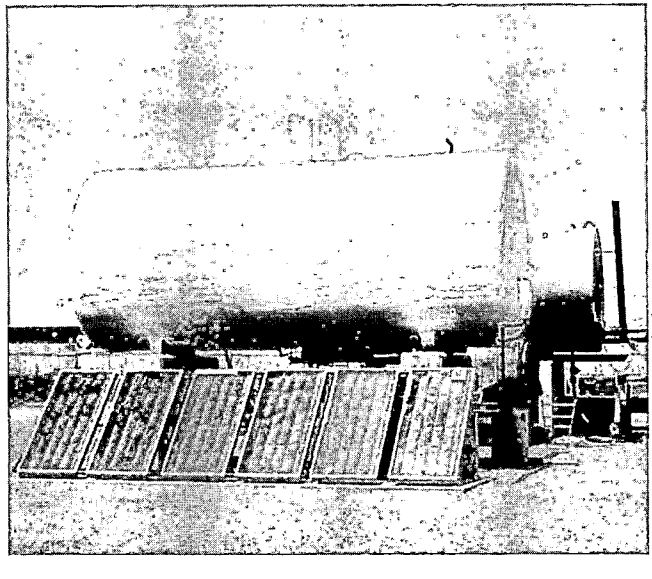
In Oklahoma, such renewable resources as solar, biomass and wind could make an increasingly important contribution to the overall energy demand question. However, Oklahoma will continue to rely heavily on oil and gas as the chief energy resources of the state for both export and in-state use.

## SOLAR ENERGY

Direct solar radiation is perhaps the most important and largest potential renewable energy resource in Oklahoma. Its use in conventional heating, cooling and lighting makes it a plausible alternative. It is estimated that the potential for solar energy is so great that it can provide more than 300 times the amount of energy currently used from all other conventional resources in a one-year period.

Despite its great potential, solar radiation remains a low priority in R&D programs. Today the technology to convert solar radiation to other forms (such as thermal and electric) remains highly inefficient and thus impractical. At this time, solar applications contribute very little to the overall energy demand both in Oklahoma and throughout the nation. Under President Carter's energy program, a goal of 20 percent reliance on solar energy by the year 2000 was established. However, this goal may prove to be too ambitious given the significant reductions in solar energy R&D since 1981.

Solar energy technology may be divided into three categories: solar heating and cooling, solar thermal, and photovoltaics. In the first category, technology concerning the collection, distribution and storage of solar energy is both feasible and available. The cost and efficiency of the technology however, limits its real potential today. The second category concerns the conversion to heat and generation of electricity; once again, the technologies are available, yet they lack competitiveness in cost effectiveness. Photovoltaics convert sunlight to electricity. Efficiency in this area is estimated at only about 10 percent. Research has been reduced considerably in recent years. Despite this apparent snag, photovoltaic processes will probably be enhanced through increased research in the private sector. According to research by the Electric Power Research Institute in 1981,

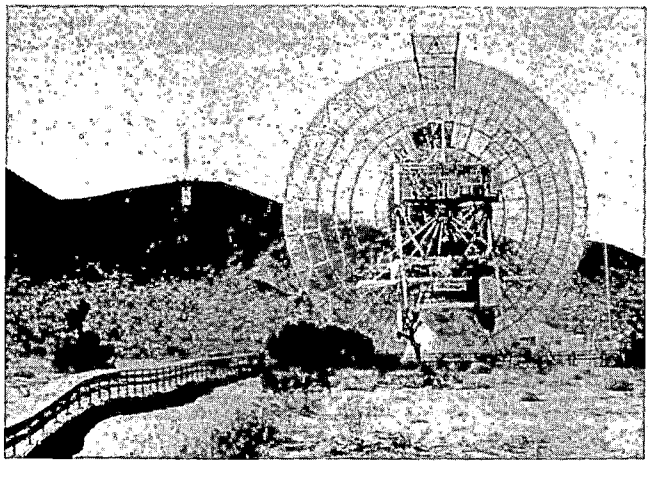


utilities are getting more involved in such areas as wind power, solar thermal conversion, photovoltaic conversion and solar heating and cooling.

The development of solar energy in Oklahoma has much potential given the state's "solar energy intensity." However, there are few incentives for industry use or development because inexpensive alternative fuels such as natural gas and electricity are readily available. State tax incentives may provide some assistance in generating greater public awareness and activity but the real potential lies in the involvement of "energy" industries in the R & D phases of this resource.

## BIOMASS ENERGY

Biomass may be defined as energy accumulated in organic materials through photosynthesis. Firewood is the most well-known biomass energy resource. The photosynthetic conversion of solar energy with carbon dioxide and water is biomass. In the United States, the use of biomass energy has taken two forms. First is the direct use of wood-burning for heating. This process has grown, yet now appears to have its limitations in terms of environmental pollution problems. The second form is the conversion of biomass to liquid form; for example ethanol or methanol. Ethanol is made from feedstock containing starch or fermentable sugar, of which corn is the preferred source. Methanol is a wood biomass gasoline substitute or additive.



Ethanol contains about 85,000 BTU's of energy per gallon, which is about 40,000 BTU's less than gasoline. However, ethanol has a higher octane and has become an important substitute for lead additives. The impediments to the full development of this resource are generally related to higher production costs, rising feedstock prices and reduced federal outlays for R & D.

Oklahoma, with its large agricultural sector, could easily develop a significant biomass program. However, lack of funds, competition from less expensive fuels and high feedstock prices have become impediments to such a program. Because there is currently lack of marketing strategies in these areas, biomass is likely to remain a rather small and sporadic program.

## WIND ENERGY

While the technology for large-scale production of wind power is in the developmental stages, the potential for wind power as an alternative energy source remains unclear. Some estimates suggest that wind power could generate as much as 7-19 percent of the electricity used in the United States. However, suitable areas for generating wind power are limited and the environmental and climate effects are yet to be assessed.

## HYDROPOWER

In Oklahoma, hydroelectric generating capacity can be increased by as much as one-third over the next ten years. Much of the development will come through decentralization of the hydropower generating capacity. By granting federal power generating licenses to states, municipalities, and cooperatives as well as permitting nonfederal investment in construction of power projects, the development of hydropower may be broadened and opportunities for greater capacity expanded. The Southwestern Power Administration (SWPA) is the wholesaler for electric power to utilities in Oklahoma and neighboring states. In 1983, SWPA distributed more than 5.5 billion kilowatt hours of energy from the system; from Corps of Engineers projects in Okla-

homa, the system generated 1.57 billion kilowatt hours of power. Through improved generating capacity, another 170,000 kilowatt hours will be possible in Oklahoma.

Oklahoma has an enormous potential for generating power through water development. Much of this potential is in the southeastern quadrant of the state. Future hydropower development will rest with Congress and private investors who seek to maximize production to meet demands not being satisfied by nuclear or other fossil fuel resources.

# ENERGY INDUSTRY IN OKLAHOMA

## IMPACT OF ENERGY INDUSTRY TO OKLAHOMA'S ECONOMY

From mid-1982 to mid-1983, Oklahoma suffered considerable losses in output, employment and income, the belated effects of a decline that occurred in the national and international economies during 1981-1982. While the nation began its recovery in early 1983, Oklahoma was in the midst of a recession which saw the unemployment rate rise to 8.3 percent and real per capita income decline 24 percent. Oklahoma experienced a decline in real output of its economy during 1983, a sluggish performance that was to contribute to a growing state fiscal problem. By mid-1982 Oklahoma government began to experience revenue shortfalls due to a significant decline in state revenues from the severance tax on oil and gas, the sales tax, federal receipts, income tax and revenue from interest, rent, dividends and royalties.

The significant role of the energy industry in Oklahoma's economy has been directly related to a large increase in exploration and production in oil and gas activities during the 1970's and early 1980's. With prices on the rise and a ready supply, the energy industry grew significantly and stimulated the growth in activities of other state industries. However, by 1983 with a softening in world oil demand and significant reductions in prices, oil and gas production experienced large decreases.

According to the Office of Business and Economic Research (OBER) of Oklahoma State University, the recovery to begin in 1984 will be slow and modest. Table 3 shows the OBER forecasts for oil and gas production.

Since the last decade of the nineteenth century, the energy industry has played an important role in the economic growth and development of Oklahoma. Currently, over 3500 Oklahoma business establishments are actively engaged in oil and gas extraction, petroleum refining, manufacture of oil field machinery, pipe line transportation of petroleum, gas production and distribution, and wholesale trade of petroleum and petroleum products. (See Table 4) Other Oklahoma firms are involved in oil and gas field machineshop work, construction of pipe lines, rental of oil field and well drilling equipment, and retail trade of gasoline and other types of fuel. Oil royalty traders, dealers in oil and gas leases and royalties, petroleum consultants, petroleum engineers, and lawyers specializing in oil and gas law are also located in Oklahoma.

These firms provide jobs for over 143,000 workers. However, the energy industry contributes more than this to Oklahoma's economy. Oil and gas companies indirectly create jobs by buying products from other industries and stimulating employment in those industries. In addition, workers employed in the energy sector use their salaries to purchase goods and

TABLE 3

OIL AND NATURAL GAS PRODUCTION IN OKLAHOMA

| | 1970 | 1982 | 1983 | 1984 |
|---|---|---|---|---|
| Total Oil Production (Millions of Barrels) | 222.6 | 157.4 | 159.6 | 160.5 |
| Natural Gas Production (Billions of Cubic Feet) | 1796.2 | 2058.8 | 2018.3 | 1730.4 |

TABLE 4

NUMBER OF ESTABLISHMENTS ENGAGED IN SELECTED ENERGY INDUSTRY ACTIVITIES IN OKLAHOMA

| | 1981 | 1971 |
|---|---|---|
| Oil and Gas Extraction | 2727 | 1605 |
| Petroleum Refining and Related Industries | 49 | 72 |
| Manufacture of Oil Field Machinery and Equipment | 109 | 48 |
| Pipelines, Except Natural Gas | 43 | 48 |
| Gas Production and Distribution | 114 | 117 |
| Wholesale Trade: Petroleum and Petroleum Products | 496 | 406 |
| TOTAL | 3538 | 2296 |

Source: U.S. Department of Commerce, Bureau of the Census, *County Business Patterns 1981, 1971: Oklahoma*

services in the state, further enhancing employment. It is estimated that, through this employment multiplier effect, the energy industry is responsible for creating at least 182,300 jobs in other sectors of Oklahoma's economy.[1] Thus, as shown in Figure 12, over 325,300 workers, or slightly more than one-quarter of Oklahoma's total nonagricultural employment, are either directly or indirectly tied to the energy industry.

## ENERGY INDUSTRY EMPLOYMENT

Oklahoma's energy industry encompasses a multitude of business activities. Although, as shown in Figure 13 most energy employment is in the oil and gas extraction sector, a considerable number of workers are employed in other sectors. Of these other energy sectors, the largest are those engaged in the manufacturing of oil field machinery and equipment and in the refining of petroleum and related products.

[1] All employment multiplier effects were estimated from the Oklahoma State Input-Output Model. See Gustely and Amos for a detailed discussion of this technique.

We also estimated the employment multiplier effects for both Tulsa and Oklahoma City. Because the results are similar to those for the state, they are not presented in this paper. The results are available on request.

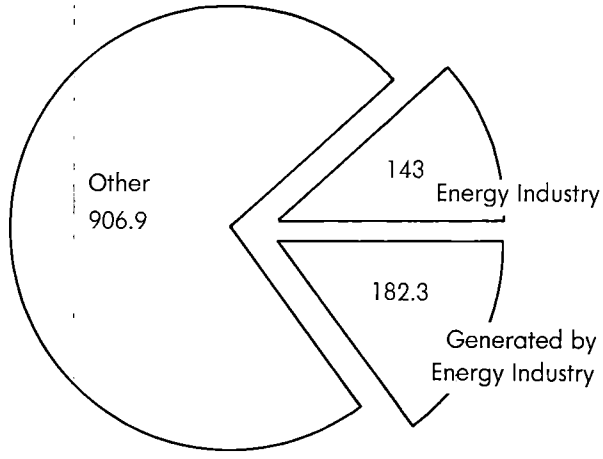



Figure 12. Nonagricultural Employment in Oklahoma, 1982 (in thousands of workers).

Source: Oklahoma Employment Security Commission, Oklahoma State Input-Output Model

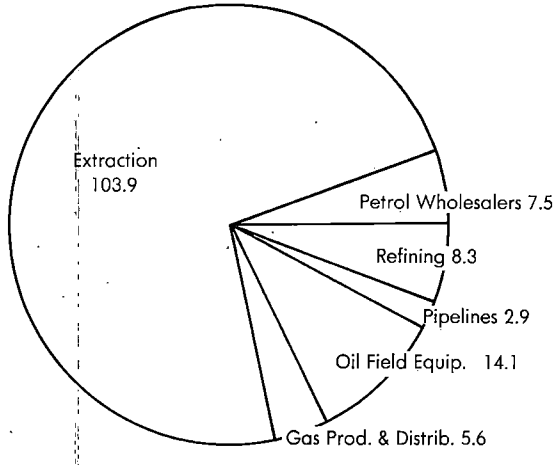



Figure 13. Energy Industry Employment in Oklahoma, 1982 (in thousands of workers).

Source: Oklahoma Employment Security Commission

## Mining: Oil and Gas Extraction

Firms involved in the extraction of oil and gas constitute the largest sector of Oklahoma's energy industry. In 1981, the latest year for which data are available, there were over 2700 Oklahoma establishments engaged in activities such as exploration, drilling, and oil and gas well operation and maintenance. As shown in Table 5, the majority of these firms (53 percent) based their operations outside Oklahoma's two largest metropolitan areas. Only 28 percent of these establishments were based in the Oklahoma City metropolitan area, while 19 percent were located in Tulsa.

On an average during 1982, Oklahoma's oil and gas extraction firms provided jobs for almost 104,000 workers, or 8.4 percent of Oklahoma's total nonagricultural work force, as shown in Figure 14. Establishments located outside of Oklahoma City and Tulsa employed a large portion of this work force. Slightly over 41,000 workers, or 40 percent of all Oklahoma oil and gas extraction employees, worked outside these two major metropolitan areas. Even so, Oklahoma City and Tulsa oil and gas extraction establishments were major employers: Oklahoma City firms employed over 34,000 oil and gas extraction workers, while Tulsa firms employed approximately 28,000.

TABLE 5

NUMBER OF ESTABLISHMENTS ENGAGED IN OIL AND GAS EXTRACTION ACTIVITIES IN OKLAHOMA

| | Oklahoma | Oklahoma City | Tulsa |
|---|---|---|---|
| Extraction of Crude Petroleum, Natural Gas, and Natural Gas Liquids | 1156 | 294 | 290 |
| Drilling Contractors | 426 | 134 | 69 |
| Exploration Contractors | 344 | 167 | 76 |
| Other Oil and Gas Field Services | 801 | 162 | 93 |
| TOTAL | 2727 | 757 | 528 |

Source: U.S. Department of Commerce, Bureau of the Census, *County Business Patterns 1981: Oklahoma*

The economic activity in the oil and gas extraction sector of the energy industry generates economic activity in other industries in Oklahoma. This economic activity results in more jobs for Oklahoma residents. There are two reasons for this. First, firms involved in oil and gas extraction use the products of other industries in their day-to-day business operations, which stimulates employment in those industries. Second, individuals employed in the Oklahoma oil and gas extraction sector earn in excess of $48 million per week, and spend a substantial portion of this income on goods and services produced and sold by nonenergy related Oklahoma firms.

The resulting employment effects are quite large, as seen in Figure 15. In addition to the 104,000 jobs directly related to oil and gas extraction, an estimated 140,800 jobs in non-energy industries were indirectly tied to the oil and gas extraction sector.

A second way to look at these employment effects is to estimate the effect on other industries of growth in the oil and gas extraction sector. If employment in Oklahoma's extraction sector increases by 100 workers, employment in Oklahoma's nonenergy related industries will go up by an estimated 135 workers. The opposite will occur if the sector contracts.

## Manufacturing: Oil Field Machinery and Equipment

The 109 establishments involved in the manufacture of oil field machinery and equipment make up the second largest sector, in terms of employment, in the Oklahoma energy industry. This sector employed over 14,000 workers in 1982. Almost half of these worked for firms in the Tulsa metropolitan area, while only 18 percent worked for Oklahoma City firms.[2] The remaining 4700 workers were employed throughout the rest of the state.

Like the oil and gas extraction sector, the oil field machinery and equipment sector creates jobs in other industries. In Oklahoma in 1982, approximately 12,800 nonenergy related jobs were the indirect result of economic activity by the oil field machinery and equipment sector. Figure 16 shows that firms and employees in this sector bought products and purchased services from other Oklahoma establishments, and this activity was associated with about 12,800 jobs in other industries.

[2]In terms of employment, this sector is the third largest energy sector in Oklahoma City

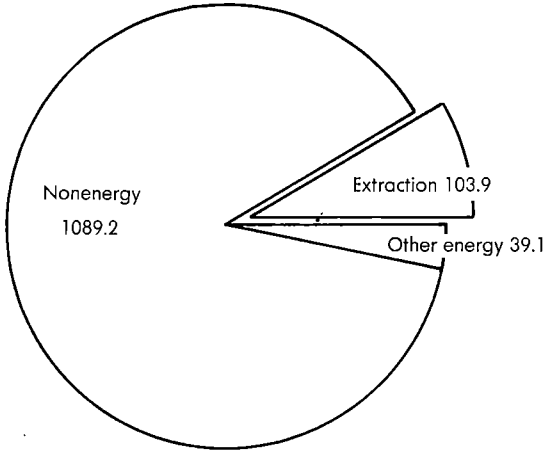



Figure 14. Employment in Oklahoma's Oil and Gas Extraction Section, 1982 (in thousands of workers).

Source: Oklahoma Employment Security Commission

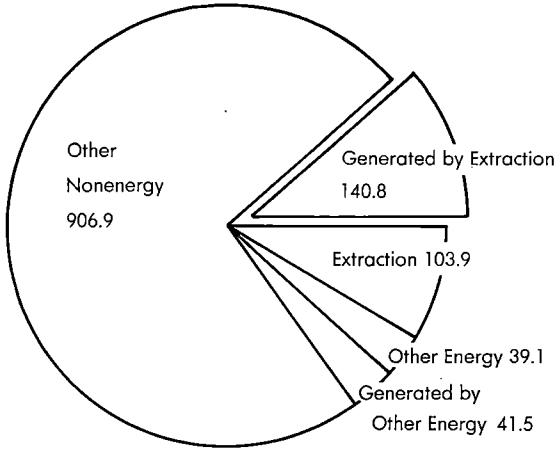



Figure 15. Nonenergy Employment Generated by Oklahoma's Oil and Gas Extraction Sector, 1982 (in thousands of workers).

Source: Oklahoma Employment Security Commission: Oklahoma State Input-Output Model

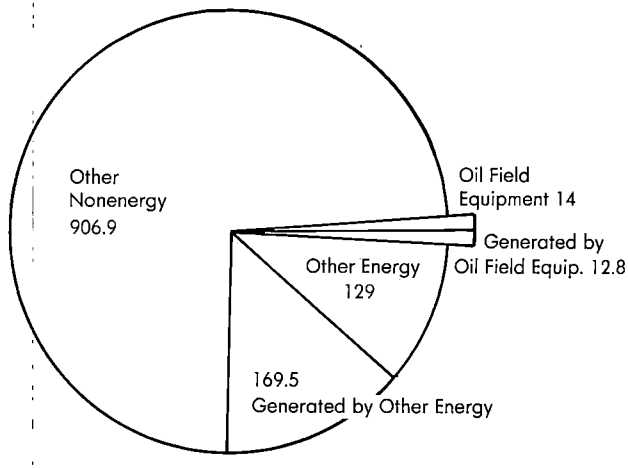



Figure 16. Employment in Oklahoma's Oil Field Machinery and Equipment Sector, 1982 (in thousands of workers).

Source: Oklahoma Employment Security Commission: Oklahoma State Input-Output Model

The employment multiplier effects are not as large as those in oil and gas extraction. It is estimated that the addition of 100 new employees to this sector will generate approximately 90 jobs in other nonenergy related Oklahoma industries. If, on the other hand, the sector dismisses 100 workers, there will be a loss in those other industries of about 90 jobs.

## Manufacturing: Petroleum Refining

In terms of employment, the third largest sector in Oklahoma's energy industry is petroleum refining. Although this is Oklahoma City's second largest energy sector, it ranks sixth in Tulsa.

Oklahoma's petroleum refining sector currently consists of forty-nine establishments primarily engaged in petroleum refining and the manufacture of related products. In 1982, there were 8300 workers employed in this sector. As shown in Figure 17 over 60 percent of Oklahoma's employment in the petroleum refining sector is generated by firms located in Oklahoma City, with Tulsa's petroleum refining establishments employing only 16 percent.

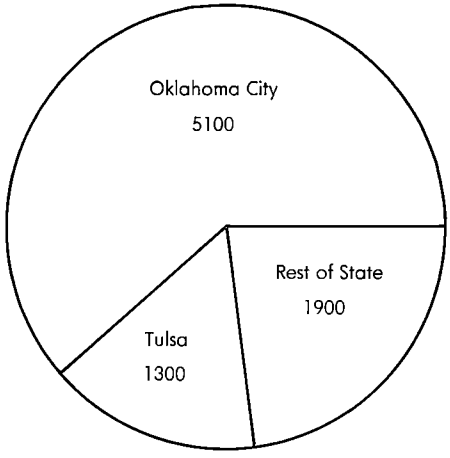



Figure 17. Employment in Oklahoma's Petroleum Refining Sector

Like the other two energy sectors, the petroleum refining sector stimulates employment in other industries. Figure 18 shows that in 1982 an estimated 21,700 nonenergy related jobs were the indirect result of economic activity by the petroleum refining sector.

For every job in refining in Oklahoma, there are 2.6 jobs generated in Oklahoma industries unrelated to energy. Thus, if the refining sector hires 100 additional workers, there will be an estimated 260 new jobs created in Oklahoma's non-energy industries. Contraction of the industry will, of course, lead to a similar loss of jobs.

## Other Energy Sectors

With a total of 7600 employees, the 496 firms involved in the wholesale trade of petroleum and petroleum products constitute the fourth largest energy sector in Oklahoma. Slightly over 2800 of these workers were located in Tulsa in 1982, while over 1100 were located in Oklahoma City.

Oklahoma businesses engaged in the pipe line transportation of petroleum employed about 2900 workers in 1982. Economic activity in this sector was associated with almost 3000 jobs in other industries.

Other major sectors of the Oklahoma City oil and gas industry are the gas production and distribution sector, with almost 5600 employees, and the oil royalty trading sector with slightly under 600 employees.

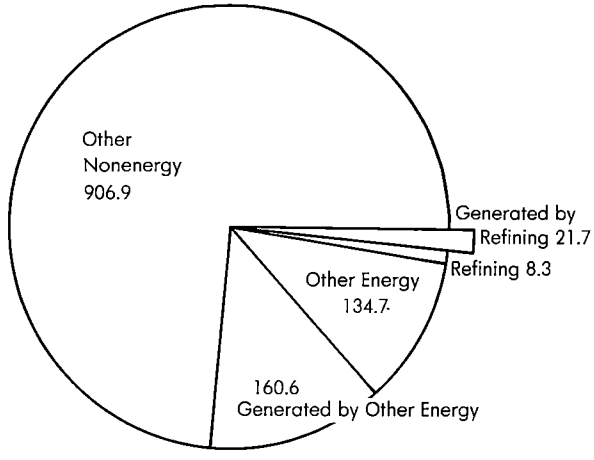



Figure 18. Employment in Oklahoma's Petroleum Refining Sector, 1982 (in thousands of workers).

Source: Oklahoma Employment Security Commission: Oklahoma State Input-Output Model

# COMPARISON WITH OTHER INDUSTRIES

All seven energy sectors provide jobs for approximately 143,000 employees. Only three major industries are larger — retail trade, services, and state and local government.

However, the energy industry contributes more than 143,000 direct jobs to Oklahoma's economy. As indicated above, economic activity in the energy industry affects the employment situation in other industries. Wholesale trade, retail trade, and business services are the industries most affected. Of the 182,300 nonenergy jobs indirectly associ-

ated with activity in the energy industry, over 100,000 jobs are in one of these three sectors. Thus, approximately 55 percent of the jobs generated by the energy industry are in either wholesale trade, retail trade, and business services.

The only Oklahoma industries responsible for creating more total jobs (both in terms of actual employment in the industry and employment generated outside the industry) are state and local government and manufacturing. This is illustrated in Table 6.

However, growth (or contraction) in the energy industry will have a greater impact on Oklahoma's employment than growth (or contraction) in these other industries. For example, for every 100 new workers hired into the Oklahoma energy industry, there will be an estimated 135 new workers hired by other industries across the state. On the other hand, an increase of 100 employees in state and local government will result in 120 new workers outside state and local government. For every 100 new workers in either the manufacturing industry or federal government, the indirect employment effects will lead to a little over 80 additional workers.

TABLE 6

EMPLOYMENT COMPARISONS
Oklahoma, 1982

| Industry | Direct Employment | Indirect Employment | Total Employment |
|---|---|---|---|
| State and Local Government | 189,000 | 234,900 | 423,900 |
| Manufacturing | 183,600 | 153,100 | 336,700 |
| Energy | 143,000 | 182,300 | 325,300 |
| Federal Government | 48,800 | 39,600 | 88,400 |

Source: Oklahoma Employment Security Commission; Oklahoma State Input-Output Model

# CONTRIBUTIONS OF THE ENERGY INDUSTRY TO OKLAHOMA'S ECONOMY:

## State Tax Revenues

The importance of the energy industry to the state from an employment standpoint is documented in the previous sections. The energy industry is also important to the state as a source of tax revenues. The energy industry supports the state through payment of severance taxes, corporate and personal income taxes (including taxes on royalties paid by oil and gas firms), and sales taxes.

## Severance Tax

The severance tax is one of Oklahoma's primary sources of tax revenues. It is a tax imposed on the extraction of natural products from the ground, such as oil and gas, based on the value of the products removed. There are three types of Oklahoma severance taxes: gross production, petroleum excise, and conservation excise.

The gross production tax produces substantial revenues for the State of Oklahoma. Most of these revenues result from that part of the tax levied on oil and gas produced in Oklahoma. In FY 1983, this amounted to $691.2 million in revenues for the state. The $350.0 million in revenues from the oil gross production tax slightly exceeded the $341.2 million from the gross production tax on natural gas.

In addition to the gross production tax, there is also a petroleum excise tax and a conservation excise tax. These taxes are excise taxes levied on oil and gas produced in the state. Revenues from these taxes constitute only a small portion of the total severance tax revenues.

The severance tax is an important source of revenues to the state. Currently, revenues from the severance tax constitute 30 percent of Oklahoma's total tax revenues. These revenues are allocated to counties for schools and highways, to the Oklahoma Teacher Retirement System, and to the General Revenue and Oklahoma Tax Commission Funds. In addition, a portion of the severance tax is used to promote recreation and land-use planning, as well as water, wildlife, and forest conservation.

## The Coal Tax

Until the year 1979, there was no tax imposed on the coal produced in Oklahoma. Beginning in November of that year, a 5¢ per ton tax was levied against the companies producing the coal. These taxes are collected quarterly, based on each company's tonnage produced for that quarter (Hoover, 1983). The enacting legislation gives the Department of Mines discretion for expenditures of the tax monies, which are deposited in a departmental revolving

fund, as are the coal permit fees. Significant expenditures include the purchase of trucks for the coal inspectors, and the matching of grant dollars for the Administration and Enforcement Grant received from the Office of Surface Mining, Department of the Interior. Under the matching fund arrangement, the federal government supplies 60 percent of the funds needed to enforce the coal reclamation program and the state provides the remaining 40 percent.

## Other Taxes

The energy industry further supports the state through payment of corporate and personal income taxes and sales taxes. These include taxes paid by businesses in the energy industry, taxes paid by individuals on wages and salaries earned while working for energy firms, taxes paid on oil and gas company royalties and dividends, taxes paid on goods and services purchased by individuals and firms connected with the energy industry, and taxes paid on the sale of energy industry products such as oil field machinery and equipment.

The energy industry is, and has been, an important component of the Oklahoma economy. Slightly more than one-quarter of Oklahoma's total nonagricultural employment is either directly or indirectly tied to this industry. Furthermore, state tax revenues are highly dependent on this industry. The state currently obtains 30 percent of its total tax revenues from the severance tax, and derives additional revenues from corporate and personal income taxes and sales taxes.

While the energy industry has always been important to Oklahoma, the state's dependence on the energy industry has increased in recent years. Since 1972, the number of workers directly employed by the energy industry has risen from approximately 67,000 (8.2 percent of total nonagricultural employment) to 143,000 (11.6 percent of the total).[3] This increasing dependence is even more dramatic from the standpoint of tax revenues. As shown in Figure 19, between FY 1972 and FY 1983, severance tax revenues rose from 13 percent of Oklahoma's total tax revenues to almost 30 percent.[4]

## CONCLUSION

Despite many changes in the production and use of energy in the United States due, in large part, to conservation practices, energy continues to play a crucial role in the economic stability of this country. Even now people in the United States, on an annual basis, use four times the barrels of oil that people in Western Europe use. The United States has an energy-based economy. Industry depends on abundant and reasonably-priced energy to produce the necessary goods and services.

As we all know, American industry, despite the fact it is very good, has not kept up with foreign competition. Higher energy costs forced foreign competitors some time ago to pursue new energy-efficient technologies to keep their product prices low. This is one reason why, on a per capita basis, they use much less oil than we do. The resulting high productivity of these foreign companies, coupled with their low labor costs, has left the United States at a disadvantage.

In the United States we have long been accustomed to being a leader in technology. If this leadership role is to continue, we must emphasize conservation efforts and increase the efficiency of new energy systems. This is why renewable natural resources such as solar, wind, and hydroelectric energy become very important to us.

Even though Oklahoma is working to diversify its economy, the energy sector will continue to be one of the most important contributors to the state economy. For this reason, it is important to make a periodic review of the energy situation in the state. This is the purpose of this report.

At Oklahoma State University, we have many professors actively involved in cutting-edge energy research. This research will help Oklahoma and the United States. A continued emphasis in the energy arena must be made if the United States and Oklahoma are to remain in an economic leadership position.

[3]Employment increases in both the oil and gas extraction sector and the oil field machinery and equipment sector account for almost all of this 114 percent increase. In the former sector, employment rose from 34,100 in 1972 to 103,900 in 1982, while in the latter sector employment increased from 5300 to 14,100 over this same time period. Employment in most of the other sectors has been relatively stable since 1972.

[4]The severance tax is based on the value of oil and gas extracted and sold in the state. Between 1978 and 1982, the value of those oil and gas sales subject to Oklahoma excise and severance taxes rose from $3.24 billion to $10.49 billion. About 90 percent of this increase in value was due to increases in price rather than in production.

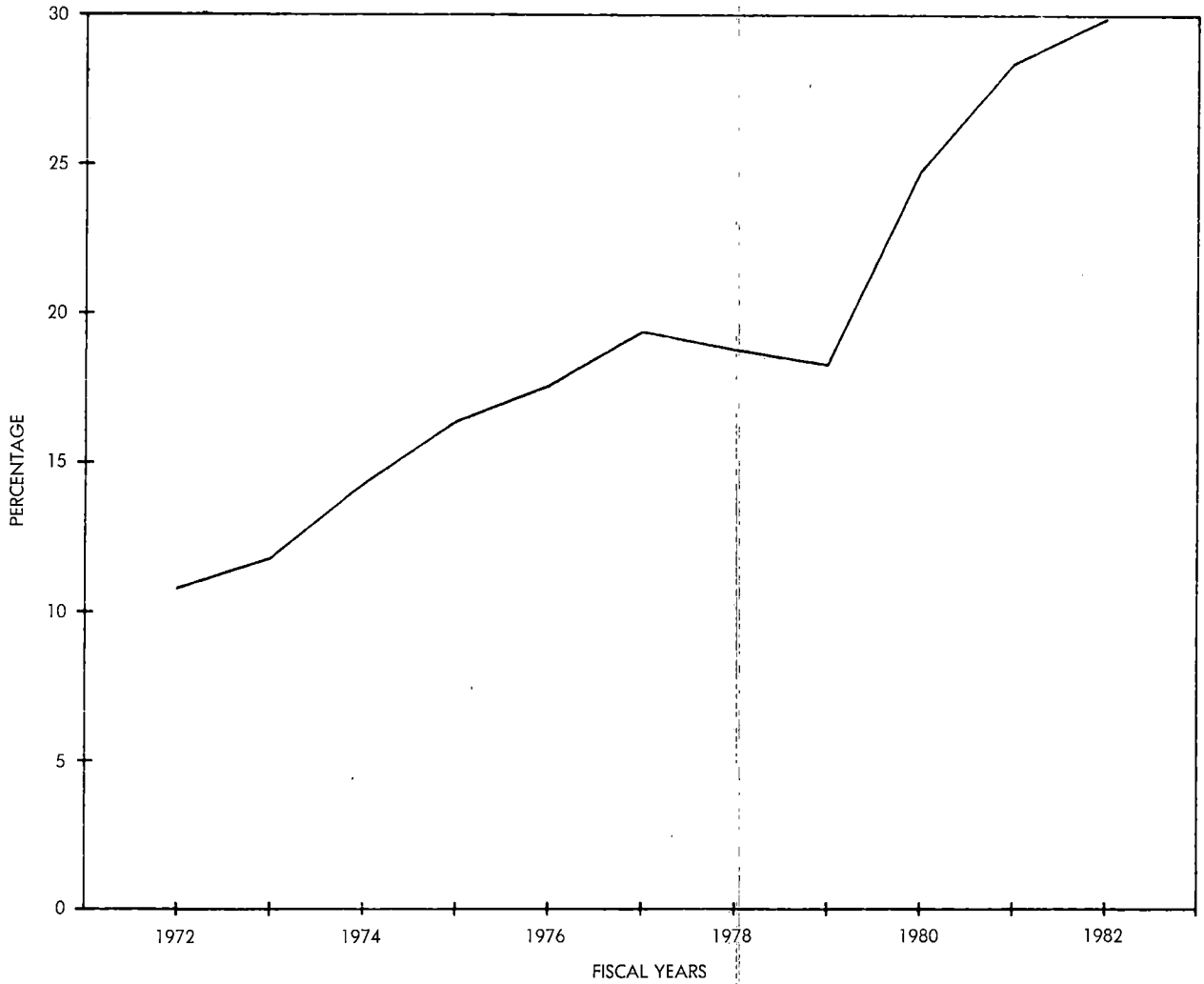



Figure 19. Oklahoma Severance Tax as a Percentage of Total Revenues

Source: Oklahoma Budget Schedule II

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Office of Business and Economic Research — OSU College of Business Administration
Oklahoma State Senate — Interim Study on Renewable Energy Resources Senate Natural Resources Committee
U.S. Department of Energy
U.S. House Committee on the Budget
American Petroleum Institute
Oklahoma Corporation Commission
U.S. Department of Commerce — Bureau of the Census
Oklahoma Tax Commission
Oklahoma Department of Mines

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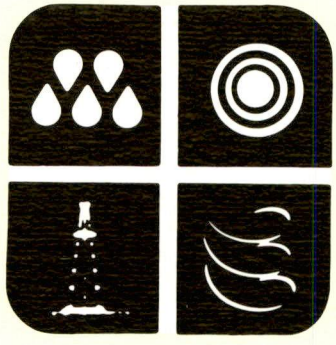

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CENTENNIAL
DECADE
1980 • 1990

# Report to the President

***Our most important research resource at OSU, our research team, continues its innovative, inquisitive methods of seeking answers to pertinent research problems.***

Dr. John Campbell, President
107 Whitehurst
CAMPUS

Dear Dr. Campbell:

The Annual Report for the Research Program at Oklahoma State University for fiscal year 1989 is submitted for your information and review. It is a pleasure to report that $58,968,952 was expended in research programs which represents an overall increase in research expenditures of approximately 9 percent over fiscal year 1988. This increase was accomplished even though capital expenditures for the Noble Research Center were $2.7 million less than in fiscal 1988. Expenditures for the Noble Center aside, sponsored research increased nearly 16 percent in FY 89.

More specifically, research expenditures during the last fiscal year by source of funds were federal sponsors 31.6 percent, state sponsors 10.5 percent, private sponsors 10.0 percent, and state general support 47.9 percent. Four of the seven colleges within the University showed increases in federal sponsor support, four showed increases in state sponsor support and four increased in private sponsor support. Each of the seven colleges increased its overall funding level for research sponsored agreements.

I am quite pleased to report that in May, two of Oklahoma State's cutting-edge research programs, Integrated Design & Manufacturing and Laser Research & Development, were among the first three Oklahoma research programs to be designated as Centers of Excellence by the Oklahoma Center for the Advancement of Science and Technology (OCAST). The funding accompanying this designation will enable researchers and administrators to expand current research programs, collaborate with other academic and industrial researchers within the state, and truly build world class centers of excellence in these important research areas which promise to positively impact the state's economic posture.

Development of research facilities also continued throughout FY 89. Phase one of the Noble Research Center for Agriculture and Renewable Natural Resources was completed in 1989, and already this state-of-the-art facility is filled with challenging research in plant pathology, entomology, agricultural biotechnology, geology, and laser development. This structure is an excellent example of what can be accomplished when individuals, corporations, foundations, and public and private organizations join with Oklahoma State University and the State of Oklahoma to encourage research to flourish. Construction has since begun on a portion of phase two of the Noble Center.

Construction continued on the facility which will house the Center for International Trade Development. Although not nearly so noticeable as the progress on the physical structure, much planning was also done this past year on the development of programs which will be housed in this new facility. Already OSU has positioned itself as a leader in the quickly changing arena of international trade and economic development.

Ground-breaking ceremonies were held this spring for the OSU Wellness

Center which is scheduled for completion in July 1990. This facility will offer opportunities for a broad base of health, exercise and related research programs. Pilot studies on faculty, staff, and student health are already underway.

Our most important research resource at OSU, our research team, continues its innovative, inquisitive methods of seeking answers to pertinent research problems. As the increases in funding mentioned above indicate, the importance of dollars to research efforts is well understood. A good portion of the research team's enthusiasm for pursuing funding has come about due to the priority which has been placed on research at OSU and the incentives and assistance which have been and are being instituted. The leadership in obtaining additional funding which you have shown during your first year at the University's helm has encouraged researchers to do the same. It will be by developing existing relationships and pursuing these opportunities that the base of support for Oklahoma State University will be broadened and strengthened. Therefore, we look forward to the research challenges and opportunities of the new decade.

Respectfully submitted,

James H. Boggs

James H. Boggs, Vice President
for Academic Affairs and Research

# Oklahoma State University Research - 1989

***OSU is fortunate to be building its future in research on a solid foundation of intelligent, experienced individuals who dare to ask questions and diligently seek answers.***

During 1989, Oklahoma State University continued development of its nationally recognized research program with priority placed on research funding, facilities, and personnel. It is a firmly held belief that the development of these resources will enable OSU's researchers to address not only the specific problems presented to the research community, but also the research issues which will unfold throughout the next decade and century.

Research expenditures during fiscal year 1989 totalled nearly $59 million for the University which is an increase of 9 percent from FY 88. The FY 89 total reflects increased federal agreements and state general support. Lower state and private agreement expenditures were experienced primarily because expenditures for the Noble Research Center decreased significantly as Phase one of that facility was completed. Disregarding funding for the Noble Center, federal and state agreements and state general support all showed increases for FY 89.

Early in the year researchers began moving their programs in plant pathology, entomology, agricultural biotechnology, geology, and laser development into the new Noble Center facilities. These individuals are now working in areas of scientific expertise and with sophisticated equipment and laboratories unknown only a few years ago. In addition to the structure reflecting the newest developments in science and technology, the funding for the facility also reflects new thinking as to what can be accomplished when individuals, public and private organizations, and government act cooperatively to move research forward. Construction has now begun on the portion of the Noble Center which will house the Department of Entomology.

The facility which will house the Center for International Trade Development began to take shape this year. In addition to the structural progress, much work was also done to develop the specific programs and services which will be housed in the new building. Outside Stillwater, the CITD has established itself as a leader in the international trade arena. On campus, it is involved in educating faculty and assisting in research project selection so as to help insure positive development of human resources, technological leadership, and innovation for international trade. The opportunities it offers for state economic development are immeasureable.

The University was involved in several other significant events this year which emphasized the role of research universities in economic development. In May, the Board of Directors of the Oklahoma Center for the Advancement of Science and Technology (OCAST) selected three university research programs which hold tremendous economic potential to be Centers of Excellence. Two of these are the OSU Integrated Design & Manufacturing and Laser Research & Development programs. As Centers of Excellence, they will be funded with both State and non-State money for five years to support high quality research and development projects. The centers will be headquartered at OSU and based on the excellent programs these researchers have

built, but are cooperative efforts involving key faculty members from other Oklahoma research institutions of higher learning and key individuals from Oklahoma industries.

Also in May, OSU hosted an extremely successful economic development symposium on the Stillwater campus. The day-long symposium illustrated the virtually limitless possible associations between university research and economic development for the State of Oklahoma.

During his first year as OSU's 15th president, Dr. John Campbell actively pursued his announced priority of procuring additional funding for research and graduate education. He sought financial support for research from the state and attempted to increase monies for additional faculty and facilities. Private donations and alumni memberships increased substantially with a 26 percent increase in foundation donations and a 34 percent increase in alumni membership. He worked with business and economic leaders to support research and graduate education at OSU, and opportunities were presented to individual researchers to hone their skills in the highly competitive quest for additional research funds.

OSU is fortunate to be building its future in research on a solid foundation of intelligent, experienced individuals who dare to ask questions and diligently seek answers. However, it will be only by retaining these individuals and adding to their ranks that we will have the human resources necessary to move the research agenda forward in the manner demanded by society. Collaboration among the various research areas will be necessary to address increasingly complex and multi-faceted research issues. Practical and innovative solutions will be needed, yet subjected to scrutiny concerning their environmental, social and political impacts. Research withstanding these tests, however, will enable the University to more capably fulfill its instruction and extension roles.

Compiled within this report are the abstracts of the research projects conducted by OSU faculty during FY 89. I believe these projects are indicative of the diversity and individual excellence assimilated at this University. On this basis, I feel confident that OSU has positioned itself well for the next decade and century of research challenges.

Norman N. Durham

Interim Assistant Vice President for Research

# Center for International Trade Development

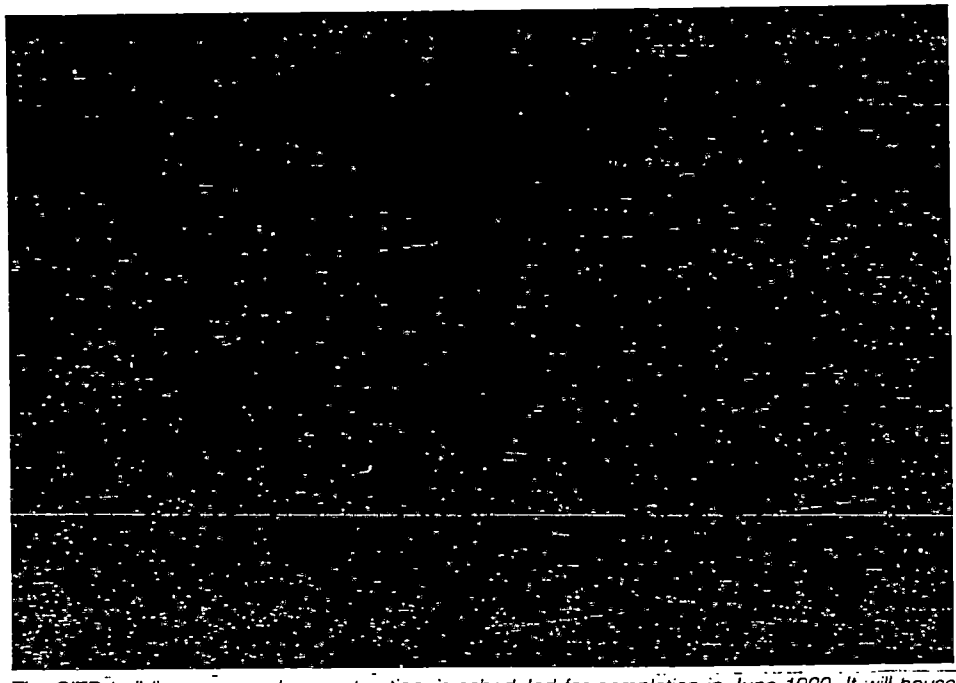
***CITD assistance is most beneficial where potential meets opportunity.***

According to the June 1989 Oklahoma Quarterly Economic Forecast (Oklahoma State University's Office of Business and Economic Research), Oklahoma's economic position seems to be improving. Oklahoma companies, and those in adjoining states, are not out of the woods yet, but there should be more companies in a position to look to international markets for growth and stability. It is at this point, where potential meets opportunity, that CITD assistance can be most beneficial to Oklahoma and regional firms.

## Mission

The missions of the OSU/CITD are two-fold. First, the immediate economic development mission of the Center is to directly motivate and assist regional agricultural, business and industrial companies in their efforts to enter and expand international operations that improve their ability to grow and provide employment opportunities through applied market research, training, and technical assistance one-on-one to such companies.

Second, the University also seeks to properly internationalize its course offerings, student educational experiences, faculty perspectives, and research project selection that directly impact on the longer-run human resource development and technological leadership and innovation for international trade development.



*The CITD building, now under construction, is scheduled for completion in June 1990. It will house an auditorium, exhibit hall, seminar rooms, and a state-of-the-art language lab for business language immersion classes for executives.*

and representing over eighty, 4-digit SIC code product groups. Fourteen product oriented market research reports will be written and the information in them will be updated through use of a data base and report supplements. Reports will be available for Automated Manufacturing; Special Industry Machinery; Aircraft, Engines, and Parts; Aircraft Instruments; Computer Equipment; Computer Software; Oil Field Machinery; Valves and Pipefittings; Pumps and Pumping Equipment; Plastic Products; General Industry Machinery; Machine Tools; Pharmaceutical Preparations; and Telecommunications Equipment.

The Target Industry report provides market size, industry profiles, end user analyses, market environment summary, and, where identifiable, best sales prospects. The data base also includes SIC numbers, Harmonized-System numbers, Schedule B numbers (prior to HS), and Schedule E numbers. Trade Associations for each industry, key international trade shows, and best target markets are also identified.

The Mini Market Country Profiles for Value-Added Agricultural Export Products were written by graduate students and faculty in Agricultural Economics. There are thirty-six market profiles which provide an overview of each country's agricultural production and trade, economic situation, and statistical data. Each profile then outlines several value-added agricultural export product recommendations. Faculty and staff in the department have also included in the packet "Keys to Success for Prospective Agricultural Exporters" which explains government and private sources of export information and services, export procedures, financing, and documentation. An agricultural export conference addressing Oklahoma's value-added industry was held December 1, 1989.

## Special Target Market Development

CITD is undertaking a pilot project for targeted foreign trade initiatives associated with the export development efforts of Sister City Programs. The Tulsa/Kaohsiung Sister City International Trade Development Program is designed to promote bilateral trade between Oklahoma and Taiwan companies. U.S. companies can find major opportunities in the health, energy, transportation, environmental, information processing, communications, electronics, consumers, and process control markets. The program includes: Phase I - market research and development of a marketing and action plan for Taiwan, and compilation of a bilateral business directory; Phase II - creation/translation of business brochures and company information; Phase III - matching Oklahoma manufacturers with Taiwanese end-users and/or intermediaries; Phase IV - arrangements for two-way visitations between companies and trade missions.

## Beyond Market Research

After company managers have learned where the best foreign markets are, through either company tailored research, industry-specific research, or a special target market development project, they need to learn how to make sales in those markets. CITD can assist companies in developing marketing plans, strategies, and sales programs. At this point the company can be ready to begin establishing distribution overseas, and CITD is there to provide guidance as needed.

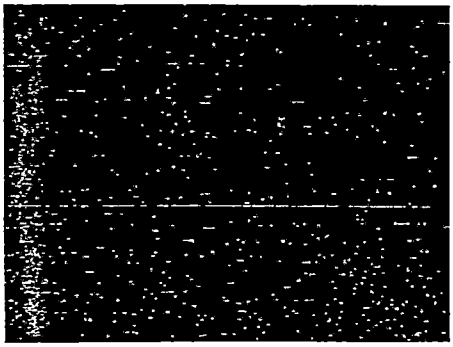
# Applied Research

Export managers want to know which countries represent the best sales potential for their products and services. They also want to know enough about their primary target markets to be able to make some preliminary managerial and strategic decisions. This preparation either justifies, or precludes, the expense of travelling to those countries to gather further information, investigate market entry strategies, and begin the process of establishing international intermediaries.

International market research can be time-consuming and frustrating for export managers in small and medium-size companies. Many also have other corporate responsibilities and don't have personnel resources available to collect, sort, and analyze the abundance of international trade and market data available from the U.S. Department of Commerce, embassies, industry associations, and other sources.

CITD assists new-to-export companies. as well as experienced exporters, by providing three types of international market research services: I) company tailored international market research, 2) industry-specific international market research, and 3) special target market developments.

Most research projects begin with an analysis of the past four-years' data available from the U.S. Bureau of Census FT 410 Report on U.S. exports for specified product categories. United Nations import statistics for foreign countries are available through the Small Business Administration's Export Information System (XIS) program and are used where appropriate. Researchers can then access the U.S. Department of Commerce district offices to obtain industry—and country—specific market data that is gathered by foreign commercial officers around the world. At this point, international market research becomes a combination of Art and Science.



*Members of an Oklahoma State University MBA student team discuss the results of an International Market Research Project (IMPR) with Macklanburg-Duncan's export manager, sales manager, vice president for consumer products, and marketing manager.*

# Company Tailored International Market Research

Company tailored market research is usually Phase I of a company's "International Business Development Program," which is a comprehensive package of services provided through CITD to assist companies in export market entry. The research can be conducted in-house at CITD, or through a coordinated effort called the International Market Research Program.

The International Market Research Program is a cooperative effort with the OSU College of Business Administration and College of Agriculture. The College of Business has been especially active in this program, carefully screening class enrollment and monitoring the projects as they develop. Teams of graduate students work under the direction of faculty and CITD staff. In addition to analyzing FT 410 Reports, United Nations statistics, and Department of Commerce or Department of Agriculture data, students contact embassies, industry associations, and foreign government agencies. When appropriate and feasible, the team may design questionnaires to facilitate the collection of primary market information. At the conclusion of the project, students make a formal presentation with recommendations.

Companies often do not have staff support for the increased work load required for follow-up to the market research findings. The Management Assistance Program uses graduate assistants to temporarily fill this specialized staff function and provides students with valuable in-company work experience.

As of March 1989, four companies have participated in the IBDP and have combined 1989 export sales forecast of approximately $5.0 million. One company in particular expects that by 1990 export sales will be close to 10 percent of total company sales, and has hired one of the MBA students who participated in the IMRP that identified their target markets. To date the IMRP has involved 11 companies, 33 graduate students, and 5 faculty members. Four Oklahoma companies and four MBA students have participated in the Management Assistance Program.

The OSU College of Engineering has a pilot project, the International Quality Improvement Research Program, that is somewhat modeled after the International Market Research Program. Teams of graduate engineering students will work on a project basis with CITD client firms who have concerns about their quality competitiveness overseas. An OSU Regents professor, Dr. Ken Case, known worldwide for his expertise on quality control, will be the project leader. The team will analyze the current quality control situation, then help the company see where they need to be and how they can get there. This program will enhance the competitiveness of Oklahoma companies in both their domestic and foreign markets. The College of Engineering is also addressing the metrication issue in Oklahoma.

# Industry Specific International Market Research

CITD sponsors two types of industry-specific international market research. The "Oklahoma Target Industry Program" is conducted by CITD staff, and the "Mini Market Country Profiles for Value-Added Agricultural Products" were compiled by OSU's Department of Agricultural Economics.

The Oklahoma Target Industry Program was created to provide foreign market research reports to ten major industry groupings which were identified as key sectors for Oklahoma economic development. These industry groups include 1,436 Oklahoma firms providing approximately 76,000 jobs

# University Center for Water Research

***Availability and quality of water have always presented challenges to the survival and economic advancement of individuals and civilizations.***

Water is an integral part of the life process and of many of man's daily activities. Thus, throughout time, the availability and quality of water have presented challenges to the survival and economic advancement of individuals and civilizations. Through careful and innovative research, planning, and management, these challenges have been met. At times enormous amounts of capital have been required; at times it has been the cooperation, commitment and change of individuals.

Today we face such challenges as the disposal of wastes and the subsequent effects on water supplies, the anticipated warming of our globe and the resulting effects on our climate, moisture and water levels, and the contamination of water supplies caused by sources far removed such as septic systems and pesticides and fertilizers used domestically and for agricultural purposes. Although the particular challenges are somewhat different, researchers will continue to rely on the tested tools of time—research, knowledge and innovation—to seek solutions. It has become clear, though, that many of the solutions may require something more than that to which we are accustomed—the cooperation of researchers and populations around the world. Because of the needs and wants associated with water and the limitations of the resource, conflicts will continue to occur. Resolution of these conflicts will require increased expertise in the biological, physical, and social understanding of water resources.

With the philosophy that clean water of adequate quantity and quality is essential to the physical and economic health of Oklahomans, Oklahoma, the nation and the world, the Oklahoma State University Center for Water Research (UCWR) strives to provide funding and information for researchers and information and management protocols for decision makers. In this way, the UCWR is meeting the challenge of making the philosophy reality.

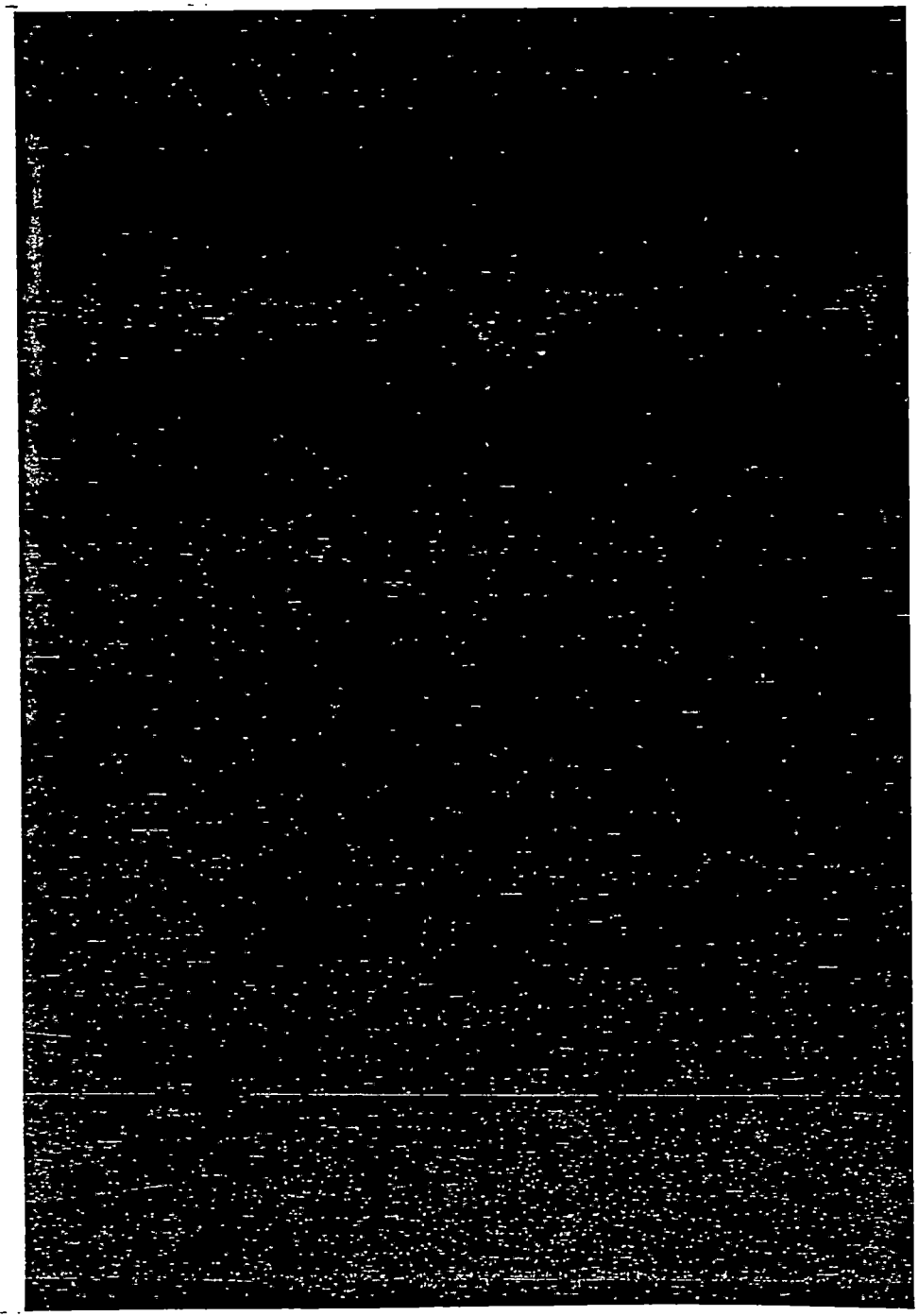
The University Center for Water Research is administratively responsible for the Oklahoma Water Resources Research Institute, the EPA National Center for Ground Water Research, and the Water Research Center developed as a "center of excellence" by the State of Oklahoma. This combination of responsibilities provides the Center with the opportunity to coordinate research programs within the University with outside agencies such as the Oklahoma Water Resources Board, the U.S. Geological Survey, the Oklahoma State Health Department, the Robert S. Kerr Environmental Research Laboratory and other state and federal agencies involved in water resources research and management programs. This involvement also provides a broad base of knowledge and experience from which new research projects can evolve. Perhaps most importantly though, it permits the UCWR to maximize the use of available resources.

The Oklahoma Water Resources Research Institute (OWRRI) was established in 1965 by the U.S. Congress. To insure a program of national interest and effectiveness, one institute was established in each state, District of Columbia, Guam, Puerto Rico, and the Virgin Islands. The National Association of

Water Institute Directors (NAWID) and the Universities Council on Water Resources (UCOWR) are professional organizations through which the institutes cooperate. In doing so, water research efforts are coordinated and a strong information network is maintained.

In 1989 the OWRRI funded six projects through the UCWR. They addressed surface and ground water issues with particular emphasis on water quality. Research topics included:

- Evaluation of the uncertainties associated with pesticide transport to groundwater and with current assessment techniques;
- The cause and effect of rapid changes in shallow groundwater quality;
- Hydrologic modeling through the integration of remotely sensed data in a geographic information system;
- Establishment and characterization of biofilms composed of inducible and constitutive monocultures capable of 2,4-D degradation;
- Agricultural impacts on stream water quality, and;
- The incorporation of risk into the design of water resources facilities.



*Dr. David Francko, botany, examines a bed of submerged macrophytes in an area lake. Francko is researching the use of aquatic plants as a monitor for heavy metals in water.*

The Water Research Center (WRC), established by the Oklahoma State Regents of Higher Education in 1979, receives state appropriations to fund projects through a state "center of excellence" in water research. In 1989, the WRC supported nineteen projects conducted by researchers from all seven colleges at Oklahoma State University. The issues addressed included:

- Operation and monitoring of water supply systems;
- Ground water quality impact associated with pesticide use in Oklahoma;
- Public education on water issues; and
- Development of assays and monitors to determine water quality.

Also funded through the Water Research Center is the Water Resources Presidential Fellowship Program. This program encourages nationally competitive graduate students to study at Oklahoma State University and work with distinguished researchers in a water resources discipline. In 1989, the Fellowship program supported twelve students in seven different disciplines. Fellowship recipients have made important contributions to the literature and knowledge base of water resources disciplines.

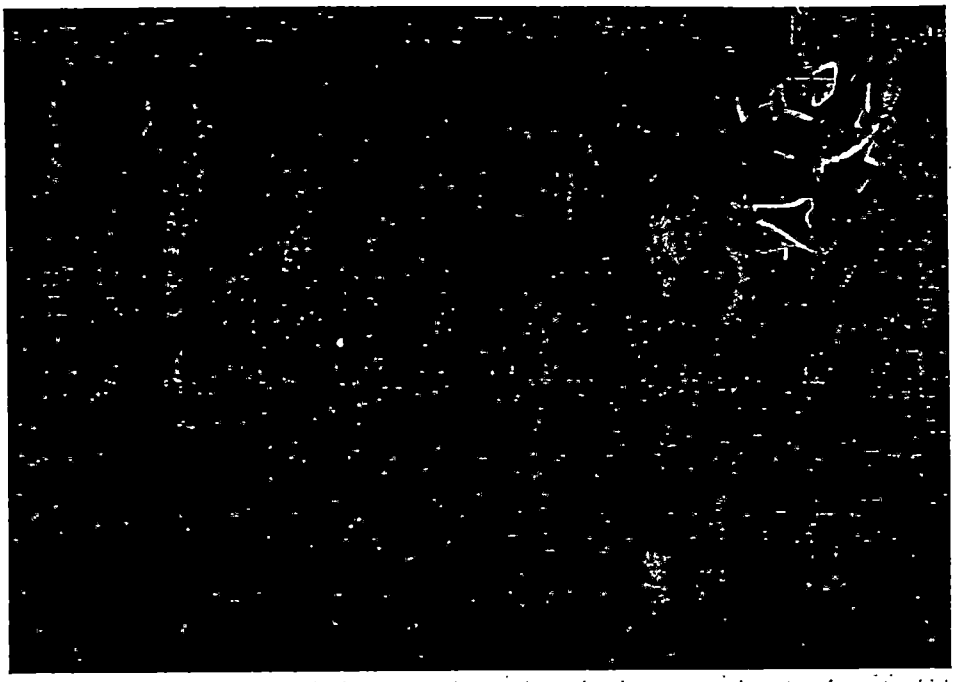
The National Center for Ground Water Research (NCGWR) is an Environmental Protection Agency consortium comprised of Oklahoma State University, University of Oklahoma, and Rice University. Established in 1979, the purpose of the NCGWR is to focus global and national attention on the importance of ground water, to train future scientists, and to establish methods and a data base for protection and management of the nation's

groundwater. The NCGWR funded three projects at OSU during 1989. The projects involved:

- A recombinant approach to the isolation and characterization of a primary degrader of trichloroethylene;
- Implementation of chemical transport and fate models as decision aids, and;
- Development of techniques for determining the metabolic status of subsurface organisms.

The University Center for Water Research is engaged in information transfer activities which promote and enhance water research efforts. The UCWR newsletter, Ripples, provides a mechanism for communicating the activities of water researchers at OSU, current events in water research, and items of interest to those involved with water resources. Other information transfer documents are produced periodically; during 1989 these included a directory of publications available from the UCWR and faculty, and a technical manual for characterizing landfill sites.

The University Center for Water Research also functions as a contact in the state for pertinent research and information. Through continued communication with state and federal administrators, legislators, faculty, scientists, and private enterprise, the University Center for Water Research disseminates information essential to sound water management.



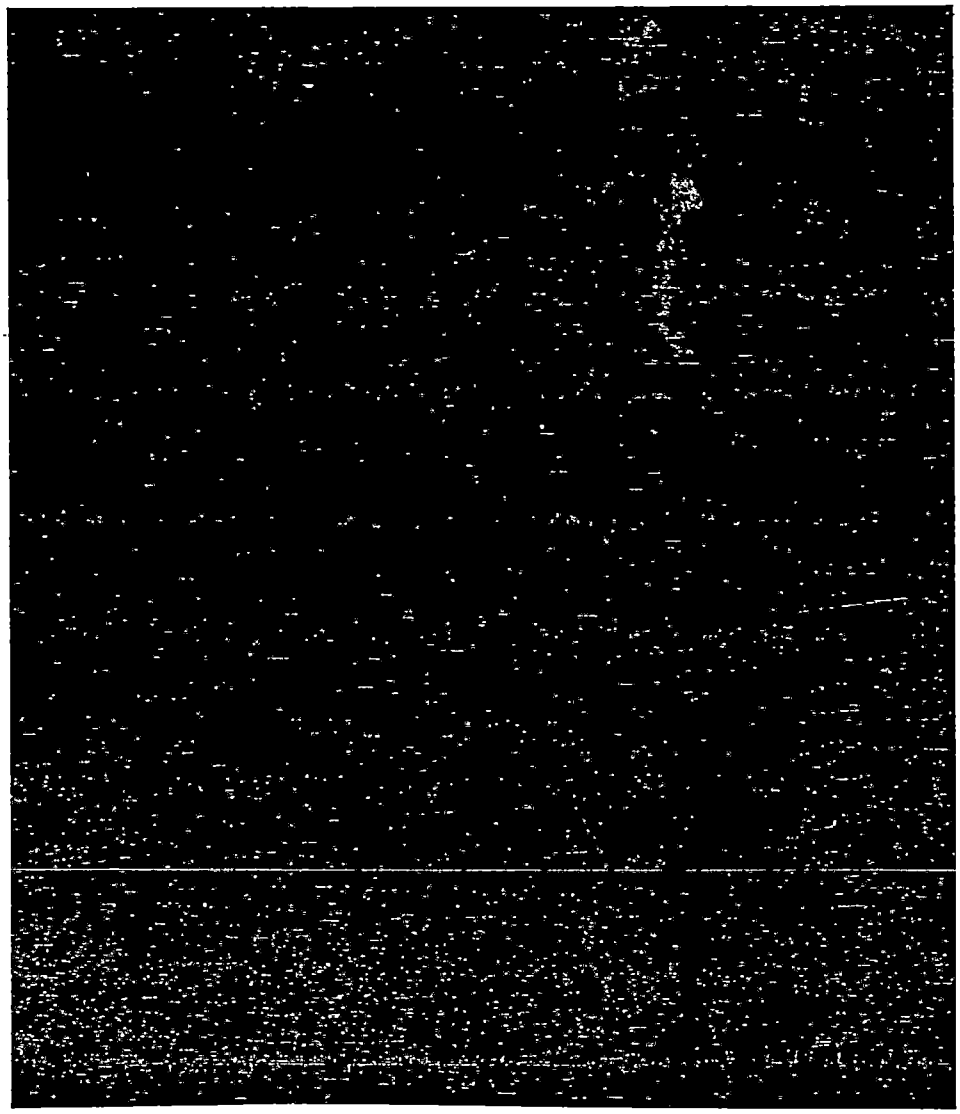
*Dr. John Bantle, zoology, is developing a procedure to determine the presence in water of agents which cause birth defects. The embryos pictured demonstrate his research. The abnormalities of the frog embryo on the bottom resulted from continuous exposure to a toxicant for 96 hours beginning with the blastula stage and terminating with a well-developed larva. The control embryo is shown on top for comparison. The transparent larvae facilitate the detection of malformations of the brain, spinal cord and digestive system.*

# The University Center for Energy Research

***The Center was created in 1979 to attack the complex problems in the energy field using a multi-disciplinary approach.***

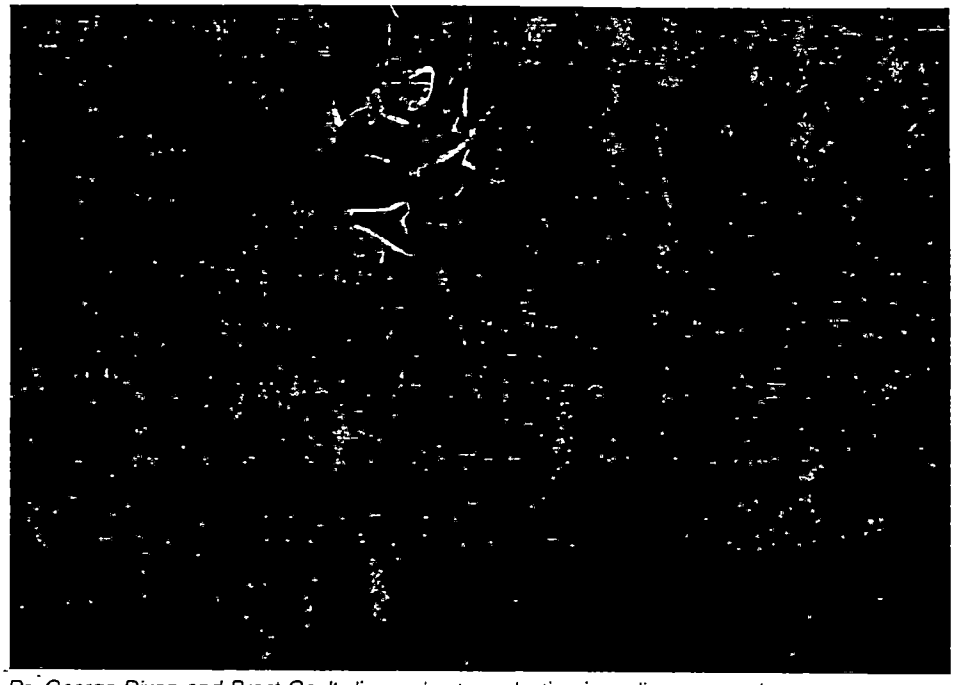
Energy production has been inextricably tied to the economic health of the United States for the past 75 years. This is even more evident for Oklahoma and surrounding states that have experienced violent fluctuations in prosperity as the price and availability of energy resources surge up and down. The University Center for Energy Research (UCER) was created in 1979 to attack the complex problems in the energy field using a multi-disciplinary approach.

UCER supports energy-related



*Dr. Ruth Erbar creates a corrosion model for the prediction of downhole corrosion.*

research programs and encourages the organization of inter-disciplinary activities. Proposals for funding are submitted to UCER in March of each year. The proposals undergo an external peer review process with final selection of projects to be funded made by the Director and the Advisory Committee. Selected projects are conducted in various departments and colleges with seed money from UCER. This seed money enables faculty to develop a sound knowledge base in their research area which will enable them to generate additional funding within two or three years. The projects support students, post-doctoral research associates and the procurement of state-of-the-art equipment.



*Dr. George Dixon and Brent Gault discuss heat conduction in sedimentary rocks.*

## 1988-89 Projects

Seventeen projects were selected for funding by UCER for the 1988-89 fiscal year. State-of-the-art equipment purchased through UCER funding was instrumental in establishing and/or enhancing laboratories for research focusing on thermal radiation within layered media and its application to solar ponds, as well as food science research related to energy utilization by organisms. Research in these laboratories led to the development of new techniques such as those to overcome the existing problems in prediction of phase equilibria of complex mixtures. Research addressed ways in which states may increase tax revenue by changing the type of tax levied at an appropriate moment. An example is a per unit tax path over time which would allow risk averse firms to produce at the efficient level. Researchers also studied human decision making in the search for energy, particularly behavioral decision theory implications. This project was an inter-disciplinary effort conducted by researchers in two OSU colleges. Other UCER projects addressed diverse areas such as corrosion modeling for the prediction of downhole corrosion, parallel methods for deconvolution—application of hypercube topology computers in geophysics, thermochromism of copper complexes, thermal diffusivity of sedimentary rocks (temperature and stress dependence), identification and characterization of methanotropic bacteria able to expoxidate halogenated ethenes, real-time bearing estimation and robust deconvolution algorithms, and the Smart House totally controlled living environment. UCER monies also supported electron microscope laboratory usage for many researchers in the various OSU colleges.

## Services

Faculty have contributed through individual research programs, seminars, journal articles, and a report "Review of Oklahoma Energy Resources and Policy." This comprehensive treatment of energy in Oklahoma provides background information over the years 1972 to the present. UCER strives to promote awareness by sponsoring symposia and providing information on energy to the public.

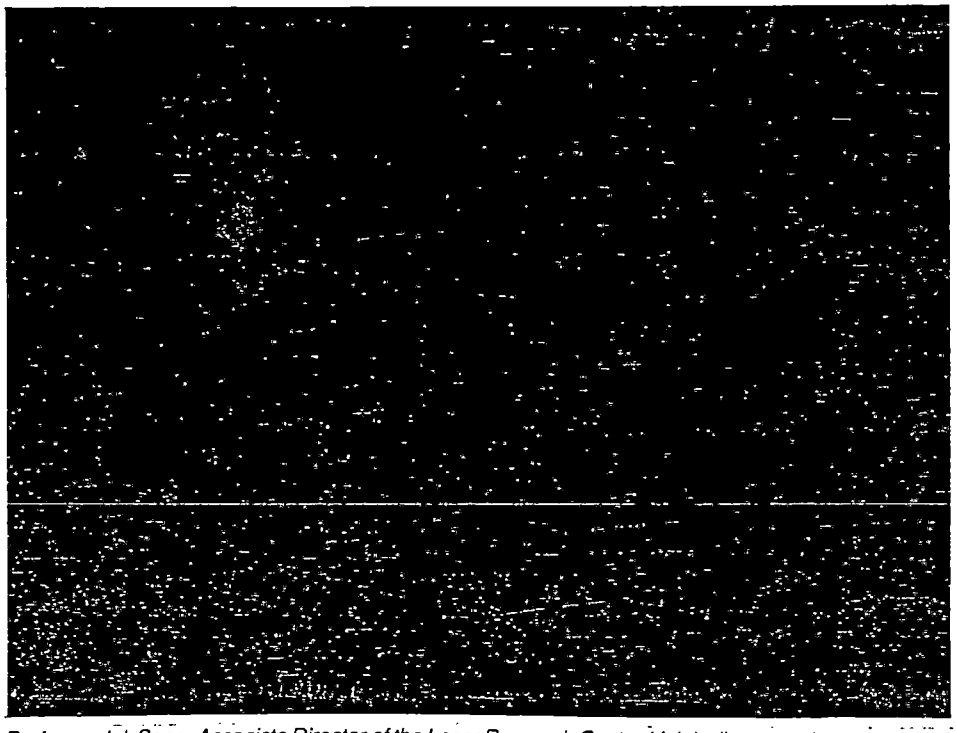
# University Center For Laser Research

***The laser represents the most important technological device developed since the transistor.***

Oklahoma State University has recently made a major commitment to the development of a world-class *Center of Excellence* in laser research. The University Center for Laser Research (UCLR) was established this year for the purpose of enhancing the laser research activities at Oklahoma State University. The Center will allow for the research in this area to expand in four ways: new laboratory space, new state-of-the-art equipment, additional faculty and student involvement, and new research projects.

The *Mission* of UCLR is to enhance the education of students in fields of advanced science and technology, to generate new fundamental knowledge relevant to advanced technology, and to work as a partner with industrial, medical, and government laboratories in transferring knowledge into technological applications. The *Goals* of the Center are:

- To expand the current OSU laser research efforts into a multidisciplinary center dedicated to the advancement of science and technology related to lasers and their applications.
- To provide a focal point of expertise in laser technology for the purpose of supporting medical institutions, high technology industries, and research laboratories both in Oklahoma and throughout the country.



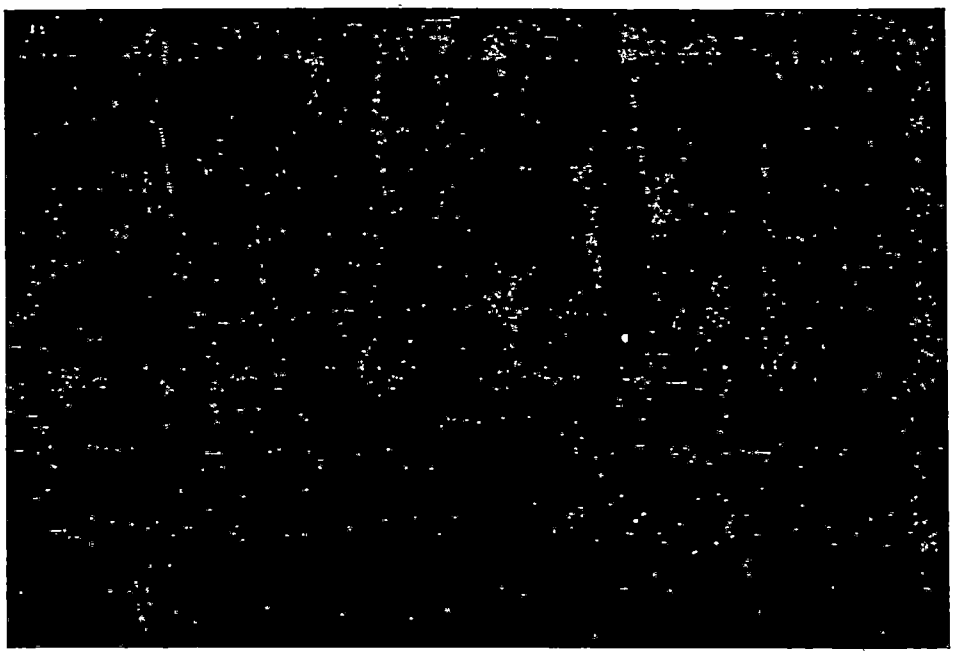
*Professor J.J. Song, Associate Director of the Laser Research Center (right), discusses the construction of a hair-thin laser waveguide device with Ph.D. students Abdul Bouchalkha and John Hays.*

- To attract top quality students and provide them with a state-of-the-art education in laser science and technology.

This type of center will benefit OSU by enhancing our competitiveness for large scale research funding, by attracting and retaining top quality faculty and students, by enabling the university to provide research support to Oklahoma industries, and by expanding our research abilities for solving critical problems in emerging areas of optical technology.

The laser represents the most important technological device developed since the transistor. It has already found hundreds of uses in every type of business and industry as well as important applications in medical and military areas. These include fiber optics communications, optical computing, and laser surgery. In addition, the laser has acted as a catalyst for new technologies such as optical communications and optical data processing. The development of laser-based technologies is currently so rapid that we are on the verge of passing into a new high-technology revolution based on optical systems and devices centered around lasers. It is this importance and broad scope of laser technology that has motivated the establishment of a *Center of Excellence* with laser research as its focus.

Over the past ten years, a strong laser research program has been developed at Oklahoma State University involving a group of faculty members in the Department of Physics and their graduate students. The work of this group focuses on fundamental scientific research utilizing lasers. Their projects are funded primarily by grants and contracts from federal agencies such as the National Science Foundation, the National Aeronautics and Space Administration, the Department of Energy, the Army Research Office, the Army Night Vision Laboratory, the Naval Research Laboratory, the Office of Naval Research, Rome Air Development Center, and the Defense Advanced Research Projects Authority. Additional funding has been provided by the state of Oklahoma through the Oklahoma Center for the Advancement of Science and Technology (OCAST) programs and by gifts from private foundations such as the Noble Foundation and the Presbyterian Foundation. This highly productive effort in fundamental laser research forms the foundation for the new UCLR.



*Theoretical Quantum Optics research at UCLR is assisted by several DEC 3100 workstations and communications through networking with the supercomputers located in various facilities across the United States. Professor Donna Bandy (second from left) is pictured with her graduate students: John Kohler (seated), David Schoonmaker, Darlena Jones, and Linda Hunter.*

The UCLR administrative office has been established in the Noble Research Building. The new laboratories for the Center are being constructed in the basement of the same building. These will provide over 9,100 sq. ft. of modern laboratory facilities. Additional support has been obtained to purchase state-of-the-art laser equipment for these laboratories. In addition, a modern computer facility is being established as part of UCLR for theoretical modeling research on lasers and optical devices. Space has also been made available for offices for visiting scientists who will work in UCLR. The personnel involved in laser research is being expanded by hiring three new faculty members in the Department of Electrical and Computer Sciences. These faculty members and their students will develop a laser engineering research program complimentary to the existing laser physics effort.

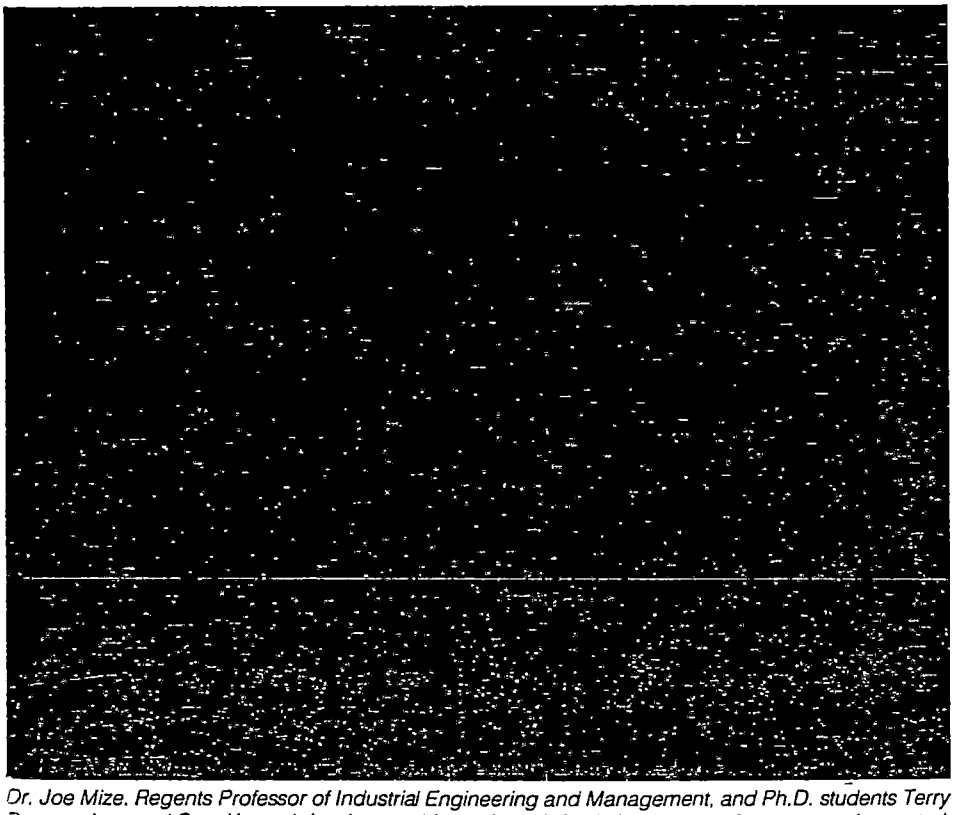
In recognition of the potential importance of this field of research to economic development, the state of Oklahoma through OCAST selected the laser research program at OSU to be one of the three state *Centers of Excellence* in research. The partners in this state center are Eagle Picher Research Laboratories and the University of Oklahoma Health Sciences Center. The OCAST support will be used specifically for the development of new laser systems and laser applications. The OCAST projects will involve joint research programs with medical institutions and industries throughout the state.

# Oklahoma Center for Integrated Design and Manufacturing

***An industrial renaissance is underway in the United States. The advanced technologies of product and process design, and the evolution of totally new concepts of production systems and management . . . emphasize manufacturing excellence.***

In May of 1989, the Oklahoma Center for Integrated Design and Manufacturing was one of three Centers of Excellence selected for funding by the Board of Directors of the Oklahoma Center for the Advancement of Science and Technology (OCAST). Including both State and non-State money, the Center will be funded at nearly $9.5 million to support high quality research and development projects for five years. The Center is based at Oklahoma State University, but is a cooperative effort involving key faculty members from the University of Oklahoma and the University of Tulsa.

An industrial renaissance is underway in the United States, not only in the advanced technologies of product and process design, but also in the evolution of totally new concepts of production systems and management which emphasize manufacturing excellence. The emergence of complementary advanced technology strategies such as computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-integrated manufacturing (CIM) make possible significant improvements in productivity and product quality. Also, the effective use of intelligent and programmable



*Dr. Joe Mize. Regents Professor of Industrial Engineering and Management, and Ph.D. students Terry Beaumariage and Cem Karacal develop an object-oriented simulation program for computer integrated manufacturing applications.*

machines—termed robots—can potentially revolutionize the way in which complex, sometimes repetitive and dangerous production processes are carried out. Automation of the product design, development, manufacturing, evaluation, and distribution processes via CAD/CAM/CIM and Robotics may well be the key to success for industrial firms seeking to attain and maintain product leadership in an increasingly competitive marketplace.

Numerous studies have shown that the existence of strong university programs available to industry is a major factor in attracting new industry and in preserving the competitiveness of existing industry. The economic vitality and rate of growth in Oklahoma's manufacturing industry will depend in part on the responsiveness of the State's educational institutions.

The primary mission of the newly established Oklahoma Center for Integrated Design and Manufacturing is to carry out research in areas of strategic importance to Oklahoma manufacturing. Primary goals of the Center are (1) to advance the science base in integrated design and manufacturing in appropriate "niches" of importance to Oklahoma; (2) to assist with the infusion of advanced technologies into existing Oklahoma manufacturing industries in order to enhance their competitive position; (3) to assist with the attraction of new manufacturing industries into Oklahoma by providing a critical mass of unique design and manufacturing expertise; (4) to establish and maintain strong cooperative relationships between the three participating universities and manufacturing firms within the state and region; and (5) to strengthen the instruction and research programs at the three participating institutions for the development of engineering graduates skilled in integrated design and manufacturing.

The Center will focus its research efforts in three complementary areas of strategic importance to Oklahoma and the nation: design, manufacturing, and system integration. Research goal 1—*design*—is to develop new and improved concurrent design methodologies for mechanical and electrical components, processes, and facilities for rapid implementation in manufacturing in order to maximize quality, efficiency and long-term profitability.

Research goal 2—*manufacturing*—is to conduct fundamental engineering research in advanced manufacturing technologies and materials for the low-cost manufacture of reliable high-quality products. Research goal 3—*system integration*—is to develop advanced concepts, methodologies, and systems for the integration of all major functions of a manufacturing enterprise in order to maximize responsiveness to the market and organizational effectiveness.

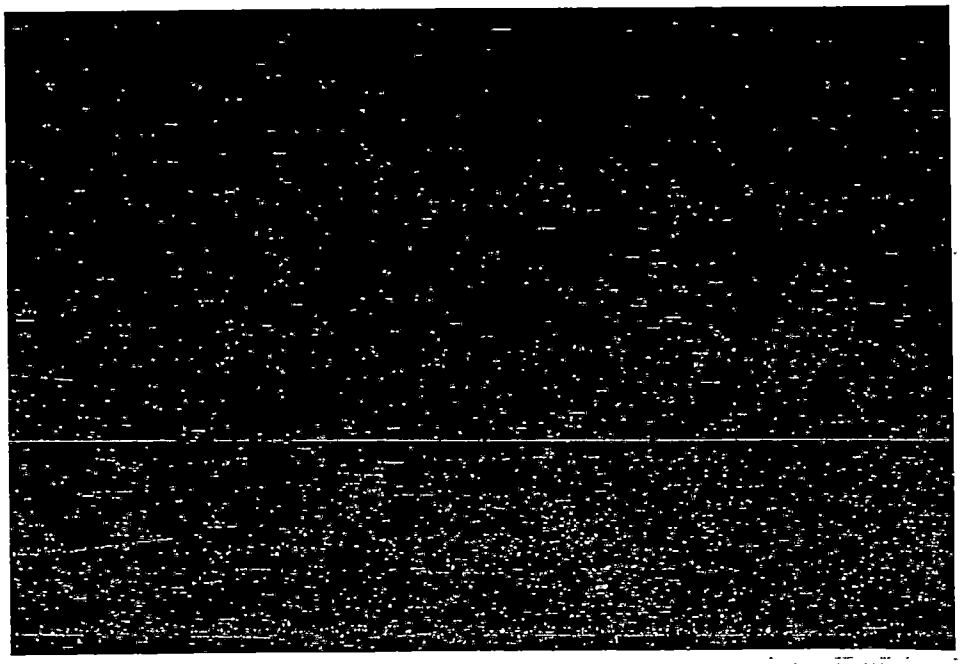
Research target areas within design, manufacturing, and system integration include computer-aided design and engineering, manufacturing processes and materials, web handling, computer-integrated manufacturing, intelligent systems, and robotics. The three strategic research areas imply a complex and interdisciplinary problem focus that requires a "center" approach. Although individuals and small groups can address specific tasks related to the target areas, collaboration across organizational boundaries is required to address the integration issues.

The research tasks envisioned for the new Center are largely basic or fundamental in nature. However, some of the tasks will involve close collaboration between university and industry personnel and will focus on problems where a potential for commercialization exists. These latter applied research tasks will focus on new products and processes. An example of an applied research task is the present collaborative effort between OSU and Integrated Manufacturing Systems to create a major tapered tube manufacturing enterprise in Tulsa.

The research programs of the Center will utilize industry/university cooperative relationships, patterned after the highly successful Web Handling Research Center at Oklahoma State University. A comprehensive technology transfer plan, based in part on the Cooperative Extension model, will be used to adapt research results to the specific needs of Oklahoma industry and to deliver that information through a variety of outlets.

An analysis of the anticipated research and technology transfer activities to be conducted by the Center indicates that the overall program will include about 60 percent basic research and 40 percent applied research.

The Center will utilize three complementary centers and three major laboratories at OSU–the Computer-



*A Mechanical Engineering graduate student measures the tension in a high-speed web at the Web Handling Research Center.*

Integrated Manufacturing Center, the Robot Design Center, the Web Handling Research Center, the Artificial Intelligence Laboratory, the Computer-Aided Design and Interactive Graphics Laboratory, and the Manufacturing Processes and Materials Laboratory.

The Computer-Integrated Manufacturing Center is concerned with the total spectrum of advanced technologies applied to the manufacture of goods, especially the use of computer and communication technologies applied to the design, manufacturing and management functions of a firm. The Robot Design Center is concerned with the design of robotic manipulators and gripping devices, the development of robotic sensor capabilities (including vision), and the effective application of robot systems in manufacturing processes. The Web Handling Research Center is concerned with the study of fundamental problems associated with the handling of materials in continuous strip form and the development of the knowledge-base required in the optimum design of automated processes and machines involving these materials.

The Computer-Aided Design and Interactive Graphics Laboratory is a facility which supports a large variety of research, instruction and technology transfer activities involving the use of computer-based analytical and graphical methods, especially in the synthesis of optimum geometrical designs and in the validation of designs against functional and operation requirements. In the Artificial Intelligence Laboratory, special emphasis is given to the development of expert systems for industrial sponsors in Oklahoma who wish to improve the productivity and profitability of their firms. The Manufacturing Processes and Materials Laboratory is concerned with baseline research in machining, casting, forming, and other manufacturing operations.

The Oklahoma Center for Integrated Design and Manufacturing will involve and utilize the expertise of more than 40 faculty members from the three participating institutions. Karl N. Reid, Dean of the College of Engineering, Architecture, and Technology, will serve as the Center Director. Assisting will be Associate Directors for Research at the three Universities involved in the Center: Oklahoma State University, University of Oklahoma, and the University of Tulsa. Also, providing direction for the Center outreach program will be an Associate Director for Technology Transfer.

In addition, to assure that the Center continues to serve the most pressing needs of its intended constituents, a Center Advisory Committee will be formed and comprised of (1) a top level manager from each of 20 Oklahoma manufacturing companies (with representatives across all sizes); (2) the Oklahoma Department of Commerce Secretary; (3) the Oklahoma Chamber of Commerce President; and (4) the Director of Engineering/Manufacturing at Tinker Air Force Base.

The "top level manager" group initially will include representatives from Imprimis Technology, Inc.; McDonnell Douglas Corp.; Rockwell International; AT&T Technologies; 3M Company; Xerox Corp.; and Mobil Chemical.

# OKLAHOMA CENTER FOR INTEGRATED DESIGN AND MANUFACTURING

**College of Engineering, Architecture and Technology**

**Oklahoma State University**

## EXECUTIVE SUMMARY

This proposal is for the establishment of an OKLAHOMA CENTER FOR INTEGRATED DESIGN AND MANUFACTURING with funding from the Oklahoma Center for the Advancement of Science and Technology. The proposed Center of Excellence will build on the foundation already established at Oklahoma State University and will involve, in a fully synergistic way, key faculty members at the University of Oklahoma and the University of Tulsa.

The primary mission of the Center is to carry out research in areas of strategic importance to Oklahoma manufacturing. Primary goals of the Center are to advance the science base in integrated design and manufacturing in appropriate niches, to assist in the infusion of advanced technologies into existing Oklahoma manufacturing industries, and to assist in the attraction of new manufacturing industries into Oklahoma.

The Center will focus its research efforts in three complementary areas of strategic importance to Oklahoma and the nation: design, manufacturing, and system integration. Research target areas include computer-aided design and engineering, manufacturing processes and materials, web handling, computer-integrated manufacturing, intelligent systems, and robotics.

The three strategic research areas imply a complex and interdisciplinary problem focus that requires a "center" approach. Although individuals and small groups can address specific tasks related to the six research target areas, collaboration across "national boundaries" will be required to address the integration issues.

The research tasks envisioned are largely basic or fundamental in nature. However, some of the tasks will involve close collaboration between university and industry personnel and will focus on problems where a potential for commercialization

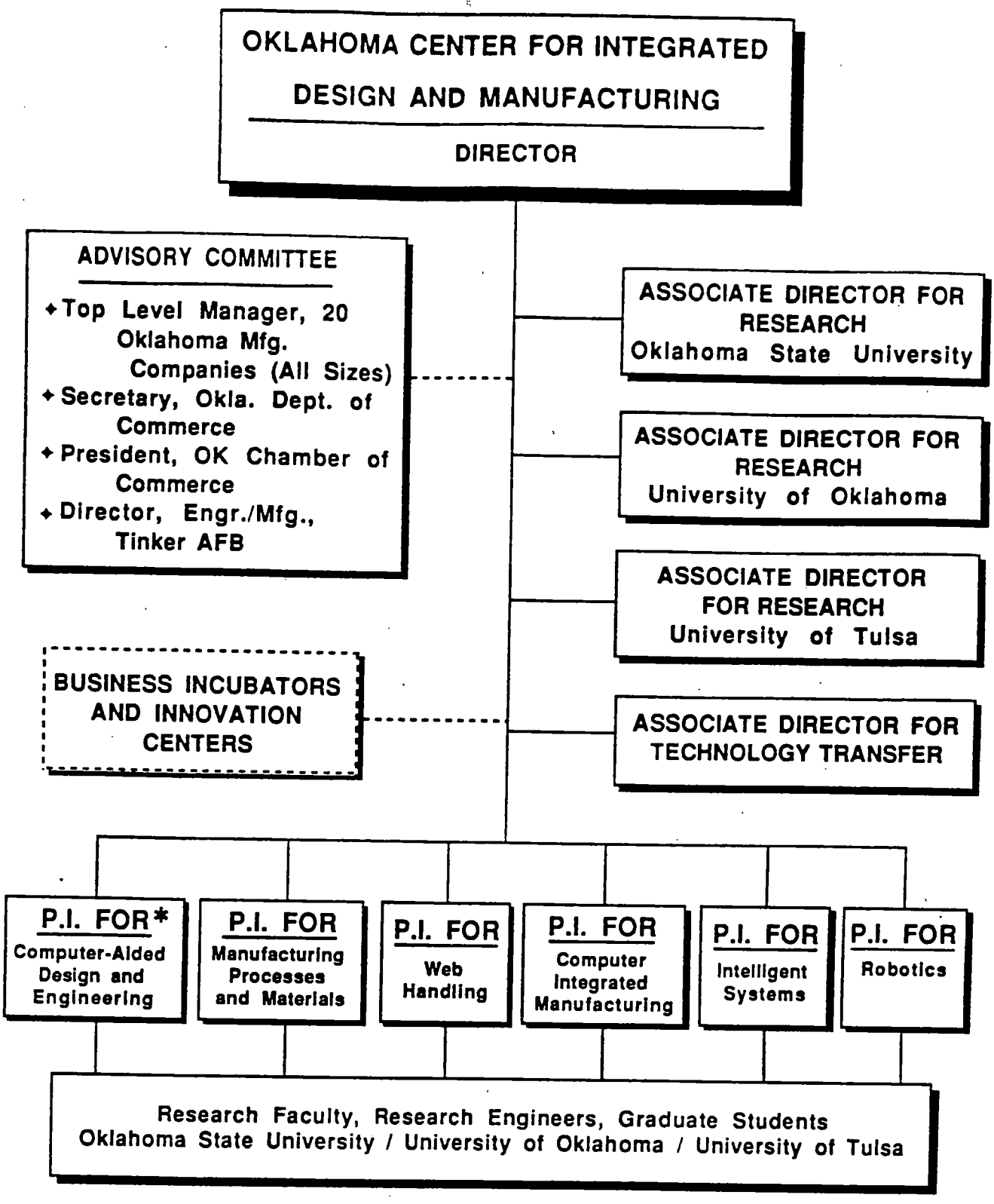
exists. These latter applied research tasks will focus on new products and processes. An example of an applied research task is the present collaborative effort between OSU and Integrated Manufacturing Systems to create a major tapered tube manufacturing enterprise in Tulsa.

The research programs of the Center will utilize industry/university cooperative relationships, patterned after the highly successful Web Handling Research Center at Oklahoma State University. A comprehensive technology transfer plan, based in part on the Cooperative Extension model, will be used to adapt research results to the specific needs of Oklahoma industry and to deliver that information through a variety of outlets.

An analysis of the anticipated research and technology transfer activities to be conducted by the Center indicates that the overall program will include about 60 percent basic research and 40 percent applied research. A total OCAST funding of $5 million over five years is requested. Matching funds from federal and private sources presently exceed the required $550,000 per year, and are expected to grow. With the stimulus from OCAST funding, it is expected that the Center will achieve the following outcomes by the sixth year: (1) retention of key faculty researchers; (2) significant increase in the number of outstanding faculty and graduate students working in the Center; (3) dynamic research programs which address fundamental and generic problems related to the science of manufacturing; (4) an established technology transfer mechanism, with a special emphasis on technical assistance to Oklahoma Manufacturing firms; (5) a reliable source of M.S. level graduates in design and manufacturing; (6) external funding from private industry and government exceeding $1 million per year, not including the value of equipment donations, other in-kind support, and institutional direct support.

The goals of the proposed Center are fully consistent with the goals of Oklahoma Futures and OCAST, as well as the recommendations of the former Oklahoma Council on Science and Technology, the recently published report on the Crisis in Higher Education in Oklahoma, and the recently completed Five-Year Strategic Economic Development Plan for Oklahoma. Oklahoma Futures has established 13 priority goals for Oklahoma's economic development. Of these, seven are addressed directly by the proposed Center.

Many studies have shown that the existence of strong university instruction and research programs available to industry is a major factor in preserving and enhancing the competitiveness of existing industry and in developing and attracting new industry. We believe that the potential impact of the Center on the economic growth of Oklahoma can be very great.




* P.I. means Principal Investigator

FIGURE VII.1 ORGANIZATION CHART

OKLAHOMA CENTER FOR INTEGRATED DESIGN AND MANUFACTURING

# OKLAHOMA CENTER FOR INTEGRATED DESIGN AND MANUFACTURING

An industrial renaissance is underway in the United States, not only in the advanced technologies of product and process design, but also in the evolution of totally new concepts of production systems and management which emphasize manufacturing excellence. The emergence of complementary advanced technology strategies such as computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-integrated manufacturing (CIM) make possible significant improvements in productivity and product quality. Also, the effective use of intelligent and programmable machines--termed robots--can potentially revolutionize the way in which complex, sometimes repetitive and dangerous production processes are carried out. Automation of the product design, development, manufacturing, evaluation, and distribution processes via CAD/CAM/CIM and Robotics may well be the key to success for industrial firms seeking to attain and maintain product leadership in an increasingly competitive marketplace.

Numerous studies have shown that the existence of strong university programs available to industry is a major factor in attracting new industry and in preserving the competitiveness of existing industry. The economic vitality and rate of growth in Oklahoma's manufacturing industry will depend in part on the responsiveness of the State's educational institutions. The primary mission of the newly established OKLAHOMA CENTER FOR INTEGRATED DESIGN AND MANUFACTURING is to carry out research in areas of strategic importance to Oklahoma manufacturing. The Center is based at Oklahoma State University, but involves key faculty members from the University of Oklahoma and the University of Tulsa. Primary goals of the Center are to advance the science base in integrated design and manufacturing in appropriate niches, to assist

in the infusion of advanced technologies into existing Oklahoma manufacturing industries, and to assist in the attraction of new manufacturing industries into Oklahoma.

The Center will focus its research efforts in three complementary areas of strategic importance to Oklahoma and the nation: design, manufacturing, and system integration. The Center will comprise three complementary centers and three major laboratories: Computer Integrated Manufacturing Center, Robot Design Center, Web Handling Research Center, Artificial Intelligence Laboratory, Computer-aided Design and Interactive Graphics Laboratory, and Manufacturing Processes and Materials Laboratory (see Figure 1).

The **Computer-Integrated Manufacturing Center** is concerned with the total spectrum of advanced technologies applied to the manufacture of goods, especially the use of computer and communication technologies applied to the design, manufacturing, and management functions of a firm. The **Robot Design Center** is concerned with the design of robotic manipulators and gripping devices, the development of robotic sensor capabilities (including vision), and the effective application of robot systems in manufacturing processes. The **Web Handling Research Center** is concerned with the study of fundamental problems associated with the handling of materials in continuous strip form and the development of the knowledge-base required in the optimum design of automated processes and machines involving these materials.

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The three strategic research areas imply a complex and interdisciplinary problem focus that requires a "center" approach. Although individuals and small groups can address specific tasks related to the six research target areas, collaboration across organizational boundaries is required to address the integration issues.

The research tasks envisioned for the new Center are largely basic or fundamental in nature. However, some of the tasks will involve close collaboration between university and industry personnel and will focus on problems where a potential for commercialization exists. These latter applied research tasks will focus on new products and processes. An example of an applied research task is the present collaborative effort between OSU and Integrated Manufacturing Systems to create a major tapered tube manufacturing enterprise in Tulsa.

The research programs of the Center will utilize industry/university cooperative relationships, patterned after the highly successful Web Handling Research Center at Oklahoma State University. A comprehensive technology transfer plan, based in part on the Cooperative Extension model, will be used to adapt research results to the specific needs of Oklahoma industry and to deliver that information through a variety of outlets.

An analysis of the anticipated research and technology transfer activities to be conducted by the Center indicates that the overall program will include about 60 percent basic research and 40 percent applied research.

Center Director:

Karl N. Reid, Dean
College of Engineering, Architecture, and Technology

Center Associate Directors and Principal Investigators:

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School of Mechanical and Aerospace Engineering

Joe H. Mize, Regents Professor
School of Industrial Engineering and Management

Ranga Komanduri, MOST Chair for Robotics
School of Mechanical and Aerospace Engineering

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Faculty Participants:

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Bruce A. Feiertag
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Richard L. Lowery
David G. Lilley
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Robert L. Swaim
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The Center's participants, principal investigators and associate directors also include faculty members from the University of Oklahoma and the University of Tulsa.

Prepared Statement for the Subcommittee on

ENERGY AND WATER DEVELOPMENT

of the

HOUSE APPROPRIATIONS COMMITTEE

April 11, 1989

by

John R. Campbell, President

OKLAHOMA STATE UNIVERSITY

Stillwater, Oklahoma

## EXECUTIVE SUMMARY

Oklahoma State University seeks $12.5 million in Federal funds for its College of Engineering, Architecture and Technology to construct an Advanced Technology Center for research, technology development and technology transfer on problems of energy conservation, storage, and conversion, and also for research on materials such as plastics and composites used in manufacturing and on manufacturing processes that consume large amounts of energy.

The motivation for such research is the realization that until an abundant source of clean cheap energy is found -- a situation not now in sight -- the prudent course is to practice energy conservation, including finding manufacturing materials and processes that make more effective use of energy currently available. Solutions to the energy efficiency problems will also contribute to the economic competitiveness of products made with these processes and materials.

The need for the Advanced Technology Center results from by the success and growth of current activities devoted to the problem area. The space to expand the research and development effort, as well as space to facilitate the technology transfer of the results, has become critically inadequate.

PREPARED STATEMENT

Mr. Chairman and Members of Congress, Ladies and Gentlemen, thank you for the opportunity to appear before you today on a matter that we believe is of great importance to the nation, as well as to our institution.

Just one century ago this month, a land run in Oklahoma -- unique in our nation's history -- opened 2,000,000 acres of fertile farmland for settlement by homesteaders. Now, one hundred years later, the descendants of those settlers are prepared to make a run on fertile vistas of new technology by establishing an "Advanced Technology Center" at the Oklahoma State University. This center will be devoted to the solution of current energy and energy-related manufacturing problems and the technology transfer of their solutions.

Oklahoma and the surrounding oil-producing states have experience with what it is like to deal with a fossil-fuel-based economy in serious decline. We realize that the apparent surplus of these fuels now, particularly petroleum, merely buys us time to anticipate and circumvent an impending crisis rather than indicating that energy supply is not an important issue.

Our national energy policy seems to place high reliance on our engineers and scientists to somehow come up with suitable alternative energy sources to replace those we now rely on, which we are consuming at a rate estimated to be literally hundreds of thousands times faster than nature is storing them! To those of us on whom such reliance is placed, the welcome vote of confidence is tempered by the sobering thought that the answers are not yet in sight.

We propose an approach that begins with the recognition of the need for a comprehensive research program in energy conservation, storage, and conversion. This beginning must be complemented with research on the use in manufacturing of materials which place high demands on the supply of energy.

The urgency of such a program is supported by the following: (1) efficient use of energy in manufacturing and producing not only reduces costs to improve economic competitiveness, but conserves fuel supplies for the many other demands that are placed upon them; (2) natural gas is the feed stock in the production of fertilizer that is so important to the production of food; (3) natural gas is also an important ingredient in the production of plastics and synthetic composite materials that have become a part of many manufactured products that we will need both near- and long-term; (4) demands for heating and refrigeration require improved processes to reduce and thus stretch out demands on existing energy resources; (5) transportation consumes roughly one-fourth of the energy we now use. Conservation through improved methods will surely become a high priority, as we are forced to make choices between adequate food, comfort, goods, and travel.

Oklahoma State University and its College of Engineering, Architecture and Technology propose that funding be provided for a new 100,000 square foot building to

house the **Advanced Technology Center** that will focus on these pressing issues. Research in manufacturing using composite materials and plastics is particularly important because these materials are increasingly replacing metals in applications such as aircraft and defense systems, automobiles and home appliances, and have shown promise as high-temperature superconductors. These materials not only utilize petroleum and gas as ingredients, but their formulation, blending, extruding and molding are all processes requiring significant energy input. The competition for natural gas and the potential impact on the cost of products made from these materials become obvious.

We also wish to expand our research into the technology and mechanisms of energy storage so vital for use with solar, wind, and tidal sources. Parallel research is needed in synthetic fuels that provide not only a means of storing energy, but a convenient means of facilitating its transport to the point of use. If biomass conversion is to become a significant source of energy, the end result will probably be a form of synthetic fuel.

Research into manufacturing processes will attempt to achieve not only cost reductions that can restore some of the competitive advantage lost in recent years, but also contribute to energy conservation which we believe to be the only prudent approach pending discovery of new and abundant sources of clean energy. Although we admittedly expect to utilize the results of our research to infuse advanced technologies into Oklahoma industries and attract new industry to Oklahoma to supplement the industrial base that has been too narrowly confined to petroleum and agriculture, we believe the problems to be researched are of national significance, and success in our research will contribute to the nation, as well as have applications world-wide.

Indeed, the need we have described is critical. I wish to make the case that Oklahoma State University is well qualified to undertake the research that would be necessary, not alone, but as one of a number of institutions that share our concern. The problems are of a magnitude that the efforts of many of us will be required if we are to find solutions in time to avert the trauma in the long run that will surely accompany a lack of attention in the short run.

Oklahoma State University is a member of the Oak Ridge Associated Universities, although this is the first time the University has sought federal support for capital projects to house the kinds of research that the consortium undertakes. Many engineering and science faculty members have had experience with DOE National Laboratories, and there are current contractual relationships with Oak Ridge, Sandia and Livermore Laboratories. Oklahoma State University is a major supplier of graduate degree holders employed by Sandia National Laboratories.

We can already point to examples of technology transfer of the results of our energy-related research to industry. A more efficient and efficiently produced impeller for a deep hole pump has been delivered to the REDA Pump Company. The Web Handling Research Center (WHRC) is one of forty National Science Foundation Industry/University Cooperative Research Centers. The WHRC has provided technical assistance to paper and plastic film products manufacturers in Oklahoma and as far away as Minnesota and Massachusetts. This center is cooperatively funded by sixteen

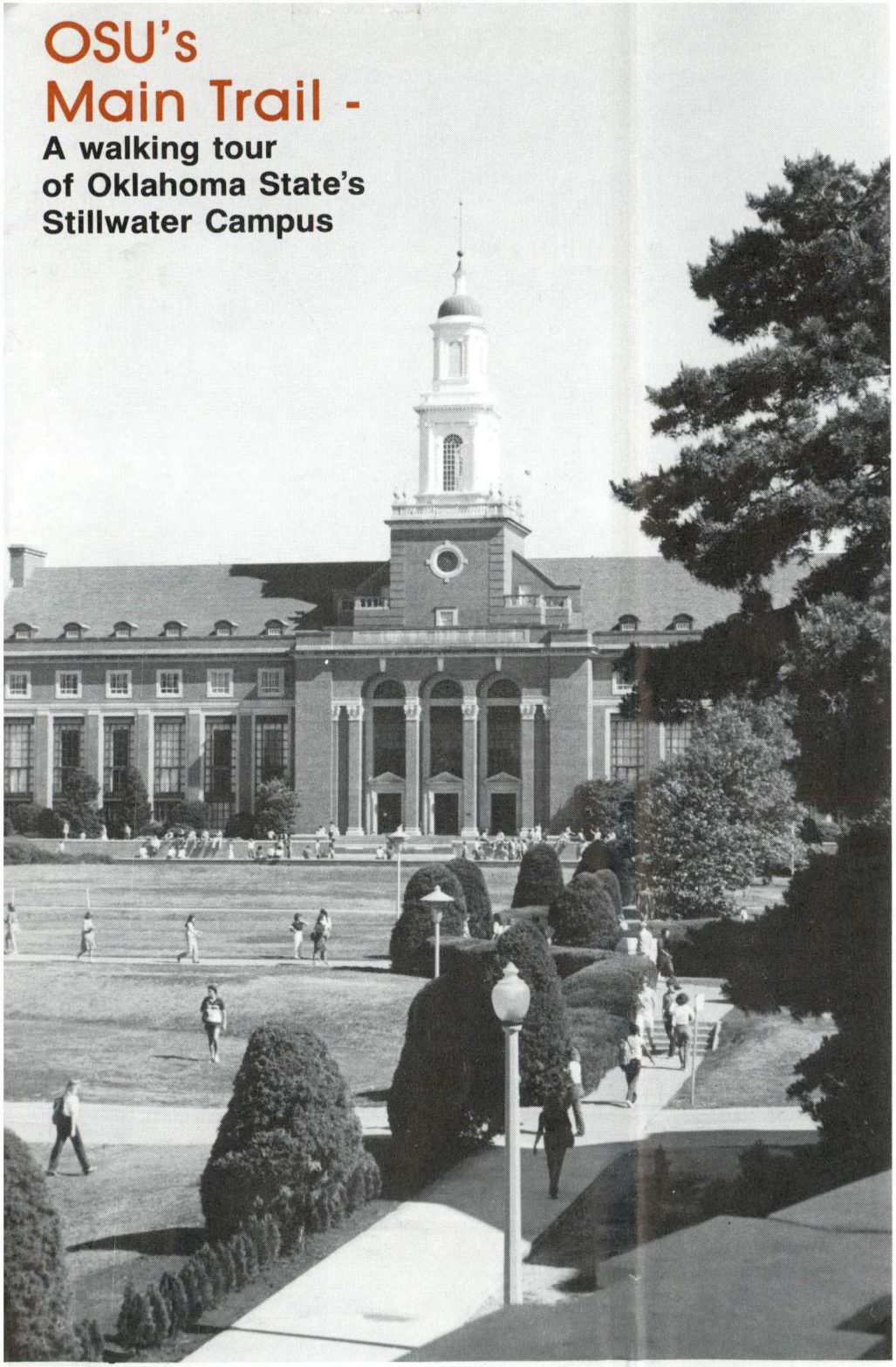
industrial firms from throughout the nation including DuPont, Eastman Kodak, Kimberly-Clark, 3M, Mead, Mobil Chemical, Polaroid, and Xerox. The center also has ties with the Materials Handling Center at Georgia Tech.

The research in each of the areas described above has been under way for several years, but space has become critically short. A new building has been a top priority on the campus since 1985. We seek $12.5 million dollars in federal funds for the building, and propose to raise a comparable amount from state and private sources to equip it. With this facility we can greatly expand our research and technology development programs to the extent that the time available, which we believe is relatively short, may produce meaningful solutions to problems we face. Furthermore, the experience gained in our current activities give us confidence that technology transfer of the solutions is a function that we can undertake effectively.

I appreciate the time and consideration you have given. Thank you.

# OSU's Main Trail -

## A walking tour of Oklahoma State's Stillwater Campus



Edmon Low Library

questions.

## Student Union

Since its construction in 1950, the Student Union has been a center for meetings, conferences, meals, recreation, and shopping. With a facility consisting of 543,441 square feet, it stands as one of the largest and most comprehensive unions in the world. The Student Union was the first union in the United States to be completely funded by self-liquidating bonds. Two major additions to the Union occurred in 1960 and 1965 with the adjacent parking garage built in 1970. Since original construction, the Union has undergone several renovations.

The Union contains an 82-room hotel, a 550-seat theater, art exhibits, lounges, meeting rooms, extensive food services, bookstores, a shopping mall, a recreation center, a post office, a travel agency, and many University offices. The Union is also the center for student organizations, such as the OSU Student Government Association.

In the shopping mall (Union Plaza) on the first level, you will find specialty stores providing gifts, clothing, shoes, copy facilities, jewelry, drug items, candy, and school supplies. (A barber shop and a beauty salon, along with bowling lanes and a game room, are located in the basement.) You may want to browse through these stores prior to starting the tour. Or you may want to visit the nearby Food Mart, where the menu items range from a full-course dinner to an ice cream cone. If you go through the Food Mart's east doors, you can eat outside in the Garden Terrace.

*If you wish to go to the Food Mart and Union Plaza on the first level, take the escalator located across the corridor from the High School and College Relations office.*

*TO CONTINUE ON THE TOUR, turn right upon leaving the High School and College Relations office. Go down the corridor past the Single Student Housing office. Take the next corridor on your left and continue down this corridor until you reach a set of double doors on your right. Go through the double doors to the outside.*

*You are now outside the Student Union's west portico balcony. Here you can see an overall view of the campus and appreciate the beauty of the Formal Gardens directly in front of you, Theta Pond to your left and the library lawn to your right.*

●*(FOR THOSE WHO ARE HANDICAPPED, use Elevator A to reach the first level where the shopping mall and Food Mart are located. Turn right upon leaving the High School and College Relations office. Elevator A is on your left just past the Single Student Housing office. Upon leaving the elevator, turn left and go down the corridor to the Food Mart.)*

●*(TO CONTINUE ON THE TOUR, take*

gardens. Located in the center of the gardens is the American Revolution Bicentennial Monument erected to commemorate the 200th anniversary of the United States in 1976. (The tour will continue near Theta Pond and through the Formal Gardens.)

## Edmon Low Library

To your right is the imposing Edmon Low Library, the nucleus of academic life at Oklahoma State. The fountain in front is a popular gathering place for students. As you continue your campus tour, you can hear the chimes coming from the white library tower. The library chimes play on the hour, 20 minutes after the hour and at half past the hour. The chimes keep students on time as they announce the changing of classes.

Originally, the library was located in Old Central. (The tour will be going past Old Central.) After Williams Hall was completed in 1899, the library's 1,600 volumes were moved into it. Williams Hall was demolished in 1967 to provide space for the construction of the Seretean Center for the Performing Arts, which is also on the tour.

The present library was erected in 1953 with the north addition completed in 1967. Covering six acres of floor space, the library is one of the largest and most modern in the Southwest. This nationally known library houses nearly 1.4 million volumes including rare books and materials relating to the history of Oklahoma and Oklahoma State. It was one of the first major university libraries in the United States to make stacks open to all users.

The library was named for Edmon Low, who was the University librarian from 1940-67. The tour will take you behind the library and you may wish to view the displays located on the first and second floors.

*Go down the balcony steps on your right. If you want something to eat or wish to window shop, the Food Mart and Union Plaza are located through the doors underneath this portico. Continue down the sidewalk to the intersection. Pause for a moment at the intersection. In front of you and just to your right is the Classroom Building.*

## Classroom Building

In addition to being the primary building for classes on campus, the Classroom Building houses the Department of Sociology, Independent and Correspondence Study offices and College of Education's Occupational and Adult Education offices. This building was completed in 1953.

*To your far left is the Whitehurst Administration Building.*

• *(FOR THOSE WHO ARE HANDICAPPED, use the sidewalk to the right of the Formal Gardens. Continue on this sidewalk until you reach the first sidewalk on your left. Turn left and go toward Theta Pond.)*

*Willard Hall, a women's residence hall, is on your right. The hall is named in honor of Frances E. Willard, a 19th century educator and temperance advocate. Several fraternity and sorority houses are located just south of Theta Pond. After crossing a bridge, turn left down a gravel pathway to the OSU Gateway Marker.*

OSU Gateway Marker

## OSU Gateway Marker

This newly-constructed campus gateway marker provides an attractive setting for individual and group pictures. Located at the southwestern entrance to the campus, the thirteen-by eight-foot granite marker was a gift from the Class of 1957 and is a Centennial Decade project.

*Continue to the intersection of Monroe Street and University Avenue. Turn right. Stop. To your left is Murray Hall.*

## Murray Hall

Since opening in 1934, Murray Hall has served as both a men's and women's residence hall. Murray is named for William A. Murray, better known as "Alfalfa Bill." He was an early day governor of Oklahoma and served as president of the Oklahoma Constitutional Convention.

## Home Economics West

Completed in 1951, this building is occupied by the College of Home Economics. It houses classrooms, laboratories and faculty offices for the Departments of Home Economics Education and Community Services; Clothing, Textiles and Merchandising; Family Relations and Child Development; Housing, Design and Consumer Resources; Food, Nutrition and Institutional Administration; and the School of Hotel and Restaurant Administration.

*Directly behind Home Economics West is the Family and Child Sciences Center.*

## Family and Child Sciences Center

Part of the College of Home Economics, the Center deals with topics ranging from early childhood education to gerontology. Constructed in 1983, this facility contains child development laboratories to provide students with an opportunity for observation and direct experience with young children.

The second story addition to this building is a Centennial Decade project. This additional space is for OSU's nationally recognized programs in Hotel and Restaurant Administration and Food, Nutrition and Institutional Administration.

*Continue north on Monroe Street. You can see the Edmon Low Library on your right with the beautiful central campus mall stretching eastward in front of it. You may wish to rest on the benches in the mall area. Life Sciences West is the next building on your right.*

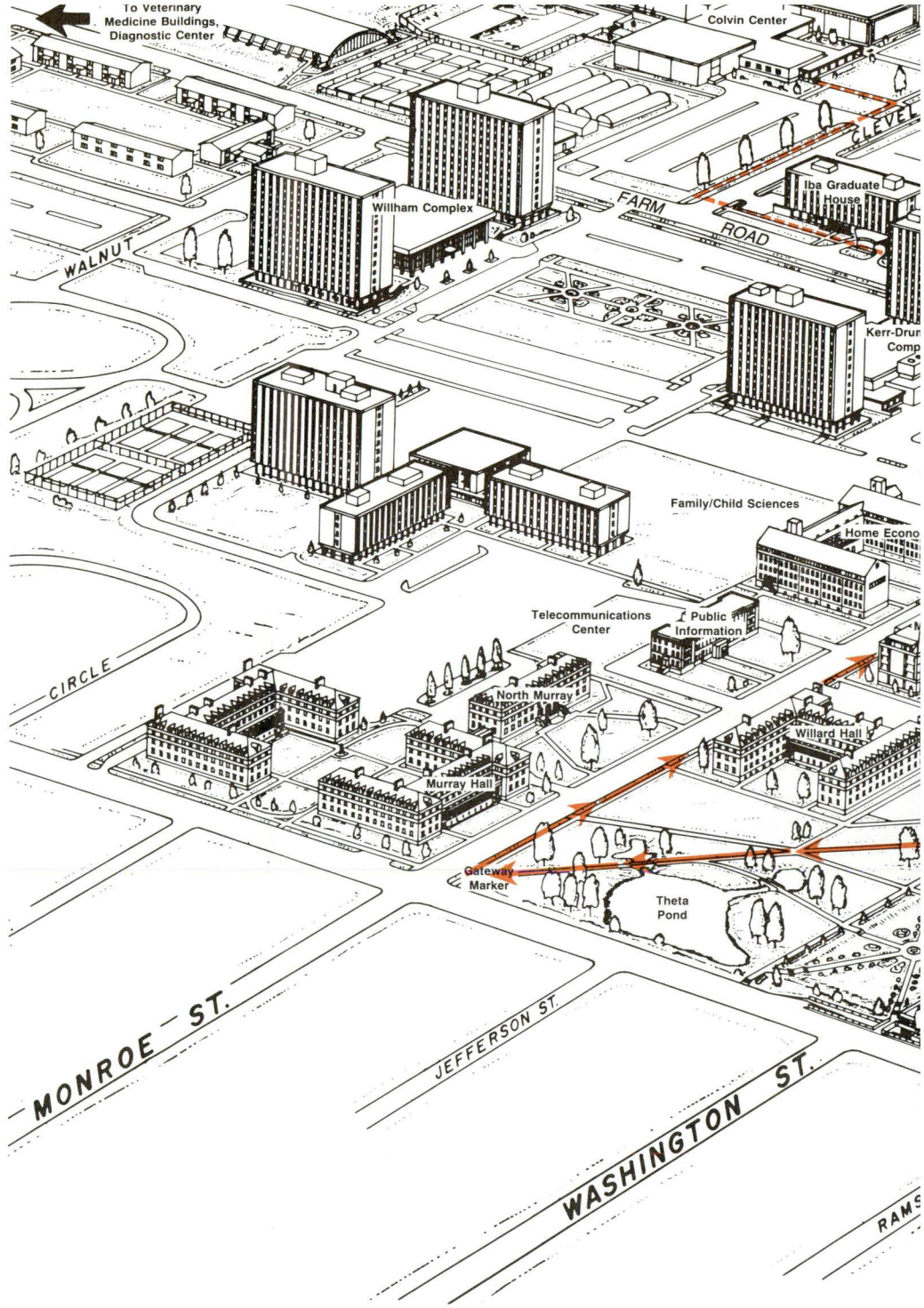
## Life Sciences West

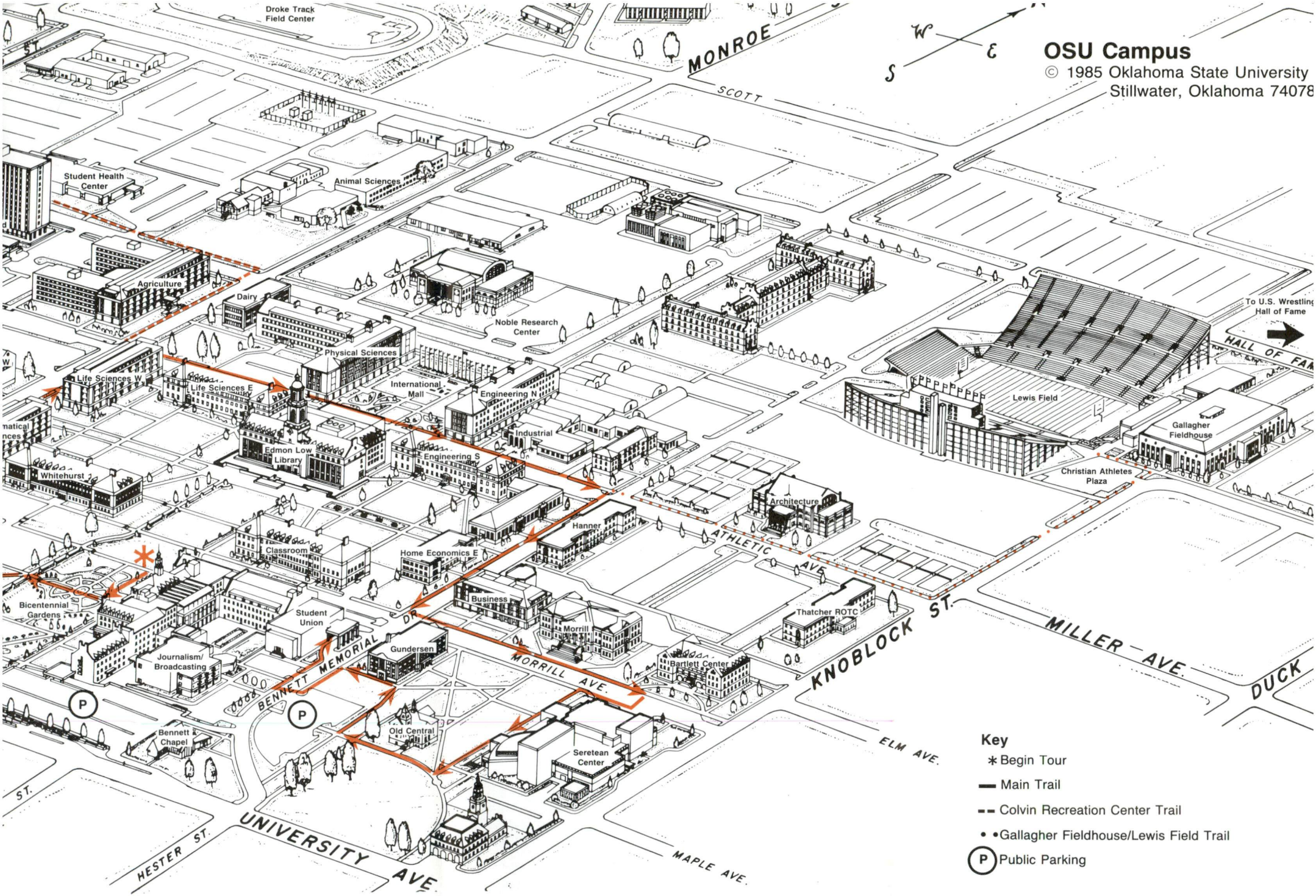
A small life sciences museum is located on the first floor at the south end and is open to visitors during regular office hours. Dedicated in 1969, this building contains classrooms, laboratories, auditoriums, and faculty offices for life sciences studies, as well as other areas of the College of Arts and Sciences.

*On your left are two high-rise residence halls - Kerr-Drummond Complex and Willham Complex. Continue to the northwest corner of Life Sciences West, where Monroe Street intersects with Athletic Avenue. Stop. The Agriculture Building is on your left just before the intersection of Monroe Street and Farm Road.*

## Agriculture Building

This building was completed in 1969 after two buildings, Agriculture South and Agriculture North, were joined together by an east wing. The administrative offices for the Division of Agriculture, including the College of Agriculture, Cooperative Extension, and Agricultural Experiment Station are located in






## International Peace Flag Mall

## Physical Sciences

Completed in 1964, this large building

*15 minutes walking time to take this trail, plus whatever time is spent visiting the facilities. You might want to also see student*

Colvin Recreation Center was completed in 1969. From 1969 until 1975, this building was the Air Force and Army ROTC headquarters

## Gallagher Fieldhouse

The fieldhouse, well-known to sports fans, was opened in December 1938 and has a seating capacity of 7,400 for basketball games and wrestling matches. The Student Association started a movement for this building in 1929, but progress was slowed by the Depression of the 1930s. Gallagher Fieldhouse was originally erected as a 4-H convention hall to be used by the state's agricultural clubs for their annual meetings.

This facility was named for Edward Clark Gallagher, athletic director and wrestling coach. As athletic director, he led a movement to develop athletic facilities on campus. As wrestling coach (1915-38), Gallagher's revolutionary training methods made Oklahoma A&M College virtually unbeatable, winning several national championships. In the east end of this building are trophies and pictures of outstanding OSU athletes.

*As you leave the south exit of Gallagher Fieldhouse, the Fellowship of Christian Athletes Plaza is on your right.*

## Fellowship of Christian Athletes Plaza

Dedicated in 1978, this plaza commemorates the founding of the Fellowship of Christian Athletes at Oklahoma State. Don McClanen, an OSU student from 1946-50, was instrumental in starting this national organization.

*Just beyond this plaza is Lewis Field.*

Lewis Field

*Memorial Drive and Morrill Avenue. Turn left. The first building on your left is the College of Business Administration.*

## College of Business Administration

This four-story building completed in August 1966 contains the College of Business Administration. The School of Accounting and the departments of Business Administration, Business Education, Management, and Economics have classrooms, laboratories, "case study" rooms, and faculty offices in this building.

*Continue east on Morrill Avenue. Morrill is the next building on your left.*

## Morrill

A great deal of political controversy surrounded the decision to construct this building. The construction helped to stop a movement among a faction of legislators who felt that Oklahoma A&M College should be relocated to a more accessible town. Completed in 1907, Morrill was called "the Showcase of Oklahoma" and was originally built to house the Division of Agriculture and college administrators. This building was named for the Morrill Act which made land grant colleges possible.

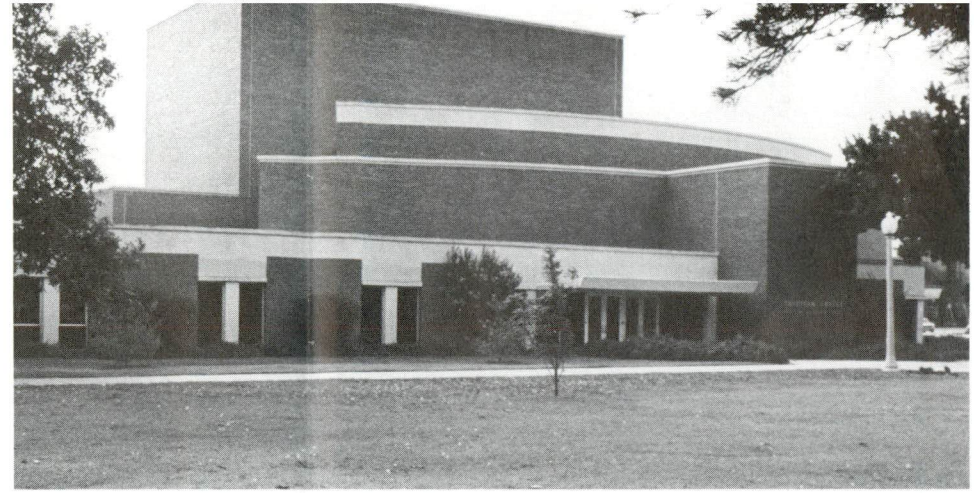
In 1914 fire completely destroyed this building. Acting President L.L. Lewis personally led the fire fighters, but because of a two-month drought, there was not enough water to extinguish the blaze. Reconstructed in 1919, Morrill now contains the classrooms and faculty offices for English and Speech Communication.

*Just past Morrill Hall is a mall area. You may wish to rest on the benches in the mall prior to continuing your tour. Continue east on Morrill Avenue. The next building on your left is the Bartlett Center for the Studio Arts.*

## Bartlett Center for the Studio Arts

Notice the unique stainless steel and porcelain enamel sculpture in front. Entitled "Blue and Rust," this sculpture symbolizes Oklahoma's Western heritage. Mr. and Mrs. F.M. "Pete" Bartlett commissioned Johanna Jordan of California to make this sculpture. They also donated $1 million in 1980 toward the renovation of this building, which was completed in January 1984. The Bartlett Center contains 11 studios, a 100-seat auditorium, and faculty offices. It's worth the time to visit the various displays in the expanded exhibition gallery on the first floor.

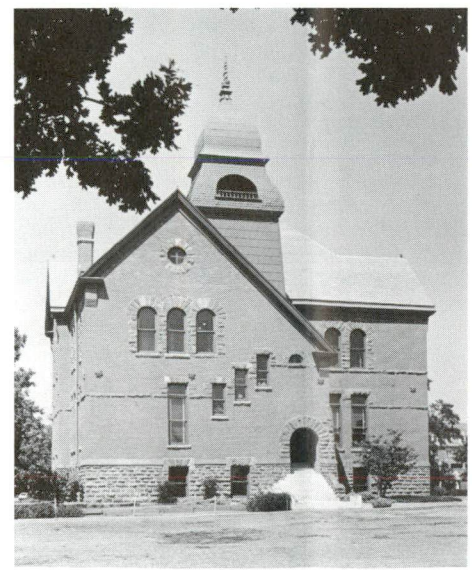
The Bartlett Center was originally named to



Seretean Center for the Performing Arts

On the north side of the building near the concert hall are temporary exhibits concerning OSU's heritage, as well as displays of art, history, and culture. No exhibits are shown during the months of July and August.

*Turn west upon leaving the Seretean Center for the Performing Arts. Old Central is on your left.*



Old Central

## Old Central

Old Central, the oldest restored building in the state, symbolizes the birth of Oklahoma State. Originally, it was called the College Building

## Gundersen

Originally the Engineering Building when it was constructed in 1902, Gundersen now houses the College of Education. In 1906, this building was expanded and it was the first building on campus with an auditorium for instruction. Gundersen was named for Carl Gundersen, an outstanding faculty member in engineering who came to Oklahoma in 1908.

*Continue west and cross Bennett Memorial Drive. Straight ahead is the Miller Journalism and Broadcasting Building.*

## Miller Journalism and Broadcasting Building

Constructed in 1918, this building was used by the Chemistry department until 1958. Since 1958, the School of Journalism and Broadcasting has occupied the building. Besides laboratories, classrooms and faculty offices, the Miller Journalism and Broadcasting Building contains the offices of the *Daily O' Collegian,* the daily newspaper, the *Redskin,* OSU's yearbook, and KOSU-FM, the radio voice of Oklahoma State and a National Public Radio affiliate.

An addition was completed in 1976 with Paul Miller making a generous gift toward the construction of the new wing. The building was named for Miller, a 1933 graduate of OSU's School of Journalism. He has been chairman of the board of the Associated Press and board chairman and chief executive officer of Gannett Co. Inc.

*(If you turn left and continue south on Bennett Memorial Drive, Bennett Chapel will be on your right.)*

## Bennett Chapel

Oklahoma State's first football team was formed in 1899. The present location for the field was opened in 1920 when the "stadium" was a wooden grandstand which seated 5,000. The first steel and concrete bleachers were constructed in 1924, increasing the total seating to 13,000. The first press box and additional seating were constructed in 1953 when Oklahoma State joined the Big Seven Conference.

In 1972, Astroturf, a new press box, and seating space were added. The press box was further expanded in 1980 to house the latest equipment for television, radio, and press coverage. Seating capacity is now 50,400. The athletic field was named in honor of Dr. Laymon Lowery Lewis, who was a professor of veterinary medicine and acting president of the University from 1913-15.

## CONTINUING ON THE MAIN TRAIL

*To continue on the Main Trail, if you are returning from Gallagher Fieldhouse and Lewis Field, return to the intersection of Bennett Memorial Drive and Athletic Avenue. Go east from Lewis Field to Knoblock Street. Turn right and continue south on Knoblock Street to Athletic Avenue. Turn right again and continue west past the Thatcher ROTC Building until you reach the intersection of Bennett Memorial Drive and Athletic Avenue. You are now on the Main Trail again.*

### Hanner Building

Located on the corner of Athletic Avenue and Bennett Memorial Drive, Hanner opened in 1925 as a men's residence hall. Hanner was built at the same time as Thatcher, a women's residence hall. For several years, Hanner was used to house varsity athletes.

In 1968, Hanner was closed as a residence hall and is presently used as office space for the Office of Student Financial Aid, the Speech and Hearing Clinic and the Philosophy department. The building's name honors the first Oklahoma A&M college student to become a casualty of World War I.

*Continue south on Bennett Memorial Drive. Home Economics East is on your right.*

### Home Economics East

Since its completion in 1926, this building has been occupied by Home Economics. It currently houses the Food, Nutrition and Institutional Administration laboratories, which are to be moved to the expanded Family and Child Sciences Center. The Geography department is also located here.

institution in 1900. The Center's gallery continues to bear her name. Opened in 1910, Gardiner Hall was the first women's residence hall on campus. Through the years, this building has served as a classroom for women's physical education, karate, speech, agriculture extension, and drafting. The Foreign Language department was housed in this building. Gardiner survived a fire in 1914 and a threat of demolition in the 1960s. The Art department moved into the building in 1970.

*From the Bartlett Center for the Studio Arts, cross Morrill Avenue. Continue south. On your left is the Seretean Center for the Performing Arts.*

### Seretean Center for the Performing Arts

The Seretean Center, dedicated in April 1971, includes the departments of Music, Theater and Humanistic Studies. M.B. Seretean, a 1949 OSU graduate, made a substantial gift to assist in the construction of this building. This $3.2 million showplace features a 974-seat concert hall, a 600-seat continental-style theater, and a host of multi-purpose classrooms, offices, and rehearsal facilities. The completely renovated concert hall was originally the auditorium of Williams Hall built in 1912. The rest of Williams Hall was demolished in 1967 to provide space for the Center. Programs of music, drama and dance, as well as meetings and lectures are presented here for thousands of campus and community patrons each year.

in turn, invested the money in the construction of the building. Built with student labor between 1892 and 1894, Old Central's 16 rooms housed the entire Oklahoma A&M College until 1900, when other buildings were built on campus. When completed in 1894, the building cost $25,000 and was built on land donated by Frank E. Duck from part of his 1899 land-run homestead. Interestingly, Duck was one of OSU's first six graduates.

Constructed largely with local materials, Old Central was always plagued by shifting ground and overuse. Condemned in 1925 and evacuated in 1927, the building underwent major renovations in the late 1920s and in 1950. At times it faced destruction from fire and from successive decisions to demolish the structure. In 1975, it was the center of a tornado path and even though damaged severely, this venerable structure survived nature's onslaught. In 1971 Old Central was placed on the National Register of Historic Places. In that same year the building was leased to the Oklahoma Historical Society for restoration and use as a museum of higher education. Old Central was dedicated in June 1982 as the Oklahoma Museum of Higher Education.

Today, Old Central is used for meetings and displaying temporary exhibits. Inside Old Central you may see photographic displays and restorations of the various rooms. Notice the wooden banister railings, wooden venetian blinds, and slate chalkboards.

*Turn right upon leaving Old Central and continue west past the parking lot. On your right is Gundersen.*

Bartlett Center for the Studio Arts

Henry G. Bennett, president of Oklahoma State from 1928-51. He was the first director of America's Point Four Program, established to provide technical assistance to nations around the world. The Point Four Program was a forerunner of the present U.S. Agency for International Development. Bennett and his wife were killed in a tragic airplane crash in Iran in 1951, while he was serving as administrator of this program.

Bennett proposed in 1936 that a chapel be built as a war memorial. Upon his death in 1951, friends organized a foundation to complete the chapel plan. In 1957, the chapel was dedicated in honor of Bennett, his wife, and University students who gave their lives in World Wars I and II. The chapel is non-denominational. Any religious organization may use this facility at any time, and any student may use the chapel for personal moments of meditation and devotion.

*Turn right and continue north past the Miller Journalism and Broadcasting Building to the east portico of the Student Union, the point at which you started the Main Trail. If you have any questions, you can contact the personnel in High School and College Relations, Room 210. The escalator on your left will take you to the Food Mart and Union Plaza on the first level.*

### First Aid Emergency Assistance

In case of personal injury or illness requiring emergency treatment while on campus, telephone the University police at 624-6523, stop any police patrol car, or use one of the blue outdoor telephone call boxes that provide a direct line to the University police.

### Office Hours

Administrative offices are open Monday through Friday from 8 a.m. to noon and 1 p.m. to 5 p.m. Admissions counselors are available during these hours. To call High School and College Relations: 1-800-522-6809 (toll free in Oklahoma) or 1-405-624-5358 (local or out-of-state).

Thank you for visiting Oklahoma State University. We hope you enjoyed your tour. Perhaps now you, too, will share our pride in the University's excellent academic programs, its history and traditions, and in the beauty of the campus. We invite you to come back often, for this is a dynamic University that is constantly changing to serve the needs of Oklahoma and society in general. As mentioned previously, Oklahoma State will celebrate its 100th anniversary in 1990, and you are invited to join in the festivities.

flags that represent the almost 80 countries which comprise OSU's international student population. In addition to the flags representing the various nations is a bronze plaque presented to the University by Emperor Haile Selassie III of Ethiopia in 1968 in recognition of the University's 16 years of service in that country.

A display case directly south of the flagpoles indicates which country's flag is flying on a particular flagpole. Flags are displayed in alphabetical order (from west to east) on a rotational basis with specific flags flown on special days, such as holidays.

The "Dove of Peace" monument of a dove perched on a globe was dedicated to the University by the on-campus International Student Association in appreciation of the University's involvement in international education and efforts in furthering world peace. One OSU president particularly involved in assisting foreign nations was Dr. Henry G. Bennett. He was the first director of the United States' Point Four Program, forerunner of the U.S. Agency for International Development. Bennett served as president of Oklahoma State from 1928-51. The "Dove of Peace" monument is located in the southwest corner of the mall.

*Directly north of this mall is the site of the Noble Research Center for Agriculture and Renewable Natural Resources.*

## Noble Research Center for Agriculture and Renewable Natural Resources

The Noble Foundation of Ardmore, Oklahoma donated $3 million toward the construction of this building. Groundbreaking ceremonies for this multi-million dollar research and educational complex were held in May 1984. The Center is being built in two phases with the first phase consisting of the south complex and one of three adjacent research buildings. The second phase will include the two additional research buildings.

The Noble Research Center, consisting of more than 200,000 square feet, will include the departments of entomology, biochemistry, plant pathology, microbiology, and the remote sensing center. The complex will also include the T. Boone Pickens Jr. School of Geology, made possible in part by a $1 million gift from Mr. Pickens.

*On your left, as you are facing the flagpoles, is the Physical Sciences Building.*

sciences. In the basement are wood, metal, and glass shops used for the construction of experimental equipment. The building also contains a rare mass spectrometer used for the analysis of mineral components of matter and the OSU Laser Spectroscopy Facility. This laser spectroscopy facility is one of the leading comprehensive research laboratories of this type in the country.

*On your right is Engineering North.*

## Engineering North

This five-story building completed in 1964 contains the offices of the Dean of the College of Engineering, Architecture and Technology and the Directors of Engineering Research and Extension. Engineering North also contains the schools of Chemical, Industrial, and Mechanical Engineering.

*The Edmon Low Library, described at the start of the tour, is south of the mall area. You may wish to view the displays located on the first and second floors. On your right, as you continue east, is Engineering South.*

## Engineering South

This 1912 building houses part of the College of Engineering, Architecture and Technology - the Schools of Civil Engineering, and Electrical and Computer Engineering - as well as the engineering energy laboratory. Originally, the College of Engineering, Architecture and Technology had offices in Gundersen. (The tour will be going past Gundersen.)

*The small building with the three arches on your left is the Industrial Building.*

## Industrial Building

Completed in 1928, this building contains the offices and classrooms for Industrial Arts Education and the Division of Engineering Technology.

*Continue to where the sidewalk ends, which is the intersection of Bennett Memorial Drive and Athletic Avenue. Cross Bennett Memorial Drive. Stop.*

# GALLAGHER FIELDHOUSE/ LEWIS FIELD TRAIL

*If you are interested in seeing the campus athletic facilities, you may wish to visit Gallagher Fieldhouse and Lewis Field. Allow*

*Building's first floor gallery. The directions to Gallagher Fieldhouse/Lewis Field are below.*

*(Beyond Gallagher Fieldhouse near the intersection of Hall of Fame Avenue and Duck Street is the U.S. Wrestling Hall of Fame opened in 1976. Its 1,000 square feet of floor space houses the Museum of Wrestling History depicting, with medals, trophies, uniforms, photographs and other memorabilia, the history of the sport since its origins in the ancient world. Also featured are the Honors Court enshrining the great wrestlers, coaches and contributors to the sport. There is an admission charge of $1 for adults and $.50 for children.)*

*If you wish to forego the trip to Gallagher Fieldhouse and Lewis Field, continue on the Main Trail, which will take you past the fine arts facilities and Oklahoma's Museum of Higher Education - Old Central.*

*To reach Gallagher Fieldhouse and Lewis Field, continue east on Athletic Avenue. On your left is the Architecture Building.*

## Architecture Building

Constructed in 1920 as a gymnasium, it was the center for physical education until the

redesigned the interior of this building for architectural classrooms. Student architectural displays can be seen in the first floor gallery, which is open to visitors.

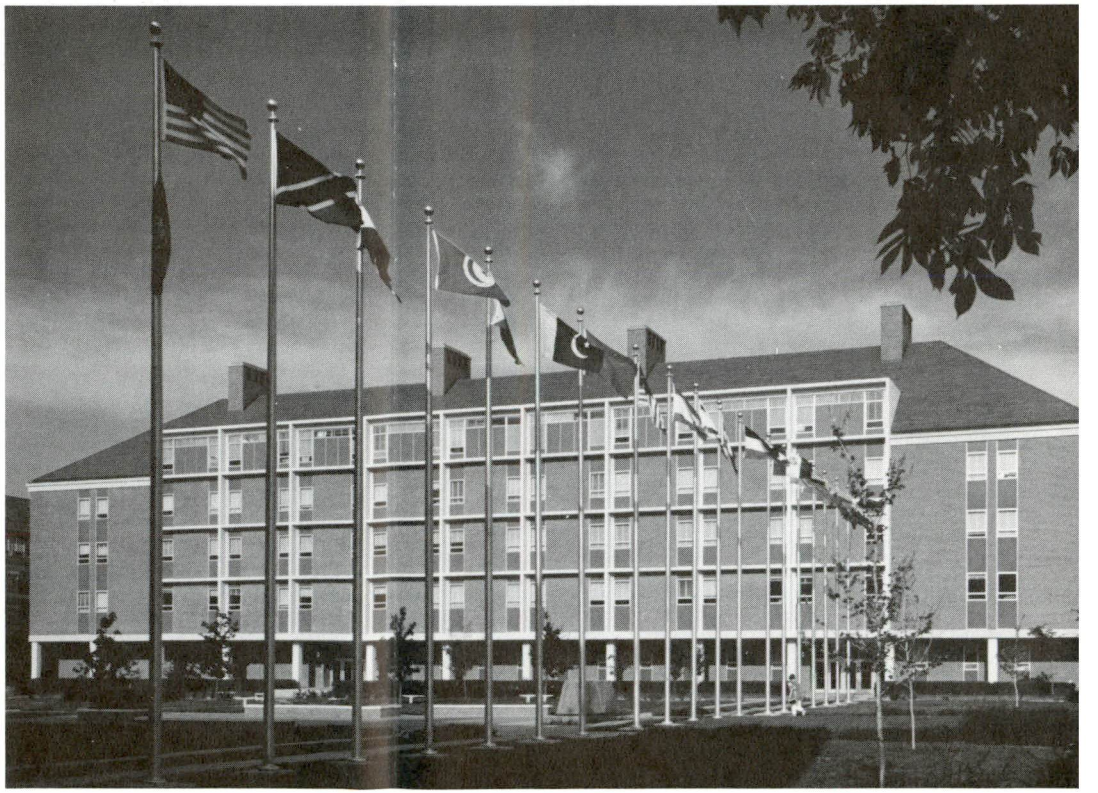
*Continue east on Athletic Avenue until you reach the intersection of this street with Knoblock Street. Thatcher ROTC Building is on your right.*

## Thatcher ROTC Building

Notice the two howitzers in front as you approach this building. One is American and the other is British. There is also a RF-84F reconnaissance airplane on the front lawn. Opened in 1925, this building was one of the first women's residence halls. Known originally as Thatcher Hall, it was named for Jessie Thatcher Bost, the first woman graduate and one of three members of the second graduating class (1897).

Thatcher was converted in 1968 to house faculty offices for the English Department and in 1974, it was renovated for Air Force and Army ROTC offices.

*Turn left on Knoblock Street and go past the tennis courts. Continue north to Gallagher Fieldhouse.*



International Peace Flag Mall

the CALL Center - Career Assistance Learning Laboratory. The CALL Center includes the Career Information/Learning Resources Center, the Writing Lab, and the Educational Information Center.

*Continue north on Monroe Street. The next building on your left is North Murray.*

## North Murray

This building is also named for William A. Murray and has also served as both a men's and women's residence hall since opening in 1936. Today, the Department of Psychology, the Applied Behavioral Studies in Education department, the Bureau of Tests and Measurements, and other offices are located here.

*The building next to North Murray on your left is the Public Information Building.*

## Public Information Building

When this building first opened in 1929, it was an infirmary. The offices of Public Information and Agricultural Information are now located here providing to the public, through the mass media, publications and periodicals, information of an informative and educational nature.

*Directly behind Public Information is the Telecommunications Center.*

## Telecommunications Center

This state-of-the-art television production facility with a total floor space of 12,000 square feet was dedicated in April 1983. The Center has the capability of both satellite reception and transmission, which enables the Center to broadcast teleconferences. Several short subjects, including Candid Campus, are produced here.

*Continue north on Monroe Street. On your right is Mathematical Sciences.*

## Mathematical Sciences

Dedicated in 1968, this building houses faculty offices, classrooms and auditoriums used by mathematical and computer sciences. The Department of Foreign Languages, History and Political Science are located here, too.

The University's computer facility consisting of an IBM 308ID and a DEC VAX 11/780 is located in the basement. This computer center performs many administrative services for the University including enrollment, tuition, billing, accounting, and payroll. Also, the center is used as an educational tool in all colleges and for faculty and graduate student research.

*To your left is Home Economics West.*

contains the departments of Agricultural Economics, Agricultural Education, Agricultural Engineering, Agronomy, Forestry, and Horticulture.

*(If you continue north on Monroe Street just beyond the intersection of this street with Farm Road, Animal Sciences will be on your left.)*

## Animal Sciences

Dedicated in 1982, this modern facility has offices, classrooms, and laboratory spaces for the Animal Sciences Department.

# COLVIN RECREATION CENTER TRAIL

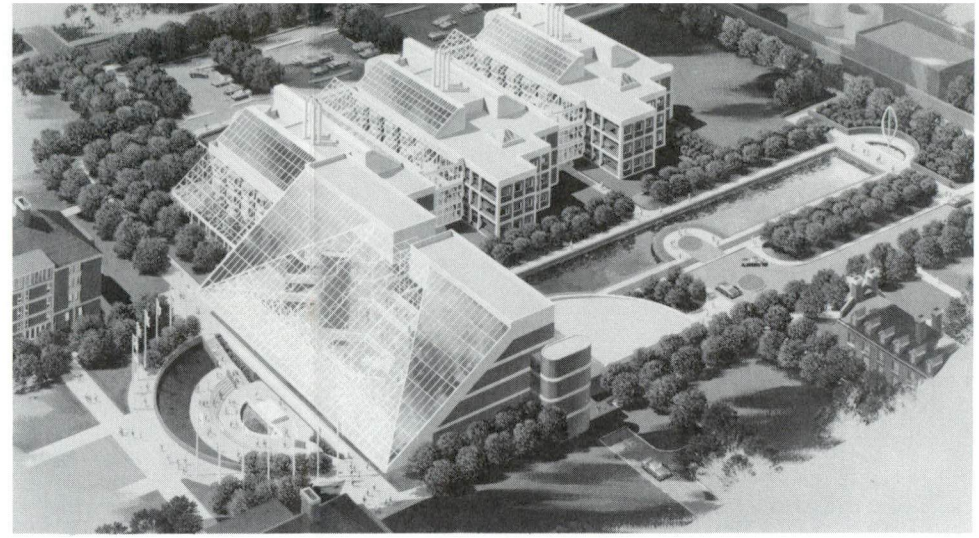
*If you are interested in seeing the extensive physical education facilities on campus, you may wish to visit the Colvin Recreation Center. Allow 20 minutes walking time to take this trail, plus whatever time is spent visiting the facilities. The directions for this trip to the Colvin Recreation Center are below.*

*If you choose to forego the trip to the Colvin Recreation Center, continue on the Main Trail, which will take you past the site of the Noble Research Center for Agriculture and Renewable Natural Resources and the campus fine arts facilities.*

*To reach the Colvin Recreation Center, cross Monroe Street and turn right toward the northeast corner of the Agriculture Building. At the intersection of Monroe Street and Farm Road, cross Farm Road. Turn left on Farm Road and continue west on the sidewalk past the Student Health Center and Iba Graduate House, a residence hall for graduate students. Cross Cleveland Street and turn right. Continue north to the driveway and then turn left toward the Colvin Recreation Center.*

## Colvin Recreation Center

The Colvin Center was named - at the request of her students - for Valerie Colvin, chairman of the women's physical education program at OSU from 1939-69. This magnificent sports center consists of two separate buildings and contains an indoor and outdoor swimming pool; a weightlifting and body mechanics area; 20 racquetball courts; a dance studio; 10 indoor and four outdoor basketball courts; 25 outdoor and four indoor tennis courts; indoor and outdoor running tracks; and lighted outdoor playing fields.



Noble Research Center for Agriculture and Renewable Natural Resources

The Center, built in 1969, also contains classrooms, laboratories, auditoriums, and faculty offices for the School of Health, Physical Education and Leisure Services. The Colvin Center Annex, the Quonset-style building adjacent to the outdoor swimming pool, opened in 1979 and provides additional space for racquetball, basketball, and tennis courts, as well as an indoor jogging track. Across the street north of the Colvin Center is the Droke Track and Field Center, made possible by a generous gift from Kaye Barrett Droke.

*(If you turn right upon leaving the Colvin Recreation Center and continue west on Farm Road, you will come to two buildings connected with the College of Veterinary Medicine - Veterinary Medicine and Boren Veterinary Medical Teaching Hospital, both on your left. OSU is the only university in the state offering a degree in Veterinary Medicine.)*

*(Oklahoma Animal Diagnostic Center on your right has laboratory facilities for the detection of diseases in small domestic animals, large wildlife and farm animals. This facility serves the entire state of Oklahoma.)*

# CONTINUING ON THE MAIN TRAIL

*To continue on the Main Trail if you are returning from the Colvin Recreation Center Trail, return to the northwest corner of Life Sciences West. The northwest corner of Life Sciences West is the intersection of Monroe Street and Athletic Avenue. Go directly south from the Colvin Recreation Center toward the high-rise residence halls. Cross Farm Road and turn left. Continue east past the two high-rise residence halls - Willham Complex and Kerr-Drummond Complex to the intersection of Monroe Street and Farm Road. Cross Monroe Street and turn right toward Life Sciences West. After you cross Athletic Avenue, you are now on the Main Trail again.*

## Dairy Building

As you are standing at the northwest corner of Life Sciences West facing east, the Dairy Building is just across Athletic Avenue on your left. This building has a snack bar on the first floor where refreshments may be purchased. At one time dairy products from the OSU herd were processed and made available for sale in this snack bar. Completed in 1928, this building once housed the School of Animal Sciences.

*Turn right at the northwest corner of Life Sciences West and go east. On your right is Life Sciences East.*

## Life Sciences East

Completed in 1938, this building contains classrooms, laboratories, and faculty offices for all areas of life sciences studies. Administrative offices for the College of Arts and Sciences, the largest college at Oklahoma State, are located on the second floor.

*Continuing east, the open area on your left is the International Peace Flag Mall. You may wish to rest on the benches here prior to continuing your tour.*

Oklahoma State University, now in its Centennial Decade (1980-1990), is preparing for its Centennial Year, 1990. The Decade is a time when the University is seeking to accelerate growth and development at a rate in excess of what would normally occur. This publication guiding you on a brief tour of the campus is one of a number of special Centennial Decade projects. We hope it will help you become better acquainted with the campus - its history, traditions, accomplishments, and contributions.

OKLAHOMA STATE UNIVERSITY
CENTENNIAL DECADE
1980 • 1990

— *Richard W. Poole*
Vice-President for University Relations and Extension
and
Centennial Program Coordinator

• • • • • • • • • • •

Welcome to the Stillwater Campus of Oklahoma State University - the largest university in Oklahoma and one of the leading institutions in the Southwest. The University is coeducational and has an enrollment, based on Fall 1984 figures, of 27,956 students of which 21,449 are on the main campus, 3,043 at the branch campus at Okmulgee and 2,982 at the branch campus in Oklahoma City, as well as 482 students at the University Center in Tulsa.

Oklahoma State's campus is people-oriented, and the best way to see the campus is on foot. You are invited to join other pedestrians - students, faculty, staff, and administrators - who travel the Main Trail around campus each day. Please follow the Main Trail as shown in the accompanying map.

This self-guided walking tour of the central portion of the Stillwater Campus will introduce you to the beauty of the Oklahoma State campus and to university life. OSU was founded in 1890 as the Oklahoma Agricultural and Mechanical College. The name was changed to Oklahoma State University July 1, 1957. The first classes were held on December 14, 1891. The first Commencement was in 1896 with six male graduates.

The University offers bachelor's, master's and doctor's degrees in a large number of fields, as well as the professional Doctor of Veterinary Medicine degree. Specialist and associate degrees are also offered in selected fields.

The Stillwater Campus consists of around 840 acres. The Payne County research stations, which includes OSU farms adjoining the campus, encompasses some 1,660 additional acres. Oklahoma State also owns close to 21,655 acres in the nearby Lake Carl Blackwell area. Outside Payne County, the University owns nearly 2,993 acres of research station land. Including another 121 miscellaneous acres, total acreage owned by OSU in Oklahoma amounts to almost 27,269 acres.

The campus consists of about 200 permanent buildings with an acquisition value, excluding the equipment in these buildings, approaching $172 million. Replacement cost of these buildings would be several times higher than that figure. All buildings constructed after 1930 are built in a modified Georgian style with red brick and white stone trim. Most buildings are accessible to the handicapped.

You can complete this brief tour in about one hour. Please allow extra time if you wish to linger at any of the locations or if you decide to take either or both of the side trails to the Colvin Recreation Center and Gallagher Fieldhouse/Lewis Field.

You are welcome to visit any building that interests you, but please do not enter classrooms while they are in use. Refreshments may be purchased in either the Student Union or the Dairy Building. The tour will direct you to these buildings.

You are ready to begin your explorations of Oklahoma State University. We hope you will enjoy your tour of the campus and your visit to one of the major learning centers in the Southwest.

• *Denotes additional instructions for the handicapped. Handicapped visitors will be able to take this tour with a few minor modifications in the route.*

*Begin your tour of the Main Trail at the star on the map inside. You may wish to visit the High School and College Relations office, Room 210 in the Student Union prior to starting your tour. As you enter the east portico of the Student Union, this office is down the corridor on your right.*

## High School and College Relations

High School and College Relations is open the same hours as other offices on campus - from 8 a.m. to noon and 1 p.m. to 5 p.m. Monday through Friday. This office is also open from 8 a.m. to noon on Saturdays, except holidays. The staff is available to answer questions you may have about the University. Guided tours are available with little advance notice. The tour will end in the Student Union and you can

Richard W. Poole, *Vice-President, University Relations and Extension*
Ralph L. Hamilton, *Director, University Information and Publication Services*
Bruce A. Ackerman, *Publications Editor*
Llyn French, *Graphic Designer*
Karen Fitch, *Photographer*

*leaving the elevator. Then go through the doors to the outside. Once outside, turn left and pause near the west side of the Student Union. Face toward the central part of the campus.)*

# MAIN TRAIL

## Formal Gardens, Theta Pond

As you view this part of the campus with its flowers, trees and shrubbery, you may understand why this is a favorite part of the campus for every generation of Oklahoma State students. The library lawn is the scene of various student activities throughout the year, including pep rallies and freshmen orientation.

Historic Theta Pond was originally used as a watering pond for horses when the University stables were nearby. Improvements in Theta Pond started in the mid-1940s have made it an ideal place for studying, for conversations with friends or for quiet reflection. In 1982, members of the Class of 1956 sponsored a Theta Pond beautification project, which involved landscaping and a scenic walkway along University Avenue.

The friendly ducks around the pond add to the peaceful setting. Benches are located

## Building

When completed in 1925, this three story building was the third largest in Oklahoma, being surpassed only by the State Capitol and Central High School in Tulsa. The fourth story was added in 1937.

The building was named for John A. Whitehurst, president of the Board of Agriculture at the time of construction. The Board of Agriculture was the original governing board of the college.

Originally constructed to house the College of Agriculture and University administrators, this building is now used for certain student services and University administration. The offices of the president, bursar, admissions director, and registrar are located on the first floor.

*Turn around and return to the west side of the Student Union. Go west through the Formal Gardens past the Bicentennial Monument and walk up the concrete steps. Take the sidewalk that is just off your left and continue toward Theta Pond.*

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Student Union

# SPONSORED RESEARCH

Annual Report 1988 • Oklahoma State University

**The Mass Spectrometry Facility,** located in Physical Sciences I, was recently completed at a cost of approximately $1.1 million and houses two VG Instruments Inc. mass spectrometers. Funds for purchase and installation of the facility were obtained from the National Science Foundation, the Oklahoma Center for the Advancement of Science and Technology, as industrial gifts from Conoco and Amoco, and Oklahoma State University. Dr. George Waller, OSU professor emeritus, was instrumental in securing the necessary funding.

The VG ZAB2-SE (pictured on the cover) is one of the world's most versatile mass spectrometers. It is a high resolution instrument capable of obtaining mass spectra over a wide mass range. The instrument's exceptional sensitivity at high mass makes it ideal for the study of large biological molecules. OSU's researchers in the biological and agricultural sciences, as well as in chemistry, will benefit greatly from the use of this instrument.

The companion instrument, a VG TS-250, is a versatile instrument for the analysis of a variety of substances. It is fitted with a gas chromatograph and a liquid chromatography-thermospray interface so that mixtures of organic compounds and biological fluids can be separated and analyzed to determine chemical composition.

The Mass Spectrometry Facility will provide state-of-the-art analytical support for the University well into the next century.

*Cover Photos: Dr. Paul Geno (foreground), director of the Mass Spectrometry Facility, and Norman Perreira, manager of the facility, work on the computer and controls for the ZAB-SE. The mass analyzer (lower photo) sits across from the computer and controls.*

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# Report to the President

***Expenditures for the Noble Center aside, sponsored research increased 18 percent in FY 88.***

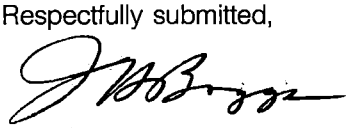
The Annual Report for the Research Program at Oklahoma State University for fiscal year 1988 is submitted for your information and review. It is a pleasure to report that $54,136,095 was expended in research programs which represents an overall increase in research expenditures of approximately 1.6 percent over fiscal year 1987. This increase becomes more meaningful when one realizes that researchers accomplished this goal even though capital expenditures for the Noble Research Center were $3.3 million less than in fiscal 1987. Expenditures for the Noble Center aside, sponsored research increased 18 percent in FY 88. More specifically, research expenditures during the last fiscal year by fund sources were private sponsors 13.6 percent, state sponsors 12.8 percent, federal sponsors 26.1 percent and state general support 47.5 percent. Six of the seven colleges within Oklahoma State University showed increases in the federal sponsor and state sponsor support levels while two of the colleges showed an increase in the private sponsor support program. Overall, all colleges within the University showed an increase in funding levels for research-sponsored agreements.

Research facilities are an important component of a major research program, and Phase I of the Noble Research Center neared completion this year. Its physical presence is quickly becoming an integral part of the Stillwater campus, and soon these facilities will become an integral part of the work conducted by the University's excellent agricultural and biological sciences researchers. With these state-of-the-art facilities, Oklahoma State University researchers will be in a more competitive position with other major research centers for sizable research agreements.

Ground breaking ceremonies were held this year for a structure which will house an organization actively involved in developing the economy of the State—the Center for International Trade Development. CITD increased its activity significantly on the campus and around the State this year as it worked with its first complete year of an operating grant from the Economic Development Administration. The Center also received a grant from the U.S. Department of Agriculture to research the potential of high value agricultural projects.

The research faculty are actively involved in innovative and creative efforts that will enhance the recognition and reputation of Oklahoma State University as a major research institution as well as assist Oklahoma in the revitalization of its economy. Our faculty, students and staff enter fiscal year 1989 with a renewed commitment to probing the pertinent research issues which face us within each discipline. Speaking on behalf of these individuals, more than just a small part of this renewal is due to your personal commitment to strengthening the University's research program. We anticipate and look forward to the research challenges of 1989.

Respectfully submitted,



James H. Boggs, Vice President
for Academic Affairs and Research

# Oklahoma State University Research - 1988

***Although OSU and the state of Oklahoma have had to deal with a difficult economic era, the University has remained competitive in recruiting and retaining quality faculty, staff and graduate students.***

Throughout the year, Oklahoma State University continued to build on its nationally recognized and respected research program. Development of research funding, facilities, and personnel continued to be top priorities on the university's research agenda. It is a firmly held belief that development of these resources will enable OSU's researchers to continue to push back the frontiers of their disciplines in the coming century.

Research expenditures during FY 88 totalled $54.1 million for the University. An increase of 1.5 percent from FY 87, this total reflects increased federal agreements and state general support. Lower state and private agreement expenditures were experienced primarily because of the reduction in expenditures for the Noble Research Center. As competition for research funds intensifies and increases in sophistication, support for faculty researchers will need to adjust accordingly within the university and each of the colleges.

Development of world-class research facilities at Oklahoma State is a continuous process as the University seeks to provide state-of-the-art technology for efficient, advanced research. FY 88 marked the completion of the Mass Spectrometry Facility. As our cover photos and story indicate, biological and agricultural scientists, chemists, physicists, and engineers will benefit greatly from the use of this new facility. Phase I of the Noble Research Center also neared completion during the year, and ground-breaking ceremonies were held for the structure which will house the Center for International Trade Development.

Although OSU and the state of Oklahoma have had to deal with a difficult economic era, the University has remained competitive in recruiting and retaining quality faculty, staff, and graduate students. An on-going and enhanced commitment to the importance of maintaining such high quality human resources will be essential to the progress of research at OSU.

Research associated personnel changes during the year included a new director of Grants and Contracts Financial Administration, Larry Henson. Henson has come to OSU with a strong background in accounting and financial management.

Bill Sibley, Assistant Vice President for Research, began a leave of absence with the National Science Foundation at the end of FY 88. His involvement with the NSF at OSU and now in the Foundation's office is indicative of OSU's involvement in the larger scope of the research mission. A change at the helm of the University also occurred at the close of the fiscal year. Upon Dr. Lawrence L. Boger's retirement, Dr. John Campbell became Oklahoma State University's 15th president.

As we look to the future of research, innovative approaches to conducting research will be of new importance. Whatever these approaches, we must constantly seek to obtain a more clear focus of our future, anticipating the short- and long-term needs of our state, nation and world.

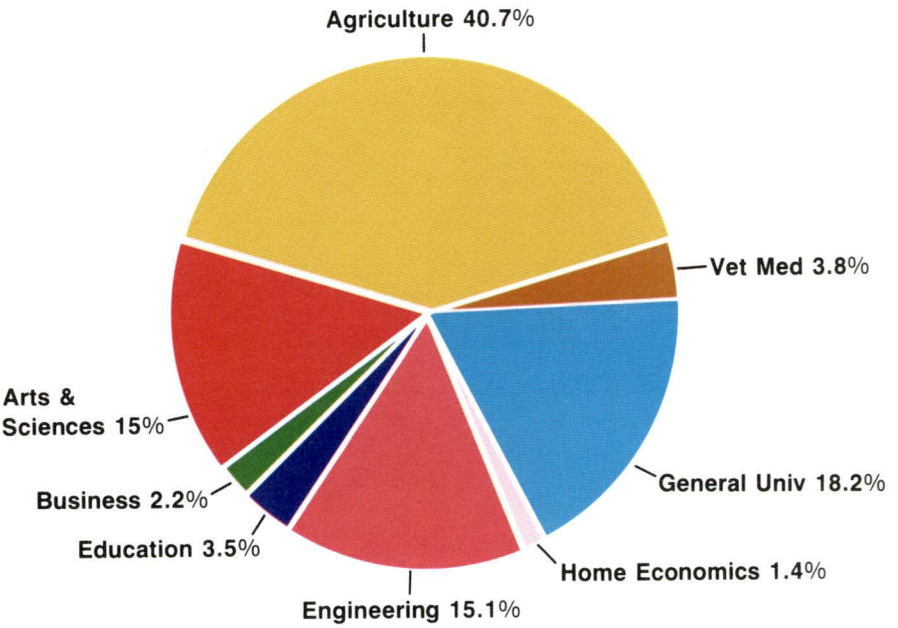
An important related function at our University is that of instilling in our young people the belief that problems are solvable. Along with developing this problem-solving mentality, it is important to help students develop a broader perspective of understanding the importance and responsibility of the individual in our society.

It is quite possible that the key to the future for our world may be the development of leadership in the technological areas and in the human resources areas, then the blending of the two. Although the reality of a global environment is inescapable and we can no longer operate without regard for impact on the world outside our national boundaries, neither can we afford to allow our sights to be spread so wide that we lose focus and direction. The better that we are able to work with this reality, the more effective our research will be.

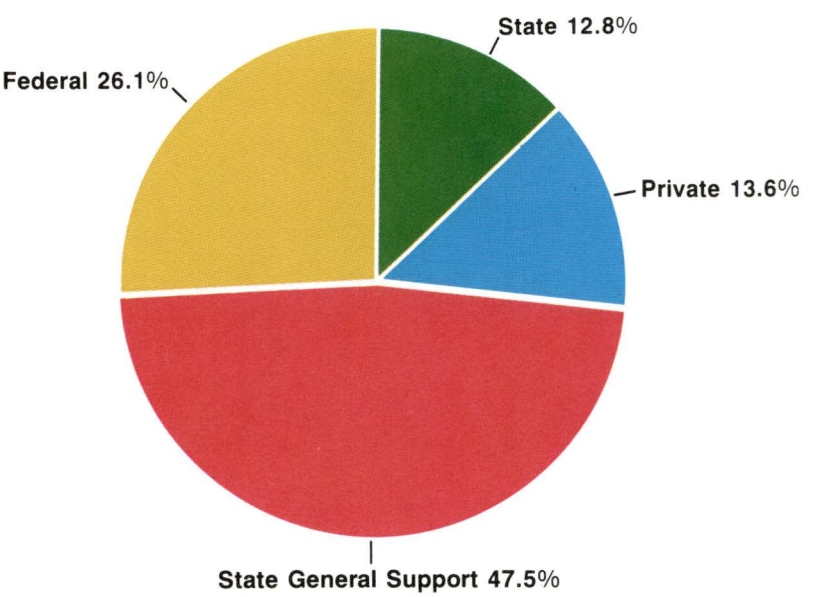
Compiled within this annual report are the abstracts of the research projects conducted by OSU researchers during FY 88. They are indicative of the expertise, curiosity, innovative thought processes and persistent ways of the research team that OSU has assimilated.

Norman N. Durham
Interim Assistant Vice President for Research

## Research Expenditures for FY 88 by College




## Research Expenditures for FY 88 by Fund Source



# RESEARCH FUND SOURCES AND EXPENDITURES BY AGENCY

## TABLE 1.

| | 1982 | 1983 | 1984 | 1985* | 1986 | 1987 | 1988** |
|---|---|---|---|---|---|---|---|
| **TOTAL UNIVERSITY** | | | | | | | |
| State (General Support) | 18,023,813 | 19,831,238[1] | 20,028,572[1] | 29,196,850[1] | 26,999,265 | 24,547,813 | 25,730,187 |
| Private Sponsors | 3,903,575 | 3,916,620 | 4,290,188[2] | 6,091,730[1] | 6,078,719 | 8,795,304 | 7,379,842 |
| Federal Sponsors | 6,845,818 | 7,336,023 | 6,181,866 | 8,565,346 | 8,558,267 | 9,351,232 | 11,196,350 |
| State Sponsors | 2,034,909 | 2,784,072 | 2,582,579 | 2,070,174 | 5,137,874 | 7,744,510 | 6,921,361 |
| **Sub-Total** | 30,808,025 | 33,867,953 | 33,083,205 | 45,924,100 | 46,774,125 | 50,438,859 | 51,227,740 |
| Federal Appropriations to the Experiment Station | 2,558,097 | 2,995,774 | 2,756,010 | 3,170,311 | 2,693,012 | 2,850,224 | 2,908,355 |
| **Grand Total** | 33,366,212 | 36,863,727 | 35,839,215 | 49,094,411 | 49,467,137 | 53,289,083 | 54,136,095 |
| **GENERAL UNIVERSITY** | | | | | | | |
| State (General Support) | 2,192,404 | 1,942,568 | 1,198,119 | 3,527,227 | 4,052,370 | 2,199,666 | 2,058,041 |
| Private Sponsors | 19,105 | 42,605 | 29,848 | 1,691,655[2] | 2,748,721[2] | 5,131,768[2] | 3,351,309[2] |
| Federal Sponsors | 519,324 | 828,425 | 515,611 | 467,807 | 837,230 | 311,604 | 721,932 |
| State Sponsors | 296,822 | 276,637 | 286,612 | 333,151[2] | 3,401,669[2] | 5,549,250[2] | 3,740,206 |
| **Total** | 3,027,655 | 3,090,235 | 2,030,190 | 6,019,840 | 11,039,990[2] | 13,192,288 | 9,871,488 |
| **AGRICULTURE** | | | | | | | |
| State (General Support) | 1,128,373 | 1,207,511 | 969,881 | 1,610,267 | 1,136,054 | 1,218,373 | 276,791[5] |
| **AGRICULTURAL EXPERIMENT STATION** | | | | | | | |
| State (General Support) | 10,725,167[1] | 11,716,926[1] | 12,688,359[1] | 15,291,907[1] | 13,950,435[1] | 13,862,735[1] | 14,999,477[1] |
| Private Sponsors | 691,782 | 825,282 | 722,413 | 808,756 | 856,014 | 980,225 | 952,711 |
| Federal Sponsors | 2,242,131 | 2,409,882 | 1,303,554 | 1,570,968 | 1,282,143 | 1,525,725 | 2,188,415 |
| State Sponsors | 325,677 | 411,221 | 396,960 | 386,322 | 386,156 | 392,803 | 716,626 |
| **Sub-Total** | 13,984,757 | 15,363,311 | 15,111,286 | 18,012,953 | 16,474,748 | 16,761,488 | 18,857,229 |
| Federal Appropriations to the Experiment Station | 2,558,097 | 2,995,774 | 2,756,010 | 3,170,311 | 2,693,012 | 2,850,224 | 2,908,355 |
| **Total** | 16,542,854 | 18,359,085 | 17,867,296 | 21,183,264 | 19,167,760 | 19,611,712[1] | 21,765,584 |
| **ARTS AND SCIENCES RESEARCH** | | | | | | | |
| State (General Support) | 986,051 | 1,515,630 | 1,402,871 | 2,792,239 | 2,661,676 | 2,344,024 | 2,623,438 |
| Private Sponsors | 580,042 | 439,360 | 476,695 | 617,798 | 814,222 | 738,254 | 1,191,470[4] |
| Federal Sponsors | 1,358,554 | 1,777,295 | 2,175,248 | 4,051,229 | 2,776,975 | 3,310,463 | 3,334,892 |
| State Sponsors | 607,317 | 794,328 | 757,457 | 523,836 | 508,249 | 820,397 | 968,588 |
| **Total** | 3,531,964 | 4,526,613 | 4,812,271 | 7,985,102 | 6,761,122 | 7,213,138 | 8,118,388 |

[1]Includes Station Sales and Other Sales & Services
[2]Includes Noble Research Center
[3]Includes Eglin AFB Project, ERF Inc.
[4]Includes Noble Foundation grants
[5]Appropriations shifted to Agricultural Experiment Station

| | 1982 | 1983 | 1984 | 1985* | 1986 | 1987 | 1988** |
|---|---|---|---|---|---|---|---|
| **BUSINESS ADMINISTRATION RESEARCH** | | | | | | | |
| State (General Support) | 378,538 | 472,508 | 462,966 | 719,238 | 605,572 | 634,398 | 678,421 |
| Private Sponsors | 85,857 | 57,969 | 87,198 | 192,393 | 110,245 | 194,169 | 153,620 |
| Federal Sponsors | 32,074 | 80,171 | 47,265 | 21,526 | 96,174 | 140,693 | 100,751 |
| State Sponsors | 131,211 | 101,588 | 188,519 | 173,788 | 201,785 | 131,574 | 264,614 |
| **Total** | 627,680 | 712,236 | 785,948 | 1,106,945 | 1,013,776 | 1,100,834 | 1,197,406 |
| **EDUCATION RESEARCH** | | | | | | | |
| State (General Support) | 678,185 | 729,973 | 774,262 | 1,021,516 | 827,218 | 1,129,774 | 1,240,905 |
| Private Sponsors | 237,895 | 227,211 | 193,494 | 47,374 | 33,866 | 29,930 | 4,951 |
| Federal Sponsors | 282,959 | 348,274 | 466,429 | 363,356 | 292,866 | 521,776 | 590,347 |
| State Sponsors | 174,805 | 43,096 | 58,221 | 12,391 | 52,845 | 51,906 | 76,450 |
| **Total** | 1,373,844 | 1,348,554 | 1,492,406 | 1,444,637 | 1,211,009 | 1,733,386 | 1,912,653 |
| **OFFICE OF ENGINEERING RESEARCH** | | | | | | | |
| State (General Support) | 1,192,057 | 1,373,749 | 1,574,518 | 2,790,616 | 2,373,703 | 1,800,781 | 2,217,416 |
| Private Sponsors | 2,224,357[3] | 2,255,437[3] | 2,695,184[3] | 2,585,619[3] | 1,439,565 | 1,428,121 | 1,391,848 |
| Federal Sponsors | 2,057,787 | 1,565,934 | 1,316,300 | 1,504,655 | 2,899,527[3] | 3,201,289[3] | 3,733,136[3] |
| State Sponsors | 471,637 | 949,568 | 817,407 | 593,916 | 557,945 | 483,402 | 850,364 |
| **Total** | 5,945,838 | 6,144,688 | 6,403,409 | 7,474,806 | 7,270,740 | 6,913,593 | 8,192,764 |
| **HOME ECONOMICS RESEARCH** | | | | | | | |
| State (General Support) | 293,697 | 346,038 | 386,072 | 524,321 | 564,555 | 533,236 | 445,442 |
| Private Sponsors | 10,554 | 4,512 | 12,362 | 74,855 | 52,779 | 104,530 | 91,194 |
| Federal Sponsors | | | | 20,180 | 96,848 | 10,538 | 38,624 |
| State Sponsors | 27,390 | 37 | 793 | 14,818 | 2,112 | 143,735 | 184,952 |
| **Total** | 331,641 | 350,581 | 399,227 | 634,174 | 716,294 | 792,039 | 760,212 |
| **VETERINARY MEDICINE SURGERY RESEARCH** | | | | | | | |
| State (General Support) | 449,341 | 526,335 | 571,524 | 919,519 | 823,468 | 824,826 | 1,190,256 |
| Private Sponsors | 53,983 | 64,244 | 72,994 | 73,280 | 23,307 | 188,307 | 242,739 |
| Federal Sponsors | 352,989 | 326,042 | 357,459 | 565,625 | 276,504 | 329,144 | 488,253 |
| State Sponsors | | 207,597 | 76,610 | 31,952 | 27,113 | 171,443 | 119,561 |
| **Total** | 856,313 | 1,124,218 | 1,078,587 | 1,590,376 | 1,150,392 | 1,513,720 | 2,040,809 |

*Denotes change to NSF guidelines accounting procedures

**Unrecovered IDC and cost share calculated from GCFA documents

(Not an audited report)

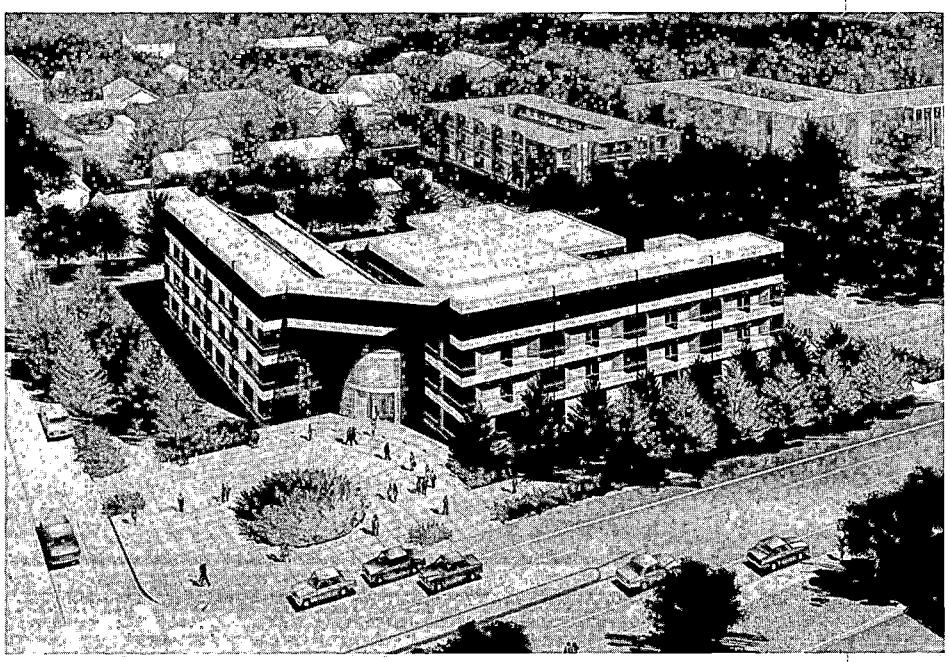
individuals previously mentioned, a coordinator of International Business Services and other staff are available to assist firms coming to campus to utilize the personnel and information resources of the University. This office provides a point of contact, campus workspace and selected basic services for public assistance and performs other coordination and referral functions.

More specifically, many OSU/CITD outreach and assistance programs have been designed to make key contributions to Oklahoma's international economic development and to establish Oklahoma State University as a key participant in this important state goal. These programs and the underlying philosophy are described below.

Like every other state in the Union, Oklahoma is taking seriously the challenge of competing successfully in the global marketplace. Like most other states, Oklahoma is in a critical growth stage in its international economic development. The availability of assistance resources for companies to draw upon is vital to this growth. The CITD was created to operate as a sort of bridge, making the resources of OSU available to companies in the state. Its two main objectives are providing company tailored direct assistance and providing for corporate professional and staff development.

The CITD tailors university resources to meet the needs of companies who are just venturing into export markets, or who have experience in exporting and have identified a specific need that the CITD might serve. The relationship between companies and the CITD is based on two premises: "Hand-Holding" and "Shared Commitment." These are simple terms, and they convey to company management the type of working relationships CITD wants to develop.

"Hand-Holding" simply means OJT: on-the-job-training. CITD cannot, and does not wish to, provide the same service as private sector consultants or other service firms. Our goal is to lead a company through an intracompany export development process, then on to work with other companies who are at the beginning of their learning curves. This strategy necessitates a "Shared Commitment" on the part of companies in the form of personnel and financial resources. The Center can work most effectively with companies that are committed to building an export department and will particiate actively in the services CITD is providing. Assigning a manager (or managers) for training and allocating budgets for international expenses is an indicator of a company's management commitment.



*An architect's rendering visualizes the new Center for International Trade Development building. The ground-breaking ceremony for the building was held April 22, 1988.*

**Programs and Services**

To meet our first objective, providing company tailored direct assistance, CITD staff have created several basic programs that can be refined and tailored to fit the defined needs of each individual company. The International Business Development Program (IBDP) is a comprehensive package of services and programs that can expand a company's activities into global markets. IBDP utilizes each of the other CITD programs, where appropriate, to meet a company's needs and goals. It begins with an evaluation of the company's international potential. This includes 1) an analysis of company and product strengths and weaknesses, and 2) an analysis of the company's current sales programs, marketing philosophy, product mix, pricing and promotion plans. The second phase of IBDP is working with the company to help them develop an international marketing plan. Through programs such as the International Market Research Program (IMRP) and other services, CITD staff help the company identify target markets and strategies for entry into those markets. The third phase of IBDP, professional management and staff development, is vital to the ongoing growth of the company's new export department. This involves one-on-one workshop or certification training in international business management and exporting operations skills.

The first questions most companies pose are "do my products have export potential?" and "where?" The International Market Research Program (IMRP), mentioned above, is expressly tailored to fit the market research needs of either the novice or the experienced exporter. A CITD staff member meets with the company to determine research needs, the parameters of the proposed study, and the availability of the resources necessary for conducting the study. The study can be as broad as a general overview of market possibilities world-wide, or as specific as studying market potential and entry strategies for specified products in a single target market. Such studies are coordinated through the OSU College of Business MBA Program or through the College of Agriculture, as is explained later. Mar-

ket research teams generally consist of two or three second-year MBA students under the supervision of a faculty member and the CITD company contact. Emphasis is on professionalism and usefulness to the company in decision-making.

Because most companies' activities have been confined to the United States, there may be a need for assistance in adapting their products to international markets and assessing their competitive manufacturing position. CITD coordinates this type of assistance through the Extension Office of the OSU College of Engineering, Architecture and Technology (CEAT). The international specialist in the CEAT Extension Office works in areas of product adaptation: metrication of products and product literature; adaptation to foreign standards and specification; adaptation to foreign market needs; packaging products for international markets; and diversification of product use. Second, he can healp evaluate the need for process adaptation: cost-effective manufacturing for special international needs; analysis of competitive position; and use of manufacturing technologies that increase quality, service and competitiveness. This program also is implemented through the interfacing of company personnel with the CEAT international specialist, faculty, and graduate students.

Agriculture is vital to Oklahoma economics. The Agriculture Resource Program is coordinated through the College of Agriculture's international specialist, and can be designed to assist agribusiness, producers of food products, and growers in assessing the potential of their products for sales in overseas markets. In the area of product development and adaption, studies can be conducted to help identify commodities in demand overseas; identify "value-added" food products with foreign market potential; determine needs for adapting food products to meet international tastes and diets; and identifying Oklahoma-made agriculture equipment that fits international needs. Market research studies are conducted through the College of Agriculture in much the same way as the IMRP in the College of Business.

**Supporting Services**

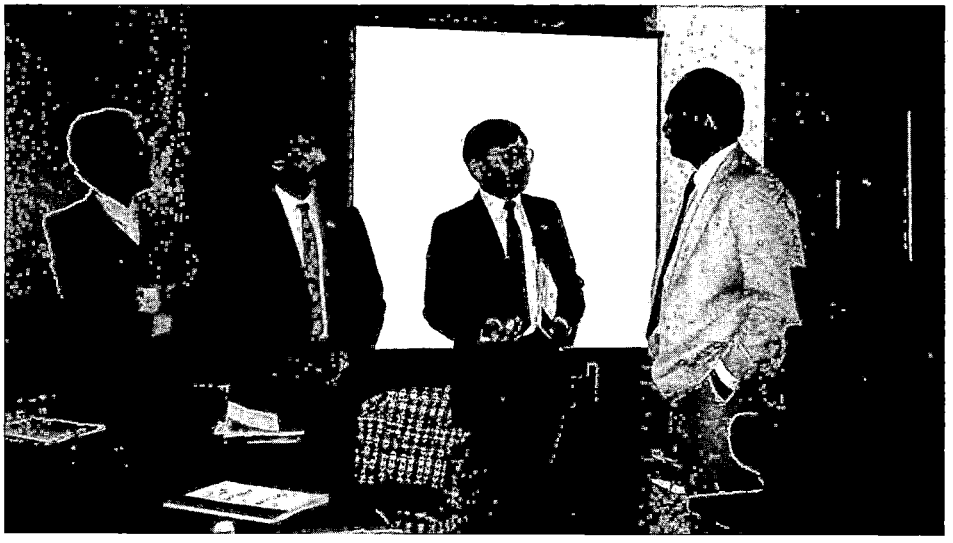
There are other services CITD is providing as opportunity or need arises. Many of these serve a function of informing companies about specific international topics. Examples are the Business Practices Series—an overview of "doing business in . . . " a certain country; Data Sheets—brief summaries on topics such as international standards, international accounting, and doing market research through the Department of Agriculture; and an Oklahoma Export Services Directory which lists Oklahoma firms such as banks, freight forwarders, law firms, export management companies, and translators who provide services exporters may need at one time or another.

Another major service being provided by CITD is the Oklahoma Target Industries Study Program. This involves the study of the international market potential for product categories in ten major industry groups in Oklahoma. There will be sixteen mini-market reports produced that will include information on market size, industry profile, end-user analysis, marketing/distribution, and market environment. The reports will then be provided to Oklahoma companies who produce these identified products as well as other members in the Oklahoma international assistance network. Assistance will be offered to those companies who would like to utilize this information to develop market entry strategies and establish sales in the targeted countries.

**Professional and Staff Development**

Our second objective is provision of programs for professional and staff development. Integral to all of these programs and services is the training of company personnel in the "internal" and "external" facets of exporting either on an individual company basis or on a public workshop basis.

The Culture/Country Orientation Program is designed to provide preparation for middle- and top-level managers who will be travelling or living abroad. CITD relies on resources from the College of Arts and Sciences, such as the Department of Foreign Languages and the Center for Global Studies, to furnish this type of expertise. An orientation could include learning about social and economic conditions, achieving a basic proficiency in the use of host-language phrases, and understanding basic cultural influences and social/business etiquette. Some insight into the business environment and training for cross-



*Ravi Kumar, Rajkumar Kesarimall, and Soo Peng Ng, second-year MBA students at OSU, visit with a Tulsa businessman after presenting their findings and recommendations on an International Market Research Project (IMRP) for the Tulsa company. The student group, advised by Dr. Raymond W. LaForge, helped the company determine its potential and develop strategies for its products in specific overseas markets. This research service is a collaborative effort between the OSU Colleges of Business Administration and Agriculture and the Center for International Trade Development. CITD provides resources, facilities, and a research budget for each team of graduate students and advisor to coordinate and conduct the project. During the Spring '88 semester, four IMRPs were conducted.*

- Transport of eroded soil particles, and;
- The incorporation of risk into the design of water resources facilities.

The Water Research Center (WRC), established by the Oklahoma State Regents of Higher Education in 1979, receives state appropriations to fund projects through a state "center of excellence" in water research. In 1988 the WRC supported twenty-two projects which examined a number of problems. These included:

- The economic aspects of water supply management;
- Ground water quality impacts associated with pesticide use in Oklahoma;
- Public education concerning water issues; and
- Development of assays and monitors that can test for agents in water which can cause birth defects.

Also funded through the Water Research Center is the Water Resources Presidential Fellowship Program. This program encourages nationally competitive graduate students to attend Oklahoma State University and work in a water resources discipline. In 1988, the Fellowship program supported ten students in six different disciplines. The results of the program have been excellent and the support of quality graduate students and their work brightens the future for us all.

The National Center for Ground Water Research (NCGWR) is an Environmental Protection Agency consortium comprised of Oklahoma State University, University of Oklahoma, and Rice University. Established in 1979, the purpose of the NCGWR is to focus global and national attention on the importance of ground water, to train future scientists, and to establish methods and a data base for protection and management of the nation's ground water. The NCGWR has continued the funding of three projects at OSU during 1988. The projects involve:

- Development of techniques for determining the metabolic status of subsurface organisms;

*The potential for shallow ground water contamination by agricultural chemicals such as fertilizers and pesticides is of increasing concern to water resource managers. The UCWR is currently sponsoring three research projects in this area.*

- Use of Fourier Transformed Infrared Spectroscopy (FTIR) in the study of fundamental chemical and physical properties of ground water aquifers; and
- Implementation of chemical transport and fate models as decision aids.

The University Center for Water Research is engaged in several projects to further assist water research efforts. The UCWR newsletter, *Ripples*, has enabled us to communicate the activities of water researchers at OSU, current events in water research, and items of interest. Special publications are also produced on a periodic basis presenting information on reports and articles available from the office and faculty.

The University Center for Water Research continues to function as a contact in the state for quality research and information. Through continued communication with state and federal representatives, faculty, scientists, legislators, and private enterprise, the University Center for Water Research is forwarding information essential to sound water management.

# The University Center For Energy Research

***ICER supports energy-related research programs and encourages the organization of inter-disciplinary activities.***

Energy production has been inextricably tied to the economic health of the United States for the past 75 years. This is even more evident for Oklahoma and surrounding states that have experienced violent fluctuations in prosperity as the price and availability of energy resources surge up and down. The University Center for Energy Research (UCER) was created in 1979 to attack the complex problems in the energy field using a multi-disciplinary approach.

UCER supports energy-related research programs and encourages the organization of inter-disciplinary activities. Proposals for funding are submitted to UCER in March of each year. The proposals undergo an external peer review process with final selection of projects to be funded made by the Director and the Advisory Committee. Selected projects are conducted in various departments and colleges with seed money from UCER. This seed money enables faculty to develop a sound knowledge base in their research area which will enable them to generate additional funding within two or three years. The projects support students, post-doctoral research associates and the procurement of state-of-the-art equipment.

**1987-88 Projects**

Fourteen projects were selected for funding by UCER for the 1987-88 fiscal year. State-of-the-art equipment pur-

*Dr. E.M. Holt and graduate student Bao Xiao Hua prepare to photograph a solid state material. This procedure will be used to determine the three-dimensional ordered structure of the material.*

*Dr. Barbara Stoecker and Marie Campbell prepare to work with the atomic asborption spectrometer with graphite furnace. This instrument is used to measure trace minerals in tissue samples.*

chased through UCER funding was instrumental to research in many areas including laser spectroscopy studies on harmonic converting materials used in controlled fusion research involving rubidium ammonium dihydrogen phosphate and the role of chromium as a trace mineral in energy metabolism. Research on the future of energy in relation to Oklahoma examined the potential effects of technological change on the state's oil industry. This project focused on whether improved methods of recovery can have a significant impact on the Oklahoma economy and on how Oklahoma can use its energy resources as a basis for diversifying its economy. UCER support contributed to the establishment of a link between industry and the university in the area of hazardous material/waste management. The Center also served as the focal point for the receipt of substantial external funding for hazardous waste research. Development of a Center for Hydrogeologic Training was established with partial support provided by UCER. Other projects addressed diverse areas such as thermochromic complexes of copper, design and improvement of thermal storage tank inlets, thermal diffusivity of sedimentary rocks (temperature and stress dependence), determination of slagging potential for blended coals, the development of the boundary elements methods to analyze the storage of gaseous matter in salt domes, improved quality of continous flow process manufacturing through merging of statistical process control (SPC) and conventional computer process control (CCPC), seismic signal analysis related to lithology (numerical modeling), denitrogenation of liquid fossil fuels, and transport properties for continuous mixtures.

**Services**

Faculty have contributed through individual research programs, seminars, journal articles, and a report "Review of Oklahoma Energy Resources and Policy." This comprehensive treatment of energy in Oklahoma provides background information over the years 1972 to the present. UCER strives to promote awareness by sponsoring symposia and providing information on energy to the public.

# Oklahoma Agricultural Experiment Station

***"For out of olde feldes, as men seith, Cometh al this newe corn fro yeer to yere; And out of olde bokes, in good feith, Cometh al this newe science that men lere." Geoffrey Chaucer, 1340(?)-1400.***

*"For out of olde feldes, as men seith, Cometh al this newe corn fro yeer to yere; And out of olde bokes, in good feith, Cometh al this newe science that men lere." Geoffrey Chaucer, 1340(?)-1400.*

Writing some 600 years ago, Chaucer alluded to the wonders of agriculture as a renewable natural resource. What is remarkable about his passage is that he also alluded to another renewable natural resource—the human kind.

The combining of these two resources has resulted in our modern system of agriculture, and in particular, our modern system of agricultural research to, "provide newe science that men lere." Researchers working for the Oklahoma Agricultural Experiment Station (OAES) are continually seeking ways to expand on our renewable natural resources with the least amount of disturbance to the environment in which we live.

In fact, many OAES studies currently underway work to improve the environment in which we live and produce our food and fiber. One such example is that of agricultural engineers studying the effects of runoff from natural sources, such as rainfall, and from irrigation practices.

The researchers have constructed a unique facility—completely under roof—that makes its own rainfall and comes equipped with its own soil to be eroded. The device is used to measure the underlying physical processes involved in erosion. It can be used to gauge the amounts and types of chemical and sediment residues the moving water contains.

Other agricultural engineers are working to produce computer models predicting how much runoff can be expected on various soils as a result of rainfall. But realizing that nature is always dynamic, and thus full of variability and uncertainty, the scientists are incorporating uncertainty into their model. The idea is to give decision makers estimates of erosion damage that will be realistically closer to what they will encounter in life.

OAES plant pathologists have made progress in developing a system that uses naturally occurring beneficial soil fungi to combat harmful soil fungi. These beneficial fungi are called biocontrol agents, and they produce antibiotics which control other fungi, or they attack other fungi directly.

By alternating the use of these biocontrol agents with chemicals, or integrating them with low rates of chemicals, they are gaining on controlling southern blight, a disease which attacks peanuts, potatoes, tomatoes, cantaloupe and even apple seedlings.

Seed priming is another trick developed by OAES horticulturists and plant pathologists working in conjunction with USDA researchers. Using special chemicals, the scientists bring seeds to the point of germination, then stop the process and dry the seeds. When these are planted in the soil later, they immediately begin germination, resulting in a more uniform crop for harvest, and shooting the seedling out of the soil before harmful fungi can arrest germination processes.

Not all of the science used by OAES scientists comes, "out of olde bokes," as Chaucer said. Much of it goes into

new books to enable future scientists to use their renewable natural resources. Very basic science is involved in a plant pathology study to prevent the "uncoating" of plant viruses.

Researchers have learned that if a plant is infected by one strain of a virus, the exposure can protect the plant from infection by another strain of the same virus. This process is referred to as cross protection. A virus must "uncoat" or shed its outer layer before it can begin the first stages of infection. OAES researchers have shown that the inhibition of this uncoating step using cross protection prevented tobacco mosaic virus from infecting an inoculated plant.

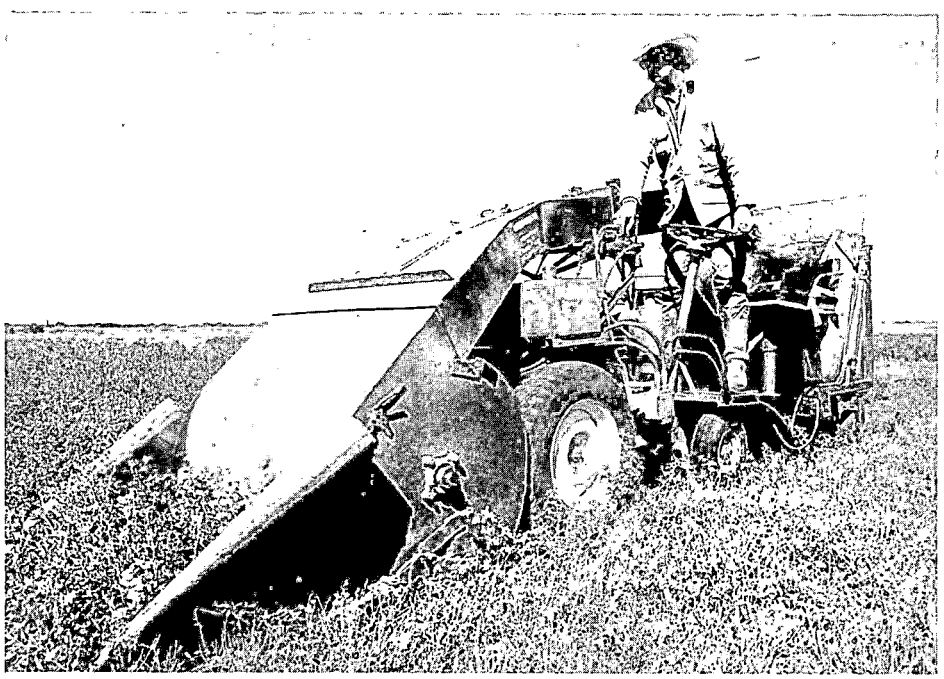
Basic science certainly isn't limited to the plant world within the OAES. Our entomologists are working with the very cells and their functions within a tick salivary gland. Salivary glands are pretty important to ticks, which use them to produce secretions cementing themselves to hosts, and to help take the blood meal they must have to reproduce.

Working with biochemists, veterinary medicine researchers and zoologists, the OAES entomologists have concentrated their efforts on the cellular controls of things that pass into and out of this all-important gland. They believe that most, if not all, tick-borne diseases are passed via this gland, and that if its actions can be inhibited, so will its feeding, reproduction and disease transmission.

OAES entomologists are also working closely with agronomists to seek more information about the greenbug, a major pest in Oklahoma wheat crops. Recent steps completed in this work show that the cuticular hydrocarbon profiles—a waxy outer layer on greenbugs and other aphids—have characteristic mixtures of components. It turns out that these are a species characteristic.

What is unique about the OAES work is that the scientists are finding characteristics between biotypes normally seen only in species differences. They are adapting this knowledge to define biotypes quickly. Previously, they had to grow out plants and see which bugs attacked them in order to determine biotypes.

Cooperative efforts between areas of science is a growing trend in the last couple of decades, and as has already been noted, OAES scientists are working together to concentrate fields of expertise on a problem. Another example is that of agronomists working with horticulturists to develop a cold-tolerant, seed-propagated bermudagrass suitable for use on golf fairways.



*Randy Boldt, field assistant for the South Central Research Station at Chickasha, uses a small plot harvester on alfalfa. Alfalfa varieties are tested here for resistance to pests, drought and disease.*

OAES agronomy researchers recently developed Guymon, a bermudagrass variety that is excellent for pasture use and is seed-propagated and cold-tolerant. But its texture was not suitable for the golf industry.

Using conventional plant breeding techniques, tissue culture and basic physiological studies learned in developing Guymon, the researchers have made significant progress in increasing the seed producing capabilities of the populations now being screened. They have been successful in increasing turfgrass characteristics such as sod density and smooth leaf texture. These characteristics are desirable by the lawn and recreation industries.

Grass release is the goal agronomic researchers aimed for when they developed practical and safe methods to burn pastures for red cedar control. This tree grows all over Oklahoma, spreading almost as fast as weeds. While it is hardy against chemicals and expensive to control that way, it is susceptible to fire.

Research results have been so effective at economically controlling this nuisance that now extension personnel have joined with industry to put on "cedar rodeos" to demonstrate control methods. The result has been and will continue to be lots of state pastures opened up for grazing.

OAES animal scientists are also cooperating with 13 other experiment stations across the country in a project to define the energy requirements of the modern, high-producing sow. The larger litters and higher milk production required of the high-producing sows means their nutrient requirements are higher, but it doesn't take long for a producer to overfeed them, wasting money. Results thus far show that the sow should be fed more during late gestation—from about day 90 after breeding to day 114.

This short period of extra feeding means a lot toward increasing the reproductive performance of the animal. Large numbers of sows and litters were required to provide the statistical information for this study. By banding together with other state experiment sta-

tions, some 1,080 litters have been included, far more that could have been managed by any one university.

Animal scientists at OAES also used pigs for a remarkable study looking at the absorption of cholesterol in their bloodstreams due to consumption of a sweet acidophilus bacteria. Available commerically in certain brands of milk, this bacteria helps lactose malabsorbers to digest lactose, or milk sugar.

When the researchers noticed that the organism absorbed cholesterol directly from an agar in a petri dish, they decided to try it on pigs. The result was that pigs receiving high amounts of cholesterol in their diets had lower blood serum cholesterol levels if fed the bacteria than those which had not received it.

The OAES joined efforts with the U.S. government to establish a vegetable growing industry in southeastern Oklahoma. The creation of the Wes Watkins Agricultural Research and Extension Center has already produced results for vegetable growers in this area.

The station, located near Lane, has become a showcase of agricultural possibilities for southeastern Oklahoma. One of its most unique features is the fact that researchers work on the site and live near the area. This provides an opportunity for expertise in horticulture, plant pathology and entomology to be concentrated in joint projects.

*Billy Webb, left, superintendent of outlying research stations for the Oklahoma Agricultural Experiment Station, demonstrates the short tap root of a cotton plant stunted by an impervious layer of compacted soil. Larry Bull, right, foreman of the Sandyland Research Station at Mangum, demonstrates a more robust plant and its longer tap root that found a way through the compacted layer.*

Cooperation among scientists, departments, universities and even countries is obviously on the increase and paying dividends. The OAES is actively progressing in agricultural science, and is active in sharing its learned knowledge and cooperating in efforts from which, "Cometh al this newe science that men lere."

# Agricultural Economics

### Economic Evaluation of Transportation Alternatives for Wheat and Feed Grain

Assess the role of transportation in marketing and pricing Oklahoma grains during the 1980s. Determine grain production and off-farm sales by county for Oklahoma. Determine optimal grain flow patterns under Oklahoma's existing transportation infrastructure and analyze the effect of anticipated change in supplies of transportation services. Determine changes in the availability of nature of transportation services which have significant economic impacts on producers, merchants, and shippers of grain in Oklahoma. (1782)

*Makus, L. D.*

### Understanding and Evaluating Effectiveness of Livestock and Meat Market Systems

Determine demand changes for meat and implications therefrom. Identify causes and consequences of structural changes in meatpacking. Evaluate price reporting system for meat. Identify performance conflicts between livestock industry segments. (1791)

*Russell, J. R.* and *Ward, C. E.*

### Economics of Improving Productivity in the Livestock-Meat Systems in the South

Analyze changes in supply and demand for livestock, meat, and meat products and the impact of these changes on the Southern Region. (1843)

*Trapp, J. N.*

### Alternative Management Strategies and Systems for Oklahoma Beef Products

Determine the economic feasibility of alternative beef stocker and cow-calf enterprises by considering pasture production variables, decision variables affecting breeding, calving, and lactation performance of cows and genetic variables. Develop normative and positive assessments of strategies which beef farmers and ranchers on selected kinds of resource units can use to maximize expected income under projected beef price and production conditions. Develop procedures and tools to assist farmers to use the simulators and other results from the project to improve the quality and timelessness of their decisions. (1851)

*Walker, O. L.*
*Frahm, R. R.*
*Lusby, K. S.*
*Horn, G. W.*
*McMurphy, W. E.*

### Improving Livestock Management Decisions Involving Risk and Forecasting

Develop improved decision-making methods for Oklahoma livestock producers. Develop forecasting/decision procedures for making optimal brood cow culling and replacement decisions. Determine the impact of forecasting error upon optimal brood cow culling and replacement decisions. Evaluate alternative forecasting methodologies that recognize the decision maker's purpose in using forecasts and develop forecasting/decision models for stocker marketing decisions. (1857)

*Trapp, J. N.*

### Analysis of Factors That Influence Soil Conservation Adoption in Oklahoma

Identify factors that influence soil conservation adoption decisions in Oklahoma. Determine the economic and institutional variables that promote or impede the adoption of soil conservation measures such as windbreaks, terraces, and conservation tillage. Analyze the impact of reduced soil loss through management practices on agricultural land values. (1858)

*Lee, L. K.*

### Economics of Risk Management Strategies for Agricultural Production Firms

Identify and quantify various sources of risk affecting the behavior and survival of farm firms. Identify, analyze, and evaluate production, marketing, and financial strategies which farmers use or can use in risk management programs. (1863)

*Mapp, H. P.* and *Walker, O. L.*

### Analysis and Forecasting of Price and Quantity Relationships for Selected Grains

Analyze and forecast price and quantity relationships for wheat and feed grains. Determine economic and government policy variables that influence prices, production, disappearance, stocks, and trade. Construct forecasting models that can be used to forecast prices and analyze policy impacts. (1865)

*Tilley, D. S.*

### Impacts of the Changing Structures of Financial Markets on Agricultural Finance

Determine optimal agricultural lending levels, from the viewpoint of the lender, for various financial institutions. Evaluate alternative farm and ranch risk management strategies with emphasis on financial risks. Evaluate the potential of new and innovative debt and equity finance systems and instruments. (1866)

*Plaxico, J. S.*

### Performance of U.S. Grain Marketing Systems in a Changing Environment

Improve the efficiency of the marketing and production system for exporting grain through an evaluation of responses of the U.S. grain marketing systems to domestic and international policies which influence and are influenced by changing world economic conditions. (1869)

*Oehrtman, R. L.*

### Impact Analysis of Federal Estate and Gift Tax Laws on Oklahoma Farmers

Identify and evaluate alternate estate planning strategies which are available to Oklahoma farm and ranch operators. Determine the goals of Oklahoma farmers in developing estate plans including minimization of estate taxes and maintenance of business continuity. Evaluate the advantages and disadvantages of using alternative estate planning tools under current tax laws. Analyze the potential impact on transfer costs for Oklahoma farm estates of using the formula and factor methods of actual use valuation compared to fair market valuation. (1897)

*Tilley, M. L.*

### An Economic Analysis of Fruit and Vegetable Production in Oklahoma

Determine the economic feasibility of producing fruits and vegetables in Oklahoma. Estimate land, capital, and labor requirements and costs associated with selected fruit and vegetable crops under a variety of management strategies. Determine the potential of fruits and vegetables for supplementing the income of small and/or part-time farmers. Determine the potential of adding fruit and/or vegetable production to the traditional crop and/or livestock farms to utilize underemployed labor, machinery and/or land or to supplement and/or stabilize income. Provide information to assist producers and financial lenders in determining the potential cash flows and risk levels associated with fruit and vegetable production. (1905)

*Schatzer, R. J.*
*Motes, J. E.*
*Kahn, B. A.*
*Taylor, G. G.*

### Impacts of Alternative Methods of Sewage Effluent Disposal

Analyze innovative and alternative methods of treating municipal sewage effluent in terms of the economic impacts on Oklahoma farmers and municipalities and the effects on the environment. Estimate benefits and costs of selected innovative and alternative (I&A) methods of handling sewage effluent, other than land application. Analyze the economics of the I&A method of land application of municipal sewage effluent specifically in a crop irrigation or pasture system designed to increase agricultural

roduction while providing adequate treatıent of the effluent. Analyze the likely longərm economic and environmental effects of ınd application of sewage on the soil and n future soil productivity. (1906)

*'adger, D. D.*

**ffect of Changes in the U.S. gricultural Transportation System**

Evaluate the major determinants of transortation rates for agriculture, including the ffects of carrier costs, competition among nd within modes, and changes in regulaory status. Evaluate the effects of changes ı rate determinants on the performance of ıe transportation system and users of gricultural transportation services. Evaluate lternative responses and strategies for sers of agricultural transportation within a hanged transportation environment. Evalute the distribution of benefits and costs of lternative transportation policies, including ser charges, taxation and subsidy, investıent/disinvestment in transportation, and ublic and private ownership. (1907)

*lakus, L. D.*

**stimate Level/Time of Major Price eversals to Improve Agricultural larketing**

Improve the ability of livestock and grain roducers to improve the timing of their marəting decisions. Identify the timing of terms the market and determine the ability of ɔlected techniques to predict the time and ıagnitude of significant changes in cash ıd futures prices. Determine the potential the techniques to improve profitability ıd/or reduce risk of the marketing program. 910)

*ranzmann, J. R.*

**lanning Community Services for ural Oklahoma Communities**

Determine and develop economic tools at will improve the allocation and efficiency public community resources used to prode services by updating and developing ıdditional budgets for rural community serves. Improve service usage and revenue ɜtimation procedures. Improve ability to ɛliver economic budgets as well as other ols, such as optimum location and routing. valuate whether economies of size exist. 921)

*oeksen, G. A.*

**rogramming Optimum Investments Rural Community Water Services**

Expand and apply methods of investent programming to rural community water ervices in Oklahoma. Review and apply ternative ways of estimating benefit funcıns for rural water services. Evaluate, odify and apply water services. Evaluate alternative methods of financing rural water services for economic and social efficiency of resource use. Construct microcomputer models for assisting rural planners in decisions of investment and financing of rural water services. (1933)

*Schreiner, D. F.*

**Economic Evaluation of Irrigation and Tillage Practices in Western Oklahoma**

Identify, for predominant soil types in western Oklahoma, a set of most promising irrigation technologies and tillage practices farmers can adopt to increase water efficiency for current and possible future crop alternatives. Estimate costs and returns per acre for each crop alternative (CA), irrigation technology (IT), tillage practice (TP) identified. Develop economic model to evaluate flexibility of CA patterns, IT and TP and determine combinations which will maximize net returns to irrigation operator. Evaluate investment strategies farm operators can use in areas where underground aquifers are nearing economic exhaustion. Analyze and evaluate the importance of risk on cropping patterns, IT and TP adopted by farm operators. Evaluate public policy actions such as cost sharing of water conserving technology, which could reduce water use and lengthen the economic life of the water supply while encouraging economically efficient utilization of water. (1937)

*Mapp, H. P.*

**Allocation and Utilization of Oklahoma Water: High Plains**

Develop information for use by water policy decision makers and farmers as they make decisions concerning the encouragement and adoption of water-saving techniques. Document the technical feasibilities of irrigation techniques, which have application in High Plains Region of Oklahoma and elsewhere. Develop estimates of costs and returns for these techniques under varying assumptions of input, prices, crop prices and agronomic situations. Conduct comparative analyses of economic feasibilities of these new irrigation techniques and existing well understood techniques. Estimate the impacts on local economies and on state economy of adoption of the irrigation techniques considered by farmers. (1941)

*Nelson, J. R.*
*Bernardo, D. J.*
*Welsh, M. P.*

**International Financial System Impacts on Major Agricultural Markets**

Determine economic variables that influence foreign exchange rates, agricultural trade financing, international private and public debt, the balance of payments and international reserves. Develop a theoretical relationship between the international financial system and trade in major agricultural commodities. Develop forecasting models that private and public commodity market analysis may employ to forecast the impact of changes in international monetary variable on markets for major agricultural commodities such as wheat and beef. (1944)

*Henneberry, D. M.*

**Feasibility of Processing Vegetables in Southeastern Oklahoma**

The overall objective of the project is to determine if vegetable and/or fruit processing is feasible in Southeastern Oklahoma. (1947)

*Tilley, D. S.* and *Schatzer, R. J.*

**Economic Analysis of Emerging Agricultural Production Technologies for Oklahoma**

The overall objective of this project will be to estimate the impact of emerging agricultural production technologies with application to Oklahoma on farm family income, utilization of resources, and income variability. (1948)

*Epplin, F. M.*

**Timely Financial Analysis of Oklahoma Farms and Ranches Using Illustrative Farms**

The overall objective of this project is to develop and use descriptions of a set of farms illustrative of the diversity in Oklahoma. These illustrative farms will provide a data base for use in making recommendations to Oklahoma farmers when economic conditions change. (1949)

*Kletke, D. D.*

**Economics of Selecting Swine Production-Marketing Systems and Strategies**

Identify and evaluate records, budgets, and other production-marketing planning tools and techniques used by swine producers. Develop, adapt, and evaluate microcomputer management programs that incorporate economic theory into the production-marketing management decision process for swine producers. Determine the impact of proposed changes in tax laws on the swine-pork industry relative to the beef and poultry industry and identify optimal tax management strategies for swine producers. Identify strategies that enable swine producers to operate in an environment of production and price uncertainty. (1952)

*Williams, J. E.*
*Tweeten, L. G.*
*Ward, C. E.*

**Economic Analysis of Electronic Agricultural Communication Systems: Feasibility and Impacts**

The overall objective of this project is to determine the feasibility of alternative applications of electronic communication systems in agriculture and to estimate potential impacts on technical and pricing efficiency of the agricultural marketing system. (1969)

*Russell, J. R.*
*Anderson, K. B.*
*Henneberry, D.M.*
*Ward, C.E.*

**Structural/Operational Efficiency of Fruit and Vegetable Production-Marketing**

The overall objective is to promote efficiency in the fruit and vegetable production-marketing system through generation and provision of information to enhance the decision-making process of producers and marketers. (1971)
*Schatzer, R. J.* and *Tilley, D. S.*

**Economic Analysis of Farm Program Alternatives**

Identify existing estimates of supply and demand elasticities for major crops. Reestimate key supply and demand elasticities for wheat, corn, and other major U.S. crops using improved equation specifications and/or using more recent data. Develop a microcomputer-based agricultural policy model with wide applicability for policy analyses. Simulate the impact of combined effects of elasticity magnitudes, stochastic production influences and alternative farm policy philosophies on farmers, consumers, and taxpayers. (1972)

*Ray, D. E.*

**A Systems Approach to the Economic Analysis of Oklahoma's Beef Production Sector**

Analyze selected forage management decisions faced by Oklahoma cattle producers. Determine the economic feasibility of various beef stocker and and cow-calf enterprises by considering the effect of their adoption on producer profitability and survivability. Identify efficient cattle production systems under alternative production settings and economic conditions. Estimate the impact of alternative production systems on farm income availability. (1980)

*Bernardo, D. J.*

**Financing Agriculture in a Changing Environment: Macro, Market, Policy, and Management Issues**

Evaluate the ability of private sector financial markets to supply debt and equity capital and related financial services to the agricultural sector. Describe and evaluate financial policies and credit programs for agriculture at federal and state levels. (1988)

*Plaxico, J. S.*

**Water Management and Conservation in Western Irrigated Agriculture**

Develop and evaluate alternative on-farm irrigation technologies and management strategies. Assess the state, regional and national economic impacts of alternative irrigation technologies, and management strategies. (2004)

*Nelson, J. R.*

**Economic Development Strategies for Oklahoma Communities**

Analyze alternative economic development strategies for rural Oklahoma communities to aid in diversifying and strengthening the local economy. Develop models and procedures to analyze impacts of changes in the local economies of rural Oklahoma communities. Determine measures of retail sector strengths and weaknesses for Oklahoma communities. (2011)

*Woods, M. D.* and *Doeksen, G. A.*

**Analysis of Economic Impacts of Soil Erosion Control Policies in Oklahoma**

Determine the potential for serious economic damages to Oklahoma agriculture from soil erosion and the economic impacts of potential cropland reductions due to the Conservation Reserve Program and sodbuster legislation. Determine the economic value of potential alternative uses of CRP acres, including outdoor recreation. (2015)

*Welsh, M. P.*

**Performance of the U.S. Grain Marketing System**

Analyze the structure, conduct, and performance of the grain and oilseed marketing system. (2020)

*Oehrtman, R. L.*

**The Role of Institutions in Market Development of Oklahoma's Farm Products**

Identify and describe institutions important in the agricultural marketing environment for the U.S. and Oklahoma. Analyze the impact of price and non-price institutional factors on market development, maintenance, and penetration for Oklahoma's farm products. Measure the influence of the existing institutional structure on the U.S. and Oklahoma's comparative advantage. Simulate impacts of alternative institutional structures on Oklahoma's agricultural markets. (2028)

*Henneberry, S. R.*

**Analysis of Managerial Alternatives for Oklahoma Livestock Farms and Ranches**

Characterize planning, implementation and control (PIC) procedures of Oklahoma farmers and ranchers. Develop and evaluate analytical methods for short, intermediate, and long-term planning suited to the risk and temporal environment of farmers. Evaluate operational procedures for implementing components of farm and ranch plans. Develop and test procedures for establishing and operating management control systems which support planning and implementation. (2029)

*Walker, O. L.*

**Competition and Change in the Fruit and Vegetable Production and Marketing Systems**

Determine the competitiveness of fruits and vegetables in domestic and international markets and the impact of government policies on competitiveness and the potential for produce crops as alternatives to traditional crops. Measure the demand for specific produce commodities and the impacts of such factors as changes in demographics, lifestyles, consumer preference, and product information. Ascertain the consequences of changing wholesale, retail, and foodservice market structure and operations encompassing processing and merchandising techniques, on producers, consumers and other system participants. (2033)

*Schatzer, R. J.*

**The Analysis of Dynamic Adjustment Mechanisms in Agricultural Economics**

Develop and analyze theoretical and empirical economic models of agricultural sectors in Oklahoma incorporating mechanisms whereby such sectors adjust to exogenous shocks.

Develop present body of theory treating dynamic adjustment. Apply such theory to the estimation of empirical models of agricultural sectors in Oklahoma. Analyze empirical models to determine duration of adjustment and factors prohibiting rapid adjustment. Use control theory to develop policy designed to accelerate adjustment. (2037)

*Pyles, D. A.*

**Improving Long-Term and Short-Term Beef Production and Marketing Decisions**

Develop improved decision-making methods for Oklahoma beef producers. Analyze the impact of a number of macro economic changes upon producer level market decisions. Analyze the sources of risk in beef production and develop integrated marketing and production strategies to dea

with these risks. Develop integrated forecasting/decision models to assist producers in making pasture grazing decisions and feedlot placements and marketing decisions. (2038)

*Trapp, J. N.*

## Agricultural Education

### Diffusion and Adoption of Alternative Farming Approaches: A Longitudinal Study

Determine the views of professional educators (Vocational Agriculture Teachers and Extension Agricultural Agents) concerning the feasibility of alternative farming approaches in southeastern Oklahoma. Determine the current farming approaches, attitudes toward alternative approaches, needs for help in adoption, rate of adoption and sources of influence on adoption of alternative farming approaches by farmers and ranchers in southeastern Oklahoma. (2003)

*Key, J. P.* and *Harrit, G.*

## Agricultural Engineering

### Design of Experimental Equipment

A research study to provide a ready mechanism for preliminary investigation of problems not covered by existing projects. Provide the vehicle for inter-departmental cooperation and to be the means by which prototype machines can be designed, constructed, and tested. (1414)

*Thompson, D. R.*

### Irrigation Decision Making Based on Risk Analysis and Crop Growth Simulation

The overall objective is to use crop growth simulation as a means for improving irrigation water management. Peanut and grain sorghum growth models will be further refined and validated. Models for other Oklahoma crops will potentially be acquired. Predetermined irrigation strategies will be evaluated on the basis of crop yield and water use efficiency. Analyses will include various weather scenarios, planting dates, and soil properties.

The scheduling model will incorporate the physical constraints of the irrigation system as well as crop growth simulation. Uncertainty in future weather events will be considered. (1834)

*Elliott, R. L.*

### Surge Flow Surface Irrigation

Determine conditions and principles under which cycled water-applications improve irrigation efficiency. Generalize and verify models which incorporate the processes associated with surface and subsurface hydraulics for insights into experimental and system designs. Develop automated equipment and related control facilities for the implementation of surge flow systems. Develop design criteria and methodologies for the practical application of the surge technique. (1840)

*Elliott, R. L.*

### Dielectric Measurement in Continuous Grain Moisture Detection

Investigate magnitude of variations of dielectric properties. Develop methods to compensate for variations and design a prototype continuous grain moisture meter. (1888)

*Stone, M. L.* and *Bursewitz, G. H.*

### Selection and Development of Equipment for Wheat Production

Determine design and operating requirements for hydraulic sprayers used in conservation tillage. Develop methods for incorporating herbicides into the soil under crop residue. Evaluate and improve grain drill and air seeder performance in reduced tillage systems. Select tillage equipment to maximize yield and minimize energy. (1899)

*Solie, J. B.*

### Monitors and Control Systems For Improving Agricultural Tractor Efficiency

Evaluate the economic benefits of measuring selected tractor, implement, and soil parameters affecting the energy efficiency of tractor and implement systems. Model the tractor drive tire to determine the effects of tire parameters on failure zone size and tractive force. Using the tractive relationships developed, design a front-wheel speed control system for a multi-axle drive tractor. Construct and field evaluate the front-wheel speed control system. (1911)

*Summers, J. D.*

### Improved Technology and Equipment For Aerial Application

Develop and evaluate techniques, instrumentation, and devices to improve aerial liquid and granular deposition patterns and increase metering precision and application safety. Investigate and analyze aerial application system characteristics to provide design data for proper spray boom location, nozzle placement and orientation, and granular spreader construction and attachment. Develop and evaluate a microprocessor-controlled on-board system to monitor, regulate, and record pertinent mission parameters and data along with compatible off-board computer software to analyze, interpret, and display application mission parameters and data. (1923)

*Whitney, R. W.* and *Roth, L. O.*

### Hydraulics of Rill Erosion

Develop a rill erosion model. Test the general applicability of the erosion model. Construct an apparatus to measure detachment forces. Evaluate the effects of suspended particles on detachment forces. Compare predicted and observed erosion rates for a single rill. (1934)

*Wilson, B. N.*

### Processing and Storage of Southern Agricultural Commodities

Develop sensors, controls, and new systems for processing and storage of agricultural products. (1942)

*Brusewitz, G. H.* and *Stone, M. L.*

### Computer Assisted Quality Assessment of Grain During Processing and Storage

Determine the variation in moisture content within a grain mass in relation to its recognized safe storage moisture. Determine the acoustic properties of grain in relation to moisture content. Determine the effect of foreign matter on the near-infrared reflectance properties of a grain sample. Determine the nuclear magnetic resonance properties as a basis for a grain moisture sensor. Process information about the grain's physical properties in real time using computers and image processing instrumentation. (1953)

*Brusewitz, G. H.*
*Stone, M.L.*
*Kranzler, G. A.*

### Functional Improvements and Alternative Uses For Combine Harvesters

Develop a data base on grain loss to be used in extension programs and extension guidance. Study methods for achieving partial control of cheat and volunteer during the combining operation, either by means of mechanical modification or chemical treatment. Research and development of sensors and automatic harvesting control which can produce improvement in machine performance and threshing efficiency without increasing the basic size and power of the unit. (1958)

*Downs, H. W.* and *Stone, M. L.*

### Assessment of Uncertainty in Hydrologic/Water Quality Models

Identify and evaluate sources of uncertainty in hydrologic and water quality models. Investigate the statistical properties of the error term in hydrologic models of various types. Investigate parameter estimation techniques to minimize uncertainty when hydrologic and water quality models are used in a predictive mode. Develop techniques for quantifying the effects of uncertainty on decisions reached using hydrologic and water quality models. (1970)

*Haan, C. T.*

### Machine Vision For Agricultural Recognition, Measurement, and Inspection Applications

Determine machine vision techniques for identification of tree seedlings. Develop techniques for machine vision evaluation of the drift and residue penetration characteristics of ground-applied granular chemicals. Develop methods for machine vision grading of tree seedlings. (1973)

*Kranzler, G. A.*
*Downs, H. W.*
*Stone, M. L.*

### Effects of Temperature Gradient and Aeration Design on Stored Grain Insects

Develop similarity models for predicting seasonal temperature variations in grain storage structures. Determine the effects of rate of temperature change on the biological processes of stored grain insects. Develop design criteria for integrating aeration systems into a stored grain pest management system. (1978)

*Clary, B. L.*
*Noyes, R. T.*
*Cuperus, G. W.*

### Hydrologic/Water Quality Modeling of Sediment and Chemical Movement

Characterize the influence of climate and cultural management on plant production and sediment and chemical movement. Integrate sediment loss, chemical loss, plant growth, and soil productivity into hydrological water quality models. (2005)

*Wilson, B. N.* and *Haan, C. T.*

### Automatic Control of Field Machine Functions for Increased Efficiency and Energy Conservation

Identify and quantify parameters affecting energy consumption and functional performance of field crop production systems. Develop sensing and control technology for field machine operations. (2007)

*Summers, J. D.* and *Downs, H. W.*

### Control, Prediction, Economics, and Environmental Effects of Soil Erosion

Work will be conducted to study fundamental processes of rill erosion. This work is part of a regional project to develop an integrated model of the erosion process.

Instrumentation techniques will be developed to accurately and efficiently measure important erosion characteristics using image processing methods. Data will be gathered to characterize the dynamic nature of rill flows and then used to test rill erosion models. This work will be done in both laboratory and field settings. If necessary, rill models will be modified to better represent the observed rill erosion process. (2030)

*Wilson, B. N.*

### Engineering Considerations Affecting Quality of Fresh Market Produce

Evaluate food process needs for fresh fruit and vegetable harvesting, handling, and processing in Oklahoma. Develop a food process engineering R&D program to address said needs. (2042)

*Clary, B. L.*
*Stone, M. L.*
*Brusewitz, G. H.*

## Agronomy

### Evaluation of Cotton Varieties for Oklahoma

Determine the agronomic characteristics and fiber properties of selected cotton varieties at several locations in Oklahoma under irrigated and/or dryland conditions and make those results available to cotton producers in the state. (0714)

*Verhalen, L. M.*
*Thomas, N. B.*
*Foraker, R. W.*

### Control and Biology of Weeds in Cultivated Agronomic Crops

Determine the biological characteristics and competitive relationship of specific weed species. Determine soil, plant, environmental, and chemical factors which affect the activity, persistence, and fate of herbicides used for weed control. Establish effective integrated weed and other pest management systems under Oklahoma conditions for conventional and reduced-tillage production procedures using chemical, biological, cultural, and mechanical control methods. (0933)

*Murray, D. S.*
*Basler, E.*
*Westerman, R. B.*

### Cotton Breeding and Genetics

Develop new, more highly adapted, medium-early to early cotton germplasm suitable for mechanical harvest with superior fiber quality, disease resistance, and insect resistance. Compare various selection procedures with more coventional types of selection used in cotton. Investigate the genetics of the quantitatively inherited, more economically important, characters in cotton as well as of selected qualitatively inherited mutants. (1135)

*Verhalen, L. M.*
*Young, J. H.*
*Greenhagen, B. E.*

### Operating of Controlled Climate Center

The operation and maintenance of growth chamber equipment and greenhouses for research purposes. (1230)

*Hartman, G. H.* and *Scifres, C. J.*

### Pasture, Range, and Turfgrass Breeding

Develop new cultivars of native and introduced grasses for pasture and turf use that are superior to existing cultivars in productivity, quality, dependability, and/or ease of establishment and maintenance. Procure and evaluate new germplasm of selected grass species. Investigate the reproductive mechanism, breeding behavior, and improvement potential of selected grasses. Determine the inheritance of important traits and elucidate genetic control mechanisms when possible. Evaluate new selection techniques and breeding models. Develop tissue culture techniques for selected grass species. (1361)

*Taliaferro, C. M.*

### Peanut Improvement: Breeding and Management

Identify basic heritable traits in peanut germplasm. Utilize superior germplasm in the development of cultivars for Oklahoma. Evaluate the production potential and market quality value of varieties and lines through cultural studies and performance testing. (1386)

*Kirby, J. S.*
*Banks, D. J.*
*Sholar, J. R.*

### Wheat Breeding

Develop wheat varieties with increased grain yield potential and improved breadmaking quality. Combine with these characteristics as many of the following traits as possible: early maturity, short straw, high grain protein content, resistance to major disease and insect pests, and tolerance to drought stress. Produce and maintain "breeder seed" of new varieties. Study genetic systems and breeding methodologies. Collect and evaluate germplasm. (1426)

*Smith, E. L.*
*Merkle, O. G.*
*Hunger, R. M.*
*Abbott, D. C.*
*Burton, R. L.*
*Carver, B. F.*

### Breeding Improved Varieties of Barley

Develop varieties of barley with high grain yield potential and acceptable malting quality. Incorporate lodging resistance, pest resistance, and other desirable agronomic traits into these varieties. (1536)

*Smith, E. L.*
*Morgan, G. H.*
*Hunger, R.M.*
*Webster, J. A.*

### Weed and Brush Control in Pastures and Rangelands

Study of life cycle and ecological relationships of problem weed and brush plants and

valuation of specific control practices along vith integration of these practices into a sys- em for increasing forage quality and roduction. (1604)

*Stritzke, J.*
*McMurphy, W.*
*Engle, D. M.*
*Gillen, R. L.*
*Basler, E.*

### louble Cropping Soybeans Under lainfed and Irrigated Conditions in he Southern Great Plains

Evaluate plant development characteris- cs, yields, and varietal interactions of soy- eans as affected by cropping systems mono- vs double-cropping after wheat grain emoval), and water (irrigated vs. rainfed). valuate plant development characteristics, nd yields of solid seeded (25 cm row spac- ng or less) monocropped and double- ropped soybeans under rainfed and rigated conditions. (1618)

*Crabtree, R. J.*
*Edwards, L. H.*
*Smith, E. L.*

### Drought Tolerance in Wheat

Find strains in the World Wheat Collec- on possessing seedling drought tolerance. ncrease and further test those strains hav- ng drought tolerance and determine vhether the tolerance continues to maturity. Determine whether drought tolerance can be ransferred to adapted genotypes. (1630)

*Merkle, O. G.* and *Smith, E. L.*

### ntegrated Weed Control Programs for Small Grains

Develop chemical weed control technol- ogy for use in small grains that is more effec- ive, reliable and/or economical than that resently available. Investigate the influence of cultural practices, and grazing on weed nfestations and their control. Develop a apid system to select for triazine herbicide olerance in wheat plants. (1644)

*Peeper, T. F.*
*Krenzer, E.*
*Carver, B. F.*
*Buenzi, A. C.*

### Soybean Improvement

Develop high yielding soybean varieties adapted to Oklahoma growing conditions. Determine the inheritance of agronomic characters in soybeans. Field test soybean varieties and advanced lines for adaptation o Oklahoma growing conditions. (1653)

*Edwards, L. H.* and *Crabtree, R. J.*

### Mungbean Improvement

Develop mungbean varieties which con- ain desirable agronomic traits, such as high yield, shattering resistance, and lodging resistance and desirable market qualities, particularly large seed size. (1654)

*Edwards, L. H.*
*Crabtree, R. J.*

### Alfalfa Breeding and Management

Develop improved alfalfa germplasm with resistance to important pests and to herbicides. Develop tests designed to identify unique types of resistance to alfalfa pests and herbicides. Evaluate alfalfa cultivars and strains for forage yield potential and pest resistance. Develop integrated management systems designed to minimize production losses and maximize forage yield. Investigate annual Medicago spp. for their potential use in the Southern Plains. (1685)

*Caddel, J. L.*
*Stritzke, J. F.*
*Donnelly, K. J.*
*Berberet, R. C.*
*Ahring, R. M.*

### Cultural and Management Effects on Seed Yield Components in Grasses

Determine the effects of mowing, herbicide(s), and fertilization on seed production of bermudagrass cultivars. Establish optimum harvest dates and yield potential of winter-hardy Old World bluestems according to numerical changes in seed development over time. Determine the effect of cultural and management practices on the quantitative expression of seed yield components of new grass cultivars. (1701)

*Ahring, R. M.*

### Soil-Plant Micronutrient Interactions of Agronomic Crops and Forages

Identify factors responsible for micronutrient deficiencies and develop practical economical methods for correcting micronutrient deficiencies in agronomic crops and forages. (1813)

*Westerman, R. L.* and *Johnson, G. V.*

### Rangeland Brush Management and Prescribed Fire

Determine vegetation composition, productivity, and forage quality responses to brush management under seasonal grazing of stocker cattle on the Cross Timbers Experimental Range. Evaluate, with cooperating scientists, the response of livestock, wildlife, soils, watersheds and economic returns associated with brush management under seasonal grazing of stocker cattle on the Cross Timbers Experimental Range. Develop predictive models of fire behavior and rangeland responses to fire used in brush and grazing management. (1822)

*Engle, D. M.*
*Stritzke, J. F.*
*McCollum, F. T.*

### Influence of Crop Herbicide Management on Weed Population and Crop Physiology

Determine the effects of cropping sequence, cultural practices, and herbicides on weed population dynamics. Develop soil test for weed species dynamics and soil colloidal constituents which will allow more precise herbicide management. Determine the influence of herbicidal control on physiology of weed propagules and subsequent crops. (1831)

*Murray, D. S.*

### Physiological Mechanisms of Stress Resistance in Winter Wheat Genotypes

Identify physiological traits for selecting wheat with improved drought resistance. Determine factors limiting wheat photosynthesis and water use efficiency. Assess wild Triticum species for superior photosynthesis and water use efficiency. (1836)

*Johnson, R. C.*

### Influence of Soil and Residue Management Systems on Wheat Production

Determine how various winter wheat tillage and residue management production systems influence long-term soil conditions, pest organism development, and wheat yield and quality. Study the effects of long-term management systems on wheat plant environment and production. (1837)

*Krenzer, E. G.*
*Burton, R. L.*
*Singleton, L. L.*

### Efficient Fertilization of Small Grains, Row Crops, and Forages

Determine proper sources, rates, methods, and time of applications for the most efficient long term use of fertilizers and lime for optimum yield, uptake, and quality of cultivated crops and forages. Describe response curves and surfaces for nutrient element addition to agronomic crops and forages. Identify factors responsible for nutrient deficiencies and toxicities and determine appropriate detection and corrective measures. (1844)

*Westerman, R. L.*
*Busman, L. M.*
*Tucker,B. B.*
*Johnson, G. V.*
*Webb, B. B.*

### Nitrogen Fertilizer Transformations in Soil-Plant Systems

Determine mineralization-immobilization (MIT) rates in soils and crop uptake of nitrogen fertilizer in soil-plant systems. Determine

the magnitude of nitrogen fertilizer loss via gaseous processes and leaching in soil plant systems. (1845)

*Westerman, R. L.* and *Busman, L. M.*

**Waste Application and Management in Agricultural Soils**

Determine leaching of cadmium from sewage sludge and the effects of time and pH. Attempt the stabilization of cadmium with clay, fly ash, or lime. Determine the cadmium uptake characteristics of at least two plants with differing rooting habits and attempt to establish a soil content-plant uptake relationship with depth or thickness and position of the cadmium containing horizon. Evaluate plant growth in fly ash-soil mixes up to 25 percent fly ash for growth of covers. Check for 'aluminate' toxicity at pH 9.0. Develop a management system for soil preparation and growth of vegetative cover for ash pits. (1861)

*Morrill, L. G.*

**Cellular and Molecular Genetics for Crop Improvement**

Identification and characterization of agriculturally important genetic systems. Regulation of gene expression and the delivery of genetic material to higher plants and associative microorganisms. Somatic cell genetics and plant development: the modification, selection, regeneration, and propagation of plants through cell and tissue culture. (1862)

*Guenzi, A. C.* and *Melcher, U. K.*

**Genetic Analysis and Improvement of Physiological and Agronomic Traits in Wheat**

Identify and characterize genetic systems vital for increased productivity under stress conditions. Utilize extraneous germplasm for photosynthetic improvement of winter wheat. Expand current wheat breeding methodology to combine forage production improvement strategies with traditional grain yield improvement strategies. Utilize alternative selection methods to more effectively exploit genetic variability for grain yield potential. (1867).

*Carver, B. F.*
*Smith, E. L.*
*Peeper, T. F.*
*Westerman, R. L.*
*Rayburn, A. L.*
*Guenzi, A. C.*

**A Basis of Understanding Weed Biology**

This project will quantify reciprocal crop/weed interactions: life history, population dynamics, and interference. (1873)

*Murray, D. S.*

**Assessment of Uniculm Winter Wheat and Barley for the High Plains of Oklahoma**

Examine the inheritance of the uniculm character in wheat and barley and develop near-isogenic multiculm and uniculm wheat and barley lines. (1877)

*Merritt, R. G.*

**Overcoming Factors Limiting Biological Nitrogen Fixation by Leguminous Plants**

Isolate and characterize indigenous and agronomically important Rhizobium species which are tolerant to stress factors limiting symbiosis. Define the role of vesicular-arbuscular mynorrhizal fungi in biological nitrogen fixation in legumes. (1878)

*Lynd, J. Q.*
*Odell, G. V., Jr.*
*McNew, R. W.*

**Drought and Greenbug Stress Interactions in Winter Wheat Genotypes**

Determine the drought avoidance and tolerance of winter wheat genotypes and how the type and extent of that resistance is modified by greenbug stress. Relate the effects of greenbug and drought stress to physiological plant factors. (1881)

*Johnson, R. C.* and *Eikenbary, R. D.*

**Improved Water Management With Wide-Spaced Band Irrigation**

Adapt the furrow diking principle to the local soil and cropping conditions. Devise a center-pivot irrigation delivery system to apply water in equivalent manner to the wide-spaced furrow irrigation technique. Conduct feasibility studies on newly developed methods for water-saving management in crop irrigation. (1882)

*Stone, J. F.*
*Reeves, H. E.*
*Garton, J. E.*

**Spatial and Temporal Soil Characteristics and Material Fluxes in Field Soils**

Quantify the spatial and temporal variability of major soil physical characteristics. Assess the variability of water and/or solute movement in field soils. (1883)

*Nofziger, D. L.*

**Soil-Forming Processes in Oklahoma**

Evaluate the effect of climate as a factor in the formation of the soil solum. Compare and contrast major processes of saline alkali soil genesis determining the relationship and distribution of these processes in Oklahoma. Determine the effect of erosion and deposition on the genesis of soils formed from unconsolidated deposits during Tertiary and Quanternary geologic ages. (1892)

*Carter, B. J.*

**Increasing Profitability From Small Farm Cattle Enterprises**

Evaluate the feasibility of retaining ownership of weaning calves through the stocker phase of a cattle enterprise. Determine the potential of fungus free tall fescue for stocker cattle grazing. (1895)

*McMurphy, W. E.*
*Lusby, K. S.*
*Walker, O. L.*

**Improved Production and Utilization of Rangeland Forage**

Determine effects of stocking rates and grazing schedules on range plants and livestock. Develop guidelines for adjustment of grazing management under fluctuating weather conditions. Develop range improvement programs which combine grazing and cultural practices and determine effects of these programs on plant and animal production. (1908)

*Gillen, R. L.*

**Narrow-Row Stomatal Effect as a Water Management Factor**

Determine whether a critical evaporative demand level must occur in order to cause the stomatal closure mechanisms in narrow-row grain sorghum. Determine difference in canopy temperature between narrow and wide row crops and changes related to stomatal closure. Relate stomatal closure effect to sap flow in the stem. Determine whether stomatal closure effects occur in other economic crops such as soybean. (1922)

*Stone, J. F.*

**Influence of Harvest Date on Physiological Factors in Alfalfa**

Determine the influence of final fall harvest date on alfalfa forage yields and stand persistence in subsequent years. Describe the relationships among various physiological parameters following different dates of final fall harvest. Evaluate techniques for monitoring physiological status of alfalfa plants. (1928)

*Donnelly, K. J.*

**Prairie Plant Production**

Geographical races and grazed ecotypes of Andropogon gerardii Schizachyrium scoparium and Bouteloua curtipendula will be used in this research to better understand prairie plant production competition, and succession under drought and grazing stress. (1955)

*Ewing, A. L.* and *Johnson, R. C.*

**Establishment and Management of Introduced Forages**

Evaluate new bermudagrass cultivars in grazing trials with steers, determine optimum sprigging date and depth for bermudagrass, assess harvest management on sudangrass and pearl millet for yield, regrowth, and forage nitrate, and to evaluate annual medics for use in central Oklahoma. (1961)

*McMurphy, W. E.*

**Soil-Chem Processes Affecting Metal Ion Uptake and Precipitation of Calcium Salts**

Evaluate the soil chemical properties associated with soils in Oklahoma that induce metal ion deficiencies and toxicities in crops. Determine the chemical processes that regulate calcium carbonate, calcium phosphate, and calcium sulphate precipitation in soils of Oklahoma, and examine how these processes influence plant nutrition and soil formation. (1963)

*Inskeep, W. P.*

**Mineralogy of Selected Soils in the Southern Region**

Determine compositional and quantitative procedures and limits for certain minerals for soil classification and interpretation. (1983)

*Carter, B. J.*

**Molecular Cytogenetic Analysis of Alien DNA in Various Wheat Lines**

The overall objective of this proposal is to develop molecular techniques which will enable plant breeders to more rapidly and efficiently select wheat-alien transfer lines with desirable agronomic traits. (1984)

*Rayburn, A. L.*

**Use of Cell Culture for Wheat Improvement**

Utilize wheat cell culture to recover mutations which will increase the levels of free lysine and threonine in the seed, increase the dehydration tolerance of wheat cells under osmotic stress and correlate this response to soil moisture stress tolerance, and improve the tolerance of wheat to aluminum toxicity resulting from acidic soils. 1996)

*Guenzi, A. C.*

**The Influence of Sorghum Genotype in Response to Mineral Nutrition**

Examine methods of identifying sorghum lines tolerant to iron deficiency chlorosis that will provide suitable yields. Investigate the possibilities of a differential response of sorghum genotypes to soil nitrogen. (1998)

*Hawkins, S. E.*
*Crabtree, R. J.*
*Inskeep, W. P.*
*Vesterman, R. L.*

**Management Systems for Wheat Production in Oklahoma**

Determine the effect of management practices such as planting date, row width, seeding rate, tillage, hybrid cultivars vs. pure line varieties, and clipping (grazing) practices on hard red winter wheat forage and grain yields and economic returns. (2016)

*Krenzer, E. G., Jr.*

**Molecular Adaptations for Greenbug Resistance Under Drought**

Determine some of the key Calvin cycle factors potentially limiting photosynthetic capacity under greenbug and dehydration stress in wheat. Assess the impact of genes for greenbug resistance on the extractability, complexity, and structure of pectins from near isogenic lines of wheat. Characterize the molecular determinants of greenbug induced chlorosis and necrosis in susceptible wheat. (2024)

*Johnson, R. C.*
*Mort, A. J.*
*Eikenbary, R. D.*

**Behavior and Fate of Selected Sulfonyl Urea & Imidazolinone Herbicides in the Southern Environment**

Determine the behavior, persistence, and biological effects of selected sulfonyl urea and imidazolinone herbicides. (2027)

*Peeper, T. F.*
*Nofziger, D. L.*
*Busman, O.*
*Santlemann, P. W.*

## Animal Science

**Improvement of Beef Cattle Through Breeding Methods**

Evaluate sources of germplasm and systems of breeding to maximize efficiency of beef production. (1502)

*Frahm, R. R.*

**Nutritive Value and Utilization of Sorghum Grains by Ruminants**

Determine effect of different hybrid sorghum endosperm types on site and extent of starch and protein utilization. Determine effect of different hybrid sorghum endosperm types on feedlot performance and to relate animal performance to nutrient composition and site and extent of digestion. Determine nutrient content and variation found in sorghum grain hybrids commercially available in Oklahoma and assess environmental effects and the relationships between nutrive characteristics. Assess nutritive characteristics and the relationships between them in various pure line sorghums. Evaluate effect of tannin content and type in sorghum on site and extent of digestion, metabolic fate of tannins and feedlot performance. (1584)

*Wagner, D. G.*
*Mitchell, E. D.*
*Weibel, D. E.*

**Genetic Improvement of Efficiency in the Production of Quality Pork**

Evaluate selection criteria to improve efficiency of lean tissue growth. Determine direct response to selection for increased growth rate on restricted vs. ad libitum intake. Determine correlated selection responses in feed efficiency, carcass merit and reproductive performance. Determine direct and correlated respones for selection for slow growth rate and evaluate biological mechanisms controlling growth. (1620)

*Buchanan, D. S.*
*Maxwell, C. V.*
*Frahm, R. R.*

**Improving Reproductive Efficiency of Cattle and Swine**

Determine in cattle the influences of body energy reserves and post-partum nutrition on hypothalamo-hypophyseal-ovarian functions and reproductive efficiency. (1730)

*Wettemann, R. P.* and *Lusby, K. S.*

**Nutrition and Management of Swine for Increased Reproductive Efficiency**

Determine the level of salt and biotin necessary for optimum reproductive performance in sows. Determine the effects of non-nutritive feed additives during specific stages of the breeding-gestation-lactation cycle. Compare the reproductive performance of gilts and sows fed different levels of energy during gestation and lactation. (1753)

*Maxwell, C. V.*
*Wettemann, R. P.*
*Buchanan, D. S.*

**Improvement of Beef Cattle Through Breeding Methods**

Evaluate sources of germplasm and systems of breeding to maximize efficiency of beef production and evaluate the importance and nature of different types of genetic-environmental interactions. (1777)

*Frahm, R. R.* and *Coleman, S. W.*

**Feeding Broilers for Maximum Productivity During Periods of Heat and Cold Stress**

Examine the influence of environmental temperatures above, within, and below zone of broiler thermoneutrality on interactions between dietary fat composition and level, rate, and efficiency of body weight gain and composition. Determine quantity of lysine and methionine needed by broilers to achieve maximal growth rates and effects of intermittent feeding of high and low protein

meals. Examine the growth rate and thyroid activity of broilers fed antipyrine and niacin, and attempt to control thyroid activity for maximum broiler productivity. (1817)

*Teeter, R. G.* and *Owens, F. N.*

**Nutrition Management/Medical Treatment on the Health and Performance of Cattle**

Test the effect of supplemental energy with ad libitum hay during the receiving program on health and subsequent grazing gain. Evaluate cost and efficacy of current and new injectable antibiotics and sulfas used in the treatment of sickness in stressed cattle. Test the effects of vaccines and internal parasite control agents on health, performance and cost of gain over the receiving and grazing periods. Develop a model to allow broader application of body temperature as an early indicator of sickness in cattle. (1875)

*Gill, D. R.*
*Smith, R. A.*
*Owens, F. N.*

**Nutrition and Anestrus in Beef Cows**

Determine the effect of glucose infusion, insulin injections, feeding a high energy diet, and weaning on LH secretion in postpartum anestrous beef cows. Evaluate nutritional indicators and endocrine function associated with the onset of anestrus and the resumption of estrous cycles due to nutrient intake in beef cows. (1889)

*Wettemann, R. P.*
*Geisert, R. D.*
*Lusby, K. S.*

**Effects of Supplementing Low Quality Forage Intake and Passage**

Evaluate the effect of grain supplementation on forage intake, rate, and extent of forage digestion and rate of passage in mature beef cows. Evaluate the potential of beet pulp, soybean hulls, and wheat midds as high energy, low starch supplements. Determine if the detrimental effects of grain supplementation can be alleviated by additional protein. Evaluate the effect of feeding frequency on intake and digestibility of low quality native grass. (1912)

*Hibberd, C. A.*

**Production of New Sectioned and Formed Beef Products**

Develop new sectioned and formed beef products utilizing low- to intermediate-value cuts. Determine the acceptability characteristics (color, flavor, juiciness, shelf life, and textural properties) of the products developed. (1925)

*Guenther, J. J.* and *Dolezal, H. G.*

**Simulation of Stocker and Cow Reproduction Components of Beef Production Systems**

Develop program modules to simulate stocker cattle growth and forage availability and intake which may be used in systems level models of stocker cattle operations for extension and producer use. Identify genetic and nutrition variables affecting reproductive function of beef cows and develop relationships among them in order to implement models of reproductive events at both the research and application levels. (1939)

*Oltjen, J. W.*

**Cattle Response to Grazing and Brush Management**

Evaluate intensive early stocking as an alternative summer program for stocker cattle. Evaluate the merit of various protocols for short duration grazing on tallgrass prairie. Determine livestock response to various brush management practices on Blackjack/Post Oak Savannah rangeland. (1943)

*McCollum, F.*
*Engle, D.*
*Gillen, R.*
*Stritzke, J.*

**Utilization of Wheat, Sorghum Grain and Mungbeans for Growing-Finishing Swine**

Determine the crude protein and essential amino acid content of the major varieties of wheat, sorghum grain and mungbeans produced in Oklahoma. Determine the apparent availability and digestibility of essential amino acids from some varieties of wheat, sorghum grain and mungbeans. Maximize the utilization of the higher protein and amino acid levels in wheat. Determine optimal utilization of mungbeans for protein and lysine in swine. Evaluate sorghum grain produced in Oklahoma as energy sources for swine. (1946)

*Luce, W.*
*Maxwell, C.*
*Buchanan, D.*
*Edwards, L.*
*Smith, E.*

**Utilization of Wheat in Rations for Dairy Cattle**

Compare the performance of lactating cows fed concentrated rations containing different amounts of hard red winter wheat in a complete ration with sorghum silage as the only forage and in rations including alfalfa hay. Evaluate the effect of amount of wheat in the ration on concentration of selected metabolites in the rumen fluid and blood of cows, and on digestibility of nutrient components of the ration in different segments of the digestive tract. (1951)

*Bush, L. J.*

**Energy Nutrition of the Exercising Horse**

Determine the effect of levels of dietary starch on muscle glycogen concentrations of exercising horses holding workload, calculated as mass times distance at a given intensity, constant. Determine the effect of increasing intensity and duration of work on muscle glycogen content at high and low starch intakes. Develop preliminary recommendations relating intensity and duration of exercise to level of starch needed in the diet to maintain normal muscle glycogen concentrations. (1964)

*Topliff, D. R.*

**Regulation of Early Conceptus Development and Survival in the Cow**

Investigate interrelationship(s) between ovarian endocrine changes and uterine secretory activity with early embryonic growth and survival in the cow. Determine the role of uterine stroma on protein secretion by surface and glandular epithelium during the estrous cycle and possible stimulatory influence of the blastocyst on these tissues. Investigate the possible existence of growth regulating factors synthesized and released by the uterine stroma and developing blastocyst. (1965)

*Geisert, R. D.*
*Zavy, M. T.*
*Morgan, G. L.*

**Effect of Carcass and Postmortem Muscle Traits on Beef Palatability**

Determine the interrelationships between carcass weight, subcutaneous fat thickness, marbling score and beef palatability and evaluate the effects of postmortem muscle temperature and pH on longissmus tenderness. (1982)

*Dolezal, H. G.*
*Gill, D. R.*
*Guenther, J. J.*

**Wheat Middlings as a Supplemental Energy and Protein Source for Beef Cattle**

Compare wheat middlings with cotton seed meal and cottonseed meal-corn mixtures as protein and energy supplements for weight maintenance of beef cows in winter and growth of replacement heifers in late summer. Compare the effects of wheat middlings, cottonseed meal and cottonseed meal-corn mixtures on forage intake and digestibility. (1985)

*Lusby, K. S.* and *Wettemann, R. P.*

**Microbial Protein Synthesis in and Escape of Dietary Protein From the Rumen**

Determine the optimal concentration of ammonia to maximize microbial protein synthesis, and digestion of starch and fiber frac

tions. Appraise effects of specific feed additives including ionophores, antioxidants, mineral chelates, antibiotics, antiprotozoal and fungiastic compounds on ruminal yield of microbial protein. Measure ruminal escape of non-microbial protein and amino acids of commonly fed cereal grains. (1986)

*Owens, F. N.* and *Gill, D. R.*

**Effects of Advanced Uterine Environment on Blastocyst Development and Survival**

Determine the effect of advancing uterine secretion during the luteal phase of the estrous cycle on subsequent blastocyst elongation, attachment, and survival between day 10 to 18 of pregnancy. Determine the role of blastocyst estrogen synthesis and release during rapid elongation of the conceptus membranes between days 10 and 12 of pregnancy and during attachment to the uterine luminal epithelium between day 12 through 20. (1989)

*Geisert, D.*

**Utilization of Wheat Forage by Growing Cattle**

Determine site and extent of apparent digestion of nutrients of growing cattle on wheat pasture, rate of ruminal digestion of organic matter and crude protein of wheat forage, and extent of ruminal degradation of high protein feedstuffs and their effect on growth of cattle grazing wheat pasture and nitrogen balance of lambs fed harvested wheat forage indoors. Compounds that alter ruminal fermentation will be evaluated for effects on *in vitro* degradation of wheat forage crude protein. (1994)

*Horn, G. W.*
*McCollum, F. T.*
*Phillips, W. A.*

**Lactobacilli as Dietary Adjuncts: Factors to Enhance Their Actions**

Determine influence of stage of growth on survival of *L. acidophilus* during frozen and refrigerated storage and the influence of storage on cholesterol assimilating ability of the organism. Determine the relationship between bile salt deconjugation and cholesterol assimilation by *L. acidophilus*. Study the influence of unsaturated fatty acids on cholesterol assimilation by this organism. Consider if strains of *L acidophilus* from intestines of various animals produce bacteriocins to cause interspecies antagonisms and to characterize the bacteriocins. (2013)

*Gilliland, S. E.*

**Ruminal Bypass Proteins For Lactating Beef Cows Fed Dormant Native Grass**

Determine the response of ruminal fiber fermentation and microbial protein synthesis by beef cattle fed low-quality grass hay to graded levels of ruminal degradable protein. Determine the effect of substituting graded amounts of blood meal for soybean meal in supplements on ruminal fiber fermentation, microbial protein synthesis and duodenal protein supply in beef cattle fed low-quality grass hay. Compare supplemental energy source and protein characteristics on ruminal fiber fermentation and microbial protein synthesis by beef cattle fed low-quality grass hay. Evaluate the effect of supplement type on ruminal protein degradability of various supplemental feeds. Determine the production responses of lactating beef cows to supplements containing bypass protein sources. (2018)

*Hibberd, C. A.*

**Augmenting Compensatory Responses to Heat Stress for Enhanced Growth Rate and Survival in Broilers**

Broiler heat distress significantly reduces broiler profitability in several major United States broiler producing areas during the summer months. This project is directed at the development of electrolyte replacement therapy and defined augmenting compensatory physiological responses by the bird to cope with the heat stress insult. (2025)

*Teeter, R. G.* and *Sangiah, S.*

**Development of Profitable Beef-Forage Production Systems for the Southern Region**

Concepts from detailed models of plant and animal growth and the interface which occurs during grazing will be aggregated into less complex production systems level models to allow evaluation of forage-beef systems at the individual producer level. Initially a microcomputer model of stocker cattle enterprises will be developed. These efforts will be in cooperation with researchers at Louisiana and Mississippi to develop models better adapted to generalized applications rather than for explanation of plant and/or animal responses per se. Relationships between animal growth and composition in the detailed Beef model will be evaluated. (2032)

*Oltjen, J. W.*

## Biochemistry

**Metabolism of the Vitamins A**

Compare the metabolism of the all-*trans*- and 13-*cis*-isomers of retinoic acid in rats and chicks. Isolate and identify metabolites of the all-*trans*- and 13-*cis*-isomers of retinoic acid formed *in vivo* and *in vitro*. (1250)

*Nelson, E. C.*

**Biosynthesis of Pyridine Nucleotides in *E. Coli* and Higher Plants**

The long-range goal of this research is to completely define the pathway for the biosynthesis of the NAD precursor quinolinc acid (QA) in higher plants and *E. coli*. Since we now have established the first enzyme (B-protein) in QA synthesis in *E. coli* as L-aspartate oxidase, the remaining objectives are to purify from *E. coli* and higher plants the enzyme which carries out the second step in QA synthesis and fully characterize its reaction. To further purify and characterize the L-aspartate oxidase of *E. coli* and higher plants. To determine the structure and mechanism of action of the presently unidentified coenzyme which is required by L-aspartate oxidase of higher plants. (1339)

*Gholson, R. K.*

**Enzyme Associations and Their Metabolic Consequences**

Characterize the binding of mitochondrial matrix (soluble) dehydrogenases to mitochondrial inner membrane components, especially complex I, with regard to identifying the receptor molecule(s), characterizing the binding properties of the receptor and testing whether the dehydrogenase-receptor complexes will permit substrate channeling of NADH from the donor enzyme to the NADH dehydrogenase of complex I. Characterize the binding of fumarse and succinate thiokinase to inner mitochondrial membrane, especially complex II, as described above for the soluble dehydrogenase binding complexes. Characterize the enzymatic properties of the heteroenzyme complexes of the soluble enzymes, especially with regard to substrate channeling capabilities. (1393)

*Spivey, H. O.*

**The Biochemical Basis for Resistance of Cotton to Bacterial Blight**

Determine whether inhibitory local concentrations of phytoalexins at infection sites can account for resistance determined by each of several major genes for resistance to bacterial blight of cotton. Investigate the times and locations of phytoalexin biosynthesis and degradation. Isolate and identify the products of avirulence genes of *Xanthomonas campestris* pv. *malvacearum*. (1504)

*Essenberg, M. K.* and *Pierce, M.*

**Biochemistry of Host/Pathogen Reaction in Cell Culture**

Determine the cellular mechanism(s) by which Im-216 in callus culture maintain high resistance to all tested races of pv malvacearum. Determine the mechanism of host/pathogen cell-cell recognition. Identify biomolucules specifically produced by the resistance host or the pathogen that initiate either disease or resistance. Study the large

or rapid increases in activities of specific enzymes involved in the production of some of these biologically active molecules. (1553)

*Mitchell, E. D., Jr.*

**Energy Conservation by Cell Membranes**

Study the properties, function, and composition of the hexose phosphate transport system in *Escherichia coli*. (1565)

*Essenberg, R. C.*

**Characterization of Snake and Arthropod Venom Toxins**

Continue to isolate and purify toxins of certain arthropod and snake venoms. Characterize each purified toxin as to its chemical nature and biological mode of action. Conduct immunological tests on each toxin with emphasis on muscle necrotic toxins. Continue comparative studies of venoms which contain similar toxins and enzymes. Continue cooperative research with The Universidad de Costa Rica in this research area and examine new techniques to determine amino acid sequence and three-dimensional structure of low molecular weight myotoxins from venoms. (1767)

*Odell, G. V., Jr.*
*Ownby, C. L.*
*Drew, W. A.*

**Cauliflower Mosaic Virus**

The existence, structure, and function of specific sites for initiation of genetic exchanges, the formation and repair of heteroduplex loops, and the relation of heteroduplex loops to gene conversion will be examined. (1789)

*Melcher, U. K.* and *Essenberg, R. C.*

**Application of Bioluminescent Measurements**

Apply bioluminescent techniques to the determination of the metabolic state of environmental microorganisms. Apply bioluminescent techniques to the measurement of microbial numbers in natural products and industrial samples. Study the mechanism, specificity, and structure of firefly luciferase. (1806)

*Leach, F. R.*

**Reaction Mechanism of Ubiquinone Protein in Bioenergetics**

This research program will elucidate a fundamental bioenergetic reaction mechanism using mitochondrial bioenergenic apparatus. The information obtained will then be applied to photosynthetic systems to improve the efficiency of solar energy harvesting and chemical energy conservation resulting in improved crop yield or other biomass production. (1819)

*Yu, C. A.* and *Yu, L.*

**Strategies of Gene Expression Used by RNA Viruses of Cereal Grains**

Determine the proteins coded for by maize chlorotic mottle virus (MCMV) and wheat streak mosaic virus (WSMV) RNAs, how the genes for these proteins are arranged on the viral chromosome, and the mechanisms by which these genes are expressed. Investigate viral gene expression in mixed infections of the two viruses to determine the role of viral gene products in the synergistic interaction between these viruses. (1823)

*Gardner, C. O., Jr.* and *Cioletti, L.*

**Characterization of Polysaccharides in Recognition Processes in Plants**

Develop specific methods to cleave polysaccharides into smaller fragments, allowing easy characterization of the polysaccharide structures to test oligosaccharides derived from plant and bacterial polysaccarides for biological activity in recognition processes. (1824)

*Mort, A. J.*

**Tissue Culture for Crops**

Develop culture techniques for use in regenerating crop species. Evaluate regenerants and their offspring for somaclonal variation. Combine mutagenesis with *in vitro* selection in order to increase the frequency of recovering variants. Develop methods to select for desired traits *in vitro*. (1848)

*Johnson, B. B.*

**Metabolism in Retinoids**

The objectives of this research are to isolate and identify metabolites of retinol, and/or retinoic acid formed *in vivo* in chicks, and to determine the properties and cellular and subcellular location of acyl-CoA retinol acyltransferase in rat testes. (1960)

*Nelson, E. C.*

**Allelopathic Interactions in Conservation-Tillage Wheat Production**

Study allelopathy that may occur in agricultural ecosystems, particularly wheat, concentrating on the soil/crop/weed associations by identifying the allelochemicals involved, their primary modes of action as mediated by soils, and as appropriate, the microflora, microclimate, soil moisture and other factors that may influence allelopathy. (1967)

*Waller, G. R.*
*McPherson, J. K.*
*Krenzer, E. G.*

**Translational Control of Eukaryotic Protein Systhesis**

Determine the roles that covalent modifications of eukaryotic initiation and elongation factors, whose activities are regulated through guanine nucleotide binding, play in the translational control of protein synthesis. Study the regulation of the enzymes which catalyze such modifications and determine the physiological consequences of their activities *in vivo* in eukaryotic cells. (1975)

*Matts, R. L.*

**Nutrient Utilization in *Brucella Abortus* Studied by Cloning the Genes in *E. Coli***

To study carbohydrate, specifically glucose, transport and utilization in *Brucella abortus* and the adaptations made in these processes to allow growth and division inside macrophages. (1993)

*Essenberg, R. C.*

**Ubiquinone Binding Sites in Bacterial Photosynthetic Apparatus**

Continue the study of the structure and function of essential components of the cytochrome b-$c^1$ complex with special emphasis on their interaction with ubiquinone, thus leading us to understanding the electron transfer mechanism in this complex. (2023)

*Yu, C.*

## Botany and Microbiology

**Cloning and Expression of *Spiroplasma Citri* Surface Protein Genes**

Construct a library of *S. citri* DNA sequences in *E. coli*. Identify clones expressing presumptive B-galactosidase fusion proteins. Prepare antibodies against the B-galactosdase fusion proteins. Determine the effect of anti-spiralin antibodies on attachment of *S. citri*. Sequence the cloned spiralin gene. Identify other proteins on the surface of *S. citri*. (1997)

*Fletcher, J.* and *Zuber, P.*

## Entomology

**Insect Survey and Detection**

A survey of crops, forests, ornamentals, and domestic animals throughout the state for the presence of insects and other pests. Report results of these surveys weekly. (0914)

*Arnold, D. C.*

**Biology, Ecology, and Control of Arthropods Attacking Cereal Crops**

Develop cereal germplasm to resist insect attack. Determine fundamental aspects of resistance. Determine impact of cultural practices on insect damage. Study native/imported natural enemies. (1127)

*Burton, R. L.* and *Webster, J. A.*

**Biology and Control of Household, Structural, and Ornamental Pests**

Evaluate new compounds for the control of household and ornamental pests. Develop a field program to check German cockroach resistance. Develop a degree-day model for Nantucket pine tip moth (NPTM) emergence. Evaluate half-sib families of Virginia pine for tolerance against the NPTM. Determine residual activity of new termiticides and develop an accurate method of dispersing these compounds. (1202)

*Price, R. G.*

**Heliothis Species: Management System for Field Crops**

Study the interaction between *Heliothis spp.*, its host plants, parasites and parasitoids. Define the reasons that the insects in agroecosystems are in a geometric distribution and explain why they return to this distribution after disruption. Develop an artificial intelligence model of *Heliothis spp.* complexes. Search for a host plant resistant mechanism on high tannin cotton. Develop the necessary data collection and analysis tools to activate the research listed above. (1265)

*Young, J. H.*
*Willson, L. J.*
*Price, R. G.*
*Verhalen, L.*

**Chemical Pathogens, Biological Agents and Resistant Cultivars for Control of Cotton Insects**

Evaluate new compounds for cotton insect control. Evaluate Pydrin and chlordimeform as yield enhancement compounds on four different cultivars. Develop an artificial intelligence system that integrates fleahopper pest management decisions into a cotton IPM model. Define the susceptibility of cotton cultivars to fleahopper damage and develop a fleahopper resistant cultivar. (1322)

*Price, R. G.*
*Young, J.H.*
*Willson, L. J.*
*Verhalen, L.*

**Biological Control and Plant Resistance to Insects and Environmental Stresses of Wheat and Sorghum**

Colonize exotic entomophags of graminaceous aphids. Study biology, ecology and behavior to exotic and native entomophags. Study aphid population, wheat and sorghum genotypes varying in drought resistance. Integrate biological control and host plant resistance to provide an holistic approach to crop protection. (1409)

*Eikenbary, R. D.*
*Richardson, P. E.*
*Johnson, B. L.*
*Stevens, G. R.*
*McNew, R. W.*
*Melcher, U. K.*

**Studies of Ion and Water Balance in Ticks**

Investigations of molecular events controlling regulation of ion and water balance in ticks shall take place. Scientists will investigate the enzymes that control the phosphorylation of proteins that regulate movements of ions and water by tick salivary glands. Studies shall be done as to how control of tissue protein synthesis and tissue differentiation help bring about secretory capability changed in the salivary gland during tick feeding. (1446)

*Sauer, J. R.* and *Essenberg, R. C.*

**Classification, Distribution, and Systematic Studies of Insects and Arthropods**

Further develop the collections with special emphasis placed on fall and spring collecting to attempt to fill in seasonal gaps. Properly maintain the collections. Continue to update and improve distribution data. Prepare papers regarding the identification and distribution of Oklahoma arthropods. Provide loan materials, data, and facilities for cooperating scientists. (1460)

*Drew, W. A.*

**Life Systems and Controls For Key Pests of Alfalfa in Oklahoma**

Study population dynamics of key insect pests and beneficials. Describe interactions of the alfalfa weevil and weeds in reducing yields and stand longevity of alfalfa. Refine the integrated pest management program. Identify germplasm with resistance to key aphid pests and characterize the nature of resistance. (1527)

*Berberet, R. C.*
*Dillwith, J. W.*
*Caddel, J. L.*
*Stritzke, J. F.*

**Integrated Management of Ticks and Tick-Borne Disease**

Evaluate integrated techniques for tick management. Improve/evaluate sustained-release control devices for internal/external livestock application. Examine biological relationships of ticks and tick-borne disease. Study feeding behavior in ticks and relate to organism development and transmission. (1702)

*Hair, J. A.*
*McMurphy, W.*
*Kocan, K. M.*
*Kocan, A. A.*

**Chemical and Auditory Perception in Ticks**

Determine the relationship between tick sensory perception (structures involved) and field survival behavior. Compare the ultrastructure of tick sensory organs between species and correlate perception of specific stimuli to these organs. Compare the ability of ticks to perceive specific stimuli before and after sensory organ alteration. (1706)

*Barker, R. W.*

**Improved Systems of Management for Pecan Arthropod Pests**

Develop improved pest management strategies for key pests of pecans which have regional economic significance: pecan weevil, hickory shuckworm, pecan nut casebearer, and aphid and phylloxera complex. (1707)

*Eikenbary, R. D.*
*Barnes, G. L.*
*Smith, M.W.*

**Pest Management Strategies For Leafhoppers, Spittlebugs, and Aphids on Alfalfa**

Establish and/or refine economic injury levels and economic thresholds. Study the biology and population ecology of homopterous pests of alfalfa, stressing quantitative data. Improve control methodologies and investigate the impact of these on homopterous pests of alfalfa. Integrate the results of these studies into pest management programs and ascertain practical implementation procedures. (1717)

*Berberet, R. C.*

**Biology and Behavior of Tabanid (Horsefly) Pests of Livestock**

Determine behavior patterns associated with preovipositional activity in the period immediately following blood meals. Investigate the reproductive activity of pest horsefly species including mating swarms, mating activity, ovipositional times and sites. Determine the levels of sugars (carbohydrates) and lipids within specimens at various periods of their life cycle and try to determine sources of these carbohydrates in nature. Investigate the short distance dispersal patterns of horseflies while seeking hosts. (1728)

*Wright, R. E.*

**Bionomics, Vector Capabilities and Management Strategies for Face Flies**

Evaluate the epizootological relationship of face flies and organisms causing IBK-Pinkeye and infectious bovine rhinotrachetitis. Compare face fly suppression technologies and integrate the most effective ones into a practical management plan. (1769)

*Wright, R. E.*

**Evaluation of New Insecticides and Control Techniques for Livestock Insect Pests**

Determine effectiveness of ear tags and possible resistance of horn flies to synthetic pyrethroids. Evaluate the effectiveness of new insecticide or repellent formulations for

### Socio Economic and Structural Dimensions of Adequate Housing Perceived by Rural Households

Define criteria used by rural households in assessing the physical and socio-economic dimensions of adequate housing. Assess the importance of specific socio-economic and production factors (SEPFs) to rural households in assessing housing quality. Determine the interactive dimensions of the SEPFs. Develop through statistical procedures a housing-decision model for use with rural households. (1999)

*Weber, M. J.*

### Quality Assurance in Fruits and Vegetables

Determine nutrient content of fruits and vegetables. Determine sensory characteristics considering varieties, regional food patterns and postharvest treatments. Assessment of microorganism types and count and other safety characteristics. (2010)

*Ebro, L. L.*

### Interactions of Chromium and Ascorbate in Absorption and Metabolism

The research will investigate the mechanisms of chromium-ascorbate interaction and effects on hyperglycemia, hypercholesterolemia, cholesterol biosynthesis and degradation, and atheromatous involvement of the vessels such as the aorta. (2035)

*Stoecker, B. J.*

### Chromium Status: Effects of Drugs and Pregnancy

Evaluate the effects of acid components (calcium, magnesium, and aluminum) on chromium absorption and retention. Investigate the effects of chromium status and pregnancy on tissue chromium concentrations, on serum glucose and lipids, and on enzymes and hormones. (2041)

*Stoecker, B. J.*

## Horticulture and Landscape Architecture

### Greenhouse and Garden Flower Crop Production

Improve greenhouse crop profitability and quality by improving scheduling, space use, growing media, nutrition, environment, and post-harvest handling. Determine the best uses of growth regulating chemicals to improve quality and/or shelf-life, garden performance, or to reduce production time. Investigate microclimator or root-zone heating as a means to reduce costs and improve plant quality. Select and work out cultural procedures for new or different species or cultivars. Test outdoor garden responses of selected bedding plants, bulbs, and pot plants to determine optimum outdoor cultural procedures under Oklahoma conditions. Determine performance of plants grown in the greenhouse using various soilless media, container sizes, fertilizer, or growth regulator treatments. (1411)

*Payne, R. N.*

### Fruit Tree Investigations

Evaluate new peach cultivars for use in Oklahoma. Evaluate peach tree spacing in combination with pruning time and method. Evaluate the meadow orchard system for use in Oklahoma. (1433)

*Smith, M. W.*

### Vegetable Breeding Material Evaluation and Variety Testing

Evaluate advanced lines and cultivars of vegetables in different areas of Oklahoma in comparison with established cultivars. Determine what diseases could potentially limit production of selected vegetables and evaluate various control techniques and strategies. (1441)

*Motes, J. E.*
*Kahn, B. A.*
*Conway, K. E.*

### Studies of Alternate Bearing in Pecans

Evaluate new pecan clone performance. Develop fruit thinning goals for pecans. Determine the influence of environmental stress on photosynthetic efficiency. (1689)

*Smith, M. W.*

### Stand Establishment and Crop Development Improvement of Cool-Season Vegetables

Evaluate different systems of stand establishment for cool-season vegetables under both spring and fall growing conditions. Evaluate trickle irrigation as an alternative to sprinkler irrigation, particularly for leaf lettuce. Develop a cultural system for growing leaf lettuce in eastern Oklahoma. (1876)

*Kahn, B. A.*

### Fruit and Vegetable Investigations in Southeast Oklahoma

Determine the asparagus establishment and production system best suited for southeastern Oklahoma. Evaluate methods to promote earliness in production of sweet corn. Evaluate new cultivars of blueberries, strawberries and brambles in southeast Oklahoma. Evaluate various cultural practices for blueberries, strawberries, and brambles. Identify soil management systems for peaches that promote productivity, minimize costs, reduce erosion, and reduce spring frost. Determine water use rates and soil moisture levels for peaches. (1931)

*Motes, J. E.* and *Smith, M. W.*

### Irrigation Methods and Mulching for Tomato Production in Southeastern Oklahoma

Determine the effects of irrigation method and plastic film mulch on plant growth, fruit yield and quality, and rooting patterns of staked tomatoes grown in southeastern Oklahoma on Wister silt loam soil. (1938)

*Motes, J. E.*

### Orchard and Vegetable Intercropping Systems for Small Farms in Southeast Oklahoma

Develop an orchard-vegetable intercropping system for small farms in southeastern Oklahoma and determine the production potential of selected vegetables and strawberries when intercropped with peaches grown at two different in-row spacings. Determine the effect that intercropping systems have on peach tree growth, production, fruit size, and longevity. Determine the impact of alternative orchard and vegetable or strawberry intercropping systems on farm income, income variability, short-run and long-run cash flow, and resource requirements. (1950)

*Motes, J. E.*
*Kahn, B. A.*
*Smith, M. W.*

### Postharvest Treatments to Delay Vegetable and Fruit Deterioration

Develop postharvest methodology to reduce water loss and respirable materials from fruit and vegetables. Conduct studies to determine how films and wrapping changes in package atmosphere and how that affects product deterioration. Organoleptic, microbiological and nutrient retention tests will determine effectiveness of postharvest methodology. (1981)

*Buchanan, D. W.* and *McCollum, T. G.*

### Container-Grown Greenhouse Flower Crop Production

Determine influences of certain environmental factors on growth and flowering responses of seed-propagated flowering perennials suitable to Oklahoma. Examine effects of environmental manipulations on the cropping cycles and growth responses of certain "minor" annual bedding plants important to the Southwest. Develop cultural procedures for flowering species that exhibit strong potential for adaptation to pot culture and sales. (1992)

*Wise, F. C.*

### Frost Protection of Annual Plants Via Reduction of Bacterial Ice Nuclei

Identify factors affecting freezing temperature of annual plants. Develop and implement procedures to reduce plant frost damage. (2002)

*Anderson, J. A.*

### Investigations into the Growth and Development of Small Fruit Crops

Evaluate new cultivars of small fruit crops and determine those which are best suited for eastern Oklahoma. Determine the areas that are best adapted for the culture of highbush and rabbiteye blueberries. Improve the establishment of small fruit crops while reducing production costs. (2008)

*Abbott, J. D.*

### Conservation Tillage for Vegetable Crops in Oklahoma

Compare different potential cover crops for adaptation, ease of establishment and suppression, and effects on the soil environment. Use selected cover crops in the development of conservation tillage techniques which minimize soil erosion while maintaining vegetable yield and quality at or above levels achieved with conventional tillage. (2012)

*Kahn, B. A.*

### Establishment, Evaluation, and Maintenance of Turfgrasses Adapted to Oklahoma

Develop and evaluate methods for enhancing the field survival and competitive ability of turf seedlings. Determine the seed characteristics that are directly related to enhanced turf seedling survival. Evaluate introduced and domestic grasses for use as improved turfgrasses in Oklahoma. Evaluate management practices concerning turfgrass pesticides, fertilizers, and equipment. (2017)

*Kenna, M. P.*

### Improved Vegetable Crop Development and Quality

Develop integrated cultural systems through manipulation of inputs including plant population, soil fertility, and chemical harvest aids to improve vegetable crop development and maximize yield of marketable quality produce. (2026)

*Kahn, B. A.* and *Brusewitz, G. H.*

### Heat Stress in Bell Peppers

Determine the effects of increasing temperature on productivity and viability of pepper plants. Determine if heat stress can be reduced in pepper plants by mulching, evaporative cooling, and use of plant growth regulators. Ascertain whether heat shock proteins are involved in stress tolerance in pepper. (2043)

*Anderson, J. A.*
*McCollum, T. G.*
*Roberts, B. W.*

## Plant Pathology

### Wheat Root Rot Disease Control

Identify important soilborne pathogens, and study their epidemiology. Develop biological and/or other methods for controlling *Pythium spp.* infection in field soils. Characterize toxic metabolite production by Pythiu-arrhenomanes. Evaluate host germplasm for resistance to *Pythium spp.* found in wheat soils. (1574)

*Singleton, L. L.* and *Russell, C. C.*

### Control of the Effects of Plant Parasitic Nematodes on Wheat and Forage Crops

Determine modes of action, particularly non-nematicidal modes, of commercial nematicides, effects of root diffusates on resuscitation of anhydrobiotic nematodes, and influence of nematicide application methods on nontarget pathogen population. Develop nematicide application techniques to the level of economical utilization. (1585)

*Russell, C. C.*
*Singleton, L. L.*
*Burton, R. L.*

### Developing Wheat Germplasm Resistance to Septoria Leaf Blotch and Tan Spot

Identify sources of resistance to Septoria leaf blotch and tan spot. Determine modes of inheritance. Analyze interactions among resistance genes. (1593)

*Gough, F. J.* and *Smith, E. L.*

### Epidemiology and Control of Sclerotinia Blight in Peanut Seeds

Develop a more sensitive detection procedure for the presence of *Sclerotinia minor* in peanut seeds. Investigate the relationship of seed infection to disease transmission. Determine the sclerotinial density in peanut fields to initiate infection under Oklahoma conditions. Study the interactions between plant densities and disease incidence among several peanut genotypes. Define the conditions that enhance transmission of sclerotinia blight from infected or contaminated seed source. Study the early stages of infection by *S. minor* on different peanut genotypes. (1661)

*Melouk, H. A.*
*Sherwood, J. L.*
*Ketring, D. L.*

### Fungicide Seed Treatment Testing Program for Wheat

Measure the performance of fungicidal chemicals used as surface seed treatments for improving plant emergence and final stand establishment of winter wheat. Determine the level of control of fungicidal chemicals used as surface seed treatments for controlling bunt in wheat. (1797)

*Williams, E., Jr.*

### Diseases of Trees in Oklahoma

Determine the mode of infection and the spread of Hypoxylon canker in oak trees and determine if resistance occurs among cultivars. Find methods of protecting oaks from oak wilt. Develop methods of disease control for several diseases of trees. (1797)

*Conway, K. E.*

### Biology and Control of Plant Viruses in Oklahoma

Compare and develop qualitative and quantitative methods for screening plants for resistance to wheat streak mosaic virus and wheat soilborne mosaic virus. Develop a means of evaluating the extent of peanut mottle virus infection in the USDA germplasm collection and evaluate methods for eliminating the virus from infected plant introductions. Examine the epidemiology of watermelon mosaic virus and devise possible control strategies. (1859)

*Sherwood, J. L.*

### Development of Disease Resistant Wheat and Studies of Selected Wheat Pathogens

A system to combine wheat leaf rust resistance with resistance to wheat soilborne mosaic virus or wheat streak mosaic virus has been established. This system utilizes traditional breeding methods, leaf rust race surveys, screening of international nurseries for effective sources of leaf rust resistance, visual assessment of symptoms, and the enzyme-linked immunosorbent assay (ELISA) to identify plants in field and greenhouse tests with resistance to these diseases. This system has contributed to the release of the wheat leaf rust resistant cultivar 'Century', and will facilitate development of wheat cultivars with resistance to these diseases in the future. (1817)

*Hunger, R. M.*
*Sherwood, J. L.*
*Smith, E. L.*
*Merkle, O. G.*

### Management of Soil Microorganisms Affecting the Health and Vigor of Plants

Determine the influence, interactions, and distribution of soil microorganisms that suppress pathogens and promote plant health and vigor. Evaluate the influence of chemical compounds, germplasm, and cultural practices on soil microorganisms affecting plant health and vigor. Devise, modify, and evaluate techniques for determining the identity, interactions, and effects on plants of biological, chemical, and physical soil

components. Develop feasible management procedures for optimum plant health and protection of the environment. (1904)

*Singleton, L. L.*
*Russell, C. C.*
*Conway, K. E.*

**Microscopic Changes at Site of Interaction Between Bacterial Blight Organism and Cotton Plant**

Characterize structural and ultrastructural features of the host cells immediately surrounding blight bacterial colonies. The host cell features most likely to be correlated with disease physiology will be analyzed in susceptible, highly resistant and intermediate single gene variants. Refine our understanding of the physical and chemical nature of the interactive site between host plant cells and the pathogen. Establish experimental procedures varying temperature, moisture and light intensity to determine if ultrastructural markers for resistance can be suppressed or modified by manipulating such parameters. (1927)

*Richardson, P. E.*
*Burton, R. L.*
*Todd, G. W.*

**Interactions of *Sprioplasma Citri* in Plant and Insect Host Systems**

Determine the effects of changing spiroplasma titer in the plant and in the insect vector on disease initiation and development. Compare the biology, pathogenicity, and transmissibility of worldwide isolates of *S. citri*. Develop and utilize a plant organ culture system for the study of host-spiroplasma interactions. Remain responsive to the needs of Oklahoma regarding diseases caused by phytopathogenic prokaryotes. (1929)

*Fletcher, J.*

**The Greenbug Feeding Site: Structural Components of the Host Plant Response**

Compare susceptible with resistant grain varieties, primarily wheat, with respect to branching, end point, amount of phloem as opposed to other damage, stylet sheath chemistry, lesion comparative histochemistry statistical analysis for E.M. component changes in the two types of host tissue damage loci: mesophyll parachyma adjacent to stylet tracks and vasular bundles especially adjacent to target phloem elements. (1932)

*Richardson, P. E.*
*Burton, R. L.*
*Todd, G. W.*

**Optimization of Microbial Nutrient Stress to Reduce Root-Infecting Fungi**

Means for enhancing the natural microbial nutrient stress in soil imposed on phytopathogenic fungal inoculum will be studied. Alterations in soil pH, temperature, and matric potential and the addition of specific agrichemicals to soil will be evaluated for their effect on the intensity of microbial nutrient stress in soil. In response to nutrient stress, loss of endogenous carbon food reserves of propagules via exudation or increased respiration will be assessed. The effect of optimized nutrient stress on the fitness of inoculum to survive in soil will be determined. (1957)

*Filonow, A. B.*

**Disease and Insect Control for Horticultural Crops and Christmas Trees in S. E. Oklahoma**

Determine what diseases and insects limit quality and quantity of vegetable and small fruit production in S. E. Oklahoma. Determine their effect on yield and their economic impact. Develop or adapt controls adequate for economic justification for their use. Select genotypes of Virginia Pine Christmas trees resistant to Nantucket pine tip moth. (1977)

*Patterson, C. L.* and *Fletcher, J.*

**Control Strategies for Tan Spot of Wheat and Leaf Spot of Peanuts in Oklahoma**

Develop an integrated management system for tan spot of wheat based on an epidemiological forecasting model that determines periods of high inoculum deposition and optimum conditions required for infection and rapid disease progress. Effective, economical, chemical and cultural control practices are to be developed. Develop forecasting models conceived similarly to those for wheat tan spot. Once models are constructed, emphasis will be on timely, minimum applications of fungicide, aimed at reducing the number of applications, yet maintaining economical levels of disease control. (1987)

*Schuh, W.*
*Melouk, H. A.*
*Hunger, R. M.*
*Gough, F. J.*

**Biological, Cultural and Chemical Control of Soilborne Diseases**

Evaluate delivery system for biocontrol agents into field soil using gel seeding and transplanting techniques. Evaluate use of various seed preparations, dry, germinated and primed in gel systems. Enhance strains and formulations of selected biocontrol agents. Evaluate various plastic, aluminum and organic mulches to reduce population densities of soilborne pathogens. Evaluate, modify and develop methods to quantify propagules of soilborne pathogens to establish model systems for inoculum density-disease incidence relationships. Evaluate fungicides in combination with new delivery systems. (1991)

*Conway, K. E.*

**Genetics of Pathogenesis and Copper Resistance in Bacterial Pathogens**

The efficacy of copper bactericides, the host range of copper resistance plasmids and the expression of copper resistance in heterologous systems will be explored. The genetics of coronatine biosynthesis will be investigated in *Pseudomonas syrinagae* pv. tomato. (2009)

*Bender, C. L.*
*Patterson, C. L.*
*Andrews, M. W.*

**Management of Peanut Pod Rot in Oklahoma With Emphasis on the Role of *Pythium Spp.***

The extent to which populations of *Pythium myriotylum* are supported by roots and pods of several agronomically suitable peanut cultivars in Oklahoma will be assessed. The influence of matric potential and soil temperature on *Pythium spp.* populations and infection of roots and pods will be determined. Efficacy of labeled and experimental fungicides for use in Oklahoma peanut fields will be evaluated. (2021)

*Filonow, A. B.*

**Biology and Control of Plant Viruses in Oklahoma**

Monitor distribution and yield effects of viruses of wheat, peanut and vegetables. Investigate expression of resistance of wheat cultivars and peanut germplasm to plant viruses. Investigate the transmission of viruses in seed. Examine mechanisms of cross protection between plant virus strains. (2022)

*Sherwood, J. L.*

## Statistics

**Statistical Computing Methodology for Research Planning and Analysis**

Develop methodology to implement a computerized research planning system. Compare different methods of computing estimates and their variances. Compare methods of testing hypotheses for general unbalanced mixed model problems. Develop computational strategies which would yield reasonable solutions to general unbalanced mixed model problems. (1902)

*McNew, R. W.*

# Veterinary Research

### Bovine Respiratory Diseases: Risk Factors, Pathogens, Diagnosis and Management

Antigens, immonogens, virulence factors and corresponding genomic sequences of the etiologic agents of bovine respiratory disease (BRD) will be identified. Specific and nonspecific resistance mechanisms which aid in control and prevention of BRD will be defined and enhanced. Basic mechanisms of respiratory tract injury in BRD will be identified and related to the evolution of the pathophysiologic basic of the lesions. Techniques and practices related to BRD will be evaluated. (1438)

*Confer, A. W.*
*Fulton, R. W.*
*Panciera, R. J.*

### Developmental Stages of *Anaplasma Marginale* in Ticks

Increase the population level of *A. marginale* in salivary glands of adult *Dermacentor variabilis*. Confirm the location and quantitate the development of *A. marginale* in salivary glands. Characterize the antigenic composition of all tick stages of *A. marginale*. (1669)

*Kocan, K. M.*
*Storz, J.*
*Ewing, S. A.*

### Immunological Mechanisms of Resistance to Bovine Pneumonic Pasteurellosis

Develop, characterize, and evaluate a subunit vaccine to protect cattle against pneumonia pasteurellosis. Study the mechanisms of pathogenicity of and host resistance to *P. haemolytica*. Evaluate the interferon system relating to the host defense mechanisms involved in bovine respiratory diseases. (1725)

*Confer, A. W.*
*Fulton, R. W.*
*Panciera, R. J.*

### Susceptibility or Resistance to *E. Coli* Diarrhea in Cattle: Receptor Mechanisms

Determine susceptibility or resistance to *E. coli* infection, isolation of the intestinal receptor that binds 0101:1999 *E. coli*, and determination of the binding affinity and efficiency of the receptor for 0101:1999 strains of *E. coli*. (1727)

*Staley, T. E.*
*Bush L. J.*
*Gilliland, S. E.*

### Development Stages of Anaplasma Marginale in Cattle

Understand the development of *Anaplasma marginale* in cattle by examining bovine tissues for stages of *A. marginale* from exposure of susceptible calves to appearance of clinical disease, confirming the identity of stages *A. marginale* in bovine tissues, and comparing parameters of clinical disease in experimental calves that resulted from exposure to infective ticks or inoculation of infective bovine blood. (1761)

*Kocan, K. M.*
*Ewing, S. A.*
*Hair, J. A.*
*Barron, S. J.*

### Immunological Factors on Neonatal Diseases in Food-Producing Animals and Horses

Determine the roles of specific immune responses on enhanced resistance of the neonate. Determine the roles of environmental and genetic factors on immunological unresponsiveness in neonates. (1830)

*Staley, T. E.*

### Seasonality of Immunologic Responses and Pepsinogen Levels Related to Inhibited Larvae in Sheep

Determine the influence of acquired immunity in sheep on serologic and pepsinogenic responses and on larval inhibition of *Haemonchus contortus* and *Ostertagia circumcincta*. Determine the influence of climatic factors during development of free-living larval stages on larval inhibition of *H. contortus* and *O. circumcincta*, and on serologic and pepsinogenic responses in sheep. Correlate a possible interaction between host factors, (i.e., developing acquired immunity) and climatic factors acting on the free-living stages as affects larval inhibition of *H. contortus* and *O. circumcincta*, in sheep. (1855)

*Jordan, H. E.*
*Fox, J. C.*
*Tungeln, D. V.*
*Phillips, W. A.*

### Vaccination for Bovine Brucellosis Field and Laboratory Studies

Evaluate low-dose *Brucella abortus* Strain 19 vaccination under field conditions. Conduct preliminary laboratory studies to determine responses of cell-mediated assays, fluorometric antibody assays, and effects of immunomodulating substances in nonvaccinated, vaccinated, and infected cattle. (1940)

*Confer, A. W.* and *Wyckoff, J. H.*

### *P. Haemolytica* Cytotoxin: Molecular Studies of Pathogenesis and Immunogenicity

Clone and express the cytotoxin gene of *Pasteurella haemolytica* in *Escherichia coli*. Biochemically and immunologically characterize the recombinant DNA-produced cytotoxin (r-cytotoxin) and compare it to purified native cytotoxin (n-cytotoxin). Determine if vaccination with r-cytotoxin affords protection in calves against experimental pneumonic pasteurellosis. (1959)

*Gentry, M. J.*
*Craven, R. C.*
*Confer, A. W.*

### Antibiotic Therapy in Pneumonia Based on MIC Tests

The long-term objective is establishment of the applicability of *in vitro* bacterial sensitivity assessment, specifically minimal inhibitory concentration to predictability of therapeutic effectiveness of antibiotics and the determination of the most appropriate dosage. (1976)

*Burrows, G. E.* and *Barto, P. B.*

### Interferon and Host Defense Mechanism

Bovine leukocyte and alveolar macrophase *in vitro* cultures will be treated with interferon (IFN) and/or intereleukin-2 (IL-2) and various procedures including phagocytosis, IFN production, and lymphocyte blastogenesis and migration inhibition performed. Calves administered IFN and IL-2 will be vaccinated with viral and bacterial vaccines to determine enhanced immune response to vaccines. *In vitro* bovine cell cultures and calves will be treated with IFN and bovine viruses and levels of 2-5 A synthetase detected in cells post-treatment. Calves will be treated by various IFN concentrations and by various routes. Serums and lung washing fluids will be assayed for IFN to determine absorption, blood levels, distribution, and clearance. (1990)

*Fulton, R. W.*
*Confer, A. W.*
*Short, E. C.*

### Characterization of an Immunogenic Carbohydrate-Protein Subunit of *P. Haemolytica*

Separate and characterize the antigenic protein and carbohydrate present in a *Pasteurella haemolytica* carbohydrate-protein subunit (CPS). Compare the antigenic components of CPS with membrane proteins, purified leukotoxin, and capsular carbohydrate. Determine which antigenic components of CPS are important for induction of resistance against pneumonic pasteurellosis. (2000)

*Confer, A. W.*
*Panciera, R. J.*
*Mort, A. J.*

### Development of BHV1 as a Bovine Respiratory Vaccine Vector

Construct a BHV1 strain as a vaccine vector. Delete the DNA sequences coding for a non-essential glycoprotein of BHV1 and determine the properties of the gene-deletion virus *in vitro* and *in vivo*. (2034)

*Eberle, R.*
*d'Offay J. M.*
*Fulton, R. W.*

## Zoology

### *Brucella Abortus* Antigen Expression by Recombinant Plasmids in *Exchericha Coli*

Study isolation methods for DNA and RNA from *B. abortus*. Determine whether pathogenic strains carry plasmids. Make a gene library of *B. abortus* DNA cloned in *E. coli*. Test for expressions of *B. abortus* genes in *E. coli* mutants. Screen a library for expression of *B. abortus* antigens. (1945)

*Bantle, J. A.*
*Confer, A.W.*
*Essenberg, R. C.*
*Sanborn, M. R.*

### Wildlife Production Potential on Cross Timbers Rangeland

Determine seasonal changes in density, recruitment, and habitat selection of small mammal, cottontail rabbit, and white-tailed deer populations in response to brush manipulation with seasonal cattle grazing on Cross Timbers rangeland. Determine the effects of brush manipulation with seasonal cattle grazing on food habits, diet quality, and condition of small mammals, cottontail rabbits, and whitetailed deer inhabiting Cross Timbers rangeland. (2036)

*Lochmiller, R. L.*
*Engle, D. M.*
*McCollum, F. T.*

# College of Arts and Sciences

***Faculty in the College recognize the relationship between teaching excellence and continued research excellence. This is especially true in the education of America's youth in the importance of science and technology.***

The College of Arts and Sciences contains 24 departments and schools ranging from the physical, mathematical, biological, and social sciences to the humanities and arts and is the largest academic unit at OSU. Research and creative activities constitute a major cornerstone of the College's scholarly activity mission. By any criterion, Arts and Sciences faculty continued to distinguish themselves during the past fiscal year.

During the past year, Arts and Sciences faculty members published more than 20 books, more than 40 book chapters, and several hundred articles in leading journals. College faculty were also invited to give more than 300 papers at state, national, and international conferences. Fine and Performing Arts faculty presented or performed in nearly 80 concerts, performances, and exhibitions.

Much of the steadily increasing volume and quality of research conducted in the College of Arts and Sciences in recent years is due to the continued success of faculty in receiving extramural research support. This year was no exception. Total grant expenditures within the College from competitive grants exceeded $5,000,000 for the first time in the history of the College. Approximately $5.5 million in new awards were received by Arts and Sciences researchers. For every dollar of state appropriated funds nearly three dollars was generated in extramural grant funds during fiscal year 1988. These figures do not include nearly $1,000,000 in competitive grants that were approved for funding during fiscal year 1988 but not yet awarded due to federal budget freezes. Seven departments and schools recorded record years for extramural awards (English; Health, Physical Education, and Leisure Services; Mathematics; Music; Philosophy, Speech Communication; Zoology), while four others had their second best years ever (Botany and Microbiology; Foreign Languages and Literature; Physics; Psychology).

Scientific and technical research requires state-of-the-art equipment that is very expensive to obtain and maintain. College research faculty received sufficient extramural funds to purchase over $1.3 million in new scientific equipment during the past year. This equipment was purchased using less than $170,000 in state funds—a ratio of almost eight to one in equipment purchased versus state funds expended. The College also obtained nearly $185,000 in competitive funds for major equipment (out of $260,000 available statewide) from the Oklahoma Center for the Advancement of Science and Technology (OCAST) MOST program. College science faculty also acquired seven new OCAST Health Research grants this year. These seven grants represent almost 20 percent of all the new health research proposals that were funded by the state this year. The Department of Mathematics welcomed a second Sloan Fellow in FY 88. Drs. J. Brian Conrey and David Wright remain the only faculty members in the state to have won this prestigious award.

Faculty in the College recognize the relationship between teaching excellence and continued research excellence. This is especially true in the education of America's youth in the

importance of science and technology. This year OSU faculty from several departments joined an elite group of American universities in offering a summer camp for junior high science students funded by the National Science Foundation's Young Scholars Program. This grant will also permit another camp to be conducted during fiscal year 1989. Two departments, Physics and Botany/Microbiology, also conducted NSF-sponsored summer research programs for undergraduates under the Research Experience for Undergraduates Program. In the latter program 20 undergraduates in the sciences were brought to OSU and placed in the laboratory of a faculty mentor for the summer. Each of these students conducted independent research under the direction of the faculty member. The Department of Geology has recently initiated a program, sponsored by an external grant, of retraining petroleum geologists in the growing field of hydrogeology. Collectively these programs placed the College among the nation's leaders in developing the scientists and engineers of tomorrow.

As befits the diversity of departments in the College, research interests among faculty members are equally broad. Specific projects are described in detail in the following section. In the life sciences, for example, researchers are examining the biology of plant, animal, microbial, and viral systems. Projects under way include work on the cloning and expression of various genes responsible for key biological traits. Other biologists are conducting important work in the ecology and physiology of the above organisms and natural communities. Similarly, chemists and physicists are doing basic research on the nature of matter and energy, including materials science, molecular processing, laser physics, and computer modeling. Mathematical researchers are conducting basic research on a variety of topics in algebra, geometry, number theory, Zeta function analysis, and other topics in basic mathematical sciences.

The social sciences, humanities, and fine arts are also areas of active research and creative activities in the College. In the social sciences, human behavior and the social, political, and economic institutions designed by human beings receive scrutiny. Many of these analyses involve important social problems ranging from juvenile delinquency to AIDS. These programs, many of which are funded by extramural competitive grants, also involve extensive undergraduate and graduate student research. For example, the Policy Sciences Group in Political Science undertakes policy analysis and evaluation research on issues of concern to public policy makers at all governmental levels. Similarly, investigators in the College's humanities departments are conducting extensive research into topics of interest to Oklahomans and others, including the origins of our state culture and societal mores. Many of these projects are funded by extramural grants from public and private agencies. Fine and Performing Arts faculty in the College excel in individual creative activities and exhibitions, and have brought numerous performing and visual arts groups to the campus for the enjoyment of all citizens in the area.

*Researcher Linda Franzmann of the botany department harvests plant tissue for genetic analysis.*

The future of scientific, humanistic, and artistic research and creative activities in the College of Arts and Sciences looks bright indeed. Faculty are increasingly productive with each passing year, and new knowledge gained by College faculty will undoubtedly enhance the quality of life for Oklahoma citizens and the nation.

## Art

### Computer Graphics and Design Education

Design education must address the changes the computer is having on visual communication. The goals of this research are to (1) gather information from universities with existing computer graphics programs, (2) assess hardware and software options, (3) document survey findings, bibliographic sources and possible corporate/government funding sources, and (4) propose implementation of computer graphics curriculum within existing art department courses. Specific applications include the use of computer aided instruction and computer aided drafting relating to the present foundation courses (color and design, drawing and 3-D design) and in upper division courses (low resolution, high resolution and extended high resolution computer graphics).

State of Oklahoma
*Lynda Halley*

### Exhibition from M-AAA/NEA Fellowships Award Winners in Sculpture

This grant enabled the Gardiner Art Gallery to present an exhibition of M-AAA/NEA Fellowship Award Winners in Sculpture. Featured artists were Barbara Kendrick (Nebraska), Jon Havener (Kansas), Kim Strommen (Missouri) and David Phelps (Oklahoma). The exhibition also featured gallery talks by each artist.

M-AAA
*B.J. Smith*
*David Roberts*

### M-AAA/NEA Exhibit

This grant enabled the Gardiner Art Gallery to present an exhibition of M-AAA/NEA Painting, Print and Drawing winners. The exhibition also featured gallery talks by each artist.

M-AAA
*B.J. Smith*

### Allegories of Triumph and Salvation: Murillo's *The Life of Jacob and The Parable of the Prodigal Son*

Preparation of a manuscript concerning the allegories introduced by the late-Baroque Spanish painter, Bartolome Esteban Murillo into the two narrative series of paintings he produced in Seville between 1660-1665.

Dean's Incentive Grant
*Mindy Taggard*

## Botany/Microbiology

### Noble Foundation Predoctoral Fellowship

This fellowship will enable a predoctoral student to complete a Ph.D. and to work on wheat tissue culture.

Noble Foundation
*Marc Bauduy*
*Becky Johnson*

### *P. haemolytica* cytotoxin: Molecular Studies of Pathogenesis and Immunogenicity

The objectives of this project are to clone and express the cytotoxin gene of *Pasteurella haemolytica* in *Escherichia coli*; to biochemically and immunologically characterize the recombinant DNA-produced cytotoxin (r-cytotoxin) and compare it to purified native cytotoxin (n-cytotoxin); to determine if vaccination with r-cytotoxin affords protection in calves against experimental pnuemonic pasteurellosis; and to construct a cytotoxin-deficient (Tox-) mutant of *P. haemolytica* and test its immunogenicity and pathogenicity in calves.

USDA
*Rebecca Craven*

### Development of Genetic Tools for the Analysis of Bacterial Virulence

A pilot project to construct a plasmid DNA molecule which will be useful as a cloning vector for the analysis of the virulence of *Pasteurella haemolytica*, a bacterium that is the cause of a severe fibrinous pneumonia of cattle known as shipping fever. A good understanding of the pathogenic processes that lead to shipping fever is currently hampered by lack of techniques for genetic manipulation of the organism. This research should considerably improve the situation by making available a plasmid vector that can be used for genetic engineering of *P. haemolytica*. The vector plasmid developed for use in *P. haemolytica* will most probably be of use in the analysis of human pathogens as well.

Dean's Incentive Grant
*Rebecca Craven*

### Cloning Vectors for Analysis of Bacterial Virulence

This project will result in the development of cloning vectors to be used as tools in the genetic analysis of *Pasteurella haemolytica*; a bacterium that causes an acute fibrinous pleuropneumonia of cattle. This disease often strikes animals that are predisposed to infection due to stress or a primary viral infection. The development of cloning vectors that can be used for the genetic manipulation of *P. haemolytica* will allow analysis of several *P. haemolytica* factors for their role in the pathogenesis of pneumonic pasteurellosis and their potential as vaccines. This will ultimately help us understand the interactions between viruses and the bacterium in the bovine respiratory disease complex and, by extension, to better understand such interactions as they occur in humans. Further, the plasmids that result from this project will likely be directly useful for genetic analysis of human, as well as veterinary, pathogens.

Oklahoma Health Research Program
*Rebecca Craven*
*Alan Harker*

### Purchase and Use of Ultracentrifuge

This equipment grant enabled the Department of Botany and Microbiology to purchase an LKB L8-80M ultracentrifuge. Research interests of primary users of the equipment include the molecular biology of Rous Sarcoma Virus; secretion of extracellular proteins by gram-negative bacteria; developmental genetics and molecular biology of *Arabidopsis thaliana*; molecular biology and physiology of *Anabaena variabilis*; biochemistry and physiological ecology of freshwater algae; and molecular biology of Sendai virus.

National Science Foundation
*Rebecca Craven*
*John Wills*
*David Francko*
*David Meinke*
*James Ownby*
*Mark Sanborn*

### Physiological Ecology of Nucleotides: Aquatic Plant Carbon Assimilation

The green alga *Selenastrum capricornutum* was used as a laboratory model system to examine cyclic AMP (cAMP) dynamics and the effect of cAMP on membrane polarity, proton efflux, and photosynthetic carbon assimilation. *Selenastrum* contained reproducibly high (ca. 5 nmol/gm fresh wt) cAMP concentrations throughout log phase. cAMP uptake was passive, linear, slow and assimilated cAMP was largely converted to ATP/ADP. Much of the unconverted cAMP was released intact into the extracellular medium. Membrane polarity experiments and media/intracellular pH measurements supported the view that additions of cAMP to cells placed in cAMP-free media could stimulate or repress the rate of photosynthetic carbon assimilation, depending on the amount of cAMP added and the time in the diurnal cycle cells were assayed. The ecophysiology of cAMP dynamics and photosynthesis was examined in epilimnetic planktonic communities of Sangre Isle Lake, OK. In fall 1986, experiments indicated that different size classes of algae (separated by membrane filtration) had different cAMP dynamics and responded differently to cAMP perturbation in terms of photosynthe-

sis. A protocol was developed to remove dissolved cAMP from lake water. Data suggested that naturally-occurring cAMP may play a role in normal photosynthetic performance of epilimnetic plankton. Other laboratory competition experiments also supported the view that different species of algae respond to media cAMP fluxes in greatly divergent manners.

National Science Foundation
*David Francko*

### Development of a *Nelumbo lutea* Toxicant Bioassay System

Seedling cultures of the floating-leaved aquatic macrophyte were used as a model system to examine the effects of heavy metals on aquatic plants. Trivalent chromium was used as a reference toxicant for 4, 48 and 96 h bioassays, using petiole elongation and 14-C-bicarbonate photoassimilation as affected growth parameters.

University Center for Water Research
*David Francko*

### Young Scholars Program—Futures in Science

A three-week academic summer camp for outstanding junior high school students. Participants become better acquainted with the manner of scientific investigation, understand the various career options in the sciences, recognize and discuss various ethical and social issues surrounding scientific investigation, and become better prepared for college.

National Science Foundation
*David Francko*
*Margaret Ewing*
*Earl Lafon*
*John Gelder*

### Enhanced Cell Growth Rate Experiments

Growth rate determinations and intracellular chlorophyll and protein, and photosynthetic rates were examined in batch cultures of *Anabaena flos-aquae* and *Selenastrum capricornutum*. Cells were grown in the presence or absence of low dose (25 and 50 W), short-duration (5 min) ultrasonic agitation.

S.R. Taylor and Associates (NSF-SBIR subcontract)
*David Francko*
*James Ownby*

### Nutrition and Physiology of *Clostridium* Species Potentially Useful in Enhanced Oil Recovery

Several strains of fermentative clostridia capable of producing large amounts of gases and solvents have been studied; also the effects of various parameters having a role in EOR on yields of gases and solvents. In particular we have focused on the mechanism of NaCL inhibition of these organisms.

U.S. Department of Energy
*Mary Grula*

### Preparation of Pure Lectins from Soybean Seed and Roots and Comparative Study of Their Properties

The development of a scale-up procedure for isolation and purification from soybeans and soybean roots of lectin specific for binding with 4-O-methyl-D-glucuronic acid. Work will include scale-up extraction from defatted meal and subsequent three-step column chromatographic purification method. Pure root lectin will be isolated and studies will be conducted on its molecular weight, subunit composition, glycoprotein character and carbohydrate-binding specificity. A comparison will be made of the properties of root and seed lectins to ascertain relationship or biosynthetic modification.

U.S. Department of Agriculture
*Alan Harker*

### Developmental and Molecular Genetics of Embryogenesis in *Arabidopsis thaliana*

The purpose of this research is to study the genetic control of embryo development in higher plants through the isolation and characterization of embryo-lethal mutants. *Arabidopsis thaliana* has been chosen as a model system because it offers the best combination of genetic and developmental characteristics for this type of study. *Arabidopsis* has also become a model system for basic research in plant molecular genetics. We have shown previously that arrested embryos from lethal mutants of *Arabidopsis* differ in size and color, extent of abnormal development, ultrastructure, gametophytic gene expression, response in culture, and accumulation of storage proteins. We have also identified a biotin auxotroph that provides a unique opportunity to study the molecular basis of lethality and the utilization of biotin during plant development. Other mutant genes are currently being mapped in preparation for molecular isolation through chromosome walking. Additional mutants with interesting phenotypes have recently been isolated from M2 populations. We are analyzing these mutants to assess the diversity of embryonic lethals before attempting to identify specific genes and phenotypes to saturate in future mutagenesis studies.

National Science Foundation
*David Meinke*

### Genetic and Molecular Localization of Mutant Genes of *Arabidopsis*

The purpose of this project is to determine the chromosomal location of mutant genes of *Arabidopsis thaliana* in preparation for molecular isolation of these genes through chromosome walking. Three genes with essential functions during embryo development have been chosen for this study. The F2 method of genetic mapping with visible markers is being used to place these genes on the existing linkage map of *Arabidopsis*. Crosses have also been made with other wild-type strains of *Arabidopsis* to facilitate the localization of these genes in relation to adjacent molecular (RFLP) markers. The ultimate goal of this project is to understand the molecular basis of embryonic lethality in higher plants and identify genes that perform essential functions throughout embryo development.

Noble Foundation Predoctoral Fellowship Program
*David Patton*
*David Meinke*

### Analysis of a Biotin Auxotroph of *Arabidopsis thaliana*

The purpose of this project is to analyze an embryo-lethal mutant of *Arabidopsis thaliana* that can be rescued by the addition of biotin to arrested embryos cultured in vitro and to mutant plants grown in soil. Very few auxotrophic mutants have been isolated in higher plants. Most of the genes required for the biosynthesis and utilization of amino acids and vitamins in plant cells remain to be identified. This bio-mutant offers a unique opportunity to study the biosynthesis and transport of biotin in plants and the function of biotin during plant development. The high frequency of lethal mutants in *Arabidopsis* has also led to the development in other laboratories of a mutagen bioassay based on the induction of embryonic lethals. This bioassay appears to be highly sensitive and provides valuable information on the biological effects of environmental toxins in a model plant system.

Presidential Predoctoral Fellowship
OSU Center for Water Research
*Joe Shellhammer*
*David Meinke*

### Antibody Labeling of Color Specific Photoreceptors

During the past few years, while studying cyclic nucleotide metabolism in goldfish retina, the researcher has come to appreciate the need for reagents that can selectively react with color specific photoreceptors (CSP). The objective of this project is to generate one or more monoclonal antibodies specific for one or another of the goldfish color specific photoreceptor types. Such sera could then be used to identify and/or isolate the various classes of goldfish photoreceptors. In the studies of the cyclic nucleotide systems in photoreceptor function (1-4) the ability to prepare cell suspensions highly enriched for red, blue, or green photoreceptors would be invaluable in trying to determine the distribution of several

nzymes associated with those systems (i.e., denylate cyclase, guanylate cyclase, cyclic ucleotide dependent protein, kinase, phosphodiesterase). Further, such anti-CSP antibodies might well cross react with their ammalian counterpart, thus making comarable studies in mammalian tissue ossible.

tate of Oklahoma
*ichard Ortez*

**olor-Specific Opsin Purification**

The process of seeing involves the capure of light photons by specific photopigments (PP) contained within specific hotoreceptors (PR) within the retina. Two najor classes of PR exist (rods and cones) vith the cones being further divided into hree types (red, blue and green). These divisions among PR types are based upon their bsorption spectra which is in turn dependent upon the presence of unique PP in ach PR. These PP are composed of a lycoprotein (opsin) and an analog of vitanin A called the chromophore. Since these P all contain the same chromophore it is elieved that the molecular basis for the arying absorption spectra resides within the psin molecule. Much is known about the nolecular structure of the opsin contained n bovine rods. Much less is known about he molecular structure of the opsins ssociated with the three color-specific PP ecause it has not been possible to purify hem. This research involves production of ntibodies to the color-specific cones which vill then be used to prepare samples of pure olor-specific cones through affinity proceures. From these purified color-specific ones, the color-specific opsins will then be urified and used as immunogens to stimuate the production of large amounts of antiolor specific opsin antibodies. These latter ntibodies will be used, in affinity proceures, to purify large amounts of colorpecific opsin from homogenized whole retna which could then be subjected to iochemical analysis. The salient feature of his research is the combination of nonoclonal antibody production, mmunocytochemistry, and the use of goldish to permit the production and isolation of ntibodies to color-specific cones without heir prior purification. Monoclonal antibody roduction procedures allow for the immuization of impure antigens. However, they lo require pure antigen for the clone screenng process. This latter requirement for pure ntigen will be circumvented through the use f immunocytochemistry on goldfish retina vhere the three types of color-specific PE are norphologically distinguishable. The overll objective of this procedure is to purify to omogeneity the three color-specific opsins. n understanding of the structural similarities and differences between the color-specific PP opsins will be important in understanding the biochemistry of color vision.

National Institutes of Health (National Eye Institute)
*Richard Ortez*

**Studies of the Molecular Basis of Aluminum Tolerance in Wheat**

During the past decade, there has been a growing interest in the mechanisms of accumulation, toxicity, and tolerance of metals by higher plants. If the molecular mechanisms of metal tolerance can be determined, the tools of genetic engineering and biotechnology can be used to establish lines of crop plants which are tolerant of metals by virtue of their altered genetic makeup. There is increasing evidence that one important mechanism for tolerance of metals such as Cd, Cr, and Al in plants is the production of small proteins or oligopeptides which specifically bind the metal and protect other parts of the cell from damage. The purpose of the work being done on this grant is to determine if the induction of Al tolerance in wheat is correlated with the synthesis of cytosolic Al-binding proteins.

National Science Foundation
*James Ownby*

**Studies of Plant Defense in *Cnidoscolus texanus***

This research represents a continuation of work carried out in 1984-85 on a Dean's Incentive Grant. The investigations of *Cnidoscolus texanus* (bull nettle) to date have determined that variation in number of stinging hairs occurs among plant samples collected in the field. Plants from sites which have a history of intensive livestock grazing bear significantly more stinging hairs per unit area of petiole than do plants from areas which have not been intensively grazed. Other patterns of variation have been described in leaf midrib stinghair densities and leaf shape characters. Knowledge of the genetic basis of variation will permit experimental studies of the responses of herbivores to plants having genetically different defensive characteristics, and provide a further understanding of the ways in which such characteristics evolve.

State of Oklahoma
*A.J. Pollard*

**Summer Biology Research Experiences for Undergraduates**

This program includes ten participant projects, all concerned with the general problem of improving green plant performance through enhancement of growth conditions. The enhancement methods to be studied will involve a variety of approaches from the fields of plant physiology and structure, plant pathology, ecology and biochemistry. A brief orientation will be concerned with philosophy of research, plant productivity, growth limiting conditions and how they may be circumvented, literature survey, report writing and presentations of results. Post program follow-up efforts will include presentation of results to biology and science clubs in participants' home schools, state collegiate academies of science and publication in appropriate journals.

National Science Foundation
*Paul Richardson*

**Non-fusion Entry of Sendai Virus into Host Cells**

This project deals with the entry of an enveloped virus into the host cell. Sendai virus has long been the model virus for virus-host cell membrane fusion, a process by which the virus membrane becomes one with the host membrane releasing the nucleocopsid to the cytoplasm and initiating infection. We have demonstrated that the virus may enter by breaking the host cell membrane and passing intact into the host cell. This breach of the plasma membrane allows molecules as large as 160,000 mw to pass out of the cell before repair is initiated.

State of Oklahoma
*Mark Sanborn*

**Influence of Temperature on Photosynthesis and Photosythate Partitioning in Alfalfa**

In the northern U.S. where very cold temperatures and snow cover in winter are of long duration, it has been found that one-half of the available carbohydrate stored in alfalfa roots during the fall was used in respiration during winter. In contrast, in the southern plains, where snow cover is intermittent and usually of short duration, it has been suggested that the mild daily maximum temperature in winter months and the presence of green leaves on alfalfa plants might allow some photosynthetic activity, which could result in adding carbohydrates to the total energy root reserve; however, experimental proof is lacking. Furthermore, growth of alfalfa in the southern plains is considerably hindered during the months of July and August. The high temperatures are commonly blamed for this decreased growth, but the effects of summer temperature on photsynthate partitioning are unknown. There is a lack of experimental data on the effects of winter and summer temperatures on the partitioning of photosynthate of alfalfa growing in the southern plains.

State of Oklahoma
*Glenn Todd*
*Safaa Al-Hamdani*

### Parameters Influencing Distribution and Population Density of Indicator Yeasts in Ross Desert Soils

The limits of life are tested in the soils of the Ross Desert of Antarctica, the most stressed and depauperate cold ecosystem of this planet. The distribution and population density of indigenous yeasts are the only available indicators of soil fertility. Limiting parameters are water availability, substrate concentration, and soil cations (primarily NA+ and CA+ +) concentrations, and, at some si tes, total inorganic-N below 0.4 uA g-1. "Standing-crop" N-concentrations, largely nitrate of abiogenic origin, are of particular interest in this ecosystem because they do not represent the equilibrium value of a flux of nitrification, denitrification etc. as in soils of more diverse microbial populations. Indigenous microbes must utilize nitrate-N. There is a possibility that soil porosity also limits distribution and density. Yeasts similar to the indigenes in many respects also occur in temperate soils from which (as thermophiles are) they could be airborne to Antarctic soils; identification as species of varieties unique to the Ross Desert is also therefore necessary for indicator yeasts. This program is being pursued through nucleic acid homologies.

State of Oklahoma
*June Klingler*
*Helen Vishniac*

### Comparative Xerotolerance of *Alnus* and Symbiotically Associated *Frankia*

The limiting factors in the resistance of dinitrogen-fixing actinorhizal *Alnus* to drought were examined in investigations of the individual species concerned and of the symbiotic partnership. *Alnus* appears to be the most vulnerable partner, contrary to previous reports correlating Frankia halotolerance with dinitrogen-fixation. The halotolerance of the endosymbiont *Frankia* did not, however, predict the xerotolerance of acetylene reduction by *Alnus* nodulated with *Frankia* ARgP5$^{AG}$. Cloned plants of *Alnus glutinosa* (L.) Gaertn. AG 8022-16 were subjected to water stress under controlled conditions in an environmental growth chamber. Transpiration, stomatal conductance, and leaf water potential had decreased after successive 10 day periods of moderate (75 percent of water demand) and severe (50 percent of water demand) water stress. After severe stress had reduced plant water potential to -2.10 MPa, nitrogenase activity had fallen to 2.51 uM per plant per hour. The reported rapid turnover of nitrogenase implies that *Frankia mycelium* was metabolically active at this low water potential, a water potential at which no *Alnus*-derived *Frankia* has been reported active. Although ARgP5$^{AG}$ was similar to other such strains in halotolerance (lower limit ca. -1.25 MPa), the low water potential limit for growth with glucose osmoticum was ca. -2.54 MPa. (This *Frankia* isolate does not assimilate) glucose.It is probable that restricted supply of photosynthate was responsible for the drastic drop in dinitrogen fixation.

State of Oklahoma
*Helen Vishniac*
(*T. H. Hennessey*—Department of Forestry)

### Microbiological Factors in Developing Traps for the Green June Beetle (*Cotinus nitida*)

Field experiments conducted by Dr. Donn T. Johnson at the University of Arkansas demonstrated that Green June Beetles produced as aggregation signal only if they had access to peach puree which had not been treated with an anti-fungal (as opposed to antibacterials or exposure without access to the food attractant provided). With partial support from Dr. Johnson, this laboratory undertook to isolate and identify the fungal components of beetle gut contents after feeding with honey-water and after feeding on peaches. While the majority of the isolates were yeasts present under both experimental conditions, significant numbers of Hanseniaspora uvarum and an unidentifiable yeast (possibly an undescribed species) were present only in the gut of peach-fed beetles. Field trials utilizing peach puree inoculated with selected isolates are being conducted at the University of Arkansas.

Oklahoma State University
*Helen Vishniac*

### The Genetic Regulation of Surfactin Production in *Bacillus subtilis*

The lipopeptide surfactin, produced by the spore-forming bacterium *Bacillus subtilis*, is a powerful surface-acting agent with a number of potential applications, including the enhancement of oil recovery. Despite the availability of simple procedures for detecting surfactin production and the facile methods of genetic analysis with which to study biosynthetic processes in *B. subtilis*, there has been no attempt to analyze genetically the regulation of surfactin production. In this project, the genes encoding the enzymes which catalyze surfactin synthesis will be identified and isolated. Specific regions of the genes will be identified and studied through the use of gene fusion technology and mutagenesis to determine at the molecular level how the expression of the surfactin genes is regulated. These experiments may provide information which can be applied to problems associated with the use of biosurfactants for industrial purposes. It may also be possible, through genetic manipulation of surfactin biosynthesis genes, to manufacture more potent derivatives of surfactin.

Dean's Incentive Grant
*Peter Zuber*

### Regulation of Sporulation-Associated Gene Transcription

The induction of gene transcription in response to environmental signals is a central but still poorly understood aspect of genetic regulation. The spore-forming bacterium *Bacillus subtilis* will activate a diverse collection of sporulation-associated genes when nutritionally deprived and provides an excellent system with which to study transcriptional regulatory mechanisms which are responsive to the nutritional environment.

National Institutes of Health
*Peter Zuber*

## Chemistry

### Titanium Organometallics in Medicinal Compound Synthesis

This research will explore the use of organotitanium complexes and their participation as chiral templates in new aldol reactions involving achiral substrates, as new nonbasic nucleophilic alkylidene complexes for the preparation of synthetic intermediates, and as new deoxygenating agents in radical and displacement reactions.

Oklahoma Health Research Program
*Christopher Adams*

### Heteroretinoids-Potential Anticancer Agents

Retinoic acid is related to vitamin A and has exhibited powerful anticancer activity in test animals. This project is focused upon the synthesis of certain related retinoids which have a heteroatom such as O, N and S which are predicted to provide less toxic retinoid derivatives. Preliminary results have indicated this to be true and efforts are in progress to determine the structure-activity relationships with this family of heterocycles for the treatment of various forms of cancer.

State of Oklahoma
*K. D. Berlin*

### Purchase of NMR Spectrometer

The purchase of a high resolution nuclear magnetic resonance (NMR) spectrometer for use by nine research groups representing more than 35 individuals on research projects.

National Science Foundation
*K. D. Berlin*

### 3,7-Diheterabicyclo[3.3.1]nonanes as Potential Antiarrhythmic Agents

This project involves the preparation of selected 3,7- diheterabicyclo[3.3.1]nonane and certain salts thereof as potential antiarrhythmic agents. Preliminary results have clearly demonstrated that (N,S) systems do exhibit strong antiarrhythmic action in dog

models. The synthesis of systems containing more polar groups around the heteroatom is planned as well as substituting a functionalized carbon group at either position-3 or position-7. Such groups as carboxyl, amine and amide are anticipated. Certain selenium-containing analogues are also targeted molecules since we have evidence which indicates certain members of the hetreocyclic family not only do not permit sustained ventricular tachycardia (VT) but prevent them from forming and often increase blood pressure slightly like the sulfur counterpart. Thus, a structure-activity profile is emerging which is expected to allow a more incisive analysis of the structural features needed for maximum activity.

OU Health Sciences Center
National Heart, Lung and Blood Institute
*K. D. Berlin*

**Modified Retinoids-Potential Carcinostats**

The major objective of this research is to develop methodology to obtain oxidized products which are reasonable candidates as oxidative metabolites of hetroarotinoids. Only a few of the latter family of modified retinoids known by the preliminary screens have revealed strong activity in specific assays, namely the tracheal organ culture assay, the ornithine decarboxylase assay, and the HL-60 cell line. It is the intent of the proposed chemistry to introduce oxygenated functions on the partially saturated ring of the retinoid nucleus, on peripheral methyl groups, and in the side chain. These sites are hypothesized to be the most vulnerable to *in vivo* oxidative degradation on the basis of model systems and the metabolites from trans-retinoic acid.

Oklahoma Health Research Program
*K. D. Berlin*

**Upgrading an NMR Spectrometer**

This grant enabled the Departments of Chemistry and Biochemistry to upgrade an NMR spectrometer which serves research personnel in the two departments. Five scientists have delineated projects which will make use of the larger computer for HETCOR 2-D and HOMCOR work. Projects using the equipment include: 3,6-Diheterabicyclo[3.3.1]nonanes and derivatives; heteroarotinoids; interactions of hydrophobic molecules with heme proteins; specific degradation of select polysaccharides with HF; retinoid metabolites; and the structure and function of ubiquinone in binding to proteins.

National Science Foundation
State of Oklahoma
*K. D. Berlin*
*H. J. Harmon*
*A. J. Mort*
*E. C. Nelson*
*C. A. Yu*

**Synthesis of New Antidepressant Agents**

This is a study involving synthesis and evaluation of new pharmaceutical agents for the treatment of depression and other stress-related mental disorders. Methods for the synthesis of carbocyclic and heterocyclic dibenzocycloalkene-based analogs of several currently used antidepressents will be explored. A novel synthetic route is planned whereupon a doubly metallated species will be cyclized on an ester or other suitably reactive compound.

Oklahoma Health Research Program
*Richard Bunce*

**Synthesis of Allenes and Alkynes Using Rigid Molecular Templates**

This project seeks to explore the use of bicyclic cycloadducts derived from anthracene as templates for the synthesis of sensitive allene and alkyne compounds. The rigid nature of these bicyclic structures will be used to advantage to set stereochemistry and adjust functional groups, then a retro-Diels-Alder process under flash vacuum pyrolysis conditions will disengage the desired allene or alkyne. Since these unsaturated groups are highly sensitive to a variety of chemical agents, their generation in the last step precludes unwanted side reactions during the synthesis.

State of Oklahoma
*Richard Bunce*

**Control of Organic Photoreactions by Molecular Design**

This project seeks to develop a means for exerting greater control over organic photoreactions. Using alkyl chains, we have linked together molecular fragments which are observed to migrate apart during the course of a photochemical reaction. When these molecules are subjected to typical rearrangement conditions, geometric constraint imposed by these internal control elements prohibits the normal reaction pathway and results in the formation of new products. It is hoped that improved stereocontrol in these transformations will permit the synthesis of ordinarily inaccessible stereoisomers and eventually advance photochemistry to a state of greater utility as a synthetic tool.

Research Corporation
*Richard Bunce*

**DOE Equipment Grant**

This grant enabled researchers to purchase high pressure equipment needed to explore new methods for synthesizing coal liquid and petroleum constituents for the Department of Energy through the National Institute for Petroleum and Energy Research (NIPER). The equipment is used for thermodynamics measurements and as standards in separation and characterization studies. These data are important to energy-related industries in improving the design of processing plants for efficient recovery from fossil fuel resources, predicting reaction paths, and providing data about thermochemical properties of fluids.

U.S. Department of Energy
*Richard Bunce*

**Spectroscopic Studies of the Structures and Dynamics of Ionic Systems**

This project focuses on the understanding of the details of ion-pair solvation in both protic and aprotic solvents and the dynamics of proton exchange and migration in hydrogen bonded systems. The new ion pair studies will build on a background of understanding of the spectra of ion pairs and solvated ion pairs in matrix media. Particular effort will be devoted to application of this understanding to the determination of solvation equilibria in the vapor phase. Based on insights recently garnered for simple H-bonded solids such as ice, the proton exchange studies will identify mechanisms for proton transfer, and the inhibition of proton transfer, for more complex systems. Questions such as "why does the low-level doping of ice with a nitrogen base effectively stop proton exchange" will be considered. Since both proton exchange and nitrogen bases are ubiquitous in living systems the answers could relate to life processes. The details sought regarding the solvation of ion pairs is needed for the continued evolution of a consistent theory describing ionic solutions which pervade nature and are also commonly used as chemical reaction media.

National Science Foundation
*J. Paul Devlin*

**Spectroscopic Studies of Ionic Systems**

Research has been directed to the understanding of the details of ion-pair solvation in common solvents and to the determination of the mobility of protons in H-bonded solids.

State of Oklahoma
*J. Paul Devlin*

**Spectroscopic Studies of Defect Activities of Icelike Solids and Structures of Ion-Pair Solvates**

An ongoing research effort whose intention is to expand studies of defect activities in H-bonded solids to include the influence of interfacial effects on defect activities near surfaces and to establish any relationship between these defect activities and the ability of an icelike crystal to grow from a metastable phase, and to continue to explore the details of ion-pair solvation in both protic and aprotic solvents by revealing the stages of solvation that occur in low-temperature matrices.

National Science Foundation
*J. Paul Devlin*

### Thermochemical and Thermophysical Properties of Substances Derived from Fossil Materials

The general objective of this research project is to provide pure compounds needed to acquire the thermodynamic data necessary for the understanding and prediction of the properties of materials derived from alternative crudes. These data allow efficient processing of fossil materials to products usable in current technologies with acceptable consequences to the environment.

NIPER
*E. J. Eisenbraun*

### Heterogeneous Catalysts in Water

In this research colloidal catalysts are prepared and tested for oxidations of organic compounds. The major objective is to understand how the interior and surface structures of colloidal catalysts affect their activities. Catalysts are synthesized by emulsion polymerization and functionalization of polystyrenes, polyacrylates, poly(perfluorinated sulfonic acids), and silica. New surfactant monomers are synthesized for preparation of polymer colloids of controlled surface structure. Oxidations of mercaptans to disulfides, phenols to quinones, and alcohols and amines to carbonyl compounds proceed in water at moderate temperatures. The results could be useful for the design of processes for decontamination of water from toxic chemicals.

U.S. Army Research Office
*Warren T. Ford*

### Colloidal Catalysts for Wastewater Treatment

Colloidal catalysts are designed for air oxidation of organic pollutants in wastewater. The catalysts are cobalt phthalocyanines bound to polystyrene and to poly(methyl methacryate) latexes. High activity for autoxidation of low concentrations of organic compounds in water is due to three factors: (1) CoPc in particular and cobalt ions in general are highly active catalysts for autoxidation of organic compounds. (2) The small particle sizes of the catalysts reduces mass transfer and diffusional limitations to catalytic activity. (3) The polymer latexes absorb organic compounds, concentrating them at the active sites. The catalysts are prepared, characterized, and tested for autoxidation of EPA priority pollutants such as toluene, phenol, methylene chloride, bis(2-ethylhexyl) phthalate, and benzene.

Environmental Protection Agency
*Warren T. Ford*

### Polymer Liquid Crystals with Side-Chain Discogens

In this research new liquid crystals will be synthesized containing phthalocyanines and macrocyclic polyamine analogs of crown ethers as discotic structural units in side chains of flexible polymers. Their phase transition temperatures and structures will be determined by thermal analysis, optical microscopy, and x-ray analysis. The primary goal is understanding how discotic structures are influenced by a polymeric environment. Preliminary experiments also will be conducted to test the potential of the new discotic polymer liquid crystals as materials for nonlinear optical devices and anisotropic electrical conductors.

Office of Naval Research
*Warren T. Ford*

### Diffusional Exchange in Heterogeneous Systems

In heterogeneous mixtures of liquids and either porous solids or gels, solvents and solutes exchange between two phases. These exchange processes are common in nature, in technology, and in the scientific laboratory. The rates at which they occur are critical to such diverse systems as transport of nutrients and waste in living organisms, recovery of oil and chemical separations by chromatographic methods. In this research exchange rates of both low molecular weight solvents and soluble polymers will be determined under the conditions of silica gel chromatography, solid phase peptide synthesis, and size exclusion chromatography by magnetization transfer NMR experiments. Knowledge of exchange rates in these well-defined heterogeneous mixtures will be important to the understanding of exchange processes in more complicated systems such as living organisms and geological formations.

American Chemical Society
*Warren T. Ford*

### AP Chemistry by Satellite

Students from small high schools are often educationally disadvantaged when they reach college because their schools lacked the resources required to teach those advanced courses that would have helped them succeed in college. This project will determine whether live instruction-by-satellite is a viable means of providing high school students with an advanced course in chemistry where their own schools are too small or lack resources to provide that instruction. Students will be able to ask questions and respond to their distant instructor during each telecast; they do experiments in their own school laboratories, and exchange data using computers.

National Science Foundation
*John Gelder*
*Dwaine Eubanks*

### Calcium Allergen Interactions

Calcium involvement in the sequence of events leading to an allergic manifestation has long been known but the involvement has not been understood at the molecular level. Complexes of calcium and low molecular weight allergens have been shown to exist. Single crystal X-ray examination of the structures of these complexes reveals a broader spectrum of behavior for calcium in complexation than previously identified and reveals structural difference between calcium and magnesium behavior in these systems.

State of Oklahoma
*Elizabeth Holt*

### Fluorescent Copper(I) Complexes

Complexes of Copper(I) iodide and electron donating ligands display thermochromic emission in the solid state. The emission has shown itself to be multicomponent and the components to be identified with aspects of the solid state structure of the materials. From a study of the emission spectra and the related structural aspects of a series of copper(I) iodide complexes, it has proved possible to tune the emission behavior of the crystalline material by choice of ligand and choice of synthetic procedure to lead to an appropriate structural framework. Work is underway to identify the uses of these materials in semiconductor photosensitization.

National Science Foundation
*Elizabeth Holt*

### Structural Investigation of Thermochromic Fluorescent Copper(I) Clusters

The preparation and determination of the single crystal x-ray structures of Copper(I) halides and a series of nitrogen and oxygen donor ligands and measurement of the absorption and emission spectra of these solid state materials will provide a structural basis for the correlation of structure with the nonfluorescent or fluorescent (thermochromic or non-thermochromic) behavior of these materials. This work will provide the solid state parameters for projected theoretical calculations of the specific energy transitions associated with the observed emission and will provide a basis for the chemical tuning of fluorescent behavior at specific temperatures by suitable choice of complex components.

American Chemical Society-Petroleum Research Fund
University Center for Energy Research
*Elizabeth Holt*

### Theoretical Study of Silylboranes

The mechanism by which amorphous silicon is deposited by chemical vapor deposition (CVD) of silane is of considerable interest. We have shown by quantum chemical calculations that the formation of silylboranes is very likely whenever mixtures of silane and diborane are pyrolyzed. Hence,

these substances are possible intermediates by which boron is incorporated into amorphous silicon in CVD (p doping). Quantum theoretical studies of silylboranes are continuing with particular emphasis on the effects of fluorine substitution on the silylborane decomposition channels. The work is being done in conjunction with Prof. M. Trachtman and Prof. C.W. Bock, Philadelphia College of Textiles and Science.

State of Oklahoma
*Gilbert Mains*

**Study of Silane Photolysis**

The mercury photosensitized decomposition of monosilane is known to result in the formation of hydrogen, disilane, trisilane, polysilane, amorphous silicon, and particulate matter depending upon the experimental conditions. We are conducting photochemical experiments using long path FTIR in an effort to experimentally determine the mechanisms which lead to these various products. A parallel quantum mechanical study is being performed to compute the structure and infra-red spectra of various proposed intermediates. The computations are being performed at OSU and the experimental work is being done at York University, Canada, by Prof. Hiromi Niki.

State of Oklahoma
*Gilbert Mains*

**Phase-Resolved Fluoroimmunoassay of Drugs**

A technique for highly selective and sensitive analysis of drugs using fluoroimmunoassay is being developed. The technique will be homogeneous, requiring no separation of bound from free labelled-antigen. Instead, the free labelled-antigen will be distinguished from the antibody-bound labelled-antigen on the basis of the difference in fluorescence lifetimes of the fluorescence label in the two different environments. Phase-resolved fluorescence intensity of a species, a function of its fluorescence lifetime, will used to measure the percents of free and antibody-bound labelled-antigen in test solutions. Calibration curves will be constructed using standard solutions of non-labelled antigen. The problem of background fluorescence in serum and other biological samples will be minimized by the use of synchronous excitation in conjunction with phase-resolved fluorimetry. The technique will be developed for the analysis of two drugs, phenobarbital and primidone. Future work will then involve the production of suitable antibodies for determination of controlled substances such as methaqualone, phencyclidine, heroin, and other abused drugs. The technique will be applicable to clinical, toxicological, and forensic drug analysis.

National Institute on Drug Abuse
*Linda McGown*

**Homogeneous Immunoassay Using Phase-Resolved Fluorescence Spectroscopy**

In this research, a new technique for immunoassay of analytes in biological samples is being developed. Phase-Resolved Fluoroimmunoassay (PRFIA) is a homogeneous immunoassay technique which requires no separation of free from antibody-bound labelled antigen. Instead, the free labelled antigen is distinguished from the antibody-bound labelled antigen on the basis of the difference in fluorescence lifetimes of the fluorescent label in the two different microenvironments. Phase-resolved fluorescence spectroscopy (PRFS), in which phase-sensitive detection is used to selectively measure the fluorescence of species excited with sinusoidally-modulated light, will be used to simultaneously determine the percents of free and bound labelled antigen in sample and standard solutions. The PRFIA technique will be optimized for determination of phenobarbital. Methods for other analytes including haptens such as insulin and macromolecules including human IgG and human albumin will then be developed to study the analyte-dependence of the PRFIA conditions. Advantages of PRFIA in comparison with other homogeneous immunoassay techniques include procedural simplicity, minimal reagent requirements, and a multicomponent approach which enables elimination of interference from sample matrix fluorescing species.

National Science Foundation
*Linda McGown*

**Multicomponent Analysis Using Synchronous-Excitation Phase-Resolved Fluorescence Spectroscopy**

A new technique for multicomponent fluorescence analysis is being developed in which three independent selectivity parameters (excitation wavelength, emission wavelength and fluorescence lifetime) are combined. Phase-resolved fluorescence spectroscopy, in which the sample is excited with sinusoidally modulated light and the resulting phase-delayed emission is detected with an adjustable phase-sensitive detector, will provide the lifetime parameter. Synchronous excitation fluorescence combines excitation and emission spectral information in a single, multiplicative function, and will be used to provide the excitation and emission in a single dimension. The proposed technique will provide a means for analysis of multicomponent samples that could not otherwise be fluorimetrically determined without prior separation of the components. Applications of the proposed technique include: determination of pesticides, herbicides and other toxic chemicals in environmental and biological samples; determination of drugs and other biologically active compounds; and determination of metals via native fluorescence (rarely occurring) or by formation of fluorescent complexes.

U.S. Army Research Office
*Linda McGown*

**Use of Fluoresence Lifetime Selectivity in the Detection and Determination of HPLC-Separated Polycyclic Aromatic Hydrocarbons in Water Samples**

This research involves the development of a detection scheme to be used in conjunction with HPLC for the determination of polycyclic aromatic hydrocarbons.

Environmental Protection Agency
*Linda McGown*

**Unsegmented Continuous-Flow Sample Processing**

This research uses a novel approach to sample processing and to detection and determination of gaseous pollutants of oxidizing and reducing character. A continuous-flow, unsegmented, all-gas carrier system and/or segmented liquid/gas interface system has been assembled for sample introduction and transport to the detection/determination point. A regenerable electrode probe based on the redox characteristics of the iron (III) and iron (II) complexes with 1,10-phenanthroline and related ligands will serve as a detection device. Several electrodes of the chemically modified type will be constructed and evaluated; typically these are carbon paste modified by incorporation of insoluble (in aqueous phases) ion pairs (salts) of the iron complex(es) and a solid modified by covalent binding of the iron complex(es). Amperometric/coulometric current measurements provide the analyte signal for quantitative purposes. Voltammetric studies are also part of the research, producing a thorough analytical evaluation of the approach.

U.S. Department of Energy
*Horacio Mottola*

**Analytical Measurements Using Optical Dichrosim**

Emphasis over the last year has moved toward the direct determination of drugs in plants and complex mixtures of pharmaceutical products. The objective test was to establish if the alkaloid content of plant materials could be determined without chromatographic separation of any kind. This was easily done for tobacco where the only optically dichroic alkaloid present in sufficient abundance is nicotine. Marijuana and opium, on the other hand, contain a significant number of optically dichroic compounds so that their simultaneous determination requires a microcomputer facilitated solution to a series of simultaneous equations. Marijuana was successfully

# English

### The Politics of Poetry

Attendance at the Dartmouth College School of Criticism and Theory's course in the Politics of Poetry presented by Dr. Barbara Johnson.

Dean's Incentive Grant
*Nuala Archer*

### The Late Aesthetics of John Ruskin

This project will culminate in a book-length manuscript about John Ruskin's late aesthetics. Completed chapters focus on Ruskin's conception of money, the second on Fors Clavigera's connection with prevalent nineteenth-century economic theories. Supplemental information from nineteenth-century texts at Beacon University's library are currently being examined. The completed manuscript will concern Ruskin's notions about art from the 1870s to his last work as they exhibit social conventions and tensions of the time.

Dean's Incentive Grant
*Linda Austin*

### Ancient Studies: The World of Classical Greece

Ancient Studies: The World of Classical Greece was a two-week camp prepared by Arts and Sciences faculty for junior high school students. The program goals were to give students a thorough understanding of ancient Greek culture and to introduce the humanities through interdisciplinary projects. All students participated in a Greek history class and chose a project group from four offered—art, astronomy, literature/theatre, and mathematics. A variety of other educational activities supplemented projects and discussions. Students were chosen for their academic achievements, motivation, and interest in program content.

National Endowment for the Humanities
*Robert Graalman* (Program Director)
*Neil Hackett* (History Department)
*Joel Haack* (Mathematics Department)
*Nancy Wilkinson* (Art Department)
*Mike McCollough* (Physics Department)
*Paul Epstein* (Foreign Languages & Literatures Department)
*Mary Anne Hempe* (Theatre Department)

### A Private Geography: George Moore's Autobiographical Vocation

Completion of a comprehensive study of Irish author George Moore's fiction, essays, letters and formal autobiographies from 1887 to 1932. The study will explore Moore's theories of autobiography and argue that even his fiction may be read as the product of his autobiographical vocation. The book also defines the relationship in which Moore places the self and the origin of the land.

Dean's Incentive Grant
*Elizabeth Grubgeld*

### Prismatic Color: Marianne Moore and the Visual Arts

Revision of a book discussing the relationships between Marianne Moore's experimental poetry and the experimental painting and photography of her contemporaries in the visual arts, particularly the painters and photographers associated with Alfred Stieglitz and 291 Gallery in New York.

Dean's Incentive Grant
Oklahoma Foundation for the Humanities
*Linda Leavell*

### The Acquisition of Rules and Natural Categories

The environment is composed of a complex and diverse set of perceptual stimuli. The task of the human organism is to take in and interpret these perceptual experiences, to combine them with the products of past experiences, and to draw inferences from them, thereby constructing an internal representation of reality. The organization of this cognitive representation will depend on the number and type of stimuli with which the organism interacts. Initially, most items are experienced as separate and distinct concepts; later the similarity will lead to their being grouped together as members of the same conceptual category. The purpose of this research is to describe the acquisition of productive irregular past tense forms by native speakers of English; and to determine the factors which affect the acquisition of such classes in order to describe the way in which the two types of organization, rule and prototype, interact in language processing. The frequency of forms in English, the applicability of a pattern, and the cue validity of a given pattern will be examined.

Dean's Incentive Grant
*Carol Lynn Moder*

### Contemporary Voices in World Literature

Preparation and production of 13 half-hour radio programs, each focusing on the achievement of one major contemporary author.

Oklahoma Foundation for the Humanities
*Mary Rohrberger/Kenneth Dollarhide*

### Regional Multifunctional Resource Center

This grant enables Oklahoma State University to collaborate with the University of Oklahoma in the operation of a Regional Multifunctional Resource Center providing technical assistance to bilingual education programs in Oklahoma, Kansas, Nebraska, South Dakota and North Dakota. Two members of the OSU Department of English serve the center as Assistant Director/English-as-a-Second Language Specialist and Educational Technology/Bilingual Education Specialist.

U.S. Department of Education
University of Oklahoma
*Ravi Sheorey*

# Foreign Languages and Literatures

### Selected Plays by French Women Playwrights, 1650-1800

This work involves the preparation of an edition of the selected plays in the period 1650-1800, with translations and a general historical introduction of women playwrights in France before the Revolution. This project consists of research of material such as the original editions of the plays, and non-dramatic writings by the same authors and biographical material.

Dean's Incentive Grant
*Perry Gethner*

### Uses of the Letter in Eighteenth-Century French Literature

This is continuing research on the uses of the letter in eighteenth-century French literature, and is concerned especially with the extent to which these uses express the epistemological concerns of the Enlightenment.

State of Oklahoma
*John Howland*

### Nineteenth Century Russian Literature

Research and seminar activity at Harvard University led to the publication of articles on Turgenev and Bakhtin, as well as a book-length study of Bakhtin's literary theory.

National Endowment for the Humanities
*David Patterson*

### Tolstoy's Religious Thought: The Geneva Manuscripts

This grant funded the study of religious and philosophical works by Tolstoy originally published in Geneva. The research was conducted at the University of Geneva Library.

South Central Modern Language Association
*David Patterson*

### A Bakhtinian Study of the Impact of the Holocaust on Literary Form and Content

The purpose of this research is to identify major literary works, particularly novels, that have arisen as a result of the Holocaust and to examine the impact of the Holocaust on their form and content from perspectives developed by the Russian thinker Mikhail

Bakhtin. The interest in such an endeavor is to determine the relation between an historical event and the artistic response it generates and to explain what that relation tells us about the nature of truth and the meaning in human life. The premise underlying this Bakhtinian study of Holocaust literature is that literature and history interact with one another in formal and substantial ways.

Dean's Incentive Grant
*David Patterson*

**Development of Russian by Satellite**

The development of computer-assisted beginning Russian language course software and manuals as the first phase of a project to provide satellite-based Russian to U.S. secondary schools. RBS will be modelled upon the exisiting German by Satellite program that has already proven successful in Oklahoma and surrounding states.

Department of Education
*John Schillinger*

**Grant for Improving Coherence Within an Institution**

With the assistance of this grant, the Department of Foreign Languages and Literatures at Oklahoma State University sought to strengthen lower division language instruction by developing a more coherent program. This included the development of a substantial computer-assisted instruction program in German which in turn led to a German by Satellite program and to the steadily increasing adoption of CAI in the other languages. The department also carried out a 3-year trial implementation of the Dartmouth approach to language instruction, and native-speaking foreign student assistants were hired to work with students and student drill instructors. Additionally, faculty members participated in oral proficiency workshops to gain insight into proficiency-based instruction; a study abroad program partnership with other universities was initiated; authentic materials for classroom use were purchased; recommended universities were visited for the purpose of examining FLL programs elsewhere; and with the assistance of state high school FL teachers, proficiency analysis tests for students entering the program were developed. The grant coincided with a period of considerable growth, development, and improvement, and was highly successful.

National Endowment for the Humanities
*John Schillinger*

## Geography

**Energy Development from 1897 to 1930**

The historic context of energy development in 18 northeast Oklahoma counties from 1897 to 1930 was developed by a thematic survey conducted in the region. Six of the counties saw significant petroleum activity from 1897 when Nellie Johnstone No. 1, Oklahoma's first commercial oil well, was drilled, through 1930. During that period several fields and pools were opened and reached their peak production including Red Fork (1901), Cleveland (1904), Glenn Pool (1905), Okmulgee Pools (1906-1907), Cushing (1912), and Burbank (1920). Priority was given to historic properties associated with the petroleum industry, housing for workers, transportation facilities, machinery systems and technology related to petroleum, and significant public, social and commercial properties constructed during boomtown development.

Oklahoma Historical Society
National Park Service
*George Carney*

**Development of a Historic Context for the Agriculture Theme in Management Region b6: 1889-1930**

The development of an historic context for agriculture in Management Region 6 for the period 1889-1930. The region consists of seven counties in central Oklahoma (six were designated as the Unassigned Lands in 1889).

Oklahoma Historical Society
*George Carney*

**Counter-Urbanization**

Completed mapping of several classes of housing for Census County Divisions in Oklahoma. Housing held for occasional use, seasonal housing, and rural non-farm housing are important components to the total housing stock in some parts of Oklahoma. In some instances two-thirds of the growth in housing may be accounted for by such types. Detailed examination of non-metropolitan population growth in Oklahoma and elsewhere will be conducted this year.

State of Oklahoma
*Richard Hecock*

**Amenity Landscapes**

In many regions land is being converted to amenity uses or uses which have an important amenity component. Parks, wildlife and scenic preserves in the public sector, are being joined by second-home developments, hobby farms, large-lot private residences, and hunting preserves and are replacing farming and forestry as land uses. This phenomenon is widespread in Oklahoma and is growing rapidly. It is believed that in many places, amenity qualities of land are dominant in determining land values. An investigation of several Oklahoma study sites is underway to determine the extent of amenity dominated landscapes, the rate of growth of this phenomenon, and its role in shaping land values.

State of Oklahoma
*Richard Hecock*

**Texas**

A document entitled Texas was completed. The manuscript is to be published by Oxford Books of Oxford, England. The monograph covers the history and geography of the state of Texas, with the emphasis on current spatial distributions within the state.

State of Oklahoma
*Robert Norris*

**Geographic Analysis of American Golf**

Supply and demand characteristics of American golf were examined at the state, metropolitan area and county level. The per capita distribution of golf facilities was analyzed as function of selected demographic, land value, historic and physical characteristics. In cooperation with the National Golf Foundation and Market Facts, Inc., a regional analysis of golf participation and golf related travel behavior was completed.

State of Oklahoma
*John Rooney, Jr.*

**Geographic Changes in American Sports Involvement**

Regional variation in American sports participation was studied for the period 1960-1986. Emphasis was on football, hockey, basketball, baseball, soccer and lacrosse. Additional data were collected from organizations and associations dealing with more than 60 sports. Content analysis of press coverage during the study period was also completed.

State of Oklahoma
*John Rooney, Jr.*

**The American Intercollegiate Sports System**

An examination of the alternatives to the present entertainmental-directed Division 1A intercollegiate sports system was conducted. The role of the people-place bond was considered in relation to the growing trend toward both interregional and international athletic recruiting. Both purification and professionalization alternatives were developed.

State of Oklahoma
*John Rooney, Jr.*

**Promoting Oklahoma as a Retirement Destination State**

As Oklahoma goes through a severe economic recession stemming from declines in the energy, manufacturing and agricultural sectors, communities within the state must

seek alternative forms of employment. There are efforts extant to attract new industry to the state as a step in this direction, but most are directed toward traditional industrial enterprises. The primary purpose of this project is to investigate the feasibility of promoting Oklahoma as a retirement destination state. The project will lead toward an expanded research program in the Geography of Retirement; and from analysis of the retirement potential in Oklahoma, a plan for destination retirement sites will be developed.

Dean's Incentive Grant
*Louis Seig*

**Relationships of Spatial Patterns of Landscape and Soil Moisture to Initiation of Local Convection**

The purpose of this project is to discern relationships between land cover and the initiation of local convection. Work is being conducted with a grant from the Oklahoma Water Research Center. The project has integrated landcover classifications, soils and terrain data, and surface meteorological data within a geographic information system in order to be able to more precisely predict the location of initial surface convection given known patterns of surface conditions.

University Center for Water Research
National Severe Storms Laboratory
*Stephen Stadler*

**Climate Parameters and Regionalization of Golf Course Maintenance Costs**

In association with the National Golf Foundation, further work has refined national regions of golf course maintenance costs on the criteria of ecoregion and climate. Several papers have been presented and an article prepared for the Applied Geography proceedings.

State of Oklahoma
*Stephen Stadler*

**Heat and Crime**

This work (in association with Keith Harries of the University of Maryland Baltimore County) has refined and summarized our work of the past into a chapter in a forthcoming book on the geography of crime. We are working with a colleague at the University of Delaware to make comparisons between cities in different climates.

State of Oklahoma
*Stephen Stadler*

**Microcomputers in Geographic Instruction and Research**

Use of microcomputers for location analysis and computer mapping, including development of interactive instructional software.

State of Oklahoma
*Stephen Tweedie*

**Higher Education Instructional Programs**

A geographical analysis of Oklahoma's higher education instructional programs. Mapping the origin of students (by high school attended) enrolled in specific degree programs for each institution will allow decision makers to assess the spatial impact of proposed changes in the system.

State of Oklahoma
*Stephen Tweedie*

## Geology

**Extensional Strike Slip Basins—Two Examples from Death Valley, California**

The purpose of this research is to improve our understanding of the interaction between the crustal movement and sedimentation in strike-slip basins that form in regions of pervasive extension and are characterized by strike-slip as well as normal faults. These basins are commonly referred to as extensional strike-slip basins. Studied in detail during this research are two of the best examples of extensional strike-slip basins, the Furnace Creek and Keene Wonder basins of Death Valley, California. The basins are associated with one of the major strike-slip faults of the Great Basin which has experienced large magnitude Basin-Range crustal extension.

American Chemical Society
*Ibrahim Cemen*

**Development of Soil, Landuse and Groundwater Aquifer Geographic Information**

The purpose of this project is to develop a Soils, Landuse and Groundwater Aquifer Geographic Information System and other related output items and interpretative maps for Okfuskee, Love, Marshall, Bryan, Atoka, Johnston, Carter, Murray, Garvin, Choctaw, McCurtain, Pushmataha, Pittsburg, Latimer, LeFlore and Haskell counties. The data will be used by the SCS, Bureau of Land Management and others in providing information about the renewable natural resources of the area and planning the economic development of the area.

Soil Conservation Service
*Mark Gregory*

**Characterization of Input Parameters Required for Simulating Agricultural Chemicals Fate and Transport in Unsaturated and Saturated Zones**

A hydrogeological site characterization was conducted for the Perkins Terrace aquifer at the OSU Agricultural Research Center, Perkins, Oklahoma. The aquifer has an average saturated thickness of 30 feet, an average transmissivity of 10,000 gpd/ft, an average hydraulic conductivity of 342 gpd/ft, and a specific yield of 0.11. Groundwater quality data regarding the inorganic elements and certain pesticides have been collected since the spring of 1986. The data were plotted and analyzed. Tracer tests using inorganic conservative tracers were conducted in the unsaturated and saturated zones of the Perkins test site. The data were used as input parameters for simulating the rate and transport of agricultural chemicals in the unsaturated and saturated zones. Three numerical models, CMIS and PRZM for the unsaturated zone and KONIKOW for the saturated zone, were utilized for this purpose.

University Center for Water Research
*Douglas Kent*

**Course and Effect of Rapid Changes in Shallow Groundwater Quality**

The objectives of this research effort are to confirm and explain why shallow groundwater quality can change significantly within a matter of hours or days; under certain conditions contaminants or naturally occuring constituents can migrate more quickly through silt and clay than they can through sand and gravel; the nature chemical quality of shallow groundwater ranges widely, both in space and time; and groundwater recharge can occur even though there is a large soil-moisture deficiency.

U.S. Geological Survey
*Wayne Pettyjohn*

**Continuing Education in Geology for a Changing Work Force**

The need for continuing education in hydrogeology is overwhelming. The U.S. is suffering an acute shortage of adequately trained hydrogeologists. The Office of Technology Assessment has identified groundwater hydrology as the top-ranking category of need for manpower relating to Superfund sites. OTA considers it one of eight critical disciplines with an inadequate workforce, and has projected a need for 8,000 professionals in the geosciences between now and 1995. The purpose of this project is to develop videotape training materials for independent study by students desiring to enhance their knowledge of groundwater. The videotapes will cover a host of subjects relating to groundwater and would emphasize practical approaches to problems.

Oklahoma State Regents for Higher Education
*Wayne Pettyjohn*

**Refinement of Lower Permian Shelf to Basin Strata in the Midland Basin, North-Central Texas**

The purpose of this research is to refine correlation of subsurface Lower Permian rocks of the Midland Basin using conodont

ecostratigraphy. Since the 1920s the Midland Basin of north-central Texas has been one of the most prolific petroleum provinces in the United States. Recently, the discovery of sulfide deposits in Permian rocks of this region has added to its economic importance. Over the last 60 years, data for literally thousands of wells have shown that Permian rocks in the Midland Basin are diverse and represent deposition in a variety of marine environments. Because of rapid facies changes and facies specific index fossils, stratigraphic relations between some Lower Permian formations have remained obscure. Conodonts are unsurpassed as biostratigraphic tools through much of the Paleozoic and Triassic. The recent establishment of complementary shallow and deep water Lower Permian conodont zones makes them ideal for resolution of stratigraphic problems in the Midland Basin.

Dean's Incentive Grant
*Scott Ritter*

**Feasibility Study of Effectiveness of Drilling Mud as a Plugging Agent in Abandoned Wells**

Current methods of plugging abandoned wells use mud asa plugging agent. A major question concerns the performance of the plugging agent when injection wells are activated in the vicinity of the plugged wells. The primary objective of this research is to test the hypothesis that drilling mud in abandoned, properly plugged wells effectively seals the borehole. However, if fluids injected into reservoirs at depth were to migrate up the boreholes of such abandoned wells, filter cake, nevertheless, would prevent passage of these fluids into other reservoirs. A secondary objective is to obtain fundamental information on conditions of mud in the simulated well in order to provide guidelines for developing a technique and an associated instrumentation system to enter abandoned wells.

Environmental Protection Agency
*Gary Stewart*

**Hydrologic Modeling Through the Integration of Remotely Sensed Data in a Geographic Information System**

Runoff from non-urban land which enters portions of stream systems that are not controlled by reservoirs can have two significant impacts on the timing of water released from flood control structures. This research will integrate the key variables in runoff into two models capable of predicting the hydrographs for runoff from non-urban land. Automated integration of the data of land use, with digital elevation data, and soil information coupled with mathematical equations for the amount and rate of runoff in each cell of the analysis will generate hydrographs for regions in which only gross estimates of flow exist. The scale of the analysis (one cell) is equivalent to a TM data unit of 30m x 30m.

Oklahoma Water Resources Research Institute
*John Vitek*
*Mark Gregory*

## History

**WPA Surveys for 1986**

This project will complete an architectural/historic structures survey of WPA constructed buildings, objects and structures in the 27 counties in Oklahoma Management Regions 1, 6 and 7. The survey results will provide information useful in making management decisions about properties and districts potentially eligible for the National Register of Historic Places.

Oklahoma Historical Society
*David Baird*

**The Southern Influence in Oklahoma**

This project seeks to take advantage of the intellectual excitement generated by the Annual Lecture of the Oklahoma Foundation for the Humanities. It aims to organize and present a symposium on the day of the Annual Lecture that will explore the theme "The Southern Influence in Oklahoma." Specifically, humanities scholars will examine the topics of literature, race, religion, politics, and women and how the Oklahoma experience in those areas manifests a southern influence. An audience of out-of-school learners, secondary school teachers and humanities scholars will discuss the issues in small group breakouts.

Oklahoma Foundation for the Humanities
*David Baird*

**Development of a Historic Context for the Native American Theme in Management**

This project will undertake to develop a historic context for the Native American theme in Management Region 7, a 17-county region. Designed to further Oklahoma's comprehensive historic preservation process, the project will provide a useful tool in the evaluation of significance of cultural resources and thus help facilitate cultural resource management decisions.

Oklahoma Historical Society
*David Baird*

**The Urban South in the Great Depression**

An examination of the impact of the New Deal on the six largest cities (according to the 1930 Census) in the South—Atlanta, Birmingham, Dallas, Houston, Memphis and New Orleans.

Dean's Incentive Grant
*Roger Biles*

**Medieval Studies for High School English and History Teachers**

This project is intended to give high school English and history teachers an interdisciplinary background in the Middle Ages. During the three-week program sessions will cover medieval English literature, social and economic elements of the period and its ideological and philosophical aspects. During the school year following the program, the director will visit the participants' schools and three newsletters will be issued during the year. A two-day follow-up workshop will be held at the end of the year.

National Endowment for the Humanities
*John Bishoff*

**Architectural/Historic Survey of Bartlesville**

This project will complete an architectural/historic structures survey of Bartlesville and will develop a historic context document for the community. The survey results will provide information useful in making management decisions about properties and districts potentially eligible for the National Register of Historic Places. The survey area will encompass a specific thirty block area in the community of Bartlesville.

Oklahoma Historical Society
*William Bryans*

**Architectural/Historic Survey of El Reno and Portions of Canadian County**

This project will complete an architectural/historic structures survey of El Reno and Canadian County and develop a historic context document of the El Reno community. The survey area will encompass specified portions of the communities of El Reno, Mustang, Union City, Calumet, Richland, Piedmont and and Okarche.

Oklahoma Historical Society
*William Bryans*

**IPA Agreement**

The purpose of this mobility assignment is to provide the United States Information Agency with state of the art academic expertise in support of European academic programs; and to furnish professional links to universities, academicians and professional organizations dealing with European Studies.

U.S. Information Agency
*George Jewsbury*

**The Life of Angie Debo**

In collaboration with Gloria Valencia-Weber a grant was obtained from the Oklahoma Foundation of the Humanities to make a film about Dr. Debo. An article based on

interviews with Dr. Debo has been submitted for publication.

Oklahoma Foundation for the Humanities
State Arts Council of Oklahoma
*Glenna Matthews*
*David Baird*

### An Analysis of Conditions Affecting Naturalization at the Turn of the Century

This project involves individual-level analysis of the 1900 census for several census districts in four Massachusetts communities. This analysis will examine French Canadian naturalization rates and will explore two hypotheses: the rates of naturalization varied from community to community in Massachusetts; and differences within and among communities may be explained best in terms of age of immigration, year of immigration and occupation.

Dean's Incentive Grant
*Ronald Petrin*

### The Medical Origins of French Anthropology

This project will explore the origins of the French school of anthropology in the nineteenth century, which, despite its theoretical breadth, extensive contemporary influence, and critical position in the development of the human sciences, is little known to scholars. Until recently, investigators in the history of anthropology have tended to search mainly for "forerunners" of modern theoretical orientations, and in consequence have ignored schools and theories that subsequently have been repudiated by the modern discipline. Of late, however, historical research into the significance of discredited science has been encouraged by the growing influence of historic methodologies. There is still, however, no general work on the origins or development of anthropology in France, and such study is the ultimate goal of this project.

Dean's Incentive Grant
Oklahoma Foundation for the Humanities
*Elizabeth Williams*

## Mathematics

### L-functions and p-adic Analysis

There are many applications of p-adic analysis to problems in algebraic geometry and algebraic number theory. This work is investigating the connections between p-adic properties of the zeros and poles of L-functions of varieties over finite fields and p-adic special functions. This will be accomplished by studying the Dwork-Reich cohomology spaces associated to such L-functions and by studying the p-adic differential equations that arise when the varieties vary in an algebraic family.

National Science Foundation
*Alan Adolphson*

### Complemented Subspaces of Classical Banach Spaces

In this continued investigation of complemented subspaces of classical Banach spaces, isomorphic classification of complemented subspaces of Orlicz sequences spaces, spaces of continuous functions and Lp spaces are to be studied.

National Science Foundation
*Dale Alspach*

### Mathematics Teacher Summer Institute Program (MTSIP)

This pilot program provides inservice opportunities for mathematics teachers (licensed/certified) from participating schools to improve and upgrade teaching skills in mathematics. It also provides inservice opportunities in mathematics/mathematics education for teachers, grades 7-12, not licensed/certified in mathematics which will apply toward meeting the certification requirements in mathematics.

Oklahoma State Regents for Higher Education
*Dennis Bertholf*

### Teleconference Instruction and Summer Institutes in Problem Solving

The principal goal of the OSU Teleconference Instruction and Summer Institutes in Problem Solving (TISIPS) project is to contribute to the improvement of mathematics instruction in the secondary schools of Oklahoma (grades 7-12).

Oklahoma State Regents for Higher Education
*Dennis Bertholf*
*Douglas Aichele*

### Zeros of L-functions

This work is mainly concerned with the zeros of the Riemann zeta-function with an object of obtaining new lower bounds for the proportion of zeta zeros on the critical line. Assuming the Riemann Hypothesis, researchers propose to investigate the vertical distribution of the zeros, in particular the distribution of the gaps between adjacent zeros. By use of a particular application, they hope to obtain lower bounds for class numbers of imaginary quadratic fields. Also under investigation is the influence of Siegel zeros on gaps between zeros of L-functions.

National Science Foundation
*J. Brian Conrey*
*Amit Ghosh*

### On Zeta and L-Functions

This research considers the problem of the asymptotic evaluation of the integral of the absolute value of a function on an interval of a vertical line for functions which are representable in some half-plane by a Dirichlet series and for a vertical line on which the function has infinitely many simple zeros. The research has been able to show that the Dirichlet series formed with Ramanujan's tau function has infinitely many simple zeros in the critical strip. The proof required the development of new methods as none of the few existing methods would work here. The method is quite general and will probably work for any FL(2) Dirichlet series which has at least one simple zero.

National Science Foundation
*J. Brian Conrey/Amit Ghosh*

### Alfred P. Sloan Research Fellowship

This grant provides funds for the general support of research carried on by the Alfred P. Sloan Fellow.

Alfred P. Sloan Foundation
*J. Brian Conrey*

### Research in Three-Dimensional Algebraic Geometry

A long-standing problem in algebraic geometry is the existence of birational minimal models for threefolds. One important part of this problem is finding minimal models of threefolds fibered over curves by surfaces. This project is a continuation of studies of the birational geometry of threefolds and degenerations of surfaces by studying degenerations of ruled surfaces.

Dean's Incentive Grant
*Bruce Crauder*

### Topics in the Theory of Zeta and L-functions

Continuation of work on the distributional properties of the zeros of the Riemann zeta-function.

Dean's Incentive Grant
*Amit Ghosh*

### The DIRECT Middle School Science and Mathematics Project

Over the past 20 years and concurrent with the emergence in the U.S. of single subject middle school classrooms and teachers, many former elementary or secondary school teachers have been reassigned to teach middle school science or mathematics. Few, if any, have been specifically trained to effectively carry out programs of teaching and learning oriented to the needs of middle/junior high school science or mathematics students. To meet these needs, the Colleges of Arts and Sciences and Education will develop, implement, research and evaluate an innovative middle school

mathematics and science preservice teacher education program. This program will consist of specially designed laboratory sections of existing science courses, capstone content and companion teaching methodology courses coupled with appropriately placed field experiences, a mentor system, and informal but structured learning activities incorporating applied mathematics and science concepts from the real world into a middle school curriculum. The middle school candidate who graduates from this program will enjoy the benefit of a special middle school endorsement of either the secondary or elementary certification and will be carefully supervised and supported through the fifth year Entry Year Assistance Program now in place. Scientific disciplines involved include biology, chemistry, computer science, earth sciences, life sciences, physical sciences, physics, geology, education and social sciences.

National Science Foundation
*Terence J. Mills*
*I. Dwaine Eubanks*
*James Choike*

**Groups and 3-Manifolds**

This project is studying the relationship between algebraic structures of group invariants of a 3-manifold and the topological structure of the manifold with the eventual aim of obtaining a classification scheme for compact 3-manifolds.

National Science Foundation
State of Oklahoma
*Benny Evans*

**Teleconference Instruction in Problem Solving (TIPS)**

This project focuses on the enhancement of the mathematics problem solving ability and awareness of pre-certified, entry-year mathematics teachers in Oklahoma. Research will determine whether problem solving techniques can be taught effectively to these teachers using a coordinated teleconferencing delivery system.

National Science Foundation
*John Jobe*
*Douglas Aichele*

**Optimal Filtering**

Two problems are studied which arise in tracking problems. The first involves the modification of a tracking filter which incorporates the missile dynamics in order to account for the delay in the commanded missile acceleration and the achieved missile acceleration. The original signal model is reformulated through state augmentation so that the standard Kalman filter applies. The second problem concerns filter stability. In particular, comparison type results are sought in order that stability of a time-varying filter may be established.

Universal Energy Systems
Air Force Office of Scientific Research
*Marvin Keener*

**Development of a Microcomputer Laboratory to Enhance Student Learning in Calculus**

A project to expand an existing microcomputer facility which is part of a comprehensive mathematics laboratory called The Mathematics Learning Resource Center. The center enhances student learning through the integration of high technology into the mathematics curriculum.

National Science Foundation
*Marvin Keener*
*Pamela Cemen*

**Geometric and Low-Dimensional Topology**

Research is being carried out in geometric topology and low-dimensional topology. Work continues on decision problems and associated algorithms in low-dimensional topology. The approach is both theoretical and computational. From the theoretical point of view the structure of 3-manifolds lands the decidability of certain questions in low-dimensional topology are investigated. From the computational point of view, algorithms with the reputation of being totally impractical are being simplified and for the first time applied to significant examples. Professor Myers is investigating the structure and classification of 3-manifolds. This includes problems on contractible open 3-manifolds, Heegaard splittings, surface differmorphisms, knot theory and homology cobordisms, and incompressible surfaces and surgery.

National Science Foundation
*William Jaco*
*J. Robert Myers*

**Applications in Mathematics**

The purpose of this project is to assist the mathematical community in introducing into the secondary school curriculum a viable component in problem solving and applied mathematics. The project staff will produce, disseminate and evaluate nine learning modules which will permit secondary school teachers to involve their students in an experiential case-study approach to learning how to apply mathematics and become better problem solvers.

Mathematics Association of America
*John Jobe*

**Geometric Constructions of Lie Group Representations**

Research in the fields of geometric constructions of unitary Lie group representations and applications to differential equations and mathematical physics. Long-term goals include extension of particular methods to more general classes of unitary representations of semisimple Lie groups and applications to differential equations.

Dean's Incentive Grant
*Lisa Mantini*

**Embeddings and Convexity Properties of Domains**

Research relating to embedding pseudoconvex domains in complex Euclidean space into higher-dimensional convex domains and convexity properties of pseudoconvex domains. Questions to be examined include: whether one can find embeddings with a minimal degree of regularity at the boundary; how much larger the dimension of the target domain has to be for continuous extensions to fail; and whether the embedding results for strongly pseudoconvex domains can be extended to weakly pseudoconvex domains (in particular whether pseudoconvex domains with real-analytic boundary in two-dimensional complex Euclidean space can be embedded into higher-dimensional convex domains).

Dean's Incentive Grant
*Alan Noell*

**Boundary Values of Holomorphic Functions and Convexity Properties of Pseudoconvex Domains**

This project will include an investigation of the relationship between the existence of local proper holomorphic embeddings of (weakly) pseudoconvex domains in higher dimensional convex domains and the existence of global embeddings of this type. Another goal is to find reasonable obstructions to the existence of such embeddings in general. There are also plans to study zero and interpolation sets (for smooth functions) in the boundaries of domains enjoying certain special convexity properties. Another question of interest is the existence of integral operators extending continuous functions on smooth interpolation sets in the boundary of the unit ball to elements of the ball algebra. The researchers also plan to show that a bounded holomorphic function in the unit ball of complex n-space must have a radial limit at almost every boundary point of a properly embedded disc; this is a special case of the conjecture asserting the existence of radial limits almost everywhere with respect to any representing measure.

National Science Foundation (EPSCoR)
*David Ullrich*
*Alan Noell*

**Zeta Functions and Density Theorems**

This research will establish basic properties of adelic zeta functions associated to representations of algebraic groups. Local

zeta functions associated to representations over local fields will be evaluated, and the function equation satisfied by these local zeta functions will be studied. More details of the shape of Teishmuller space in Maskit's embedding will be determined, and a computer graphics system for drawing fundamental domains for kleinian groups representing pairs of once-punctured tori will be created.

National Science Foundation
*David Wright*

### Riemann Surface Theory

This project involves work on the development of a sophisticated computer program for the investigation of mathematical problems in the theory of surfaces and higher-dimensional manifolds.

Dean's Incentive Grant
*David Wright*

## Music

### Analysis of Unpublished American Works for Chorus

The purpose of this project is to elucidate the work of lesser-known American composers and their contributions to the choral art. The final product of this research will be a compendium and analyses of about fifty significant, yet lesser-known choral works. Each analysis will cite compositional techniques employed which signal developing trends in choral music composition over the past five years. In addition, the discussion of each work will include evaluations of textual and musical merit, suggestions for appropriate performance techniques, discussions of required performing forces, and the means of locating each transcript.

Dean's Incentive Grant
*Jerry McCoy*

### Conducting Study

For the conductor, learning to help players and audiences better understand the expressive, emotional and aesthetic content of a musical work is the crux of his/her creative existence. Certain concepts and techniques from mime and theater can help the conductor discover how creative and expressive he/she can become. This research involved study with conductors at the University of Michigan, Michigan State University and the University of Colorado in an effort to expand individual movement vocabulary.

Dean's Incentive Grant
*Joseph Missal*

### Jazz Artist in Residence

This project brought a world-class jazz musician to Stillwater for an artist-in-residence program. Activities included rehearsals, informal clinics and workshops and public performances. The program took advantage of the 12th Annual OSU Jazz Festival taking place the same weekend, affording more than 400 junior high, high school and college and university students the opportunity to meet and interact with the artist.

State Arts Council of Oklahoma
*Tom Walker*

## Philosophy

### Moral Justification

This project aims to 1) develop a supplemental text for use in courses in applied and professional ethics that will introduce students to the fundamental concepts and techniques of moral justification, and 2) develop both for purposes of this text and for one or more journal articles a theory of moral justification that synthesizes the two major approaches to the problem—naturalism and formalism—into a single principle, the principle of rational agency. The text is complete and currently under consideration for publication.

Department of Philosophy
*Richard W. Eggerman*

### Autonomy, Authenticity and the Educated Person

This project involves the analysis of the concept of moral autonomy as an educational aim. Connections between the concepts of rationality, automony and moral responsibility are examined and explained, and it is contended that educators are justified in attempting to establish these qualities in their students. The concluding view is that there is an educational obligation to promote the development of dispositions necessary for moral character.

Dean's Incentive Grant
*Michael Taylor*

### An Ethical Analysis of Treatment Abatement with Critically Ill Patients

This project is an ethical analysis of the issue of treatment abatement with critically ill patients. Part of the project involves a description of clinical settings in which treatment abatement decisions are made: intensive care, geriatric settings, and hospices. Another part of the project consists of an interpretation of recent case law concerning treatment abatement decisions made by competent patients and made on the behalf of patients lacking decision making capacity.

National Endowment for the Humanities
Oklahoma Foundation for the Humanities
*Robert Weir*

## Physics

### Studies of Structure, Dynamics and Phase Transitions of Suspensions of Charged Polymer Spheres in Equilibrium and Nonequilibrium States

The unique length and time scales characteristic of aqueous suspensions of charged polymer spheres are exploited to study the basic equilibrium and non—equilibrium properties of strongly interacting spherical particle systems. Experiments include optical microscopy and light scattering intensity fluctuation spectroscopy, techniques which have already been developed, as well as novel applications of other methods including laser trapping of particles and neutron scattering. Studies of shear induced structure changes will be extended to include concentrated particle samples which form liquid-like and solid-like structures in equilibrium. Equilibrium studies will investigate local order, dynamics and phase transitions in one, two or three dimensions. Theoretical studies including computer simulation will support and extend work on local liquid structure, laser trapping and non—equilibrium behavior.

National Science Foundation
*Bruce Ackerson*

### Laser Induced Freezing

Laser manipulation of particles has allowed researchers to freeze a two dimensional sample of strongly interacting particles by stimulating a single density mode to which other modes are slaved. Details of the nature of freezing, as well as commensurate-incommensurate effects, are being studied.

State of Oklahoma
*Bruce Ackerson*

### Shear Induced Structure in Nonaqueous Suspensions

The microscopic order in nonaqueous suspensions of uniformly sized spherical particles will be studied by scattering techniques as a function of applied shear rate. Samples with well characterized equilibrium states will be studied over a broad range of particle concentration. Shear induced structures and structural evolution will be correlated with known equilibrium phase behavior and with observed rheological behavior which has or will be measured. Index matched samples will be used to minimize multiple scattering so that structural measurements may be made on high density large particulate samples. These measurements are directed at mapping out the structural phase space as a function of concentration and shear rate. The results will provide a basis for relating the microstructure of suspensions with macroscopic behavior. Such work is important in understanding fundamental problems of

nonequilibrium processes, as well as the more practical problems involving the design of products and control of industrial processes.

National Science Foundation
*Bruce Ackerson*

### Studies of Radiation Damage in Transition-Metal Carbides

This subcontract provided assistance to the ORNL Solid State Division staff in investigations of damage produced in single crystals of transition-metal carbides by high-energy neutrons and electrons.

Oak Ridge National Laboratory
*Craig Allison*

### Lattice Dynamics of Perovskite-Structured Fluorides

The phonon dispersion curves of the fluoride perovskite material $KMgF_3$ was measured by means of coherent inelastic neutron scattering. These measurements were made using the HFIR facility at the Oak Ridge National Laboratory. The aim of this investigation is to provide the phonon spectrum of $KMgF_3$ which, unlike $KMnF_3$, is not believed to undergo a structural phase transition at low temperatures. To analyze the phonon spectra, we have employed a lattice dynamical shell model program developed at ORNL by M. Mostoller. In this calculation, an analytic form of the pair potentials was assumed. The parameters in this potential were varied to obtain a "best" fit to the measured data points, subject to certain physical constraints.

Oak Ridge National Laboratory
State of Oklahoma
*George Dixon*
*Timothy Wilson*

### Thermal Properties of Nonlinear Optical Materials

Materials subjected to high intensity laser beams produce heat from absorbed radiation. This results in thermal lensing and degradation of optical performance. Nonlinear optical materials are being characterized by measurement of thermal expansion and thermal transport coefficients from 1 to 500 K.

State of Oklahoma
*George Dixon*

### Nonlinear Optical Materials

The Department of Physics at OSU will conduct a summer research program for undergraduates in the area of nonlinear optical materials. The materials to be investigated in this program include lithium niobate, bismuth silicon oxide (BSO), and II-VI semiconductor compounds. The participants will be actively involved in six closely related projects involving crystal growth, holographic grating studies, characterization of defects by ESR, thermal and electrical transport properties, Brillouin scattering, and thermally and optically stimulated luminescence. OSU is one of the leading American research centers in electro-optic and solid state laser materials. Each of the investigations will be carried out in state-of-the-art laboratories.

National Science Foundation
*George Dixon*

### Radiation Effects in Materials for Optical Interferometric Devices

The effects of ionizing radiation have been investigated in a series of materials commonly used in optical interferometric devices. Included in the study were three glass-ceramics (Zerodur, Cer-Vit 101, and Cer-Vit 142) and one Faraday-rotator glass (SF-57). Each of the glass-ceramics was irradiated at room temperature with 1.5-MeV electrons from a Van de Graaff accelerator. Similar irradiations were done on the Faraday-rotator glass at room temperature and at 77 K. Optical absorption and electron spin resonance (ESR) measurements provided a monitor of the radiation-induced point defects in all cases. The spectral characteristics and the production and thermal annealing behavior of these defects are described, and their possible effect on the performance of optical devices which incorporate these materials is considered.

State of Oklahoma
*Larry Halliburton*

### Defect Characterization in Quartz and Related Materials

Quartz has many direct aerospace applications (e.g., precision oscillators, filters and SAW devices). The materials selected for use in these critical applications must be as defect-free as possible in order to minimize aging and radiation effects. At the present time, two problems must be faced; one is to produce defect-free quartz and the other is to easily verify the purity and quality. To help develop the understanding needed to solve these problems, this research uses a multidimensional approach. Studies include: (a) developing advanced material screening methods; (b) systematically investigating the use of electrolysis (sweeping) as a means of altering point defects; (c) determining the effects of aluminum-related defect centers on the acoustic loss of SC-cut resonators; (d) continuing the characterization of defects, including model determination, in quartz; (e) monitoring changes in point defects as a function of aging; (f) evaluating RADC-grown materials.

Hanscom Air Force Base (RADC)
*Larry Halliburton*
*Joel Martin*
*William Sibley*
*Richard Powell*

### A Study of Defects in Quartz and Fluoride Glass

The main objectives of this project are to conduct a study of defects in quartz crystals and in fluoride glasses, and to determine evaluation criteria for their applications as frequency/timing devices and optical fiber communication devices respectively. The study, therefore, has two parts: one directed toward improving the performance of quartz oscillators and the other involving fluoride glass materials. Both radiation-induced defects and intrinsic defects in quartz are investigated with a variety of techniques such as acoustic loss, infrared absorption, and electron paramagnetic resonance. Electrodiffusion or electrolysis is used to exchange impurity ions in quartz and, therefore, improve the performance of the quartz device. Quartz grown by the Air Force Quartz Facility at Hanscom AFB, as well as commercially grown material, is used in the investigation. The production of laser induced gratings by four-wave mixing techniques in the fluoride glasses is being investigated. Both permanent and transient gratings are produced. The transient component is associated with an $Eu^{3+}$ population grating, and the permanent component with a holographic grating.

U.S. Air Force
*Larry Halliburton*
*Joel Martin*
*Richard Powell*
*William Sibley*

### Magnetic Resonance Service

The aluminum impurity concentration and hole content of RADC supplied samples of quartz are to be determined by a nondestructive procedure (i.e., electron spin resonance analysis). The hole content and substitutional aluminum impurity concentration of government furnished quartz samples will be determined by converting all substitutional aluminum into aluminum-hole defect centers and measuring their electron spin resonance signal.

Hanscom Air Force Base (RADC)
*Larry Halliburton*

### Photorefractive Damage Mechanisms in Electro-Optic Materials

This three-year research program has the dual goals of characterizing point defects in $LiNbO_3$ and related electro-optic materials, and correlating these defects with the actual response of the same material when it is exposed to an intense laser beam. Researchers will conduct fundamental characterization studies that will lead to well established models of point defects in these materials. Experimental spectroscopic techniques such as optical absorption, ESR, and ENDOR will be used and the types of defects to be investigated include Fe impurities, oxygen vacancies, self-trapped electron centers,

radiation-induced hole centers, and Mg-associated defects. A laser system will be established to make measurements of the photorefractive effect in crystals that have been previously characterized with our spectroscopic techniques. Crystals with specific dopings will be grown in those cases where commercial samples are unavailable.

Air Force Office of Scientific Research
*Larry Halliburton*

### Characterization of Materials for Signal Processing Applications

The goal of this research is to develop a center of excellence for research on materials used in signal processing. This is a cooperative effort of three groups: the Oklahoma State University Materials Research Center, the Oklahoma State University Signal Processing and Analysis Center, and the materials research group at Eagle Picher Research Laboratories. The research will involve the characterization of point defects in II-VI and III-V crystals and thin films prepared at Eagle Picher Laboratories and studies of the effects of different defects on the interaction of laser light with these materials, especially with respect to four-wave mixing and optical bistability. Finally, the response of these materials as infrared detectors, and the use of the detectors in a variety of object recognition systems, will be analyzed and the effect of defects on detector characteristics will be determined.

Office of Naval Research
*Larry Halliburton*
*Richard Powell*
*Stephen McKeever*
*Timothy Wilson*
*James Wicksted*

### Electronic Structure of Surfaces

In the past this research has centered around developing a family of programs that would permit the investigation of the electronic structure of systems with extremely large unit cells. These programs are now completed and are in the process of being applied to calculate the surface states of a copper (100) surface. These programs employ a thirty-three atom unit cell and thus enable researchers to see directly into the formation of the surface states and into the segregation of these surface states from the remaining "bulk" states. Hopefully, these programs will allow researchers to see the charge density of the surface, the formation of "dangling bonds" and the other details of the electronic surface configuration which are a vital first-step to understanding surface chemistry. These programs are very fast and so allow investigation of much more realistic models than has been possible in the past.

State of Oklahoma
*Earl Lafon*

### A Device to Measure Soil Water Content In Situ

A device is under development which monitors the microwave properties of soils and leads to a determination of the water content. The object is to develop apparatus and techniques which will make minimum intrusion into the soil and not require any extensive preparation such as drilling bore holes or setting piezometers. Applications include a wide range of hydrological problems which require detailed knowledge of water infiltration and migration in the soil.

University Center for Water Research
*James Lange*

### Development of a Model to Predict Radiation-Induced Frequency Shifts in Quartz-Controlled Oscillators

This project will measure the production of the Al-hole center 23K and 100K acoustic loss peaks and the reduction of the Al-Na 53K as a function of radiation dose in Li-swept and Na-swept Premium Q grade quartz crystals for irradiations at 80K, room temperature and 60°C operating temperature of an OCXO. It will also measure the production of the 23K and 100K Al-hole loss peaks versus irradiation dose in H-swept Premium Q grade quartz crystals and in crystals swept by both the Sandia and OSU vacuum sweeping processes for irradiations at 80K, room temperature and 60°C as well as measuring the acoustic loss spectra of the Sandia and OSU vacuum swept crystals. The changes in acoustic loss spectra will be used to develop a model relating steady state df/f versus radiation dose based upon the aluminum content, alkali content and sweeping process. The model will be tested by making comparison measurements of df/f for the crystals used with irradiation at room temperature and 60°C. Researchers will determine the transient change in acoustic loss, $Q^{-1}$, and equivalent crystal resistance, R, during irradiation at low dose rates and following the cessation of irradiation as a function of temperature for Li-swept, Na-swept, H-swept, and vacuum-swept Premium Q grade quartz. These measurements will be correlated with parallel frequency shift measurements at the turnover temperatures of the crystals. These data will be used to construct a model for predicting the number of alkali ions released during the irradiation and their trapping rate. The current transient acoustic loss measurements for short high dose rate radiation pulses will be continued.

Sandia National Laboratories
*Joel Martin*
*Timothy Wilson*

### An Evaluation of Characterization Techniques Applicable to Etch Pipe Defects in Quartz

An evaluation of the usefulness of various electron microscope techniques for characterizing the "etch pipes" in commercially available, high-quality quartz. These pipes, or tunnels, are revealed by deep etching and are thought to be highly decorated dislocation networks. Future advances in quartz resonator fabrication processes require limiting the densities of these etch pipes. However, before growth or post-growth techniques can be developed to eliminate the unwanted pipes, the structures and chemistry of the dislocation networks responsible for the pipes must be understood. An initial step toward this goal is the development of routine methods of monitoring the topography and chemical composition of these networks. Scanning electron microscopy, with elemental x-ray analysis, transmission electron microscopy, and secondary-ion mass spectroscopy will be used to examine as-grown and swept samples of commercial quartz. Those techniques providing the most information will be emphasized in the latter stages of the project.

Electronic Industries Association
*Joel Martin*
*Larry Halliburton*

### Crystal Growth Laboratory

The Crystal Growth Laboratory has been in operation for the past 17 years. The purpose of the lab is primarily to provide custom crystal growth for the solid state program at OSU. This service usually takes the form of growing doped crystals such as $KMgF_3$:Eu which are not commercially available. We are currently able to grow a wide variety of fluoride perovskite materials, alkali halides, and oxides such as $LiNbO_3$. Most of the fluorides and halides can be produced with rare earth and/or transition metal ion dopants. While most of our production has been used in-house, we frequently sell custom doped crystals to workers at other universities and laboratories. The crystal growth systems used are: two platinum wound Bridgman furnaces used for fluorides; an internally heated puller used for alkali halides and fluorides; a RAP Bridgman furnace for growing low OH- KCl and NaCl; and an induction heated puller used mainly for $LiNbO_3$. Crystals grown in the lab include: fluorides—$KMgF_3$ and $RbMgF_3$ dopes with 3d's, 4d's, 5d's and rare earths; other fluorides—$Mn_{1-x}Zn_xF_2$, $NaMgF_3$, $RbCaF_3$, and $KZnF_3$ ; halides—KCl: Eu, Sm, Mn, or Mg, NaCl and KF:Pd; oxides—$LiNbO_3$ and $Bi_{12}GeO_{20}$. Typically, 1 to 1.5 cm dia by 2 to 3 cm long crystals are grown. The crystal lab has two diamond wafering saws for sample cutting. A Minimet polisher, a larger Buehler polishing machine and a vibratory polisher can be used to optically polish samples. A general purpose box furnace is available for annealing samples. A small sputter coating machine and vacuum evaporator are used for plating electrodes. A computer controlled electrodiffusion (sweeping) system is available for exchang-

ng alkalis, protons and deuterons in crystalline quartz. While this system has been used mainly for research size samples, it can accommodate one half of a full lumbered quartz bar. It has also been used to "pole" $LiNbO_3$.

State of Oklahoma
*Joel Martin*

### An Investigation of the Factors Governing the Effects of Charged Particle Beams on Insulating Materials for Use in Thermoluminescence Dosimetry

There are several uncertainties concerning the effects of charged particle beams on insulators, compared with the effects produced by energetic photon irradiation. These uncertainties led to problems with the use of thermoluminescence (TL) dosimetry to monitor the dose absorbed in inorganic materials by the passage of heavy charged particles. This research project is concerned with the identification of these problems and the development of methodologies designed to limit their effect.

Sachs/Freeman
*Stephen McKeever*

### Defect Characterization of the Pre-Dose Effect as Used in Thermoluminescence Dating and Dosimetry

The "Pre-Dose" mechanisms in crystalline quartz is currently a favored technique used in both thermoluminescence (TL) dating of archaeological artifacts and in the assessment of radiation dose in a variety of applications in radiation dosimetry. However, recent uses of the technique have highlighted certain complexities which are difficult to explain on the basis of currently accepted models for the phenomenon. The major problems to be faced include: uncertainties with the thermal activation procedure; apparent saturation effects requiring complex testing and correction procedures; and various unwanted sensitization effects which cause erroneous results but for which correction is difficult. To help in the development of the understanding necessary to solve these problems, this research program will identify the defects responsible for the "Pre-Dose" phenomenon in quartz and monitor how the defects behave during the activation of the "Pre-Dose" mechanism.

National Science Foundation (EPSCoR)
*Stephen McKeever*

### Theoretical Calculations on Energy States of Radiation-Induced Defects in $CaF_2$:Mn

This work supports our ongoing experimental studies of irradiated $CaF_2$:Mn. Theoretical calculations on the energy states and electronic charge distribution of various radiation-induced-defects/Mn impurity complexes in irradiated $CaF_2$:Mn will be performed. These calculations will involve utilizing methods developed by Wood and Wilson to study defects in ionic crystals. Particular emphasis must be placed on Mn/F complexes in this system. This model should include the effects of lattice relaxation around the defect and of polarization. A preliminary study of the electronic states of the $Mn^{2+}$/F complex will be made using the Guassian-82 code developed by Pople. The defect in the crystal should be approximated by a finite cluster comprised of the $Mn^{2+}$ ion, the fluoride vacancy and their nearest fluoride and calcium ions. The effects of the rest of the lattice should then be approximated by treating the ions outside the cluster as point charges. This procedure should be used to obtain a description of the ground state of the defect of the ($Mn^{2+}$/F)-center in $CaF_2$. The results from these calculations must then be used as input to the model of Wood and Wilson and the optical transition energies and excited state wavefunctions of the defects determined. These results must be compared to experimentally available optical absorption, annealing and thermoluminescence data to establish the identity of the defects responsible for the thermoluminescence in dosimetry-grade $CaF_2$:Mn.

Naval Surface Weapons Center
*Stephen McKeever*
*Timothy Wilson*

### Defect Clustering Reactions in LiF:Mg,Ti

An examination of the clustering reactions which take place between Mg-related defects in dosimetry-grade LiF is undertaken. Correlations between optical absorption, ionic thermocurrents, thermoluminescence and photoluminescence reveal details of the role played by the Mg-clusters in the thermoluminescence process.

State of Oklahoma
*Stephen McKeever*

### Unification of the Fundamental Interactions

The project involves research in the area of the weak, electromagnetic, strong and gravitational interactions and covers seven different areas of high energy theory. These areas include the physics of the extra neutral and the charged massive gauge bosons, the neutrino masses and mixings, the solar neutrino problem, superstring phenomenology, neutrino counting at the $Z^0$-resonance, composite models and astrophysics and cosmology. The main emphasis will be the phenomenological implications of these theories as they relate to present and future experiments.

Dean's Incentive Grant
*Satyanarayan Nandi*

### ONR Graduate Fellowship

The Office of Naval Research awards a graduate fellowship in support of a student enrolled full-time in graduate studies. The award helps support the student by payment of all tuition costs and payment of a stipend for one year.

American Society for Engineering Education (ONR)
*Richard Powell*

### Air Force Weapons Laboratory Graduate Fellowship

The Air Force Weapons Laboratory awards a graduate fellowship in support of a student enrolled full-time in doctoral studies.

Air Force Weapons Laboratory
*Richard Powell*

### Establishment of the OSU Materials Research Center

The goal of this research project is to develop joint university/industrial research activities in the area of laser and electro-optical materials. Projects were initiated with four companies:

Allied Corporation—Spectroscopic Properties of Alexandrite. Alexandrite crystals used for tunable solid state lasers were fabricated by Allied and provided to OSU for laser spectroscopy studies. Electron-phonon interactions, ion-ion interactions, and the four-wave mixing properties of the materials have been characterized and the results related to possible effects on laser properties.

Phillips Laboratories—Spectroscopic Properties of New Laser Materials. Several different types of rare earth and transition metal ion doped crystals were grown at Phillips and sent to OSU for evaluation of their optical properties. A concentrated manganese crystal and a germanate crystal with Ti have been identified as possible laser materials and are being studied in detail.

Union Carbide—Photorefractive Properties of Lithium Niobate. Union Carbide sent to OSU a series of lithium niobate crystals grown by them for use as laser Q-switches. The Center has characterized the holographic grating properties of these samples and related the results to the characteristics of laser damage in these materials.

TRW Corporation—Development of New Laser Materials. The optical properties of materials synthesized at OSU have been surveyed to determine possible tunable laser materials. The four companies involved in these projects sent representatives to the organizational meeting of the OSU Materials Research Center and each company has expressed an interest in becoming an Industrial Affiliate of the Center.

State of Oklahoma
*Richard Powell*

### Laser Spectroscopy Investigations of Materials for Solid State Laser Systems

The goal of this research is to develop an understanding of dynamic processes such as energy transfer, radiationless relaxation, excited state absorption, and nonlinear optical interactions in different types of materials presently used in solid state laser systems as well as to explore the potential of new types of materials for laser systems applications. Materials to be studied include various new oxide host crystals doped with transition metal ions or rare earth ions, stoichiometric rare earth and transition metal materials, vibronic laser materials, and transition metal materials. Laser spectroscopy techniques to be used to characterize these materials include four-wave mixing, multiphoton absorption, picosecond fluorescence detection and time resolved site-selection methods. The results of characterizing the spectral dynamics of these materials will be related to crystal growth parameters and laser device parameters in order to determine the effects of the basic physical processes on the operational device parameters and to optimize the material characteristics for device applications.

U.S. Army Research Office
*Richard Powell*

### Growth and Characterization of Materials for Tunable Lasers in the Near Infrared Spectral Region

The purpose of this research is to synthesize and characterize materials for use as tunable lasers in the near infrared spectral region. The focus will be on fluoride host materials doped with transition metal and divalent rare earth ions. The crystals will be grown in the OSU Crystal Growth Laboratory and their optical properties characterized in both the OSU Laser Facility and at NASA Langley Research Center. The results will be used to assess the potential of the crystals for laser applications and gain measurements will be made on promising materials.

National Aeronautics and Space Administration
*Richard Powell*
*Joel Martin*

### Growth and Characterization of Materials for Tunable Lasers in the Near Infrared Spectral Region

Single crystals of $LiNbO_3$ doped with a variety of 3d and rare earth ions are being investigated as potential solid state tunable laser materials for use in the near infrared. The $LiNbO_3$ crystals are pulled from congruently melting starting materials. In order to reduce photorefractive damage the crystals are also doped with magnesium. The growth of doped $LiYF_3$ has just been started. $LiYF_3$ and its alloys should prove to be a more satisfactory host for the 3+ ions which are more active around 800 nm.

National Aeronautics and Space Administration
*Joel Martin*
*Richard Powell*

### Laser Spectroscopy Characterization of Materials for Frequency Agile Solid State Laser Systems

Continuing research on the optical properties of materials having applications in solid state laser systems. The goal of the research is to enhance our understanding of the fundamental physical processes involved in frequency agility. The work is divided into three thrust areas based on the materials useful in the different methods for obtaining frequency agility: broadband vibronic emitters; narrow line emitters with multiple lasing channels; and nonlinear optical materials.

U.S. Army
*Richard Powell*

### Theoretical Studies in Weak, Electromagnetic and Strong Interactions

This group carries out specific perturbative and nonperturbative field-theoretic calculations and developments so that experimental tests of theories of weak, electromagnetic, and strong interactions can be made and better theoretical understanding of these theories can be achieved. Perturbative work includes the following topics: Production of Intermediate Vector Bosons, Locating Amplitude Zeros, Amplitude Zeros in Higher Order, Radiative Corrections to Psuedoscalar Meson Decays, Projection Operator Method, Decay of $Z^0$ into Three Gluons, Higgs Boson Production in Quark-Gluon Collisions, and Gauge Dependence of Green's Functions in the non-linear r Gauge.

State of Oklahoma
*Mark Samuel*
*S. Nandi*

### Theoretical Studies in Weak, Electromagnetic and Strong Interactions

One of the major results to date is the discovery of amplitude radiation zeros which can be used as a way of measuring the g value of the W boson and the quarks as well as measuring the quark changes in pp-W-X. We have also studied radiation zeros in general and shown how to determine whether or not the zeros occur in the physical region. Nonperturbatively, we have shown that the Casimir effect provides a natural mechanism for quark and gluon condensates; that chromostatics implies bag formation in the color-singlet channel only for qq,qqq, and gg systems; and that the finite element approach naturally solves the lattice fermion doubling problem. In general, it is hoped in these and other directions to elucidate theory and facilitate contact with experiment.

U.S. Department of Energy
*Mark Samuel*

### Statistical Mechanics of the Ripple Phase in Lipid Bilayers

We are devising models for low-temperature phases in lipid bilayers. The aim of this modeling effort is to obtain a theoretical description of some of the unusual structures which appear in bilayers below the fluid melting temperature. Among these are the chain-tilted ordered phase and the sinusoidally modulated "ripple" phase. The models are devised with input from computed intermolecular energies and from experimental data. The models are then analyzed using some of the newly developed tools of statistical mechanics such as finite-size scaling.

State of Oklahoma
*H.L. Scott*

### Model Studies of Molecular Interactions in Biomembranes

This project involves two studies which address questions involving the nature and manifestations of molecular interactions in biomembranes. The first is an analytic project in which new models for lipid bilayer condensed phases will be constructed and analyzed. Preliminary work has determined that it is possible to devise Statistical Mechanical models which include anisotropic interactions between neighboring lipid molecules and harmonic elastic interactions which govern motion perpendicular to the bilayer plane. The second project is a large scale Monte Carlo study of model lipid-protein interactions in membranes.

National Science Foundation
*H.L. Scott*

### Continued Computer Studies of Surfactant Solutions

The overall objective of this project is to study computer models for the interactions of surfactant aggregates in solution with the aqueous solvent. Solutions of surfactant in water are found in a multitude of important areas of research ranging from biochemistry to geophysics. This research will address the problem of the physical nature of groundwater contaminated with surfactant. The research will specifically address the microscopic properties of microemulsions formed by a great variety of surfactants with widely varying properties.

University Center for Water Research
*H.L. Scott*

### ligh-Resolution Echelle Spectroscopy of Supernova Remnants

The goal of this research program is to nake significant advances in determining iow the structure of Type Ib and Type II supernova remnants (SNRs) can be understood in terms of the interactions of both the SNRs and their progenitors with the ambient nterstellar medium. A five-pronged approach will be used. First, theoretical calculations of how SN progenitor stars alter heir environments through winds, sudden nass loss and ionizing radiation fields will be nade. Second, high-resolution optical echelle spectra of eight SNRs in the southern Milky Way and Large Magellanic Cloud will be interactively reduced and analyzed. This will enlarge the observational base. Third, when possible, researchers will take advantage of the observable differences between equilibrium and non-equilibrium optical shock waves in order to deduce time and distance scales within the program SNRs. Fourth, the planned acquisition of additional, relevant infrared and optical observations will be made. The infrared observations will indicate the importance of infrared cooling mechanisms to SNR evolutionary timescales. The optical observations equired a longer-range plan, the subject of future proposal, involving the use of nedium-dispersion spectra and high-esolution imagery to supplement the echelle spectra. Finally, by synthesizing the observational and theoretical results, researchers will study how present SNR structure can be attributed to initial ISM conditions and to progenitor/SNR evolution in a heterogeneous nterstellar medium.

National Science Foundation (EPSCoR)
*Peter Shull*

### Plotter Purchase

A plotter was purchased for the OSU Astronomical Image Processor. The computer plotter generates page-sized, high-quality images suitable for easy study from data obtained from the Image Reduction and Analysis Facility.

Dean's Incentive Grant
*Peter Shull*

### Characterization of the Optical Properties of Impurities and Radiation Defects in Non-Cubic Crystals

Non-cubic crystals play an important role n optical devices. Only well characterized ew materials can be used by applied naterials scientists and physicists for evices. For this reason, continuing research n the characterization of potentially useful naterials is a necessity. The objective of our roup has been to discover and understand efect interactions and radiation damage rocesses in transparent insulators. Special ttention has been placed on materials such s $MgF_2$, $RbMgF_3$, and $LiYF_4$. Since these materials lend themselves to the formation of mixed crystals, it has been possible to investigate a series of materials such as $RbMg_{1-x}MnxF_3$. Research on the temperature dependence of the optical absorption, emission and radiation lifetimes have resulted in a better understanding of electron-phonon interactions and energy transfer in these crystals. The continued investigation of the following two new research areas are proposed. This will provide more complete characterization of radiation damage aggregates in these crystals: (1) The investigation of a recently discovered impurity pairing phenomena in materials such as $RbCaF_3$. In this case, it is found that impurity ions larger than those for which they substitute (such as $Er^{3+}$ or $Mn^{2+}$ for $Mg^{2+}$) have a greater tendency to pair with small impurities substituting for larger indigenous ions (such as $Eu^{2+}$ for $Rb^{+}$). This leads to exciting energy transfer prospects; (2) The investigation of impurities and radiation damage defects in $RbCdF_3$.

National Science Foundation
*William Sibley*

### More Oklahoma Science and Technology

A grant from the National Science Foundation for the purpose of participating in the Experimental Program to Stimulate Competitive Research for the State of Oklahoma.

National Science Foundation
*William Sibley*

### Spectroscopic Studies and Characterization of Excitonic States in Semiconductor Quantum Wells and Superlattices

Continuation of optical studies in semiconductor quantum wells and superlattices. A variety of optical phenomena associated with carrier confinement and quantum size effects will be investigated using both cw and pulsed lasers. In particular, excitonic effects and zone boundary optical transitions in superlattices, which are distinct from those in quantum wells, will be investigated.

Office of Naval Research
*J.J. Song*

### Density Functional Theory of Intermolecular Forces

A theory of intermolecular forces within the framework of an energy functional of the electron density has been developed. A "clean separation" of classical (electrostatic and induction) and quantum (exchange and dispersion) forces emerges in these considerations. Computer codes to carry out the calculations of these terms at various levels of approximations are now being developed and tested. Researchers' immediate problems concern the $H_2O$ dimer interaction energy and the interaction of heavy metals with one or more water molecules. Long range goals include implementing formalism and computer codes as a general approach to calculating intermolecular forces.

State of Oklahoma
*Paul Westhaus*

### Dynamic Critical Behavior of Structural Glass Systems

An international collaboration between Oklahoma State University and the Universidad Autonoma de Madrid in Spain has been established to conduct a joint study on a variety of systems which exhibit glass-like behavior at low temperatures. In particular, the mixed crystal, $Rb_{1-x}(NH_4)xH_2PO_4$ (RADP), will be investigated via Brillouin and degenerate four-wave mixing (DFWM) spectroscopies as a function of temperature and concentration, x. The Brillouin studies will focus on the acoustic and soft optic mode properties and how these change between the crystalline and glass phases. Additional Brillouin investigations will include: (1) behavior of the dynamic central peak for various concentrations in the glass phase, (2) effects of induced defects, radiation damage and external perturbations on the elasto-optic constants. The DFWM experiments, which will be carried out in the OSU Laser Spectroscopy Facility, will be used to probe the nonlinear properties of this mixed crystal system in both its crystalline and glass phases. Additional studies on the other structural glass systems, such as $(KCN)x(KBr)_{1-x}$, will also be conducted using the above technique.

NATO Scientific Affairs Division
*James Wicksted*
*Richard Powell*

### Laser Spectroscopy Studies of Harmonic Converting Materials Used in Controlled Fusion Research

The use of KDP crystals and their homologs as harmonic converters for intense laser sources has recently been applied to the studies of controlled fusion reactors. Such investigations require materials possessing nonlinear properties which allow noncritical phase matching to occur over a range of laser wavelengths and which are durable when subjected to high intensity laser light. The proposed research will utilize Brillouin spectroscopy and degenerate four-wave mixing (DFWM) to probe a specific RDP homolog, rubidium dihydrogen ammonium phosphate (RADP). The Brillouin studies will result in values of various elastic compliance and photoelastic constants of this mixed system at room temperature, and determine how these properties change as a function of concentration and temperature. Changes in the elastic constants, which indicate structural changes in the sample, will also be noted after these systems are exposed to high pulsed laser beams. Laser-induced

gratings, which will be formed using DFWM techniques, will be used to determine the nonlinear optical properties of the RADP crystal system as a function of laser power, temperature and material composition. These studies on the aforementioned properties will assist in determining the possible applications of the RADP system to controlled fusion research.

University Center for Energy Research
*James Wicksted*

**Materials for Optical Communications**

The goal of this research is to investigate the optical and acoustic properties of several II-VI semiconductors in an attempt to evaluate the use of these materials in optical communication devices. Brillouin spectroscopy will be used to explore the elasto-optic and photoelastic properties of the semiconductors as a function of laser wavelength, temperature and doping concentration. In addition, resonant Brillouin scattering will be used to study the optical properties near an exciton resonance; in particular, the exciton energy, lifetime, effective mass and oscillator strength. These studies will commence with CdTe at various doping levels, and then move on to the CdS, CdSe and other II-VI semiconducting systems.

Noble Foundation
*James Wicksted*

**Light Scattering Studies of Structural Glass Systems**

This project is an investigation of a variety of systems with competing interactions of the KDP family, which exhibit structural glass behavior at low temperatures. The primary purpose of this research is to determine what remains of both the acoustic and optic soft modes in the glass phase of RADP. This will allow a comparison between a system which is structurally ordered with a system which is structurally frustrated and exhibits glass-like properties. The results of these experiments will be used both to understand the fundamental properties of a mixed crystal system and to evaluate the potential use of this material in optical device applications.

Dean's Incentive Grant
*James Wicksted*

**Oxygen Divacancy Model for the $E_1$" Center in a-$SiO_2$**

The paramagnetic forms of oxygen-vacancy-associated centers are usually classified as the E' or E" centers, where the single or double prime superscript denotes whether there is one or two unpaired electrons (i.e., S = 1/2 or S = 1) associated with the specific center. Recent experimental studies have provided a detailed description of the production and thermal decay properties of E" centers and the angular dependence of their ESR spectra. Ab initio HF-SCF-MO calculations were made on twenty-one atom clusters $[Si_3O_{10}H_8]^0$, designed to simulate alpha-quartz and on a nineteen-atom di-vacancy cluster, $[Si_3O_8H_8]^q$, q = 0, +2, to simulate the E" center. A comparison of the present calculations with the ESR data strongly suggests that the $E_1$" center is a neutral single oxygen vacancy defect. The calculations predict that the two unpaired-spin electrons associated with the S = 1 state are localized on the two end silicons, approximately 3.7 A apart.

State of Oklahoma
*Timothy Wilson*

**Electronic Structure of Interstitial Ion-Related Electron Traps in Crystalline Quartz**

A new, paramagnetic (S = 1/2) defect, designated the $[SiO_4/Li]^0$ center, consisting of an interstitial lithium "ion" and a trapped electron, recently has been observed by Jani et al. in irradiated alpha-quartz. A model for this defect has been developed utilizing *ab initio* self-consistent-field, electronic structure calculations. In this model, the interstitial lithium nucleus lies on a crystal twofold axis passing through two adjacent silicon ions, and has a slightly negative charge but small spin density at the nucleus. The properties calculated using this model appear consistent with all the available experimental information for this defect. The calculations are being extended to the study of interstitial hydrogen and sodium. Preliminary results show the centers associated with these ions to have quite different properties from that of the lithium-associated center.

State of Oklahoma
*Timothy Wilson*

## Political Science

**A Comparative Analysis of the Bargaining Power of Public Employee Organizations**

This research is intended to build on and refine an approach to the study and measurement of public employee organization bargaining power. The research involves several significant innovations that have been substantially explored and developed in previous research. The innovations include: a focus on the sources of variation in public employee group power and effectiveness rather than merely the extent of power; the examination of a wide range of independent sources of variation in public employee group power and effectiveness; the use of nonmaterial policy goals as a second, independent dimension in the measurement of public employee group power; and the examination of the attitudes of both government and employee group negotiators toward negotiations and group power and the implications of these attitudes for public employee group power.

Dean's Incentive Grant
*David Billeaux*

**Juvenile Justice Technical Assistance: Information System**

The purpose of this project is to develop a model computerized, integrated, juvenile justice data system that can be used for case management, planning, program development, and evaluation, and to test it in at least one county in Oklahoma.

OCCY
*Anthony Brown*

**Oklahoma Government: People, Politics and Policies**

This book, forthcoming from the University of Nebraska Press, is part of a 50-volume series focusing on government and politics in the American states. The book provides a comprehensive analysis of Oklahoma government and politics using political culture as an underlying theme.

State of Oklahoma
*Robert England*

**Race, Class, and Education: The Politics of Second Generation Discrimination**

This book, forthcoming from the University of Wisconsin Press, offers a theoretically-specified, empirical analysis of a phenomenon generally referred to as "second generation school discrimination." Second generation school discrimination concerns practices that occur within public schools that affect both the quality and quantity of education minority children receive. Manifestations of the phenomenon include disproportionate placement of black students in lower ability groups and special education classes; disparities in the use of disciplinary practices (corporal punishment, suspension, and expulsion) against black students; and discrimination in the hiring of black teachers. Findings suggest that second generation school discrimination can be attenuated through the political arena.

State of Oklahoma
*Robert England*

**Barriers to International Trade in Agriculture: Politics, Economics and Foreign Policy of Protectionism**

This will be a national teleconference for agricultural leaders, farmers, agri-business, and academicians focusing on the problems of protectionism and options for solution.

A&S Extension
*Harold Sare*

**Restitution Education, Specialized Training and Technical Assistance**

This project represents a collective effort to bring together individuals and organizations who are uniquely qualified to carry out a program designed to expand the use, effectiveness and efficiency of restitution in juvenile courts. The OSU research focuses on surveys of restitution programs and analysis of the effects of restitution on recidivism rates of juvenile offenders.

U.S. Department of Justice
*Anne Schneider*

**A Longitudinal Study of the Relationship Between Legal Sanctions, Perceptions and Delinquent Behavior**

This research will test a series of hypotheses about the relationship between experiences in the juvenile justice system, perceptions of the certainty and severity of punishment, and subsequent delinquent behavior. Many of the findings from previous studies of perceptions and crime have been questioned because of methodological problems or lack of relevance to serious crime. This study corrects both problems and permits several of the most important propositions to be re-examined, including the comparative importance of perceived certainty, perceived severity, commitment to basic moral or legal principles, and perceptions of labelling on subsequent referrals to both juvenile and adult court. Tests will also be conducted on several new propositions including whether perceptions of fairness and attitudes toward the victim are associated with reduced recidivism rates. The effect of celerity in administrating the sanctions on perceptions as well as on subsequent offense behavior can be examined.

National Science Foundation
*Anne Schneider*

**Project Evaluation**

This agreement provided project evaluation services for a Snohomish County Prosecutor's Office's (Everett, Washington). The project, entitled "Improving Evidence Gathering," was intended to reduce trial delay. The analysis revealed no significant effects.

Urban Policy Research
*Anne Schneider*

**Juvenile Justice Technical Assistance: Information System**

The purpose of this project is to develop a model computerized, integrated, juvenile justice data system that can be used for case management, planning, program development, and evaluation, and to test it in at least one county in Oklahoma.

OCCY
*Anne Schneider*

**IPA Agreement**

The assigned employee will contribute to current and planned navigation studies concerning financing and intergovernmental relations. The employee's knowledge of non-Federal institutions and legal mechanisms for project financing will help the Army Corps of Engineers, through IWR studies, make appropriate adjustments to Federal project planning to account for new cost sharing provisions. In return, the employee will gain a greater understanding of federal constraints and concerns in overall project planning which will enhance teaching and research activities at the university.

Army Corps of Engineers
*Joseph Westphal*

## Psychology

**AIDS Education**

Principles of learning, persuasion, and mass communication are being employed to design programs to inform the public about AIDS and other sexually transmitted diseases. Efforts are also being made to change attitudes and modify behaviors. Results of our first major AIDS education project indicate that videotapes designed for AIDS education can be successful in increasing knowledge about AIDS and in improving attitudes toward people with AIDS. There is some suggestion, however, that such effects may be short-lived, especially for attitudes, and that repeated instruction may be necessary. We have also found that attitudes toward practicing "safer" sex may be especially resistant to change. We will focus on the latter in one of our next projects.

State of Oklahoma
*Larry Brown*

**Affective Communication and Its Modification**

A series of related studies are in progress examining a model of emotional behavior, the communication of affect through expressive behavior, and the modification of affective expression in a small group, quasi-therapeutic setting. The role of touch, attitudes toward touch, empathy, self-disclosure, and social support networks are among the variables being examined.

State of Oklahoma
*Donald Fromme*

**Adolescent Cognition, Egocentrism and Decision-Making**

Testing of a model to account for behavioral variance in adolescent risk taking, e.g., substance abuse, juvenile delinquency, sexual behavior without contraceptive usage.

State of Oklahoma
*Vicki Green*

**Patricia Roberts Harris Fellowship Program**

A program focused on recruitment, retention and enrichment of students in psychology graduate programs from underrepresented groups, especially ethnic minorities and the handicapped.

U.S. Department of Education
*Vicki Green*

**The History of the Institute of Human Development, University of California at Berkeley**

The perusal of institute files and oral history interviews with 37 professionals have provided materials that are currently being processed. (The data were gathered while on sabbatical.) A monograph will be co-authored with the associate director of the Institute. The tapes and transcribed interviews will be placed in archives.

State of Oklahoma
*Vicki Green*

**Effects of Pyridostigmine on Aircrew Flight Performance: Ground Support Aircraft**

The study is directed to determination of how pyridostigmine (in oral dosages) modifies physiological functions and/or degrades performance of mission-ready pilots who have the task of executing a simulated mission in a state-of-the-art flight simulator. Side effects of pyriodstigmine, as these effects may diminish value of the drug in chemical warfare defense, have not been determined previously. The evaluation have been undertaken in support of the USAF Surgeon General who has decided that military personnel will be best protected in a chemical warfare environment if they are given pyridostigmine before entering a locale or region that may be contaminated with any of a variety of agents used in modern chemical warfare.

AFOSR/AFHRL-OT
*Arthur Harriman*

**Substance Abuse Vulnerability: Family and Personality**

Part of a long term project on drug and alcohol intake and factors mediating the level and variety of intake. This project will assess cognitive and personality factors as well as physiological responding in people who are closely related to someone who has had an alcohol and/or a drug problem vs. those who have not been related to such an individual.

Dean's Incentive Grant
*Joan Holloway*

**Shadow Mountain Institute Practicum Placement Agreement**

This agreement placed three doctoral candidates in clinical psychology at the

Shadow Mountain Institute in Tulsa, a private residential treatment setting and outpatient program for children and adolescents. This clinical services practicum provided extensive training and supervised experience with psychological assessment.

Shadow Mountain Institute
*Daniel McNeil*

**Family Mental Health Center Practicum Placement Agreement**

The Family Mental Health Center in Tulsa was the setting for this contract. One clinical psychology doctoral candidate was placed as part of this agreement. This student received training and experience in providing psychological services in a community mental health center, and gained exposure to a variety of clinical problems.

Tulsa Family Mental Health Center
*Daniel McNeil*

**Payne County Child Guidance Clinic Practicum Placement Agreement**

This agreement provided for placement of two clinical psychology graduate students in a clinical services practicum at the Payne County Child Guidance Clinic in Stillwater.

Payne County Guidance Center
*Daniel McNeil*

**Enid State School Practicum Placement Agreement**

This program allowed for placement of three clinical psychology graduate students at the Enid State School, a state facility for the mentally retarded. Clinical training and supervised practicum experiences were provided for the doctoral students involved with this agreement.

Enid State School
*Daniel McNeil*

**Department of Mental Health Practicum Placement Agreement**

This agreement provided for placement of four clinical psychology doctoral students in various Department of Mental Health facilities across the state of Oklahoma. These sites included Red Rock Comprehensive Mental Health Center in Oklahoma City, Family Mental Health Center in Tulsa, and the Stillwater Community Mental Health Clinic. The graduate students supported by this agreement received supervised clinical training and experience in providing psychological services.

Oklahoma Department of Mental Health
*Daniel McNeil*

**Red Rock Comprehensive Mental Health Center Practicum Placement Agreement**

This agreement provided partial support for placement of one graduate student in a clinical psychology practicum at the Red Rock Comprehensive Mental Health Center in Oklahoma City.

Red Rock Comprehensive Mental Health Center
*Daniel McNeil*

**Hillcrest Health Center Practicum Placement Agreement**

This agreement provides for the placement of one graduate student in a clinical psychology practicum at the Hillcrest Health Center.

Hillcrest Health Center, Inc.
*Daniel McNeil*

**Determinants of Dental Fear**

Both researchers and clinicians have been interested in the possible anxiety-related components of dental fear/avoidance. Most of the information in this area, however, is anecdotal in nature, coming from hypotheses generated from observations of patients in the dental operatory setting. This project provided empirical evidence that outlined the relative importance of possible components of dental fear/avoidance, including fear of pain, confinement in the dental chair, mutilation, and social contact.

Dean's Incentive Grant
*Daniel McNeil*

**Interrelationships Between Social Anxiety and Alcohol Consumption Patterns in Young Adults**

The relationship between alcohol abuse and clinically significant anxiety states is an area of interest in the contemporary psychological literature. Social anxiety is particularly relevant because research has shown that a major expectation in using alcohol is the reduction of tension and the enhancement of general social assertiveness. This study explored relationships among social anxiety, alcohol consumption patterns, and expectations of reinforcement from use of alcohol.

Dean's Incentive Grant
*Daniel McNeil*

**Misuses of the Pearson Correlation Coefficient**

Several novel uses of the Pearson r have been published recently that have serious drawbacks; unmentioned assumptions, limited interpretability, etc. The authors of these techniques do not mention these problems, or gloss over them. The present research attempts to point out the very real dangers in their indiscriminate use.

State of Oklahoma
*James Price*

**Analysis of Methods for Locating Signal Information in Background EEG Noise**

A number of methods have been proposed for determining the location and nature of the brain's response to external stimuli, through the analysis of event related potentials. Michalweski's method of simple averaging, Woody filtering, and various combinations of filtering and pre-alignment are among these. Validation studies (usually computer simulations) have been conducted only under very restrictive and artificial conditions. The present research, with D.G. Thomas, seeks to examine the accuracy of these methods under more realistic conditions and determine the limits of operational accuracy.

State of Oklahoma
*James Price*

**Estimation of Signal-to-Noise Ratio in EEG Data**

Bershad and Rockmore (1973) proposed two methods for estimating signal-to-noise ratios from correlation coefficients based on sample data. Although general characteristics are known on the basis of their derivations, neither method has been established for bias or variability in individual cases. The present research involves examining bias and variability under a variety of simulated data collection conditions.

State of Oklahoma
*James Price*

**Dimensions of Interpersonal Verbs**

Multidimensional scalings of verbs used to express interpersonal relations (e.g., likes, trusts, admires, fears, leads, dominates) have reliably disclosed two underlying dimensions: affect and control. Work is now underway to determine how such relational terms produce attributional qualities in person perception.

State of Oklahoma
*James Phillips*

**Risk in Interpersonal Relationships**

Factors in such interpersonal relationships such as dating that can be associated with risk have been found to influence preferences for dating partners. Preliminary results indicate the strong presence of a risk aversion in the interpersonal arena, paralleling the finding that such an effect is present in monetary valued situations. The effect appears to be stronger for females than for males.

State of Oklahoma
*James Phillips*

**NIMH Clinical Training/Manpower Development Program**

The objective of this training program is to educate and train persons of minority

background and handicapped persons for professional work in clinical psychology. The initial clinical training facility is the Department of Psychology's Psychological Services Center under faculty supervision. Later practicum are in settings such as a state mental health hospital, an inpatient hospital for children ages 6 to 15 who are court-referred as in need of mental treatment, a diagnostic and treatment center for neglected children, a state operated rehabilitation hospital, an Indian Health Services Hospital, and a Hispanic community center in an urban setting.

National Institute of Mental Health
*Kenneth Sandvold*

**The FIRO-B: Cross Validation and the Development of Local Norms**

Application of the FIRO-B Guttman scales to Oklahoma students is being investigated to determine if they meet the 90 percent reproducibility criterion established by the test developer. Alternative scoring procedures and the development of local norms are being considered, as well as the impact of these changes on the validity of automated interpretations and the use of revised compatibility measures on the study of therapeutic outcome.

State of Oklahoma
*Robert Schlottmann*

**United Community Action Program—Psychology Services, Noble County—1986-1987**

Diagnostic/therapy was performed for approximately 10 children in Perry, Oklahoma.

United Community Action Program, Inc.
*Robert Schlottmann*

**Development of Measures Based on the Cortical Evoked Potential**

Current research activities involve the development of measures based on the cortical evoked potential (EP) which characterize fundamental mechanisms utilized in the processing of sensory information by the human brain. These measures are being used within the context of modern theories of brain function, which describe the processing of information in terms of large networks of neurons, in order to study the physiology of attention, hemispheric specialization and infant perceptual development.

State of Oklahoma
*David Thomas*

**Neural Networks in Infant Psychological Development**

Although there are considerable differences among contemporary theories characterizing the neural encoding of sensory experience, there is a consensus regarding basic concept—a particular sensation, perception, or memory is represented in the brain by a large number of neurons, particularly in the cerebral cortex, responding in a spatio-temporal pattern which uniquely specifies that particular experience. The purpose of this study is to assess the role that differential exposure to a stimulus plays in the development of neural networks. The study is addressing the issue of general versus stimulus-specific decreases in the EP variablity by presenting infants with different degrees of experience with auditory stimuli over the first 16 weeks of life.

Dean's Incentive Grant
*David Thomas*

**Neural Networks in Infant Psychological Development**

In the neuropsychological theory of Hebb, perceptual development is characterized by the establishment of consistent neural networks and by a gradually decreasing variability in the spatio-temporal pattern of responding of such networks. This research will test that theory by defining neural network variability in terms of the trial to trial variability of the scalp-recorded evoked potential (EP). Specifically, it is predicted that EP variability will decrease in infants tested longitudinally across the first 16 weeks of life, with a greater decrease shown to auditory stimuli presented frequently compared to stimuli presented only twice. The second specific aim will be to assess the usefulness of EP variability as a tool for measuring developmental progress and developmental risk in premature infants.

Oklahoma Health Research Program
*David Thomas*

**Invention: A Bridge Between Technology and Cognitive Science**

Historically, people in technology have been inventing on the basis of intuition, while people in cognitive psychology have been isolated from the rich problems of technology and the constraints of the practical world. At a recent meeting of the National Inventor's Conference, for example, only two academic people were present. This project is an attempt to bring concepts from cognitive psychology to bear on the creative aspects of invention. The methods used range from interviewing professional inventors to conducting experiments in which students attempt to solve a problem by inventing a suitable artifact. The output is a rich set of heuristic principles, that is, rules of thumb for going about invention.

Dean's Incentive Grant
*Robert Weber*

**Invention Heuristics**

Famous historical inventions are examined with the question in mind of why they were not invented sooner. Several explanations are considered: lack of essential components being present on the historical scene; lack of cognitive models, such as biological or physical analogies; and lack of powerful invention heuristics, rules that guide the invention process. Evidence is obtained to indicate that in many cases the critical missing ingredient is an insufficient reservoir of invention heuristics.

State of Oklahoma
*Robert Weber*

## Religious Studies

**American Council of Learned Societies Fellowship**

This fellowship was awarded to enable travel for attendance at the International Association for the History of Religious Conference in Syndey, Australia.

American Council of Learned Societies
*Azim Nanji*

**Phoebe Schertz Young Professorship Chair**

This agreement establishes a fund endowed by Raymond A. Young. The professor selected is to be an employee of Oklahoma State University in the Department of Religious Studies.

Baptist General Convention Foundation
*Kyle Yates, Jr.*

## School of Health, Physical Education and Leisure Services

**Stillwater Public Schools—Exceptional Child Center**

This an agreement between the Board of Education of Stillwater and Oklahoma State University's School of HPELS to provide a program of adapted physical education for the Stillwater Public Schools Exceptional Child Center.

Stillwater Board of Education
*Betty Abercrombie*

**Summer Food Service Program (NYSP)**

Food services were provided at no personal cost to youth in the Payne County area during a five-week summer sports program. The purpose of the grant is to provide a nutritional program to economically disadvantaged youth. Each participant received one hot meal and a morning supplement daily for 27 days.

Oklahoma State Department of Education
*John Bayless*

### National Youth Sports Program

A 27-day summer sports instructional program was provided for approximately 300 youth between the ages of 10 and 16 from the Payne County area and surrounding communities. This program included sports instruction, nutritional programs, transportation, physical examinations and health information, instruction in personal hygiene, social and personal enrichment, plus other activities for each participant. The program includes an on-going youth fitness evaluation.

NCAA
*John Bayless*

### YMCA Agreement

Under the terms of this agreement, the School of Health, Physical Education and Leisure Services is providing the Stillwater YMCA with management services and assistance in the search and screening process for a new executive director. The agreement also provides for development of a basic program plan and assistance in implementation of facility upgrading.

Stillwater YMCA
*Lowell Caneday*

### Pink Slip Program

Guest and service receipts from state parks and state recreation areas were sampled and analyzed to develop a profile of quantity, type and time of activities of park users. Some demographic data were also developed to assist in marketing and programming of Department of Tourism and Recreation facilities.

Oklahoma Department of Tourism and Recreation
*Lowell Caneday*

### Park Visitor Survey

As part of the five-year Statewide Comprehensive Outdoor Recreation Plan, a survey was designed, developed and implemented from July 1, 1987 through June 30, 1988. This survey investigated the demographics, activities, economic impact and opinions of park users throughout the Oklahoma state park and state recreation area system. Data generated will be used in planning for the next five year period.

Oklahoma Department of Tourism and Recreation
*Lowell Caneday*

### Long Term and Short Term Effects of an Adventure Education Experience on Participants' Self Efficacy, Synergism and Fellowship

This project is aimed at determining if purported outcomes of a single adventure education experience exist and if these outcomes are maintained over time. Adventure education has been defined as "activities which create an environment, such as a high ropes course, or contrive an obstacle, such as a 14-foot wall, and present it as a challenge to a group of students. The goal is not skill but rather the personal or group challenge of overcoming anxiety and functioning under stress to solve a problem. The process of group involvement is usually more significant in adventure education than the acquisition of skill or even the successful completion of a task."

Dean's Incentive Grant
*Christine Cashel*

### Experience and Alternate Methods of Instruction in the Sports Skill Analysis Process

This study will investigate the effects of teaching experience and alternate forms of kinesiological instruction on visual retention of selected sports skills. Prior to and after 40 hours of instruction, 40 experienced physical educators, 40 physical education undergraduates, and 40 control subjects will be administered a modified version of the Utah Sport Skill Analysis Test to assess visual retention of movement phenomena. The results of this study will further efforts to empirically verify the efficacy of two types of methodological approaches of sport skill analysis instruction.

Dean's Incentive Grant
*Sandy Gangstead*

### A Study of the Physiological Effects of Caffeine

Caffeine is readily absorbed by skeletal muscle tissue which may alter contractile status and fiber recruitment. However, the scarcity of literature regarding the effect of caffeine ingestion on maximal strength output and anareobic fatigue curves in human subjects warrants investigation. The purpose of this research is to explore the acute effects of moderate and high doses of caffeine on skeletal muscle strength and fatigue in subjects exhibiting little or no tolerance to caffeine.

Dean's Incentive Grant
*Bert Jacobson*

### Practice Methods and Procedures of Chiropractic Doctors in Oklahoma

The purpose of this study is to ascertain information of the common modalities used in treatment and to attempt to describe the range of practice by Oklahoma chiropractors.

Chiropractic Association of Oklahoma
*Bert Jacobson*

### Therapeutic Recreation Services Agreement

The purpose of this contract is to provide therapeutic recreation services to a child referred by the Pleasant View School District.

Pleasant View School District
*Jerry Jordan*

### Training in Therapeutic Recreation

A program for the preparation of related service personnel on the bachelor's and master's level in therapeutic recreation.

U.S. Department of Education
*Jerry Jordan*

### Special Olympics International Director of Unified Sports Program

This agreement with Special Olympics International provides the Special Olympics Unified Sports Program with a chief administrative officer responsible for planning, organizing and directing the program. The program is designed to improve sports skills of mentally retarded participants, develop in non-mentally retarded persons a better understanding and socialization of mentally retarded individuals and to promote the fact that Special Olympics contributes to mainstreaming/normalization of individuals with mental retardation.

Special Olympics International
*George Oberle*

## School of Journalism and Broadcasting

### Ethics and Professionalism in Public Relations

The continuation of research in the area of ethics and professionalism in public relations. As the mass media have become increasingly dependent on public relations practitioners as sources of information, large agencies have become major providers of information to the public through the mass media. With this growth in influence and power, the concern for ethical and professional practices in public relations has also increased. Questionnaires distributed at random to members of the Public Relations Society of America are currently being analyzed.

Dean's Incentive Grant
*Brooks Garner*

### A Case Study of Community Relations Activities of the Southwestern Bell Telephone Company of Oklahoma

This project will make use of survey and market research techniques to develop a traditional case study of innovative approaches to handling public relations in shrinking economic situations. This is the first attempt at a case study in public relations for the utility after divestiture.

Dean's Incentive Grant
*Brooks Garner*

**The Ways in Which Teenagers and Their Parents Discern Sexual Values and Gender Roles in Popular R-Rated Videocassette Rental and Pay TV Movies**

This exploratory study is designed as a first step in ascertaining how and when teens and their parents identify and accept (or reject) values in films. The study will attempt to code and classify the sexual values in popular teen-age comedies and horror films.

Dean's Incentive Grant
*Maureen Nemecek*

**A Study of the Presentation of Glasnost Policies of the Gorbachev Administration as Reflected in Newspapers of the Soviet Union**

An expansion of earlier content analysis of two local Moscow newspapers, *Muskovskaya Pravda* and *Vechernaya Moskva*, and the all-Union newspaper *Pravda*. This represents an effort to understand local press function and measure the impact of the Gorbachev administration's glasnost policies.

Dean's Incentive Grant
*Elisabeth Schillinger*

## Sociology

**Nations Within a Nation: Sovereignty and Native American Communities**

This media production grant provided funds to produce a 60-minute television documentary on the topic of sovereignty and Native American governments. Videotaping took place in New Mexico and Oklahoma and included interviews with lawyers, historians and tribal leaders. The program provides a basic understanding of the issues involved in the controversy over the sovereignty of Native American governments. An advisory board of Native American leaders provided guidance for this program which was produced through the facilities of the Educational Television Services of Oklahoma State University.

Oklahoma Foundation for the Humanities
Oklahoma State University Foundation
National Endowment for the Humanities
State of Oklahoma
*Donald Brown*

**Medical School Socialization and the New Physician: Role, Status and Social Identity**

The intermediate phase of a four-year, longitudinal research project on the dynamics and impact of medical school socialization was completed during the summer of 1984. On July 1, 1984, the two medical student cohorts under study were three-fourths of the way through their medical school experience. A large amount of both quantitative and qualitative data continues to be collected and synthesized. The specific research objectives are: (1) to refine the data base comprised of demographic, attitudinal and behavioral information elicited from the medical student-subjects when they first entered medical school in 1981; (2) to continue to identify and analyze the social and psychological coping techniques of medical students facing stressful conditions and crisis situations; and (3) to trace the longitudinal modification and development of values, ideals and self-identity under the intense socialization of the medical school experience as the emerging physician prepares for membership in the medical subculture and his/her role in society. Several articles, based on this research, have appeared in professional journals. The project was completed in August, 1985.

State of Oklahoma
*Jack Bynum*

**Legalization of Gambling: An Examination of Cultural Hegemony in the Definition of Deviant Activity**

A review of North Dakota newspapers and government documents from 1971 through 1973 found that the issue of gambling, which had been defined historically as deviant, had taken on a new definition during this period. It was shown that the media largely ignored previous definitions of gambling and began to identify it as a normal event which did not carry the stigma of the previous period. The data show the move to legalize gambling was treated as a routine event with possible positive consequences. The purpose of this research is to continue analysis of the move to legalize gambling in North Dakota. The focus is to explain why this initiative passed rather than detail how it passed. The research will consider further the relationship between cultural and structural constraints and authority for defining events.

Dean's Incentive Grant
*John Cross*

**Raising the Legal Minimum Drinking Age**

Data collection proceeded on the second year of a continuing grant to examine the effects of legislation in Oklahoma which raised the minimum drinking age for 3.2 beer. Data from the 1984-85 school year were compared with samples gathered during the previous year and with samples obtained prior to the new law (September of 1983 and January of 1981). A partial analysis of the first year's findings will appear in the *Journal of Drug Issues*: 17(1), 1987.

National Institute on Alcohol Abuse and Alcoholism
*Stella Hughes*
State of Oklahoma
*Richard Dodder*

**Sociology Alumni's Perceptions of Their Undergraduate Department, First and Current Jobs: A Mailed Questionnaire**

This research was a study of sociology bachelor's degree alumni from Oklahoma State University. A questionnaire was mailed to the entire population of graduates from a five year period. Results indicated a positive view of the department and of advising overall. Respondents were in a variety of occupations, most often in social service, office/clerical, business management/administration, teacher, sales, corrections and service occupations. They reported little difficulty finding their jobs, primarily through self-inquiry and personal contacts. A majority reported that they used their sociological skills/knowledge often or very often on their jobs. An article reporting their study is in review at the American Sociological Association journal, *Teaching Sociology*, and is being considered for presentation at state professional meetings. The findings will also be used in a departmental self evaluation.

State of Oklahoma
*Kathleen McKinney*

**Sociology of Agriculture**

The focal point of this project is the organization of productive and reproductive activities of independent and semi-autonomous households as they confront the macro-level structures and processes which set the conditions of their existence. This perspective emphasizes various forms of formal and informal labor necessary for social reproduction, particularly focusing on women's roles in the maintenance of family socio-economic well-being, as well as in production. The underlying intention is to develop a broader theory of household reproduction.

Dean's Incentive Grant
*Keith Moore*

**Farm Operator Stewardship Decision-Making with Respect to Water Resources**

This study investigates groundwater policy and management practices in Oklahoma agriculture. It begins by assessing the scope of the issues involved and recent work on the socio-economic relationships between water quality and agricultural practices. Using a sample of Oklahoma rural leaders, the study focuses on the testing and examination of a set of attitudinal scales reflecting basic beliefs concerning political, economic and environmental issues. The overall objectives of the project are to provide a basis for a more substantial in-depth investigation of both the public opinion context for developing water quality policies and programs and the attitudinal components of farm operator decision-making with respect

to land use practices which impact on groundwater quality in Oklahoma. It concludes that the attitudinal scales are relevant and applicable in contemporary rural Oklahoma and that there is potential support for innovative water quality protection initiatives which further investigation could help to specify.

University Center for Water Research
*Keith Moore*

**Aging in a Small Rural Anglo Community**

Research focuses on the process of growing old as an Anglo rural person with an emphasis on roles and attitudes. The life history is the method used to collect the data.

State of Oklahoma
*Marjorie Schweitzer*

**Oklahoma's House Arrest Program: A Critical Evaluation**

Oklahoma has embarked on a new and ambitious plan, called house arrest, of transferring a large number of prisoners from their prisons to their homes where they will stay under the intensive supervision of correctional officers and case managers. The primary goal of the House Arrest Program is to relieve overcrowding in prisons and to help them reintegrate in society under close supervision. This study plans to evaluate the effectiveness of this program, comparing the house arrestees with control groups of similar characteristics. Since the house arrestees are likely to stay under house arrest for an approximate period of six months to one year before they are paroled or released on expiration of their term of sentence, the major criterion of comparison between the two groups will be the commission of a new offense during that period. Several other criteria measuring the success or failure of the house arrestees will also be suggested.

State of Oklahoma
*Harjit Sandhu*

## Speech Communication

**Teaching, Learning and Evaluation Outcomes in the Basic Speech Course**

Three different areas of educational outcomes in the multi-sectioned basic speech communication course were investigated. Two articles, regarding grading and learning outcomes and student evaluation of instructors, were printed in national journals. One paper examining the ethics of teaching persuasion in the basic course was presented at a national conference.

State of Oklahoma
*Bena Harper*

**Summer Program for Economically Disadvantaged Youth**

This agreement provides assistance to the East Central Private Industry Council in development of a summer program for economically disadvantaged Oklahoma youth. The eight-week program will assist participating students in academic development, development of career orientations and provide structured work experiences for the students.

East Central Private Industry Council
*Paul Harper*

**AIDS, Health Care Interventions, and Communication Responsiveness**

Two papers were presented at national and international meetings on the correlates of communication responsiveness in the AIDS crisis. Four papers presented at national and international conferences and one journal article dealt with AIDS, health care interventions, and communication responsiveness.

State of Oklahoma
*Jim Hughey*

## Speech Pathology and Audiology

**Sheltered Workshop for Payne County, Inc.**

This agreement provides speech-language pathology services for clients of the Sheltered Workshop for Payne County.

Sheltered Workshop for Payne County, Inc.
*Carol Headrick*

## Statistics

**Research Experiences for Undergraduates**

This project will establish a National Science Foundation Research Experiences for Undergraduates site in the Department of Statistics. The program is designed to expose ten undergraduate students to the initial stages of planning and designing research experiments, to teach these students how to manage data from collection and recording of data through the procedures used to enter the data into a computerized database, and to train them in the basic concepts of statistical data analysis including the associated decision making process.

National Science Foundation
*P.L. Claypool*

**Characterization of Probability Distributions**

Let $X_0$, $X_1$, $X_2$ be three independent random variables (r.v.s) with nonvanishing characteristic functions (ch.f.s). Let $Y_1 = X_0 + X_1$, $Y_2 = X_0 +$ It is known that the joint distribution of $Y = (Y_1, Y_2)$ determines the distributions of the Xs, except for an additive constant, which can be added to $X_0$, but subtracted from $X_1$ and $X_2$. However no explicit formulas for the distributions of the Xs in terms of the distributions of Y were known. This problem is solved here; explicit formulas for the ch.f.s of the Xs are given in terms of the ch.f.s of Y.

State of Oklahoma
*Ignacy Kotlarski*

**A Low-Dimensional Representation for Multivariate One-Way Analysis of Variance**

A computationally simple low-dimensional representation for comparing multivariate samples is investigated. This representation is based on finding a low-dimensional hyperplane that preserves or nearly preserves the separation of the individual samples in the lower dimensional space. Real and simulated data will be used to explore the utility of the representation for comparing two or more groups of multivariate observations. Furthermore, the low-dimensional procedure motivates a possible solution to the multivariate Behrens-Fisher problem. This is also being investigated.

Dean's Incentive Grant
*Virgil Marco*

**A Solution to the Behrens-Fisher Problem**

The objective of this research is to develop a univariate test procedure for the BF problem based on the GF distribution and compare the power of the GF procedure with the powers of existing methods through simulation studies.

Dean's Incentive Grant
*Barry Moser*

**Statistical Laboratory**

The Statistical Laboratory provides statistical help for researchers from every college, both faculty and students. Statistical consultants help with design, analysis and interpretation of research results as well as engaging in collaborative research.

State of Oklahoma
*William Warde*
Oklahoma Agricultural Experiment Station
*Ronald McNew/David Weeks/P.Larry Claypool/Andronikos Mauromoustakos*

**Development of a Discriminant Function**

The objectives of this research are to develop a discriminant function based on the Parzen information divergence criterion, which involves a consistent estimator of the spectral density; to use the methods of New-

ton and Pagano to determine the important frequencies; to compare the power of the proposed procedure with the DN&L procedure; and to extend these ideas to spatial time series.

Dean's Incentive Grant
*Gary Stevens*

**Statistical Survey Institute Fellowship**

Award of a one-year research fellowship to the Statistical Survey Institute of the U.S. Department of Agriculture.

American Statistical Association
*William Warde*

**Research and Development of Methodology for Identifying, Classifying and Handling Nonsampling Errors in Sample Surveys Conducted by the National Agricultural Statistics Service**

The general objective of this project is to develop survey methodology to identify the magnitude of nonsampling error associated with surveys conducted by the National Agricultural Statistics Service. The project will develop methodology to identify the magnitude of nonsampling error associated with surveys conducted by the Service; develop procedures to separate out the various components of error attributed to nonsampling (methods of data collection, type of respondents, timing of collection); and develop procedures to statistically handle nonsampling error in estimation and variances.

USDA National Agricultural Statistics Service
*William Warde*

**Modeling the Distribution of Insects**

Models of the distribution of insects based on Maxwell-Boltzmann statistics and on Bose-Einstein statistics have been developed for the case where there is no restriction on the behavior of the insects. Employing Bose-Einstein statistics, the most probable distribution of insects when the number of insects per minor habitat is restricted to be no more than r has been derived, and models of this case have been developed. Work is being done on determining the most probable distribution for other cases, such as females attracting males, both through Monte Carlo and analytical methods.

State of Oklahoma
*Linda Young*

**Sequential Hypothesis Testing for Discrete Distributions**

Wald's sequential probability ratio test has been used extensively when collecting data from numerous distributions. Monte Carlo studies have shown that when Wald's approximate formulae are used, the average sample size is understated and the probability of possible errors is overstated. Work is now being conducted to develop methods by which the average sample size and error probabilities for the negative binomial and Poisson distributions may be computed exactly.

State of Oklahoma
*Linda Young*

**Selection Procedures for the Negative Binomial Distribution**

Selection procedures were developed to allow an investigator to determine which one or ones of several treatments is "best" where best must be defined. A method has been developed which would allow a researcher to determine the sample size necessary to select the best negative binomial population with stated probability using an indifference zone approach. This method is now being evaluated as it is applied in an entomological framework.

State of Oklahoma
*Linda Young*

## Theatre

***Come Back to the Five and Dime, Jimmy Dean, Jimmy Dean*—Stage Direction, Scene Design, Costume Design, Lighting Design**

Creative preparation of the Ed Graczyck drama for OSU Theatre.

Department of Theatre
*Kenneth Cox* (direction)
*Richard Mahaney* (scene direction)
*Mary Anne Hempe* (costume design)
*M. C. Friedrich* (lighting design)

***Grease*—Stage Direction, Choreography, Scene Design, Costume Design, Lighting Design**

Musical theatre production for OSU Theatre.

Department of Theatre
*Peter Westerhoff* (direction & choreography)
*Mary Anne Hempe* (scene and costume design)
*M. C. Friedrich* (lighting design)

***Noises Off*—Stage Direction, Scene Design, Costume Design, Lighting Design**

Production of the British farce by Michael Frayn for OSU Theatre.

Department of Theatre
*Peter Westerhoff* (direction)
*Paul Weeks* (scene design)
*Mary Anne Hempe* (costume design)
*Jerry L. Davis* (lighting design)

***A Streetcar Named Desire*—Stage Direction, Scene Design, Costume Design, Lighting Design**

Production of the Williams classic for OSU Theatre and the American College Theatre Festival XIX.

Department of Theatre
*Billye Sue Harmon* (direction)
*Jerry L. Davis* (scene and lighting design)
*Mary Anne Hempe* (costume design)

**Oklahoma State American College Theatre Festival—Host**

Producer of a theatre festival featuring full productions from six Oklahoma college and university theatres, workshops and critiques by guest scholar/artists from Louisiana, Indiana, Arkansas and Texas.

Department of Theatre
*Kenneth Cox*

**American Association of Community Theatre Festival for Oklahoma, Co-host**

Producer of a theatre festival co-hosted by Stillwater's Town & Gown Community Theatre, Inc., featuring productions of nine community theatres in Oklahoma, workshops and critiques by guest artists/critics from California, Colorado and Arkansas.

Department of Theatre
*Jerry L. Davis*

**Summer Director's Institute**

Participation in the Oscar Hammerstein II Center for Theatre Studies, Columbia University.

Dean's Incentive Grant
*Peter Westerhoff*

## Zoology

**The Use of *X. laevis* Oocytes and Embryos as a Teratogenicity Screening Assay for Chemical Hazards in the Workplace**

Normal development depends on the timely expression of genes. Agents that alter or delay this expression may well be teratogenic. A short-term assay that tests for the genotoxicity of a substance as well as its effect on DNA, RNA and protein synthesis is under development in this laboratory. The assay should prove useful in complementing the Ames mutagenicity test and can be linked to a well-tested whole embryo teratogenicity screening assay. Although the test is primarily designed to detect human health hazards in the environment, the proposed test is broadly predictive so that results will apply to many species. It is predictive because it has been shown that heterologous genes and messenger RNAs can be efficiently processed in *Xenopus*

oocytes. This indicates that the molecular mechanisms being tested are the same from species to species. Because alterations in gene structure and function may deleteriously affect embryonic development, the test should be particularly effective in discovering potential teratogens. Pure substances as well as complex mixtures can be quickly tested at relatively low cost.

March of Dimes Birth Defects Foundation
*John Bantle*

### *Brucella abortus* Antigen Expression by Recombinant Plasmids in *Escherichia coli*

*Brucella abortus* infections cause a serious loss in cattle and present methods of vaccination produce only limited protection and lead to other problems. A study of the antigenic determinants of *Brucella* is hampered by difficulties in extracting them from the cells and by the fact that handling large amounts of the bacterium is dangerous because of its pathogenicity. Both of the problems can be overcome if the appropriate genes from *B. abortus* could be cloned and expressed in a host that is easier to work with, such as *Escherichia coli*. In this research, genes from *B. abortus* are isolated and transferred into *E. coli* to study their expression by *E. coli*. Clones expressing antigens will be further studied and engineered to get high-level expression and secretion in the *E. coli* host for study as possible vaccines. We are also developing a diagnostic test that will identify brucellosis in clinical specimens using biotinlyated DNA.

U.S. Department of Agriculture—ARS
*John Bantle*

### Development of a Teratogenesis Screening Test

The first specific aim of this research is to validate an *in vitro* metabolic activation system using Aroclor 1254 induced rat liver microsomes coupled to FETAX. This procedure will reduce the number of false negatives by converting proteratogens to teratogens. The second aim of the research will be to validate FETAX using 26 additional direct acting compounds of teratogenic potential. The long term benefit of this research is the protection of human reproductive health by screening for developmental toxicants.

Oklahoma Health Research Program
*John Bantle*

### Development of a Standard Frog Embryo Teratogenesis Assay-*Xenopus* Protocol

This project was designed to support the development of an American Society for Testing and Materials "New Standard Guide" for the Frog Embryo Teratogenesis Assay (FETAX). The guide would ensure that FETAX data was collected in such a way that it would be both repeatable and reliable. A secondary goal of this grant was to continue validating FETAX using known mammalian teratogens, and to modify FETAX protocol in such a way as to minimize false positives and negatives. The long term benefit of this research isre the protection of human reproductive health by screening for developmental toxicants.

University Center for Water Research
*John Bantle*

### The Influence of Dietary Factors Upon Cholesterolemia in Two Animal Models

This research employs swine as a model to evaluate the influence of whey and whey fractions on plasma and bile lipids.

State of Oklahoma
*Calvin Beames*

### Cell Types in Frogskin

Electron microscope evidence has been accumulated to show that the number of gap junctions (intercellular coupling elements) changes during the first hour of removal of the frog skin from the animal. These changes may drastically affect the accuracy of our models for active transport. The first manuscript of this study has been submitted for publication. Secondly, a multiple excitation fluorescence microphotometer has been constructed (using college and EPSCoR funds) to acquire quantitative measurements of intracellular CA++, pH, Na+. Measurement of these ions w ill enable discrimination among the models for control of membrane-membrane and cell-to-cell interaction. Electrochromic dyes have been used to evaluate the membrane potential of cells in epithelia that are difficult to access with conventional microelectrodes. Considerable evidence has been accumulated for the frog (and skate) stomach and for tick salivary gland. One aspect of the skate stomach study is published; the frog stomach and further progress on the skate stomach are planned. The effect of polycyclic aromatic hydrocarbons on active transport has been studied in frog skin. We found that naphthalene rapidly changes active transport of sodium in concentrations as low as 1 mg/l and shows a dose-response relationship up to 10 mg/l.

State of Oklahoma
*James Blankemeyer*

### Status of the Pecos River Pupfish (*Cyprinodon pecosensis*)

This project will document the present distribution and abundance of *C. pecosensis* and *C. variegatus* at about 40 localities from Bluff Reservoir at the Texas-New Mexico boundary to the confluence of the Pecos and Rio Grande rivers. An electrophoretic survey of selected samples of 50-100 pupfish from 10-15 localities will be conducted. Specimens will be analyzed for genotypes across four loci that provide information on hybirdization between *C. pecosensis* and *C. variegatus*. Data will be analyzed for geographic trends in frequency of alleles of the two pupfish species. Additionally, genetic data will be stratified on the basis of morphological characteristics and searched for correlations between morphology and genotype.

U.S. Fish and Wildlife Service
*Anthony Echelle*

### Reproductive Patterns of *Ichthyophythirius multifiliis*

It has been generally accepted for 75 years that *Ichthyophthirius multifiliis* reproduces only in the free-living stage. Evidence that trophonts reproduce within the epithelium of the host was obtained from experimental infections of channel catfish. Mean number of parasites spontaneously leaving the fish increased from 0 on day 3 postexposure (PE) to 66.5 per fish on day 7 PE. However, mean population density in fin increased five-fold from day 3 to day 5 PE in the absence of opportunity for reinfection. At day 3 PE 100 percent of parasite loci in fin and gill arches contained solitary trophonts. At day 4 PE 10 percent of loci in fin contained clusters of two trophonts; at day 7 PE 69 percent contained clusters of two or more trophonts. The first clusters of four trophonts in fin were observed day 5 PE and eight trophonts, day 8 PE.

State of Oklahoma
*Margaret Ewing*

### Predation and Thermal Environment as Selective Constraints on Lizard Social Organization

Social organization of animals is known to be adapted to the environment. Two important environmental parameters that must constrain and shape the social organization of lizards are predation and thermal regime. Although lizards display a wide breadth of social organization, and as small ecotherms are vulnerable and sensitive to predation and thermal environment, no study has yet explored how different environmental pressures of predation and thermal limitations interact to shape their specific social behavior. The *Liolaemus* lizards of South America will be studied under different regimes of predation and thermal conditions to see how these environmental pressures have constrained their social organization. *Liolaemus* offers a perfect opportunity for this study since its many, closely-related species inhabit environments over a steep elevational gradient known to differ in predation and thermal rigor. Social behavior will be quantified from field observation and experimentation; thermal environment and predation pressure will also be

neasured. The relationship among these will ɔe analyzed for both the same species and different species along an elevational tran-sect. This study, by using closely related taxa with a common evolutionary history, will be able to demonstrate the adaptive response of the social behavior to different environmental pressures unconfounded by disparate phylogenetic potentials.

National Science Foundation
*Stanley Fox*

**Gene Exchange Between Eastern and Western Forms of the Gray Treefrog: Separate Species?**

The range of the gray treefrog (*Hyla chrysoscelis*) is split into eastern and western sections by the intervening range of the cryptic, sibling species *H. versicolor* in the southcentral United States. The intervening frog species is a tetraploid, and thus serves as a barrier to gene flow in the diploid *H. chrysoscelis*. Conspecifics on either side of the tetraploid barrier are different with respect to calls, morphology and biochemistry. This study examines the calls, morphology and biochemistry of the two forms north of the diploid's range where the forms are free to interbreed. It is unknown to what extent these forms intergrade or remain distinct in this key geographical area. This study advances our knowledge of genetic structure and partitioning of wild populations and the importance of a polyploid as a generator of additional variation in a related diploid species.

State of Oklahoma
*Stanley Fox*
*G. Cline*

**Stability of Social Relations Over Time Among Dyadid Pairs of Lizards**

Past studies have shown that *Uta stansburiana* lizards lose dominance status following tail loss, which translates to reduced ability to defend a territory and lowered survival. Females appear to use the tail length itself as a status-signalling badge. This study analyzes the stability of dominance status among both male and female lizards matched by sex and size which have not suffered tail loss. If tail loss is a purported cause of lowered social status in lizards, it must be known to what extent dominance rank shifts naturally in its absence.

State of Oklahoma
*Stanley Fox*

**Gene Flow in a Lizard Related to a River's Flow**

Barriers to gene flow often produce genetic differences among conspecifics on either side. This study examines genetic differences indexed electrophoretically and morphologically in the eastern fence lizard on either side of the Cimarron River. Inspection for enhanced gene flow along the continuous habitat strip at the river itself and particularly in the direction of the current (brought on by flooding and transport of lizard and/or eggs downstream) is additionally being carried out. This study advances our knowledge of genetic structure and partitioning in wild populations.

State of Oklahoma
*Stanley Fox*
*N. Rachuk*

**Interaction of Hydrophobic Molecules with Heme Proteins**

Environmental hazards, combustion products and fuels, noxious agents used in warfare, and therapeutic drugs are frequently hydrophobic molecules. Preliminary evidence supports the view that hydrophobic molecules can interact with the hydrophobic interior of soluble globular proteins as well as the lipid-binding surfaces of intrinsic membrane proteins. The effects of the hydrophobic agents acenaphthene, naphthalene, phenanthrene, and benzene, as well as the local anesthetics lidocaine, tetracaine, dibusaine, and procaine on the physico-chemical properties of cytochrome c, myblobin and cytochrome oxidase will be determined. These three proteins are heme proteins, whose characteristics are sensitive to slight conformational changes in structure, and that are biologically important to organism survival. The characteristics to be investigated include visible light absorbance, midpotential, proton nuclear magnetic resonance, electron paramagnetic resonance, and CO or O binding. None of the hydrophobic perturbants are specific effectors of these heme proteins. Any perturbation must occur by general hydrophobic interaction with the hydrophobic molecules. Cytochrome c and myoglobin are well-characterized, biologically important heme proteins while mitochondrial cytochrome oxidase is a representative lipid-requiring membrane heme protein. These proteins represent model proteins to study the non-specific interaction of hydrophobic molecules with proteins.

Air Force Office of Scientific Research
*H. James Harmon*

**Fiber Optic Prototype**

Ground-level based remote sensing of the quality of groundwater, where measurements of the type and quantity of groundwater pollutants are made without sample removal, is of prime importance in water quality research. The prototype instrument will measure groundwater pollutants in the field without physical removal of the sample. Further, the identity and quantification of the pollutants will be made in real time in the field without delay. The instrument will perform these determinations via a fiber optic link between analytical instruments on the surface and a probe. The device will be unaffected by electrical, magnetic, or radio frequency interference and capable of detecting several important pollutants.

University Center for Water Research
*H. James Harmon*

**Age-Dependent Changes in Mitochondrial DNA from Brain**

With increasing age, brain and heart function decrease. The marked decrease in respiratory metabolic activity in mitochondria, the seat of energy production in the cell, in neuronal but not in non-synaptic tissue in rate brain has been chronicled. Synaptic mitochondria also exhibit changes in the amount of cytochrome oxidase present and in the characteristics of cytochrome b: both of these proteins are coded by mitochondrial DNA and synthesized in the mitochondria. Age-dependent changes in heart mitochondria are not observed. Our hypothesis is that the change in synaptic mitochondrial cytochromes is caused by an alteration in the genes of the mitochondria. This research is aimed at determining why aging occurs and what molecular biological changes occur in neuronal time.

Oklahoma Health Research Program
*H. James Harmon*

**Study to Assess Factors Influencing Productivity in Nesting Bald Eagles in Oklahoma**

The objectives of this study are to determine the causes of low productivity in nesting bald eagles in Oklahoma; to acquire baseline information on the behavior, food habits and general reproductive biology of bald eagles in Oklahoma; and to establish methods to monitor bald eagle nesting activity in Oklahoma and make recommendations for the management of nesting sites.

U.S. Fish and Wildlife Service
*Jim Lish*

**Nutritional Influence on Growth and Reproduction and the Physiological Assessment of Nutritional Status in the Collard Peccary**

The objectives of this research are to investigate the influence of maternal collard peccary protein intake during gestation on the passive immunization of neonatal collard peccaries; to determine the degree of microbial fermentation of ingesta within the forestomach of the collared peccary as measured by pH, dry matter, moisture content, and volatile fatty acid concentration of gastrointestinal contents; and to explore the feasibility of using thyroid iodine concentration as an index to collared peccary energy intake, hence nutritional condition.

National Rifle Association
*Robert Lochmiller*

### NSF Presidential Young Investigator Award

NSF awards a maximum of 100 new Presidential Young Investigator awards annually. These grants are made for up to five years to support research by the nation's most outstanding and promising young science and engineering faculty. This particular award will fund research in animal ecology with special emphasis on nutrition and its relationship to mammalian population ecology. In addition to greatly increasing our understanding of mammalian population ecology, the results of this research may provide suitable animal models for exploring nutrition-disease related problems in biomedical science.

National Science Foundation
*Robert Lochmiller*

### Cottontail Rabbit Responses to Brush Management in a Cross Timbers Ecosystem

The overall purpose of the proposed study is to evaluate the impact of "brush control" on cottontail rabbit populations, when the management goal is to optimize cattle production on Cross Timbers rangeland. The impact of five "brush-control" range treatments will be evaluated: no treatment, tebuthiuron, tebuthiuron with annual burning, triclopyr and triclopyr with annual burning. The effects of each treatment on rabbit condition, nutritional status, reproduction, food habits and abundance will be assessed during summer and winter.

National Rifle Association
*Robert Lochmiller*

### Phylogeny of Fishes of the Genus *Ctenopoma* (Anabantidae)

The overall goal of this project is to clarify the genealogical relationships of the fishes in this important African fish group. We are studying both morphological and behavioral characteristics of representative forms, using both live and preserved museum specimens. Steven Norris, the graduate assistant on this project, was the recipient of a Jessup/McHenry Fellowship for Museum Study at the Academy of Natural Sciences in Philadelphia. The fellowship enabled him to study at the ANSP and several other eastern museums. Currently we are conducting morphological studies on specimens borrowed from six major museums and behavioral data from several dozen live specimens that we have been culturing in the OSU Fish Behavior Laboratory. A research proposal supporting this project was recently funded for three years by the National Science Foundation.

State of Oklahoma
*R.J. Miller*
*Steve Norris*

### Homing and Home Range Behavior in Sunfishes (*Centrarchidae*)

As an initial step in a long-range program to test life-history models of population changes in stream-inhabiting fishes, we are re-examining the nature and causation of homing and home-range behavior in sunfishes. A long series of marking and transplanting experiments have verified the existence of such behaviors in local sunfish inhabiting streams with wide fluctuations in flow. On-going and planned experiments have been designed to test the nature of factors determining the strength of the response in different sexes and age classes of fish and the permanency of the site tenacity that is exhibited by a portion of each population.

State of Oklahoma
*R.J. Miller*

### Reproductive Biology of Spiny Lizards Under Controlled Conditions

The purpose of this research is to determine the genetic basis for intraspecific variation in reproductive tactics of spiny lizards (*Sceloporus sp.*). Lizards from different populations will be bred in captivity under identical conditions to elucidate the genetic component of their reproductive strategies. Offspring of captive lizards will be reared under various experimental conditions to determine the effects of developmental conditions on reproductive tactics.

State of Oklahoma
*Larry Talent*

### The Effects of Selenium on the Growth and Reproduction of the Leopard Gecko, *Eublepharis macularis*

The goal of this research is to develop a lizard model for evaluating the effects of environmental contaminants on reptiles. Initially, the focus will be on determining the effects of selenium on lizard reproduction. The results will be used to evaluate whether reptiles are protected via risk assessment criteria developed for birds and mammals.

State of Oklahoma
*Larry Talent*
*Nelson Rich*

### Effect of Toxicants on Nitrogen Fixation

Nitrogen fixation (acetylene reduction activity) is an important step in the biogeochemical cycle of nitrogen, but little is known about the impact of toxicants on the process. This research seeks to learn if liquid cultures of *Anabaena flos aquae* are a rugged test system. If the method proves durable given small modifications of test protocol, the research will focus on precision and sensitivity.

State of Oklahoma
*Dale Toetz*

### Long Term Ecological Research in the Colorado Alpine: "Valley-Toetz"

This study will focus on the wetland between Green Lake 4 and Green Lake 5. It represents the first year of a five-year study to learn how alpine ecosystems resist perturbation and recover from disturbance. Researchers will study a microcatchment containing extensive wetlands. The well-defined 2-ha area contains wetland communities and habitats representative of those on the floor of the upper valley. The study will be conducted in two phases: (1) Basic mapping of attributes such as topography, vegetation, composition and production, animal populations, soils, sediments, and water chemistry will be made in 1986 and 1987. (2) Selected measurements will be continued in the intensively studied catchment in phase 2 (1988-1990).

INSTAAR University of Colorado
*Dale Toetz*

### Impact of Toxicants on Biogeochemical Cycling

Effects of toxicants on biogeochemical cycling have important ramifications on ecosystem function. Reliable systems to test potential toxicants for effects on the nitrogen cycle are under development, with particular focus on nitrogen fixation.

University Center for Water Research
*Dale Toetz*

## Zoology-Oklahoma Cooperative Fish and Wildlife Research Unit

### Management Study of the Ozark Big-Eared Bat in Oklahoma

In this study, caves occupied by Ozark big-eared bats will be located to monitor population size, including numbers of adult females and offspring. Additional objectives include: determination of time of departure for and location of foraging areas, using a night vision scope and microtelemetry; determination of when bats arrive at maternity colony caves; collection of bat feces to determine diet and monitor for pesticides; and trapping of insects to determine availability and abundance of prey.

U.S. Fish and Wildlife Service
*Tracy Carter*
*David Leslie*
*Brenda Clark*

### IPA Assignment

The recipient of this assignment will provide a final report on the conservation genetics of threatened fishes in Region 2 of the U.S. Fish and Wildlife Service—Oklahoma, Texas, New Mexico and Arizona.

he report will evaluate present procedures nd make recommendations for future fforts to identify and preserve the gene esources of threatened fishes in the area.

J.S. Fish and Wildlife Service
*nthony Echelle*

**oil/Plant Correlations in Pitcher lant Bogs of Southern Mississippi**

The ability to delineate wetland cosystems is a necessary tool for agencies, uch as the U.S. Fish and Wildlife Service USFWS), charged with the management nd protection of such habitats. Most clas- ification systems depend on information bout the flora, soils, and hydrology of a iven area. Currently, the USFWS is com- iling a wetland plant list, and the Soil Con- ervation Services has compiled a hydric oils list. If these two lists are correlated, the JSFWS will be better able to establish rules nd guidelines for delineating important wet- and types throughout the United States. This esearch will represent one component of a ationwide effort to examine correlations etween wetland plants, hydric soils, and ydrology; it will be conducted on the Mis- issippi Sandhill Crance National Wildlife Ref- uge in coastal Mississippi.

J.S. Fish and Wildlife Service
*Vanette Erickson*
*David Leslie*

**ood Habits and Nutritional Condition f White-tailed Deer and Cattle Under arying Stocking Rates on Managed orests**

The object of this project is to determine easonal food habits and nutritional status f white-tailed deer and cattle in relation to he latter's density in managed forests. Three tudy sites have been selected on Weyerhaeuser Company property that rep- esent cattle stocking rates from high to inter- mediate to zero. Seasonal (four times per year) food habits of white-tailed deer and cat- le in three areas will be determined; levels f nitrogen, diaminopimelic acid, and other physiological indices will be determined from easonal fecal collections from white-tailed deer and cattle to compare differences in dietary quality.

Oklahoma Department of Wildlife Conser- vation
Weyerhaeuser Company
*David Leslie*
*Robert Lochmiller*

**Response of Avifauna to Herbicide Treatment in the Cross Timbers Ecosystem of Oklahoma**

The objectives of this research are to document use of Cross Timbers habitat by nongame avian species, including breeding and fall/winter residents; and to examine the effect of intensive brush management with herbicides on bird use of the Cross Timbers habitat type.

Oklahoma Department of Wildlife Conservation
*David Leslie*
*Robert Lochmiller*

*Pictured are the staff and students who participated in the Arts and Sciences Futures in Science Program in July. The program was funded by the National Science Foundation and attracted 36 exceptional junior high students for three weeks of study in biology, chemistry and physics.*

**Shoreline Vegetation and Wildlife Use (Primarily Waterfowl) of Grand Lake, Oklahoma**

The objectives of this research are to describe vegetational communities between the 735-foot and 755-foot elevations of the Grand River Dam Reservoir, focusing on riparian vegetation; to describe impacts on riparian vegetation that resulted from rule curve changes in 1982; to assess vegetation between the 735-foot and 755-foot elevations with regard to its value as food, cover, and nesting habitat for wildlife of recreational and commercial value; to survey monthly waterfowl use of Grand Lake and project-related wetlands from January through December 1987; and to estimate production of waterfowl in 1987 on Grand Lake and project-related wetlands.

Benham-Holway Power Group
*David Leslie*

**Diet, Population Size and Locations of High Use Areas for Bald Eagles Wintering On Grand Lake (January-February 1982)**

The objectives of this study are to identify important prey species utilized by bald eagles wintering on the study area; estimate the population size of wintering bald eagles using this area; and identify high use areas for wintering bald eagles on Grand Lake and along Grand River directly below Pensacola Dam.

Benham-Holway Power Group
*James Lish*

**Reproduction Ecology of the Leopard Darter, *Percina pantherina***

The leopard darter, *Percina pantherina*, an endemic fish of the Little River system in southeastern Oklahoma and southwestern Arkansas, was first collected in 1884 but received little attention until the 1970s. The U.S. Fish and Wildlife Service, in cooperation with the Oklahoma Cooperative Fishery Unit and Oklahoma State University, conduct research on Glover Creek to update information on the status of leopard darter populations and to collect data on the biology and ecology of the species.

Oklahoma Department of Wildlife Conservation
*O.E. Maughan*
*Paul James*

**Distribution and Abundance of the Leopard Darter**

A survey of the distribution and abundance of the leopard darter at various sites.

U.S. Army Corps of Engineers
*O.E. Maughan*
*Alexander Zale*

**Comparative Habitat Use by White-Tailed Deer and Elk on Sympatric Range Enzootic for *Paralaphostrongulus tenuis***

Reintroductions of elk onto range enzootic for meningeal worm (*Paralaphostrongulus tenuis*) have failed largely due to the susceptibility of elk to meningeal worm infection. However, at the Cookson Hills Wildlife Management Area in eastern Oklahoma, elk populations are stable and support a limited hunt in the presence of a large, highly infected deer herd. The factors responsible for the success of the Cookson Hills elk herd are not known. Habitat use patterns of deer and elk were investigated dur-

ing the summers of 1985-86 using pellet-group counts on permanent transects, circular pellet-plots, and visual observations. Possible intermediate gastropod hosts and fecal pellets were collected and are being analyzed for meningeal worm larvae. Preliminary results indicate that elk confine most of their activities to large forest openings during the warmer months. This pattern may help them avoid meningeal worm infection because the gastropods, acting as intermediate hosts, seldom if ever occur in forest openings. Further analysis is underway.

State of Oklahoma
*James Shaw*
*Robert F. Raskevitz*

### Species Profiles of the Ladyfish and Tarpon, and the Reef-Building Tube Worm (South Florida)

The species profiles on the ladyfish and tarpon and on the reef-building tube worm will be prepared largely on the basis of a review and synthesis of existing literature. These profiles are prepared for use by field biologists for predicting the impacts of industrial and urban development on fish and wildlife resources.

U.S. Fish and Wildlife Service
*Jerry Wilhm*
*Alexander Zale*
*Susan Merrifield*

### Fisheries Assistantship

The Fisheries Assistantship is given to a highly qualified fisheries student at the Oklahoma Cooperative Fishery Research Unit for work on an approved state project.

Oklahoma Department of Wildlife Conservation
*Alexander Zale*

### Effects of the Pensacola Hydropower Project on the Fishery Resource of the Grand River

Grand Lake is the uppermost and largest of three lakes located on the Grand River in northeastern Oklahoma. The Grand River Dam Authority controls hydroelectric operations of the Pensacola Hydropower Project located between the communities of Langley and Disney; flood-control storage is the responsibility of the U.S. Army Corps of Engineers. Grand Lake and its tailwaters support popular recreational and important commercial fisheries. The objective of this project is to determine the effects of the Pensacola Hydropower Power project on the fishery resource of the Grand River.

Benham-Holway Power Group
*Alexander Zale*

### Kaw Hydroelectric Project Aquatic Resources Investigations

A four-year monitoring program of angling and striped bass spawning success at Kaw Dam on the Arkansas River in Kay County, Oklahoma, to assess the effects of hydropower on the system's fishery. The study compares fishery data collected for two years prior to turbine installation (1987-88) to data collected after commencement of hydropower generation (1989-90). Findings will enable mitigation of adverse impacts (if any) and promote enhancement of fishery resources.

Benham-Holway Power Group
*Alexander Zale*

### Factors Influencing Fish Populations in Oklahoma Waters

This research will quantify movements of striped bass in the Arkansas River downstream from Keystone Dam; assess the suitability of Keystone Reservoir for habitation by adult striped bass via limnological and biochemical/hematological analyses; describe the development of a white crappie fishery in a stage-fill impoundment in Oklahoma; and determine abundances, size distributions and age structures of smallmouth bass populations in eastern Oklahoma.

Oklahoma Department of Wildlife Conservation
*Alexander Zale*

### Graduate Assistantship

This agreement provides a graduate assistantship in the Oklahoma Cooperative Fish and Wildlife Research Unit.

Langston University
*Phillip Zwank*

## Zoology—Water Quality Research Laboratory

### Illinois River Water Clarity Investigations

The effect of both inorganic suspended materials and nutrients upon the clarity of water in the Illinois River will be evaluated. Major sources of contaminants affecting water clarity will be determined and methods for controlling contaminants from both point and nonpoint sources will be recommended.

Environmental Protection Agency
*Sterling Burks*
*Jerry Wilhm*
*M. Schatz*

### Oil Refinery Wastewater Investigation

A project to identify major sources of toxic contaminants within process wastewaters from the oil refining industry and to evaluate the effectiveness of selected lab-scale treatment systems for removal of the toxic contaminants.

Oil Refiners Waste Control Council
*Sterling Burks*

### Clean Lakes Program

The purpose of the Clean Lakes Phase I Diagnostic/Feasibility study is to determine Grand Lake's water quality problems, evaluate possible solutions, and recommend a feasible program to restore and preserve the quality of Grand Lake. A year of intensive monitoring of the lake and its principal tributaries will be conducted to determine significant pollutants and their sources. From this data, viable alternatives for controlling pollution and restoring the lake will be determined. In addition, morphological, demographic, socio-economic data, and other relevant information concerning the lake and surrounding area will be compiled.

Oklahoma Water Resources Board
*Sterling Burks*

# College of Business Administration

***Faculty are involved in work that follows classic lines of inquiry, as well as work which explores new and emerging fields.***

The discovery, critical examination, and transfer of knowledge about complex business and government organizations is the nexus of research conducted within the College of Business Administration at Oklahoma State University. The futherance of understanding of their functionings, their interactions, and their role in the global society is sought through study of the ethical, legal, economic, and social contect in which such organizations operate. Some of this research is basic research activity, that is, research that seeks to advance the state-of-the-art in the business disciplines. At other times, the research is best described as applied research, focusing on the application of existing knowledge to the solution of present-day problems. Research activities, at any given time, are a mixture of these two fundamental fields of inquiry.

Faculty are involved in work that follows classic lines of inquiry, as well as work which explores new and emerging fields. Both quantitative and qualitative methodologies are used by researchers in the departments of Accounting, Administrative Services, Economics, Finance, Management, and Marketing, and the Office of Business and Economic Research. Cross-disciplinary investigations bring together researchers from these departments, the academic community at large, the corporate world, and government in pursuit of common research interests. The unique contributions of each investigator serve to produce a more comprehensive final product.

Through the Office of Business and Economic Research, technical service and assistance are offered to the faculty in support of their research activities. Information on potential funding opportunities, assistance in the preparation of research proposals, administration of sponsored research agreements, manuscript typing and graphic preparation, mainframe computer consultation, and provision of a well-equipped computer laboratory all serve as aids to faculty research productivity. The mix of services provided by the Office is under constant evaluation and revision, both in response to faculty requests and in anticipation of future faculty needs. The College is committed to providing a professional research environment and will continue to seek ways to facilitate the research activities of the faculty through the most efficient utilization of the available resources.

The Office of Business and Economic Research is also engaged in significant research activities in response to the economic information needs of state government, industry, and the general public. Professional economists and support staff are engaged in a number of continuing and special research projects.

The increasingly rapid pace of technological change presents new challenges to business and government, spurring extensive study by CBA faculty of the *management of technology and innovation.* According to a recent report sponsored by the National Academy of Science, the inability of managers to incorporate new technology into their organizations is one of the major factors effecting economic development within the United States. Specific concerns expressed in the report addressed the need for cross-disciplinary study of the development of

technological opportunities, for proactive management in the face of shortened product life cycles, for faster product development time and increased organizational flexibility, for awareness of increasing international competition that demands that organizations maximize competitiveness through the adoption of new technologies, and the need for new tools of management. The cross-disciplinary aspect of this field presents research opportunities for scientists in management, marketing, economics, computer science, and engineering. Faculty in the College of Business Administration are engaged in a number of studies designed to enhance the effectiveness by which advanced technologies are developed, implemented, and institutionalized.

The process of strategic management, research, and development and integration of key functions of management of technology are being studied via an innovative capacities audit of a high-technology Oklahoma corporation. This study brings together faculty from business and engineering. Specific outputs include analyses of the management of technology under a kind of business (KOB) structure, examination of strategic alliances, technological forecasting and enviornmental scanning, strategic management of technology, application of management of technology principals to a local area (LAN) project, an examination of the overall organizational structure, recommendations for organization of development units, review of the match and balance of resources for strategic attainment, and an analysis of the institutionalization of innovation through LAN and artifical intelligence (AI) projects.

A project which examines economic characteristics of technological innovation tests cyclical patterns of long run trends in economic production offers a fundamental explanation of long waves of economic development and government regulatory activity empirically for a hypothesized relationship. It is based on the proposition that they are a fundamental influence on all types of behavioral decisions, including investment in new product innovations. A model capturing the induced interaction between innovation development, utility, aspirations, and economic production offers a fundamental explanation of long waves of economic development and is augmented to include the induced interaction of regulatory activity.

Another study examines the impact of the adoption of new technology within an organization during the initiation stage of an automated system. Correlates of attitudes toward working with computers are identified and strategies are introduced for helping individuals adjust to computer technology during the introduction of such a system in a university library.

The concept of quality improvement in the products and services provided by business and government is another area of increased activity for scientists in business, engineering, science, and statistics. A competitive world-wide marketplace provided initial impetus, in response to a percieved Japanese competitive advantage in providing better quality at a lower price. Also, the selection criteria of the American consumer has shifted to greater emphasis on quality, in recognition that this can often lead to lower long-run costs. Current research of the CBA faculty focuses on integration of quality improvement programs into organizational administration and builds upon previous work in diverse areas such as consumer and organizational behavior, research methods, strategic planning, and production management with a focus on providing total customer satisfaction.

The perspective of marketing researchers on quality improvement is being explored in a study that calls for development of an agenda for the integration of data traditionally gathered during the market research process into the development of overall strategy for the organization. A scale will be developed for the measurement of customer satisfaction in alternative product and service settings. Statistical and computer-aided methods will be established for measuring the dimensionality of customer satisfaction and positioning relative to competitors. Finally, methods for implementation of quality improvement programs within organizations will be investigated.

With a view toward improvement of the economic development potential of the state and region, CBA faculty and research staff from the Office of Business and Economic Research are now engaged in the development and continued maintenance of an economic database for use by government, business, and individual citizens. The ORI

*Dr. Robert C. Dauffenbach introduces the* 1988 Oklahoma Economic Outlook *to the press in January 1988. The publication presents forecasts of likely economic activity for that year.*

GINS database is being developed in cooperation with the Oklahoma Department of Commerce and the University of Oklahoma and has been structured with input from leaders in the business community, government, and academia. It provides a unique consolidation of economic information that is frequently difficult to identify and qualify, highly accessible through utilization of the latest computer and data transmission technology. Its availabilty will significantly enhance state economic development efforts by providing data vital to the informed development of growth and regulatory policies by our elected and appointed government officials. Additionally, it will provide the business community insight into the Oklahoma economy on the basis of knowledge not previously assembled.

A continuing project of the Office of Business and Economic Research is the Oklahoma State Econometric Model. 1988 marked the ninth consecutive year of publication of the *Oklahoma Economic Outlook*. This publication presents forecasts of likely economic activity in the coming year based on results from the Oklahoma State Econometric Model. The model simulates economic activity for the state based on anticipated national events in a long-term forecast prepared by a major national economic forecasting firm. It uses statistical methods to identify the relationships between the national and state economy but transforms the information in consideration of the unique characteristics of the Oklahoma economy. The model is continuously revised, updated, and augmented to incorporate the most recent information and statistical methodology. A quarterly econometric model is now under development in order to enhance the ability to process alternative scenarios of key variables and to ascertain their impact on the state and national economy. Models of substate regions, principally the Tulsa and Oklahoma City Metropolitan Statistical Areas, will also be developed in conjunction with this research.

Other areas of faculty research interest include decision, risk, and management science, information sciences, strategic management of business operations, production management, human resources management, marketing practices, international aspects of business operations, economic development and regional studies, the impact of government policies, energy and water resources, stock and bond market studies, and financial institutions.

For additional information about continuing research and capabilities at the Oklahoma State University College of Business Administration, write or call Robert C. Dauffenbach, Director, Office of Business and Economic Research, College of Business Administration, Oklahoma State University, Stillwater, Oklahoma 74078-0555, (405) 744-5125.

# Accounting

### Ranking Convertible Securities for Earnings Per Share

A graphical approach is used to illustrate the logic of a ranking algorithm for convertible securities in earnings per share calculations. The graphical approach is also used to interpret key variables in the algorithm.

State of Oklahoma
*Lanny G. Chasteen* and *Marvin S. Keener*

### Dividend Announcement Effects and Methodological Issues

This study examines whether the diverse results found in previous studies of the magnitude and duration of the change in the prices of common stock which resulted from unexpected dividend announcements could be attributed to methodological differences in the studies. The findings indicate the difference in effect which the past studies found is a function of the study's methods of estimating the unexpected dividend changes and that the influence of other methodological differences are trivial and are confounded with sampling errors.

Dean's Excellence Fund
*R. Dan Edwards*

### Teaching Cost Accounting in the Age of Technology

The impact of videotechnology on teaching a cost accounting course is examined. Classes using a traditional format versus a satellite TV format are composed and implications are drawn.

State of Oklahoma
*Lawrence H. Hammer*
*Amy H. Lau*
*Maryanne M. Mowen*
*Charlotte J. Wright*

### Multiproduct Cost-Volume-Profit Analysis with Salvage Cost and Alternative Optimization Objectives

Solution procedures are developed for the multiproduct newsboy problem to determine the optimal production quantities of each product under various optimization objectives.

School of Accounting Research Grant
*Amy H. Lau*

### The Value-Added Statement: An Innovation for U.S. Companies

This study discusses the value added statement, a financial report developed in Europe, and assesses its relevance as a disclosure for U.S. companies.

State of Oklahoma
*Gary K. Meek* and *Sidney J. Gray* (University of Glasgow, Glasgow, Scotland)

### Globalization of Stock Markets and Foreign Listing Requirements: Voluntary Disclosures by Continental European Multi-nationals Listed on the London Stock Exchange

This study investigates the extent to which European companies listed on the London Stock Exchange voluntarily disclose information in their annual reports in excess of Exchange reporting requirements.

State of Oklahoma
*Gary K. Meek* and *Sidney J. Gray* (University of Glasgow, Glasgow, Scotland)

### The Impact of Stock Market and Corporate Globalization on Disclosure Trends in International Financial Reporting

This study discusses emerging trends in the financial reporting practices of multinational corporations.

State of Oklahoma
*Gary K. Meek* and *Sidney J. Gray* (University of Glasgow, Glasgow, Scotland)

### The Impact of Proportion Bias on Managerial Decision Making

The existence of a decision making bias, the proportion bias, is hypothesized. The impact of the proportion bias on differential costing is examined using an experimental framework.

Dean's Excellence Fund
*Maryanne M. Mowen*

### The Impact of Mental Accounting on Resource Allocation Decisions

The goal of this research is to identify conditions in which mental accounting affects the framing of decisions. A laboratory experiment is used to examine the operation of mental accounts in a capital budgeting context.

Dean's Excellence Fund
*Maryanne M. Mowen*

### Information Content of Alternative Acounting Systems: An Ex Post Analysis

This study examines the empirical relationship between alternative accounting methods and the related information content of earnings announcements using these various accounting methods. Of particular interest is the effect of conservative or liberal choices individually and the consistent or inconsistent combinations of choices collectively.

School of Accounting Research Grant
*Charles R. Ransom*

### The Market for Corporate Control and Its Implications for Accounting Policy Choice

This research examines accounting policy choices made by firms which were subsequently takeover targets. The results indicate that choices made by takeover target firms and non-takeover target firms differ significantly.

State of Oklahoma
*Charlotte J. Wright* and *James E. Groff*

### Accounting for End-User Spot Sales Made by Oil and Gas Producing Companies

This study evaluates current accounting treatment of the more troublesome aspects of end-user spot sales. Alternative treatments under current GAAP are developed.

State of Oklahoma
*Charlotte J. Wright*

### Intra-Industry Information Transfer: An International Perspective

This study examines the intra-industry effects of quarterly earnings announcements made by foreign corporations on their U.S counterparts. The findings have implications for globalization of accounting policies.

State of Oklahoma
*Charlotte J. Wright*

### Intra-Industry Information Transfer and Firm Size

This research evaluates the role of firm size in the transfer of earnings information between firms within the same industry. The goal is to expand knowledge of capital markets.

School of Accounting Research Grant
*Charlotte J. Wright*

# Economics

### Patterns of Regional Income Inequality in the Latter Stages of Development

This area of investigation empirically examines the pattern of regional income inequality displayed in the United States. It is hypothesized that, contrary to conventiona expectations, regional income inequality increases after several decades of decline.

Dean's Excellence Fund
*Orley M. Amos, Jr.*

### An Economic Analysis of the Impact of Cogeneration Technology on the State of Oklahoma

This research undertakes an empirica assessment of the impact that the introduc tion of electrical cogeneration has on the Oklahoma economy. Input-output analysis is used to estimate impacts based on alter native scenarios of cogeneration activity and

lectricity demand growth until the year 000.

)klahoma Gas and Electric Company
*lobert C. Dauffenbach*
*'abitha A. Doescher*
*)rley M. Amos, Jr.*
*'eith D. Willett*
*'ohn R. Wingender*

**'he Behavioral Foundation Inderlying Innovations, Regulation, ind Long Run Economic )evelopment**

This study theoretically investigates a itility-based explanation of cyclical patterns if technological innovation activity and jovernment regulatory activity within the :ontext of the long run progression of eco- iomic development. It is hypothesized that )oth types of behavioral activity are moti- 'ated by the desire to fulfill unsatisfied aspi- ations.

State of Oklahoma
*)rley M. Amos, Jr.* and *Kevin M. Currier*

**The Relationship Between the Progression of Economic Thought and Long Run Economic Development**

This research investigates the hypothe- sis that economic thought is induced by underlying trends in economic development. Based on the proposition that economic development proceeds in a wave-like man- ner, it is argued that periods of revolution- ary and normal scientific activity in the economics profession is attributable to periods of prosperity and decline of eco- nomic activity.

State of Oklahoma
*Orley M. Amos, Jr.* and *Edward O. Price III*

**Regional Financial Markets and Unbalanced Regional Growth**

This line of research theoretically inves- tigates the critical, but overlooked, role that regional credit availability plays in differen- tial rates of regional growth. Given that differential regional credit availability can both hinder and promote regional growth, this research investigates the role financial policy variables can play in stimulating regional growth.

State of Oklahoma
*Orley M. Amos, Jr.*
*Janice W. Jadlow*
*John R. Wingender*
*Tim C. Ireland*

**Impact and Implications of the Foreign Exchange Auction for the Agricultural Sector**

A chapter was written in "Dynamics of Agricultural Policy and Reform in Zambia." (Forthcoming Iowa State University Press)

State of Oklahoma
*Michael J. Applegate*

**A Nonlinear Multisectoral Simulation Analysis of Devaluation and Import Substitution in Zambia**

A computable general equilibrium model is used to analyze the impact of devaluation on prices and real output in Zambia.

State of Oklahoma
*Michael J. Applegate*

**An Incentive Compatible Regulatory Adjustment Process for Optimal Emissions Discharge**

In this paper, we present a decentralized regulatory procedure for the attainment of environmental quality goals. It is shown that our procedure provides the proper incentives for accurate reporting of emissions data by firms.

State of Oklahoma
*Kevin M. Currier* and *Keith D. Willett*

**A Behavioral Model of Innovation and Long Waves of Economic Development**

This paper presents a model of innovation behavior that offers a more fundamental explanation of endogenous long waves of economic development than currently available. This model implies that the degree of unfulfilled aspirations is the fundamental driving force of cyclical fluctuations with innovation activity part of the transmission mechanism.

State of Oklahoma
*Kevin M. Currier* and *Orley M. Amos, Jr.*

**An Application of Cremer's Planning Procedure to the Optimal Commodity Taxation Problem**

Using a computational technique developed by Cremer (Econometrica 45, 1977), we present a decentralized procedure which determines optimal commodity taxes iteratively, under minimal information requirements. This analysis extends the class of non-convex optimization problems to which Cremer's procedure is applicable.

State of Oklahoma
*Kevin M. Currier*

**Negotiated Transfer Prices and Divisional Performance Evaluation**

In this paper, we assess the ability of a transfer pricing system within a decentralized firm to provide information regarding divisional performance when transfer prices are determined via negotiation between divisional managers.

State of Oklahoma
*Kevin M. Currier*

**A Firm-Level Comparison of Alternative Theories of Business Fixed Investment: Further Results**

This study extends our earlier work to a consideration of which theories of investment are appropriate for different types of firms. Both chi-square tests and discriminant analysis are used to relate the different theories to the different types of firms.

State of Oklahoma
*Michael R. Edgmand*
*John D. Rea*
*Bienvenido S. Cortes* (Pittsburg State University)

**A Study of Union Success In Multiple Union Elections**

This study attempts to explain the phenomenal success rate of labor unions in multiple union certification elections.

State of Oklahoma
*James R. Fain* and *James B. Dworkin* (Purdue University)

**Agenda Control and a Balance of Power**

This theoretical work develops a new model of agenda control. This model is significant in that it captures for the first time the balance of power between the agenda setter and the committee.

Dean's Excellence Fund
*James R. Fain*

**Tax Exporting and State Revenue Structures**

This study examines the effects of tax exporting on state tax structures. The findings indicate that the shifting of taxes through federal deductability provisions and the interstate movement of consumer, goods, and factors of production do affect the use of various state tax sources.

Dean's Excellence Fund
*Mary N. Gade*

**Comparative Advantage in Competition for Foreign Direct Investment by State**

Based on the brand-specific effect model of marketing, this paper measures relative position of each state in the U.S. in the competition for foreign direct investment.

Dean's Excellence Fund
*Yoo Soo Hong*

**Anticompetitive Exclusion and Antitrust**

This theoretical research concerns the development of antitrust rules pertaining to exclusionary behavior by firms. The emphasis is on the identification of tests designed to distinguish between behavior which harms consumer welfare and that which benefits consumers.

State of Oklahoma
*Joseph M. Jadlow*

**Centennial History: Equal Opportunity at OSU: 1890-Present**

This study examines the history of women, minorities, veterans, and the handicapped from the beginning of Oklahoma A&M College to the present time. Emphasis is on the role federal and state legislation has played in providing equal opportunity to all persons at a land-grant institution.

State of Oklahoma
*Pauline W. Kopecky*

**U.S.-Korea Bilateral Trade Relations: Prospects and Future Directions**

The research investigates bilateral trade relations between the U.S. and the Republic of Korea focusing on the impacts of changes in tariff/quota, tax/subsidies, and exchange rate policy to discuss the directions of trade and commercial policy between the two countries.

The Korean Traders Scholarship Foundation
*Gerald M. Lage*
*Kap-Soo Oh*
*Yoo Soo Hong*
*Andreas Savvides*

**International Trade Development in Oklahoma: A Synopsis of the Problem and a Review of the Literature**

This research reviews the economic development task force studies and recommendations for Oklahoma initiatives involving international trade, reverse investment and international tourism. These recommendations are analyzed relative to international business research studies and expert opinions of consultants in the field.

State of Oklahoma
*Gerald M. Lage*

**Cyclical and Equilibrium Unemployment for Metropolitan Areas: An Empirical Analysis**

The unemployment rate at "full employment," the equilibrium unemployment rate (EUR), in the United States economy is approximately six percent, which is almost a full percentage point higher than it was in 1960. The purpose of this project is to use the variation in metropolitan area unemployment rates to investigate the determinants of the level of the EUR.

Dean's Excellence Fund
*Ronald L. Moomaw*

**Unemployment in Local Labor Markets: A Literature Review**

The fact that unemployment rates differ substantially among local labor markets has stimulated much economic research about the determinants of these differences. This project is an analytic review of that literature.

U.S. Department of Commerce
*Ronald L. Moomaw*

**Measuring Unemployment at the Substate Level**

Empirical analysis of local labor markets requires data, but many people contend that available data are inadequate. This project assesses the usefulness of existing county unemployment rate data.

U.S. Department of Commerce
*Ronald L. Moomaw*

**Total Factor Productivity Growth in Manufacturing: Evidence from the States**

This project develops a measure of total factor productivity (TFP) growth and summarizes a source-of-growth analysis for the manufacturing sectors of 48 states. We also use cross-sectional data to estimate the determinants of the variation in TFP growth and find that state investments in education and in transportation infrastructure may increase TFP growth.

State of Oklahoma
*Ronald L. Moomaw* and *Martin William* (Northern Illinois University)

**Economic Development Data Needs in Oklahoma**

This study is a survey of over 80 studies related to the theme of Oklahoma economic development designed to determine essential information needs for development planning purposes. The findings are presented in the first year's report on the ORIGINS Project.

Oklahoma Department of Commerce
*Kent W. Olson*

**Income and Revenue Stability of Alternative Severance Taxes**

This study is a comparison of two tax bases for the severance tax in terms of their effect on revenue and income stability.

State of Oklahoma
*Kent W. Olson* and *James W. Kleckley* (East Carolina University)

**Financial Consequences of Alternative Sentences for Burglars: A Cost-Benefit Perspective**

This study is a cost-benefit analysis of alternative sentences for burglars, based on interview data and incorporating extensive sensitivity analysis.

State of Oklahoma
*Kent W. Olson* and *Tara J. Gray* (Denison University)

**Redwood National Park Expansion: Impact on Old-Growth Redwood Stumpage Prices**

This study is a time series analysis of the effect of the 1978 expansion of the Redwood National Park on old-growth redwood stumpage prices.

State of Oklahoma
*Kent W. Olson*
*Ronald L. Moomaw*
*Richard P. Thompson* (Texas A&M)

**Real Exchange Rate Variability and the Choice of Exchange Rate Required by Developing Countries**

The project estimates a model for the simultaneous determination of real exchange rate variability and the type of exchange rate arrangement chosen by a group of developing countries for the period 1976-84.

Dean's Excellence Fund
*Andreas Savvides*

**LDC-Creditworthiness and Capital Inflows**

The paper investigates the influence of capital inflows on creditworthiness for a group of developing countries which were major borrowers in the international capital markets in the 1970's.

State of Oklahoma
*Andreas Savvides*

**Market Structure Imports and Import Deterrence in the U.K.**

The paper examines whether domestic firms attempt to deter import competition through their pricing and what kind of structural characteristics are necessary to implement successfully such a strategy.

Dean's Excellence Fund
*Joseph Shaanan*

**On the Estimation of Limit Pricing Values Without Entry Data**

The study presents a technique that enables economists to estimate the entry forestalling price level. The methodology employed does not require data on past entry, but requires the use of price elasticity of demand values.

State of Oklahoma
*Joseph Shaanan*

**Interest Rates in a Monetary Growth Model With a Government Budget Restraint**

A model in which the capital accumulation relation relates impact and steady staff growth is studied. The effect on interest rates of a change in government expenditures when expectations and money finance are endogenous is the principal focus.

State of Oklahoma
*Frank G. Steindl*

**1987 Oklahoma State Government Expenditures in Brief**

Compilation of data and preparation of

a report on state government expenditures by functional areas.

The Kerr Foundation, Inc. and The Grayce B. Kerr Fund, Inc.
*Larkin Warner*

**The Oklahoma Insurance Premium Tax From an Economic Viewpoint**

This is an analyisis of the economic impact of Oklahoma's insurance premium tax and an examination of the special features aimed at promoting Oklahoma-based insurance firms and investment in the state.

State of Oklahoma
*Larkin Warner*

**Economic Rationale of the Decline Curve in Modeling Crude Oil Extraction**

The purpose of this research is to show an economic model that leads to the decline curve hypothesis. This hypothesis is used in modeling crude oil supply behavior. Key assumptions include unit extraction cost being inversely proportional to reserves and a constant-percentage growth in the price of crude oil.

University Center for Energy Research
*Keith D. Willett* and *Tabitha A. Doescher*

**Tax Policy Models for Production and Exploration Decisions in the Crude Oil and Natural Gas Industries**

This research is concerned with developing a tax policy model for production and exploration decisions for the crude oil and natural gas industries. The model is stated as problem in optimal control theory and solved using the maximum principle. Crude oil and natural gas are treated as joint products. An analysis of the model's equilibrium conditions is presented. Specific functional forms for the cost functions and the exploration and development function are introduced and explicit mathematical expressions are derived for production and exploration decisions. Terminal conditions which are derived from the transversality conditions are also analyzed.

University Center for Energy Research
*Keith D. Willett*

**An Economic Model of Production and Investment Decisions for the Natural Gas Industry**

This research develops a model which provides a benchmark case for optimally managing natural gas resources. Characteristics of the model include spatial specifications as well as investments in transportation capital stocks. Stockpiling of unrefined natural gas is also modeled. A description of the model is presented along with an analysis of its equilibrium properties.

University Center for Energy Research
*Keith D. Willett*

**The Risk of a Deliberate Oil-Supply Disruption and an Oil Import Tariff**

Some researchers have argued that the risk of a deliberate oil-supply disruption increases with oil imports and can be viewed as an externality in a dynamic setting with the intention of deriving the optimal tariff which should be imposed on crude oil imports. The analysis proceeds by first deriving optimal imports under conditions of Pareto optimality. These results are then compared with behavior under competetive equilibrium conditions. The economic models are dynamic in nature.

State of Oklahoma
*Keith D. Willett*

## Finance

**Measuring and Monitoring Interest Rate Risk Exposure of Thrift Institutions**

This paper proposes a new way to measure and monitor interest rate risk exposure of financial institutions. The methodology is based on stochastic dominance and, when applied, results in a quanitative value of interest rate risk exposure for individual thrift institutions.

Dean's Excellence Fund
*Mary S. Broske*

**Stochastic Dominance Estimation of Default Probability in a Diversified Portfolio**

This paper applies stochastic dominance to measuring default risk inherent in a diversified portfolio, where the portfolio contains stocks and bonds. Default risk is estimated when the returns on bonds are assumed to be statistically independent of the returns on stocks, and also estimated in the more general case, when the associate returns are assumed to be statistically dependent.

State of Oklahoma
*Mary S. Broske* and *Haim Levy* (University of Florida and the Hebrew University, Jerusalem)

**Do Investment Grade Bonds Differ From One Another in Default Risk?**

Bond ratings commonly are assumed to indicate difference in default risk. This empirical study determines that bonds of investment grade quality ratings do not statistically significantly differ from one another once we control for all dimensions of bond risk except default risk.

State of Oklahoma
*Mary S. Broske*

**The Price Volatility of Deep Discount Bonds**

This project is concerned with analyzing the effect of the level of interest rates on price risk in the bond market. It is shown that under certain conditions, some deep discount bonds can possess less risk than normally expected.

Dean's Excellence Fund
*Mary S. Broske*

**The Interest Rate Risk of Deep Discount Bonds: Empirical Evidence**

This is an empirical paper which examines the prevalence during periods of high interest rates of deep discount bonds possessing less risk than conventional theory would predict.

State of Oklahoma
*Mary S. Broske*

**Are All Investment Grade Bonds Equally Endowed With Default Risk?**

Bond rating assignments are generally assumed to represent differences in default risk. This research statistically analyzes bond yields and holding period returns to determine whether investment grade bonds actually differ in default risk once all other types of risk are neutralized.

State of Oklahoma
*Mary S. Broske*

**Recent Trends in Foreign Direct Investment in Oklahoma**

This study investigates the extent of foreign direct investment in Oklahoma.

State of Oklahoma
*Janice W. Jadlow* and *Donald L. Bumpass*

**Valuation Effects of Commercial Bank Securities Offerings: A Test of the Information Hypothesis**

This paper examines the effects of shareholder wealth of the issuance of both debt and equity securities by commercial banks.

State of Oklahoma
*John A. Polonchek*
*Myron Slovin* (Louisana State University)
*Marie Sushka* (Arizona State University)

**Market Valuation Effects of Commercial Banking Relationships**

This paper examines the role of commercial banks as processors and evaluators of private information.

Dean's Excellence Fund
*John A. Polonchek*

**Signaling, Regulation, and Commercial Bank Sale and Leasebacks, Divestitures, and Repurchases of Stock**

This paper ties together work on the topic of securities issuance and the effect of regu-

lation by focusing on the impact of bank regulation on major managerial actions by commercial banks which can serve as substitutes for security offerings.

State of Oklahoma
*John A. Polonchek*
*Myron Slovin* (Louisiana State University)
*Marie Sushka* (Arizona State University)

**A Comparison of Duration & Gap Analysis As Methods of Balance Sheet Immunization for Depository Financial Institutions**

The research compares the effectiveness of duration and gap hedging of the interest rate risk encountered by financial institutions through a series of conceptual numerical examples. The results suggest that gap hedging is just as effective as duration hedging and may be better from the viewpoint of the practicing manager.

State of Oklahoma
*W. Gary Simpson* and *Mary S. Broske*

**An Examination of Skewness in Preferred Stock**

The historical return distributions of preferred stock need to be tested for skewness to determine if past comparisons to common stock returns have been appropriate. If not, a better test needs to be formulated.

State of Oklahoma
*John R. Wingender*

**The Distributional Properties of Savings and Loan Financial Ratios**

Many models in finance are based on the assumption of the underlying variables having normal distributions: e.g., bankruptcy prediction models. If the variables are not normally distributed, the model's returns are questionable.

State of Oklahoma
*John R. Wingender*

## Management

**Effects of Feedback in Work Groups**

This study examines interactive effects of sign, magnitude, and distribution of feedback on individual intentions and group decisions of persistence in newly introduced work tasks.

State of Oklahoma
*Steve H. Barr* and *Edward J. Conlon* (University of Iowa)

**Multi-Theoretical Perspectives on Group Feedback**

Responses to feedback in work group settings are evaluated from different theories. Hypotheses about effects of feedback administered in work groups are developed and compared. Important distinctions between individual and group feedback are proposed.

State of Oklahoma
*Steve H. Barr* and *Edward J. Conlon* (University of Iowa)

**An Examination of the Stability of Selection Decision Factors**

A repeated measures design is used to examine the stability or importance of particular decision cues in the selection of middle and upper level managerial applicants.

State of Oklahoma
*Steve H. Barr*
*R. Dennis Middlemist* (Colorado State University)
*Michael A. Hitt* (Texas A&M University)

**The Impact of Modes of Information Presentation on Decision-Making Effectiveness**

This is accomplished as follows: Decisions are categorized on the basis of degree of structure and management level; a "typical" problem for each decision category is selected; a decision support tool is developed with different modes of information presentation; and the decision support tool is tested on the "typical" problems using a set of student subjects. The objective is to determine whether or not special modes of presentation add to the effectiveness of the decision-making process.

State of Oklahoma
*Aumshumali I. Chahande* and *Meg G. Kletke*

**Venture Capital Research: Past, Present, and Future**

Based upon a review of existing research on venture capital, a descriptive model of the venture capital process was proposed. Suggestions for future research were also made.

State of Oklahoma
*Vance F. Fried* and *Robert D. Hisricih* (University of Tulsa)

**Porter's Missing Chapter: The Risk of Antitrust Violations**

Michael Porter has provided valuable advice about firm strategies, but has neglected the sometimes significant risks of violating antitrust laws. This paper describes those risks.

State of Oklahoma
*Vance F. Fried* and *Benjamin M. Oviatt*

**An Empirical Investigation of Countercyclical Hiring**

A follow-up study of countercyclical hiring (CCH) strategies was conducted using survey and financial data. Several correlates of CCH were identified but no financial performance effects were found.

State of Oklahoma
*Charles R. Greer* and *Tim C. Ireland*

**Evaluating the Impact of Operating Environments on MRP System Nervousness**

A simulation factory is used as the experimental vehicle to investigate the impact on MRP system nervousness of various environmental factors, such as cost structure and the lot-sizing algorithm.

Dean's Excellence Fund
*David C. Ho*

**MIS, DSS, EIS, MSS, ES, ETC.: An Interdisciplinary Framework for Artifical Intelligence Research and Development**

The objective is to develop a framework to blend the pieces represented by MIS, DSS, EIS, MSS, AS, and the like, and to examine the contribution to management literature from several different disciplines.

State of Oklahoma
*Meg G. Kletke* and *David L. Schroeder*

**An Interfirm Marketing Information System: The Development of a Model for Channel Management**

A model of a marketing information system linking within marketing channels is being developed. Emphasis is on decision making, information flows, and long-term relationships between interacting firms.

State of Oklahoma
*Ruth H. Krieger* and *Meg G. Kletke*

**Studying Unpaced Lines as Queues in Tandem**

This is an ongoing project to develop more efficient methods for designing unpaced production lines.

National Science Foundation (EPSCoR)
*Hon-Shiang Lau*

**Ability-to-Pay and Equity: Considerations in Salary Adjustment Decisions**

This study examines factors influencing school officials and employee representatives in their calculation of appropriate annual salary adjustments. It is hypothesized that the district's ability to pay will dominate school official's judgment, while whatever factor maximizes salary adjustment will dominate employee representatives' judgment.

Dean's Excellence Fund
*Chalmer E. Labig* and *Garry Bruton*

**The Short- and Long-Term Effectiveness of Recruiting Methods**

This longitudinal project involves the

evaluation of various recruiting methods for registered nurses employed by Oklahoma acute care hospitals. These methods may vary in terms of number of nurses attracted as well as nurse performance and retention.

American Society for Personnel Administration Foundation
State of Oklahoma
*Chalmer E. Labig*

**Developing a System of Technology Forecasting and Strategic Management of Technology Forecasting**

The process of strategic management, research and development, and integration of key functions of management of technology will be studied via an innovative capabilities audit.

Memorex-Telex, Inc.
*Wayne A. Meinhart*
*David E. Mandeville* (Industrial Engineering)
*Ramesh Sharda*
*Margaret A. White*

**Adjusting to a New Organization**

This paper examines a newcomer's transition into an organization. Strategies are developed for both newcomers and organizations to ease the adjustment process.

State of Oklahoma, R. D. Irwin Foundation
*Debra L. Nelson*

**Men and Women of the Personnel Profession: Differences and Similarities in Their Experience of Stress**

This study examines the role of gender in the experience of work demands, coping strategies, and distress symptoms.

Dean's Excellence Fund
*Debra L. Nelson* and *James C. Quick* (University of Texas-Arlington)

**The Relationship Between Organizational Context, Job Characteristics, and Individual Attitudes in the Initiation Stage of Technological Innovation**

Initial results from the first stage of an automation innovation in a university library are presented. Correlates of attitudes toward working with computers are identified, and strategies introduced for helping individuals adjust to computer technology.

State of Oklahoma
*Debra L. Nelson* and *Margaret A. White*

**Working Women, Stress, and Organizational Politics**

A survey of male and female administrators is reported in which females report more stress resulting from organizational politics. Reasons for this finding are proposed and a model for future investigators is presented.

Dean's Excellence Fund
*Debra L. Nelson*
*Michael A. Hitt* (Texas A&M University)
*James C. Quick* (University of Texas-Arlington)

**Newcomer Adjustment, Social Support and Socialization**

Newcomers seek out social support as a primary coping mechanism. Differences in use of social supports between successful newcomers and unsuccessful newcomers are presented.

R. D. Irwin Foundation
*Debra L. Nelson* and *James C. Quick* (University of Texas-Arlington)

**Causes and Consequences of Academic Intransigence in Response to Demands for More Relevant Business Education**

This article describes the industry structure, university culture, and professorial reward system that keeps business professors from responding to calls for more applied research and teaching in business schools.

State of Oklahoma
*Benjamin M. Oviatt* and *Warren D. Miller* (University of Oklahoma)

**Risk, Return, and Generic Business Strategy**

This reports an empirical examination of the association of risk and return with each of Porter's generic business strategies.

State of Oklahoma
*Benjamin M. Oviatt*
*Alan A. Bauerschmidt* (University of South Carolina)

**Strategic Planning in Hospitals: A Review and Proposal for Research**

This paper relies on research on business planning to describe a program of research to determine if formal planning benefits hospitals.

State of Oklahoma
*Benjamin M. Oviatt*
*Garry D. Bruton*
*L. Kallas-Bruton*

**Dominant Firms: Review of the Literature and Proposal for Research**

This paper combines theory and research on dominant firms from the disciplines of strategic management and industrial organization economics to propose a line of research on dominant firms.

State of Oklahoma
*Benjamin M. Oviatt* and *Margaret A. White*

**An Investigation of the Effectiveness of Decision Support Systems**

A strategic decision-making simulation is used to assess antecedents and consequences of using decision support systems as an aid to decision-making.

Dean's Excellence Fund
*Ramesh Sharda* and *Steve H. Barr*

**Market-Based Institutions for Water Quality Management: An Experimental Economics Approach**

This project addresses the problem of achieving water quality goals in a cost-effective manner. It is directed at testing the effectiveness of marketable permits for pollution.

University Center for Water Research
*Ramesh Sharda*
*Keith D. Willett*
*John R. Wingender*

**Comparative Performance of Linear Programming Systems on Microcomputers**

This project entails performance comparisons of advanced linear programming systems on microcomputers. Bench marking of software and testing its ability to solve medium to large LP problems is its major contribution.

State of Oklahoma
*Ramesh Sharda*

**Analysis of Method II in the Oklahoma Individual Income Tax**

The 1986 Federal Tax Reform Act will reduce the effectiveness of Method II in the Oklahoma Individual Income Tax. It is the objective of this study to identify the impact of the federal policy on Oklahoma tax returns.

State of Oklahoma
*J. Scott Turner*

**Analysis of Proposals to Increase the Amount of the Personal Exemption in the Oklahoma Tax Code**

The objective of this study is to estimate the impact on Oklahoma tax returns of increasing the personal exemption from $1,000 to $2,000.

State of Oklahoma
*J. Scott Turner*

**The Relationship Between Top Management Team Demography and Organizational Performance**

This study examines the relationship of the demographic characteristics of internal board members and organizational performance. The demographic variables include mean and degree of homogeneity of tenure in the organization, age, and tenure in the

current position as well as homogeneity in educational level and functional background.

Dean's Excellence Fund
*Margaret A. White* and *Michael A. Abelson* (Texas A&M University)

**The Transfer of Learning During Technological Innovation: From Organizational Knowledge to Individual Usage**

This research examines the relationship between the stages of technological innovation and the differing learning perspectives of individuals and organizations.

State of Oklahoma
*Margaret A. White* and *Debra L. Nelson*

## Marketing

**SERVMARK: An Electronic Bibliography**

The creation of and updating of an electronic bibliography of services marketing that is sold to academic and business researchers. The bibliography includes almost 4,000 citations and spans more than 25 years. Semi-annual updates are offered.

First Interstate Center for Services Marketing at Arizona State University
*Raymond P. Fisk* and *Larry A. Crosby* (Arizona State University)

**Dramatizing the Service Encounter: A Managerial Approach**

A study of the applicability of dramaturgy concepts to the marketing management of service firms. Service industry examples are explicated to clarify the applications, and strategic guidelines are developed.

State of Oklahoma
*Raymond P. Fisk*
*Mary J. Bitner* (Arizona State University)
*Stephen J. Grove* (Clemson University)

**The Impact of Shared Values in Organizational Control**

This study examines how organizations control behavior of employees through the establishment and communication of values. Behavior that is often not observed or is difficult to measure by the company, such as ethical conduct, is the focus of the research.

State of Oklahoma
*Jerry R. Goolsby*

**Customer Satisfaction in Services**

How consumers of services evaluate performance and what factors are important in this evaluation constitutes the major focus of the research. Based in part upon SERVQUAL research, the study explores the roles of tangibles, reliability, responsiveness, assurance, empathy, and access in satisfaction formation. The health care, restaurant, and insurance industries are used as samples to investigate the relationships.

State of Oklahoma
*Jerry R. Goolsby*

**The Influence of Gender Differences in Professional Marketing Roles: A Critical Assessment**

This study examines reports of gender-related differences in the marketing and managerial literature and assesses the overall impact of gender in the marketing professions on such dimensions as satisfaction, ethics, commitment and perceived position.

State of Oklahoma
*Jerry R. Goolsby*

**An Interfirm Marketing Information System: The Development of a Model for Channel Management**

A model of a marketing information system linking firms within marketing channels is being developed. Emphasis is on decision making, information flows, and long-term relationships between interacting firms.

State of Oklahoma
*Meg G. Kletke* and *Ruth H. Krieger*

**The Impact of Just-in-Time Relationship on Marketing Channel Behaviors**

The link between suppliers and industrial buyers known as just-in-time purchasing causes a much closer link between firms than is traditional in U.S. business relationships. This study examines dependence, power, conflict and satisfaction in the just-in-time setting.

Dean's Excellence Fund
*Ruth H. Krieger*

**Competitive Structure of the Financial Services Industry in Oklahoma**

This paper examines consumer attitudes toward banks and patronage behavior among alternative financial services organizations. The data is a telephone survey of 350 households in metropolitan and rural areas of Oklahoma.

State of Oklahoma
*Stephen J. Miller*
*Raymond W. LaForge*
*Clifford E. Young*

**A Cross-Channel Analysis of the Conflict Relationship for Appliance Retailers**

This study examines the nature of channel conflict that arises between retailers and manufacturers and the conflict resolution response to the conflict. It is a mail survey of appliance retailers in the Midwest.

State of Oklahoma
*Stephen J. Miller* and *Jeffrey Dilts* (University of Akron)

**Decision Making and Releasing Water from Dams**

The series of studies investigate: (a) factors that may influence the risk taking tendencies of managers who must decide when to increase the amount of water released from dams, and (b) factors that influence the evaluation of the managers of dams, who must make decisions under risk and uncertainty, by the general public.

University Center for Water Research
Dean's Excellence Fund
*John C. Mowen*

**Source Effects in Advertising**

Currently, advertisers use a variety of sources to present information in advertisements, including celebrities, average people, effigies of dead people, cartoon characters, and various fictional animals. The study investigates the differential impact of the various types of sources on consumers.

State of Oklahoma and the Carson Centennial Professorship
*John C. Mowen* and *Joshua L. Wiener*

**The Effects of Sales Taxes on Decisions to Purchase Via Mail Order**

In a series of three studies the research investigates whether the absence of sales taxes for out-of-state mail order companies may shift demand away from products sold in-state. The research provides strong evidence that in-state buying is negatively affected by current laws—particularly so for higher priced products.

State of Oklahoma and the Carson Centennial Professorship
*John C. Mowen*
*Alan S. Gordon*
*Clifford E. Young*

**Behavioral Decision Theory and the Marketing Manager**

The paper reviews the behavioral decision literature and discusses the various factors that could act to bias the decisions of marketing managers. In addition, data were collected to test predictions concerning factors that could bias the decisions of managers.

State of Oklahoma
*John C. Mowen* and *Gary Gaeth* (University of Iowa)

**The Preference Detection Model and Assessing Consumer Effectiveness.**

The paper develops a new model of consumer choice based upon principles derived from the theory of signal detection. Data were collected from simulated consumers who had to decide whether to purchase a warranty on a television set. The results supported hypotheses developed from the model.

State of Oklahoma and the Carson Centennial Professorship
*John C. Mowen*

**ın Evaluation of the Magnuson-Moss ıct**

The study found that the Act achieved s objective of transforming a product's war- ɜnty into an accurate signal of a product's ɜliability.

ɜtate of Oklahoma
*oshua L. Wiener*

**ın Analysis of Grass Roots ıdvertising**

The project identified the characteristics f successful grass roots advertising cam- ıaigns and evaluated proposed regulatory ıptions

ɜtate of Oklahoma
*oshua L. Wiener*

**he Effects of the Presence of Sales axes on Store Choice**

Conjoint analysis and experiments are ısed to understand the impact of sales tax ın a consumer's willingness to shop via mail rder catalog stores. Implications for public ıolicy are given based on significant tax ffect results.

ɜtate of Oklahoma
*lifford E. Young*
*ohn C. Mowen*
*lan S. Gordon*

**lole Ambiguity and Role Conflict: heir Effect on Job Satisfaction and ɜmployee Turnover in Retail ınstitutions**

This research establishes the idea that ɹternative definitions of role conflict aid in ınderstanding job satisfaction, intention to ɜave, and employee turnover at various ɲanagerial levels in retail institutions.

ɜtate of Oklahoma
*lifford E. Young* and *Linda Good*

## )ffice of Business and ɜconomic Research

**)RIGINS: Oklahoma Resources ıtegrated General Information letwork System**

This research examines the role informa- ɔn and an information system play in the romotion of regional economic develop- ıent. An examination of theoretical regional rowth literature and an evaluation of exist- ıg statewide information systems indicate ıe most effective structure of an information ystem for Oklahoma.

)klahoma Department of Commerce
*obert C. Dauffenbach*
*)rley M. Amos*
*abitha A. Doescher*
*ent W. Olson*
*arkin Warner*
*lifford E. Young*

*Jane Bryant Quinn, Economics and Finance Editor for Newsweek magazine, was one of several business leaders to address the Tulsa Business Forum Series sponsored by the College of Business Administration.*

**Oklahoma State Econometric Model**

The Oklahoma State Econometric Model is a large-scale economic model of the state's economy which is used to forecast future economic conditions and assess the impact of various policy alternatives. Periodic forecasts are generated during the course of the year and released to the public.

Oklahoma Tax Commission
*Robert C. Dauffenbach*
*Manoj Shanker*
*John P. Shellnut*
*Tabitha A. Doescher*

**Oklahoma State Quarterly Econometric Model**

The Oklahoma State Quarterly Econometric Model is a large-scale econometric model of the state's economy which is used to produce quarterly forecasts of future economic conditions in Oklahoma, Tulsa, and Oklahoma City.

Oklahoma Gas & Electric and Public Service of Oklahoma
*Robert C. Dauffenbach*
*James W. Kleckley*
*Manoj Shanker*
*Tabitha A. Doescher*

**Energy and the Future of the Oklahoma Economy**

This project investigates the role of energy in the future economic development of Oklahoma. The first part of the project develops a computer simulation model of drilling and production for oil and natural gas in Oklahoma. The second section of the project investigates how Oklahoma can use its energy resources as a basis for diversifying its economy.

University Center for Energy Research
*Tabitha A. Doescher*
*Keith D. Willett*
*John R. Wingender*

**Social Security Benefits and the Baby Boom Generation**

This study predicts the level of social security benefits the baby boom generation can expect to receive. These are compared to OASI's actuarial projections of future benefits.

State of Oklahoma
*Tabitha A. Doescher* and *John A. Turner* (U.S. Department of Labor)

**Projections of Demand and Supply of Engineers to Meet Defense and Non-Defense Requirements: 1987-1995**

This study develops occupational demand and supply projections and analyzes for scientific and engineering occupations to 1995. Alternative scenarios of high/low defense spending and optimistic/pessimistic macroeconomic conditions are appraised.

National Science Foundation
*Robert C. Dauffenbach* and *Tabitha A. Doescher*

**1988 Economic Report to the Governor**

Four research projects are being conducted in support of both the 1988 report issue as well as other information needs of the Oklahoma Department of Commerce. The studies will develop scenarios for the long-term economic growth of Oklahoma, forecasts of state and national economic performance for 1988 and through 1993, a functional analysis of the state economy, and an analysis of the relative productivity of Oklahoma workers.

Oklahoma Department of Commerce
*Robert C. Dauffenbach*
*Tabitha A. Doescher*
*John P. Shelnutt*
*Manoj Shanker*

**Three Scenarios for the Long-term Economic Outlook for Oklahoma**

Projections for the long-term (15 years) are being developed on specific variables for three scenarios of economic growth: pessimistic, baseline, and optimistic.

Smith Cogeneration, Inc.
*Robert C. Dauffenbach*
*Tabitha A. Doescher*
*John P. Shelnutt*
*Manoj Shanker*

# College of Education

***Although the mission statement emphasizes leadership in teacher education as its highest priority, the College is committed to a balance of excellence in instruction, research, and service in all program areas.***

The study of human processes, resources, and development, as well as the preparation of individuals for careers in education and supporting professions are included in the mission of the Oklahoma State University College of Education. Although the mission statement emphasizes leadership in teacher education as its highest priority, the College is committed to a balance of excellence in instruction, research, and service in all program areas. The departments of Applied Behavioral Studies, Aviation and Space Education, Curriculum and Instruction, Educational Administration and Higher Education, and the School of Occupational and Adult Education are the major academic units of the College.

In order to develop and maintain superior teaching, perform quality research and provide an effective extension of its knowledge, the College is involved in an ongoing effort to generate funding from a variety of sources to support the research and development activities of the faculty and staff. The Office of Education Research and Projects, which offers technical assistance and service to faculty and departments in support of their research and development projects, is an integral component of this effort.

During fiscal year 1988, the College of Education faculty were activ in a wide variety of research, development, and dissemination activities. In some cases, faculty awards from sources external to the University resulted from preliminary and development efforts supported by state-allocated research funds. Many of these extramural awards include commitments for additional funding over the next several years providing some stability to the ongoing support of faculty research and development efforts. Nine of the major funded projects of the College are highlighted.

The challenge presented in understanding sophisticated technology is being met by the College of Education through research/and development (R&D) activities such as the *NASA Aerospace Education Service Project (AESP)*. The College administers the activities of the AESP which provides teachers, students, and the general public nationwide with information about NASA's latest R&D programs. Information is disseminated through demonstration and lecture programs provided by faculty of the College and by 33 aerospace education specialists based at nine space flight and research centers across the nation.

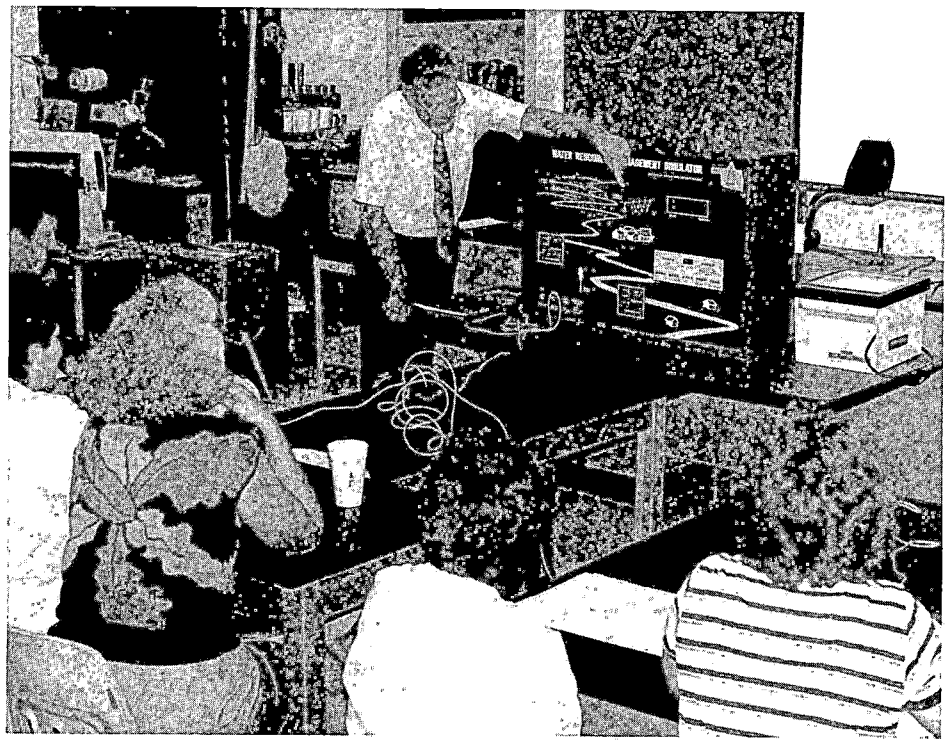
President Reagan announced on August 27, 1984, that a teacher would be chosen as the first private citizen to fly on the Space Shuttle. The *Teacher in Space Participant Project (TISP)* is part of the National Aeronautics and Space Administration's Space Flight Participant Program, designed to expand Shuttle opportunities to a wider segment of private citizens with the purpose of communicating the experience and flight activities to the public through educational and public information programs.

Under a support agreement with NASA, the College of Education is responsible for the general administration of the TISP and for the disbursement of funds. The College also provides logistical support for the workshops and conferences, coordinates

and prepares itineraries of the Teacher in Space finalists to public speaking engagements and educational presentations at elementary and secondary schools, universities, civic centers, museums, and planetaria, and provides the finalists with guidance and assistance in educational and public affairs matters. Subsequent to the Challenger disaster of January 28, 1986, which claimed the life of Christa McAuliffe, the contract was extended through August 31, 1988, with Barbara Morgan designated as Teacher in Space and six other finalists also participating in the program.

Addressing the need for the preparation of individuals for careers in education, the Oklahoma State University Colleges of Education and Arts and Sciences have developed, implemented, researched, and evaluated an innovative middle school mathematics and science pre-service teacher education program entitled *The DIRECT Middle School Science and Mathematics Project* which is funded by the National Science Foundation. Over the past 20 years and concurrent with the emergence in the United States of single subject middle school classrooms and teachers, many former elementary or secondary school teachers have been reassigned to teach middle school science or mathematics. Few, if any, have been specifically trained to effectively carry out programs of teaching and learning oriented to the needs of middle/junior high school science or mathematics students.

This undergraduate teacher education research and development project consists of specially designed laboratory sections of existing science courses, capstone content and companion teaching methodology courses coupled with appropriately placed field experiences, a mentor system, and informal but structured learning activities incorporating applied mathematics and science concepts from the real world into a middle school curriculum. The candidate who graduates from this program will achieve a state special middle school endorsement of either the secondary or elementary certification and will be carefully supervised and supported through the fifth-year Entry Year Assistance Program which is now in place.



*Dr. Ted Mills demonstrates the Water Resources Management Simulator (WRMS) to a class of teachers at a Woods County staff development workshop. This computer realistically models both ground and surface water supply, as well as the demands made by municipal/industrial and agricultural users of a water resource.*

The research project, *Increasing the Participation of Native American Students in Higher Mathematics*, funded by the National Science Foundation (NSF), was designed to write and test a culturally-based supplemental mathematics curriculum (K-12) in order to increase the participation of Native American students in the study of higher mathematics. Additional funding was obtained during 1988 from NSF to extend and complete activities which were conducted during the previous two years. A comprehensive review of the K-3 curriculum based on data collected from students and teachers participating in the initial testing was made. A kit of manipulative materials was assembled and field tested by 24 K-3 teachers in Jones, Perry, and Shawnee, Oklahoma. The curriculum was reviewed and prepared for publication. Field testing of revised 7-8 grade materials was conducted in Okemah, Oklahoma, and those materials revised and prepared for publication.

In celebration of the Bicentennial of the U.S. Constitution, a second annual summer institute entitled *The Constitution, Its Roots and Significance: A Summer Institute for Elementary School Faculty, Administrators, and Teacher Educators* was funded by the National Endowment for the Humanities and conducted in the summer of 1988. This institute was designed for 45 Oklahoma public school elementary teaching team members, with teams consisting of a library media specialist and an elementary social studies teacher, any level (K-8). The institute was predicated on the premise that history can be taught interestingly and effectively using trade books. Literature written to capture the attention of children and young adults was used as a base, with library media (print and non-print) viewed as the primary teaching materials. As a result of the project, it is hoped that elementary students will acquire a more complete understanding of our Constitution and the interrelationship among philosophy, history and political science.

The School of Occupational and Adult Education, through a contract with the State Board for Vocational and Technical Education, cooperates with the State Board's Division of Research, Planning, and Evaluation to maintain adequate and appropriate research

ffforts for the improvement of vocational ducation. Thus, the *Vocational-echnical Systems Design Agreement* 'as developed to provide assistance in ystems Design and also in the areas f Computer and Occupational Informa-on Services.

Research-based activities designed ) provide an integrated special-regular ducation pre-service program to equip achers to serve mildly handicapped hildren in rural school districts in Okla-oma are being implemented in the pro-ct *Preparing Teachers to Serve Mildly landicapped Students in Rural School )istricts*. The program is organized ccording to a Unified Pre-service Cur-culum Model which places emphasis n direct experiences in working with oth mildly handicapped and non-andicapped children and on opportu-ities to reflect on the meaning of those xperiences. Students are recruited into ıis program on a competitive basis and are awarded stipends. Participation in the program leads to certification in both elementary (K-8) and special education (mental retardation and learning disabilities, K-12). Students are then placed in rural and remote school districts in Oklahoma upon completion of the curriculum. New groups of college juniors enter and participate in the program each year.

The mission of the *National Clearing House of Rehabilitation Training Materials (NCHRTM)* is to facilitate the development and dissemination of materials with potential use in the research and development efforts of rehabilitation personnel nationwide. Over the past 24 years, NCHRTM has helped to shorten the time between the discovery of research findings and their utilization by practitioners.

On the international scene, the College has achieved a degree of prominence through participation in the *Jordan Fourth Education Project*. In this project, the College of Education is providing technical assistance to the Kingdom of Jordan under a four-year contract. Assistance is provided in two ways: (1) through the services of ten experts (in the areas of computer systems analysis, continuing education, curriculum development, health sciences, mining engineering, and vocational and technical education) who travel to Jordan and remain in residence for periods varying from three months to one year; and (2) through the provision of training in the United States for over 150 Jordanian teachers and administrators whose residence in this country varies from three to nine months. Other nations whom the College of Education has joined with in technical assistance and educational programs include: Brazil, Indonesia, Jamaica, Nigeria, Thailand, and Venezuela.

# Applied Behavioral Studies in Education

### Preparing Teachers to Serve Mildly Handicapped Students in Rural School Districts

In this project, qualified undergraduate students are identified and recruited into a special certification program designed by the investigators. The program includes work in both elementary and special education and leads to dual certification in these two areas. In addition to recruiting and advising the students throughout this program, a special seminar was designed and taught which focused on the development of reflective thinking skills by pre-service teachers. The seminars were taught on Wednesdays in conjunction with a specially arranged field observation participation experience for all of the students.

United States Department of Education
*Michael Warner*
*David Yellin*

### A Survey of Attitudes Toward Extended Teacher Education Programs

Faculty and graduate students from teacher education programs in the Holmes southcentral region were surveyed concerning their attitudes toward extended teacher education programs and related proposals for teacher education reform. It was found that participants are divided with respect to issues concerning extended programs. Also, participants expressed little support for expanding liberal arts coursework, but a great deal of support for expanding the amount of field experiences in teacher education programs. More than 40 percent of the faculty and graduate students surveyed agreed that admission and grading standards in teacher education programs are currently too easy. Faculty and students from Holmes-member institutions tended to be more supportive of the concept of extending teacher education programs beyond the traditional four years than their counterparts in non-Holmes institutions.

State of Oklahoma
*Kay S. Bull*
*Michael Warner*
*David Yellin*
*Gay Neuberger*
*Donald W. Robinson*

### Sex Differences in College Students' Computer Attributions

The computer attributions of 195 college freshmen and sophomores, including 93 males and 102 females, were measured using eight subscales—four each for success and failure experiences in using computers—which measure the four attribution categories of ability, environment, effort, and task. Students responded to each attribution statement using a 5-point Likert-type scale ranging from strongly agree to strongly disagree. A total score was calculated for each student for each of the eight subscales.

The results of analyses of variance indicate females and males differ in the categories of attributions they use to explain their success or failure in using computers. Females attribute their success in using computers more to the amount of time spent preparing for computer courses or studying for computer exams, their own determination and/or concentration, and the effectiveness of the computer teacher. Males perceive their successful performance using computers as due more often to their own skills and/or talents than do females. No significant differences were found between the responses of males and females to the other four attribution subscales.

State of Oklahoma
*N. Jo Campbell*

### Ethnic and Sex Differences in Public School Students' Computer Attitudes

A sample of 177 high school students, including 99 females and 78 males, in grades 10, 11, and 12 completed a 48-item inventory of computer attitudes (four 12-item subscales which measure students' perceptions of usefulness of computers and computers as a male domain, effectance motivation in computers, and computer anxiety), and a demographic questionnaire. Ethnic groups represented in the sample included White, Black, Hispanic, Asian, and American Indian.

Results of Chi-Square analyses indicated the male students tended to rate their levels of proficiency in using computers higher than female students even though males did not report having completed significantly more semesters of classes in which computers were used. Analyses of computer attitudes of the students revealed the males tended to be more anxious about using computers than the female students, while the females viewed the computers as more of a male domain than did the males. There were no sex differences in the students' perceptions of the usefulness of computers or in the effectance motivation provided by computers.

Analyses of variance and post hoc tests revealed the White students perceived computers as being more useful than did the American Indian students, with no significant pairwise differences in the perceptions of computer usefulness reported by the other ethnic groups. The White students were also more anxious about using computers than the American Indian students; however, no significant pairwise differences between the computer anxiety levels of the other ethnic groups were identified. Additionally, the White students tended to perceive computers more as a male domain than did th Asian students.

State of Oklahoma
*N. Jo Campbell*
*Katye M. Perry*

### Influence of Native Americans' Cultural Commitment on Preferences for Counselor Ethnicity and Expectations About Counseling

Eighty-four Native American college stu dents were asked to participate in this stud in an attempt to determine the impact o degree of cultural commitment on attitude about counseling. It was found that those stu dents with a strong commitment to the Native American culture placed greater importance on seeing an ethnically similar counselo than those students with a weak com mitment.

The results also indicated that cultura commitment affects Native Americans expectations about counseling, with those reporting a strong commitment to Native American culture expecting more nurtur ance, facilitative conditions and counselo expertise than those with a weak commit ment. This study highlighted the need to con sider within-group differences, such as degree of cultural commitment, when explor ing various cultural groups' attitudes abou counseling.

State of Oklahoma
*Mark E. Johnson*
*Karen Lashley*

### Differences in Interpersonal Functioning as Related to Sex-Role Orientation

To explore the effects of sex role orien tation on various aspects of interpersona behavior, 140 female college students com pleted the Bem Sex Role Inventory, severa scales of the California Psychological Inven tory, and the FIRO-B. Results revealed sig nificant findings on six of ten dependen variables: Expressed Affection, Wantec Affection, Expressed Control, Wanted Con trol, Sociability, and Empathy. Femininity was most significant in predicting Expressed anc Wanted Affection, whereas Masculinity predicted the other four variables. All rela tionships were positive with the exception o Masculinity being inversely related tc Wanted Control.

State of Oklahoma
*Mark E. Johnson*
*Karen Lashley*

### Ethics and Psychological Practice: Behavior, Attitudes, and Risk-taking Propensity

Several recent studies on the ethica beliefs and practices of psychologists across the country have failed to fully examine the discrepancy between what psychologists

elieve is ethical and what they actually do their practices. This project consists of a eries of studies to investigate the dis-epancy between belief and practice, risk-king propensity, ethical decision making, nd ethical ideologies drawn from a national ample of psychologists.

ate of Oklahoma
*amela Knox-Harbour*

## viation and Space ducation

### klahoma Aerospace Education 'orkshop

Involved in this workshop were Okla-oma educators interested in learning more oout the field of aerospace education. It as designed to provide materials and ethods for integrating the subject matter to the existing science curriculum, regard-ss of grade level. Interesting field trips were anned to give educators exposure to pace and aviation. Three semester hours graduate credit were awarded to those ho successfully completed the workshop.

klahoma Aeronautics Commission
*elson Ehrlich*

## urriculum and nstruction

### he DIRECT Middle School Science nd Mathematics Project

Over the past 20 years and concurrent ith the emergence in the United States of ngle-subject middle school classrooms and achers, many former elementary or secon-ary school teachers have been reassigned teach middle school science or athematics. Few have been specifically ained to effectively carry out programs of aching and learning oriented to the needs middle/junior high school science or athematics students. To meet these needs, e Oklahoma State University Colleges of ducation and Arts and Sciences have eveloped, implemented, researched, and valuated an innovative middle school athematics and science pre-service acher education program. This teacher ducation training consists of specially esigned laboratory sections of existing ience courses, capstone content and com-anion teaching methodology courses cou-ed with appropriately placed field periences, a mentor system, and informal t structured learning activities incorporat-g applied mathematics and science con-pts from the real world into a middle hool curriculum. The candidate who aduates from this pre-service program will hieve a state special middle school dorsement of either the secondary or elementary certification and will be carefully supervised and supported through the fifth-year Entry Year Assistance Program.

National Science Foundation
*Ted J. Mills*
*James Choike*
*Dwayne Eubanks*

### Increasing the Participation of Native American Students in Higher Mathematics

This research project, funded by the National Science Foundation, was designed to write and test a culturally-based supplemental mathematics curriculum (K-12) in order to increase the participation of Native American students in the study of higher mathematics. Additional funding was obtained during 1988 from the National Science Foundation to extend and complete activities which were conducted during the previous two years. A comprehensive review of the K-3 curriculum based on data collected from students and teachers participating in the initial testing was made. A kit of manipulative materials was assembled and field tested by 24 K-3 teachers in Jones, Perry, and Shawnee, Oklahoma. The curriculum was reviewed and prepared for publication. Field testing of revised 7-8 grade materials was conducted in Okemah, Oklahoma, and those materials revised and prepared for publication. The final report was submitted to NSF.

Central State University is a subcontractor on this project.

National Science Foundation
*Douglas B. Aichele*
*Margaret M. Scott*
*Carl Downing*

### American Indian Educational Personnel Development Project

The Office of Indian Education of the U.S. Department of Education is providing support to further prepare American Indian educators to serve in leadership roles in educational settings involving school guidance and counseling, curriculum supervision, and school administration. Qualified educators are selected competitively to receive fellowship assistance while pursuing master's and doctoral degrees in these fields.

Beginning August 1, 1987, the first year of a two-year grant, financial assistance was provided for eight fellows by the U.S. Department of Education, the OSU Graduate College, and the OSU College of Education.

United States Department of Education
*Russell L. Dobson*
*Larry Foreman*

### The Constitution, Its Roots and Significance: A Summer Institute for Elementary School Teaching Teams

This research grant, funded by the National Endowment for the Humanities, supported a 1988 Summer Institute for public school teachers and librarians. Professors from the College of Arts and Sciences taught courses on the philosophical, historical, and political foundations of the U.S. Constitution, and College of Education professors worked with the teachers on developing appropriate classroom units on the material presented.

National Endowment for the Humanities
*Carolyn J. Bauer*

### Teleconference Instruction in Problem Solving (TIPS)

This project will focus on the enhancement of the mathematics problem-solving ability and awareness of pre-service mathematics teachers in Oklahoma. Research will be undertaken to determine whether problem solving techniques can be taught effectively using a coordinated teleconference delivery system.

- Approximately 100 pre-service mathematics teachers in Oklahoma will be pre- and post-tested to determine the level of their problem solving skills and awareness.
- A series of four mathematics problem-solving teleconferences coordinated with a set of four problem-solving learning modules will be telecast statewide as well as nationwide.
- A series of four mathematics staff development video cassettes from the teleconference series will be produced.
- An experimental treatment with 50 of the pre-service mathematics teachers will be conducted.
- The findings will be disseminated to each state department of education in the U.S.

The desired outcome of the project is to improve mathematics instruction in the public schools of the United States. The TIPS project could serve as a model to other states and thus contribute to improve instruction in mathematics (and perhaps other disciplines) nationwide.

Oklahoma State Regents for Higher Education
*Douglas B. Aichele*
*Dennis Bertholf*

### Teleconference Instruction and Summer Institutes: Networking Educators Through Telecommunications (TISI-NETT)

The principal goal of this project is to heighten awareness and enhance classroom instruction and effective use of information

technology through telecommunications (i.e., electronic bulletin board and data base) in Oklahoma schools. Teachers need to be trained to take full advantage of the electronic community at their fingertips. In order to accomplish the intended goal, the following steps would be:

- Create a network of rural and urban schools in Oklahoma by joining "Computer Mail System (CMS)" School-Net.
- Provide in-service opportunities concerning the use of telecommunications through delivery of a teleconference and summer institute.
- Improve skills and confidence of Oklahoma educators in utilizing telecommunications through hands-on training delivered in a summer institute focusing on applications presented in the teleconference.
- Enhance effective use of information technology through telecommunications by assisting Oklahoma educators and their students within rural and urban environments in planning meaningful and appropriate collaborative projects.

Oklahoma State Regents for Higher Education
*Joyce Friske*

### The Continuing Critical Shortage of Secondary Mathematics Teachers in Oklahoma

Each Oklahoma institution of higher education was surveyed to identify the secondary mathematics teachers it graduated during FY 1987-1988. The results of this study document the continuing critical shortage of secondary mathematics teachers being produced by Oklahoma institutions of higher education. Further, it identified those beginning mathematics teachers who will be participating in the NSF-supported project *Teleconference Instruction in Problem Solving (Math TIPS)* during FY 1988-1989 under the direction of co-principal investigators Aichele and Jobe.

State of Oklahoma
*Douglas B. Aichele*
*John Jobe*

### Effects of Best Example and Critical Attributes on Kindergartners' Acquisition of a Concept

This study examined the effects of critical attributes and a best example on concept development. Forty-eight kindergartners were randomly assigned to one of two treatment groups. Subjects were presented the social studies concept of land pollution through the use of a best example or through explication of the critical attributes of the concept. An achievement test and a protocol test were administered following the lessons. The same two tests were administered one week later as retention tests. Subjects taught with critical attributes scored significantly higher on the achievement post-test; there was no difference between groups on the retention achievement test. On the protocol retention test, subjects taught using critical attributes generated significantly more correct examples of the concept than subjects taught with a best example.

State of Oklahoma
*Diane C. Burts*
*Mary J. Ford*
*C. Warren McKinney*

### Effects of Critical Attributes and a Best Example on Fifth-Grade Students' Concept and Prototype Formation

The purpose of this research was to examine the effectiveness of a best example, critical attributes, and student practice on fifth-grade students' concept and prototype formation. The first study compared the effects of critical attributes and a best example. Results indicated that students taught with a best example; a definition and a best example; or a definition and critical attributes performed better on achievement tests than did students taught with critical attributes. Furthermore, those students taught with only critical attributes failed to form a clear mental prototype of the concept. Study 2 compared the effects of a best example; critical attributes; a best example and practice; and critical attributes and practice. Results indicated that students who were taught with critical attributes and practice performed significantly better on the immediate and retention achievement post-tests than did the group taught with only critical attributes. Also, it was concluded that practice facilitated concept formation and prototype formation.

State of Oklahoma
*C. Warren McKinney*
*Allison C. Gilmore*
*A. G. Larkins*
*Kay C. McKinney*

### Pre-service Elementary Education Majors' Knowledge of World Geography

A standardized test was administered to 124 university undergraduates to estimate the extent of their knowledge of world geography. Overall, the students performed poorly on the content that they will be expected to teach. The students appeared to have the most difficulty identifying landforms, place location, and type of map projection. They encountered the least difficulty in recognizing the shape of the state of Louisiana, identification of a population density map, and using longitude and latitude.

State of Oklahoma
*C. Warren McKinney*
*Kay C. McKinney*
*Mary J. Ford*
*Allison C. Gilmore*
*A. G. Larkins*

### Pre-service Elementary Education Majors' Knowledge of American History

A 50-item test designed to measure high school students' knowledge of American history was administered to 139 elementary education majors. The students' performance was poor. Students appeared to be more knowledgeable of recent American history than of early American history. These data provide evidence that many of these prospective teachers may have difficulty teaching social studies content.

State of Oklahoma
*Mary J. Ford*
*C. Warren McKinney*
*Allison C. Gilmore*
*A. G. Larkins*
*Kay C. McKinney*

### Pre-service Elementary Education Majors' Knowledge of Economics

The authors present evidence from the research literature that elementary school children possess inadequate knowledge of economics. Four arguments are given for the importance of economic education in the public schools. It is argued that poor pupil performance on economics achievement tests might reflect vacuous social studies texts in the primary grades and an inadequate stock of economics knowledge possessed by teachers. Data from the present study support the latter claim; the mean score for this sample of pre-service teachers was less than 50 percent on the Test of Economic Literacy. It is then argued that providing teachers with additional training in economics could increase the stock of economic knowledge possessed by the students.

State of Oklahoma
*C. Warren McKinney*
*A. G. Larkins*
*Kay C. McKinney*
*Allison C. Gilmore*
*Mary J. Ford*

### Pre-service Elementary Education Majors' Knowledge of American Government

A standardized test was administered to 130 elementary education majors to estimate their knowledge of American government. Students responded correctly to about 5 percent of the items. Student performance

was best on the content area related to guarantees of liberty. Performance was poorest on the content area related to governmental powers. It was concluded that most of these students will have difficulty explaining to elementary students how our government works.

State of Oklahoma
*Allison C. Gilmore*
*C. Warren McKinney*
*A. G. Larkins*
*Mary J. Ford*
*Kay C. McKinney*

**An Investigation into the Formation of Selected Aquatic Conceptual Schemes**

"If teachers do not understand elementary physical science concepts, how can they be expected to teach their students?" The objective of this study was to gain insight into the nature and magnitude of this problem through the use of clinical interviews to ascertain teachers' knowledge of water, the administration of written tests to determine the cognitive developmental level of reasoning of the teachers, and the utilization of the "Teaching Preference Scale" (Sunal, 1982) to identify the pre-service teachers' preference for language arts, mathematics, social studies or science subject matter and grade level placement.

A pilot study using ten recent teacher education graduates will also be conducted to perfect the clinical interview and validate the written exams.

University Center for Water Research/OSU
*Ted J. Mills*

**Comparative Study of Thesis and Dissertation Candidates and Graduate Committee Composition in the Department of Curriculum and Instruction at Oklahoma State University from 1970-1988**

This study was conducted with the following objectives:

- To determine the percentage of male and female candidates receiving advanced degrees from 1970-1988 in the Department of Curriculum and Instruction.
- To examine the gender composition of the graduate committees.
- To compare the number and gender of graduate committee members from within the department with members outside of the department.

While 63 percent of the candidates were female and 37 percent were male, only 10 percent of the graduate committee members were female and 90 percent were male. Of the male committee members, 54 percent were from within the department and 46 percent were from colleges and departments outside the Department of Curriculum and Instruction.

Of the female committee members, 58 percent were from within the Department of Curriculum and Instruction and 42 percent were from other colleges and departments.

State of Oklahoma
*Audrey E. Oaks*

**Management Values Survey**

A survey of 1,000 members of the Division of Educational Media Management of the Association for Educational Communications and Technology was undertaken using an instrument produced by the Center for Values Research (CVR) in Dallas, Texas. In both a pilot study and the general research, CVR tested the responses against their data base of managers in business and industry.

Attitudinal differences were compared with managers in business and industry as well as with educational media managers by regions. The study found changes in values occurred as the number of educational degrees increased and marked changes in attitudes as a result of regional influences.

State of Oklahoma
*Ron Payne*
*Barbara Duffy*

**Attitudes Toward Mathematics of Pre-service Elementary Teachers**

Attitude toward a subject has an impact on the effectiveness of instruction. The literature has not shown elementary teachers have a more negative attitude toward mathematics than other groups, although many elementary education majors have avoided taking mathematics courses. Several instruments have been used to measure attitude but these are lengthy and designed to identify anxiety.

The purpose of this research was:

- To develop a short instrument which can be used to measure attitudes and beliefs about mathematics.
- To compare attitudes of OSU students enrolled in the primary mathematics methods courses at the beginning and the end of the course.

Progress and initial findings were reported at a CIED Colloquium.

State of Oklahoma
*Margaret M. Scott*

**An Examination of the Metacognitive Learning Strategies of Students**

This study investigated the metacognitive skills and self-reported learning behaviors of secondary students and the effectiveness of those reported learning behaviors in helping these students comprehend reading assignments from different content areas.

Results from the investigation revealed that:

- Students were deficient in their awareness of and ability to control their own learning strategies.
- Students employed text-based strategies for reading and learning regardless of the content area and throughout the learning process.
- Students did not consistently practice efficient learning strategies or effective study habits.

Findings suggest the need for direct instruction in effective learning strategies to secondary students.

State of Oklahoma
*Gwendolyn Y. Turner*

**The Academic Bowl**

The major focus of the Academic Bowl is to challenge academically motivated senior high school students in Oklahoma. While the intent of the Bowl is to highlight the meritorious student as a role model in the high schools of the state, the purpose of the present project is to enhance the Bowl's quality as well as its delivery systems. One of the features earmarked for special attention is the more than 13,000 professionally composed questions in the areas of history, literature, current events, mathematics and science which have now been computerized. To guarantee accuracy in the statewide event, a special electronic digital scoreboard system has also been installed.

State of Oklahoma
*William E. Segall*

## Educational Administration and Higher Education

**The Oklahoma Leadership in Educational Administration Development Program (LEAD)**

Because current legislation and activity in the area addressed by the LEAD Program has already set the stage in Oklahoma, the members of the Oklahoma LEAD Consortium feel that this project will enhance and supplement those efforts. The Technical Assistance Center established through Project LEAD will be supported by a Consortium, a Resource Network and an Advisory Committee.

Due to the fact that Oklahoma is a relatively large and sparsely populated state, the locations of the two dissemination sites in the central region (Norman) and north central region (Stillwater) of the state will allow maximum accessibility for administrators to participate in training module and training/information development and delivery. An additional benefit stems from the

*Drs. Kenneth King, Steve Marks, and Donald W. Robinson display a plaque recently awarded by the Association of Teacher Educators to the Oklahoma Cooperative for Clinical Experiences in Teacher Education (OCCETE) for its efforts in establishing systematic clinical experiences in teacher education.*

locations of ten institutions of higher education offering certificate programs in school administration, which can serve as training delivery sites in all quadrants of the state.

State of Oklahoma
*J. Kenneth St. Clair*

### Leadership Teams: Restructuring Higher Education for the Information Society

Teams are the building blocks of the emerging information society. As a result, a reworking of thinking on leadership may be in order. During 1987-1988, the principal investigator was involved in writing four papers based on this premise. Continued work in this important area has also led to editing duties on the publication *Handbook on Teaching and Instructional Resources*, as well as membership with the American Council on Education's Leadership Development Group.

State of Oklahoma
*John J. Gardiner*

### College of Education Centennial History

As a part of the University centennial celebration, historical research has been conducted concerning the history of the College of Education. This research forms the basis for a book which is one of a series of historical volumes being developed to celebrate the life of the University from its inception until its hundredth anniversary.

State of Oklahoma
*Thomas A. Karman*

### Oklahoma Public School Research Council (OPSRC)

The Oklahoma Public School Research Council is a consortium of approximately 75 independent school districts in Oklahoma which join together with the Department of Educational Administration and Higher Education to conduct both short- and long-range research projects including: salary surveys, curriculum reviews, and board policy and procedures reviews. The Consortium also sponsors at least one annual seminar for the exchange and sharing of ideas relative to a common school issue of importance and high priority to consortium members. Oklahoma State University's Department of Educational Administration and Higher Education houses and administers the project supported by membership dues.

Oklahoma Public School Districts
*J. Kenneth St. Clair*

### Objective and Reputational Rankings of Ph.D.-Granting Departments of Sociology

From its inception in 1965 until 1975 when it stopped publishing such studies, *The American Sociologist* (TAS) published numerous quality rankings of Ph.D.-granting sociology departments and several articles that compared different rankings. During the years, TAS published far more rankings of sociology departments found in three major multi-disciplinary rankings (Cartter, 1966; Jones, Lindzey, & Coggeshall, 1982; Roose & Andersen, 1970).

The purpose of this research was to discuss the major methodological approaches used in these studies and review the debate among scholars regarding the most appropriate ways to rank departments. An analysis of the various objective and subjective rankings revealed that there is an elite group of seven departments that consistently rank at the top regardless of the ranking method employed.

State of Oklahoma
*David S. Webster*
*Clifton F. Conrad*
*Eric L. Jensen*

## Occupational and Adult Education

### Vocational-Technical Computer Systems Design Agreement

The School of Occupational and Adult Education, through a contract with the State Board of Vocational and Technical Education, cooperated with the State Board's Division of Research, Planning, and Evaluation to maintain adequate and appropriate research efforts for the improvement of vocational education. Services in the area of Systems Design, Computer Services, and Occupational Information were also provided under this contract.

Oklahoma State Board of Vocational and Technical Education
*H. Gene Smith*

### Vocational-Technical Teacher Education

Personnel were provided by the School of Occupational and Adult Education to assist the Oklahoma State Department of Vocational and Technical Education in both pre- and in-service training for students in the several related fields of Trade and Industrial Education, Adult and Career Education, Technical Education, etc. This contract is related to similar programs in Agriculture Education, Business Education, and Home Economics Education.

Oklahoma State Regents for Higher Education
Oklahoma State Department of Vocational and Technical Education
*Melvin D. Miller*

### Vocational-Technical Graduate Research Associate Project

The School of Occupational and Adult Education provided funding to allow for professional development activities and graduate students in fields related to vocational education. Support for five graduate students was allocated under this project.

Oklahoma State Regents for Higher Education
Oklahoma State Department of Vocational and Technical Education
*Melvin D. Miller*

### acuity Development rogram/Vocational-Technical eacher Education

At the Fall 1986 College of Education ıculty meeting, Dean Donald W. Robinson :ated that, as the research university of the :ate, Oklahoma State University should provide the teacher-educators for other ;acher education institutions of the state." ı keeping with Dean Robinson's sentiments, ıis project has identified self-renewal and lanned progress as vital components of a uccessful vocational-technical education rogram. Vocational-technical education ;acher educators must become a driving )rce in assuring that appropriate and rganized programs are developed for pre- nd in-service vocational-technical teachers ırough incorporation of state-of-the art con- epts in teacher training.

Activities proposed through this project /ould implement a sharply focused series f discussions on analysis of current and ıture curriculum and the direction of ocational-technical education.

)klahoma State Board of Vocational and 'echnical Education
*Jarry Bice*

### :ducating the Vocational Teacher- :ducator

This study analyzed current practices of ;ducating vocational teacher-educators in ıe 36 doctoral degree-granting institutions ıat educate vocational teachers in five or nore disciplines. Coordinators listed 27 lifferent courses as required for all teacher- ;ducators. They also listed the courses cur- ently required in their institutions as those hat should be required. None suggested ıny new courses. Teacher educators ranked ;econdary teaching of the occupation; work- ıg in the occupation; and studying classes ı curriculum development, research tech- ıiques, and advanced methods of teaching ıs the most valuable experiences in prepar- ıg one to become a teacher-educator.

State of Oklahoma
*Clyde Knight*

### Historical Study of State Directors of Vocational Education

The purpose of this study was to estab- ish an historical data set for all state direc- ors of vocational education from 1913 to )resent. Results include information on time ınd length of service, certification back- ground, and positions prior to and following ervice as state director.

State of Oklahoma
*Melvin D. Miller*

### The Influence of Professional Schooling on Achievement Rates of Adults Learning a Second Language

Using his Learning Style Inventory (LSI), Kolb (1984) purported to demonstrate a correspondence between learners' LSI scores and corresponding undergraduate majors (*Experiential Learning*, p. 85). This investigation attempted to determine if, in fact, learning styles acquired through specialized models of enquiry and problem solving characterized by the scientific fields would enable technically trained adult learners to learn at a different rate than those with generalist undergraduate degrees.

Two hundred eight learners of Spanish as a second language, whose occupations were highly technical, were observed over a two-year period. Those students, especially nurses, experienced considerable affective dissonance with learning/teaching methodologies employed in second language and cross cultural training.

Intact groups were subjected to 220 hours of immersion language training. Pre- and post-test scores were obtained for 208 subjects. The findings showed that using the Foreign Service Institute eleven-point scale as the dependent variable, there was no difference between group scores of specific occupational orientations at the .05 alpha level. However, there were differences across the generalist/specialist variable and the gender variable.

State of Oklahoma
*Robert E. Nolan*

### Professional Certification Programs as Sources of New Adult Audiences

From a population of 425 professional associations and societies identified by Gilley (1985) and Galey (1979) in the *Encyclopedia of Associations*, 32 associations operating non-technical credentialing programs were selected according to three criteria: 1) certification programs whose testing could be accomplished using pencil and paper tests; 2) associations having large national memberships representative of the given profession as a whole; and 3) associations which were business oriented.

From the analysis of the survey, it appears that continuing education institutions can assist professional associations in three ways. The first area of assistance is in testing. It would appear that both universities and community colleges could play a significant role in helping associations test applicants, and improve and validate their testing procedures. Secondly, continuing education institutions, by advertising staff development opportunities related to specific professional associations, would thereby indirectly promote the professional association in question. Finally, institutions of continuing education would lend academic respectability to practitioner oriented associations.

State of Oklahoma
*Robert E. Nolan*
*Lary Rampp*

### 1988 National Adult Education Conference

The theme of the 220 concurrent session conference held in Tulsa, Oklahoma, the week of October 31 to November 5, 1988, was "Adult Education for Personal and Economic Development." The keynote speaker was Michael Vance, Dean of the University of Disneyland, often referred to as the "Dean of Creativity." The second notable speaker was G. Edward Schuh of the Hubert Humphrey Institute of Public Affairs. Dr. Schuh, whose experience with the World Bank gives him a unique perspective on economic development, addressed the topic of "The Role of the Land Grant University in Promoting Economic Development."

The sessions were selected on the basis of competitive review by 30 review committees. Topical areas included: adult basic education, adult psychology, armed services, business and industry education services, continuing professional education, cooperative extension service, corrections, educational media and technology, gerontology, human resource development, international adult education, labor education, religious adult education, university extension, vocational and career education, and many others.

This conference brought 2,500 participants to Tulsa from all 50 states, Australia, Barbados, Canada, Great Britain, Jamaica, Mexico, Sweden, and Venezuela.

State of Oklahoma
*Robert E. Nolan*
*Constance Lawry*
*Dianne Wimberley*

## College of Education

### Jordan Fourth Education Project

Under the terms of a contract which extends from January 1, 1984, through December 31, 1988, OSU is providing technical educational assistance to the Kingdom of Jordan as part of its Fourth Education Project, funded by the United Nations Development Programme and administered through the World Bank. The assistance is provided in two ways: (1) through the services of ten experts (in the areas of computer systems analysis, continuing education, curriculum development, health science, mining engineering, and vocational and technical education) who travel to Jordan and remain in residence for periods varying from three months to one year (for a total of 42 man-months of assistance); and (2) through the provision of training in the United States for over 150 Jordanian teachers and administrators (in the areas mentioned above plus engineering technology) whose residence in this country varies from three to nine months (for a total of 468 man-months of fellowship training).

The World Bank
*Kenneth H. McKinley*

### NASA Aerospace Education Services Project (AESP)

Through this project, the College of Education administers the activities of the Aerospace Education Services Project (AESP) of the National Aeronautics and Space Administration (NASA), which provides teachers, students, and the general public nationwide with information about NASA's latest research and development (R&D) activities. Information is disseminated through demonstration and lecture programs provided by faculty of the College and by 33 aerospace education specialists based at nine space flight and research centers across the nation. Specifically, the project provides for aerospace education community involvement programs; courses and workshops for elementary and secondary school teachers; assistance with curriculum revision and development activities of national, state, regional, and local programs; presentations for delivery on educational television and radio; presentations before civic clubs and professional organizations; special services at science and technology centers; in-service programs for aerospace specialists; and the development of instructional materials for various aerospace activities. The program has recently expanded the number of these activities offered in selected inner city areas.

National Aeronautics and Space Administration
*Kenneth Wiggins*

### NASA Teacher in Space Participant Program (TISP)

Under a support contract with NASA, which has been extended through August 31, 1988, the College of Education is responsible for the general administration of the Teacher in Space Participant Program (TISP) and for the disbursement of funds. The College also provides logistical support for workshops and conferences, coordinates and prepares itineraries for Barbara Morgan and six other Teacher in Space finalists to public speaking engagements and educational presentations at elementary and secondary schools, universities, civic centers, museums, and planetaria, and provides the finalists with guidance and assistance on educational and public affairs matters.

National Aeronautics and Space Administration
*Kenneth Wiggins*

### Oklahoma State Regents for Higher Education Future Teacher Scholarship Program: A Statewide Summary 1984-1987

The Oklahoma Legislature provided authorization for implementation of this Future Teacher Scholarship Program. These scholarships are available to Teacher Education students across the state of Oklahoma who are pursuing a Teacher Certification Program in the identified teacher shortage areas. For the academic years of 1984-1987, 300 students received scholarships in foreign languages, industrial arts and music, mathematics, science, and special education.

In general, all reporting institutions felt the program is having a positive effect. The data reflects that the program is attracting academically talented students into the identified teacher shortage areas, as seen in high GPA's and ACT scores. Data also shows students who graduate from the program are going into teaching, with the vast majority (61 percent) staying in the state of Oklahoma as compared with those leaving the state (11 percent).

State of Oklahoma
*Steve Marks*

## Office of Education Research and Projects

### National Clearing House of Rehabilitation Training Materials

The mission of the National Clearing House of Rehabilitation Training Materials (NCHRTM) is to facilitate the development and dissemination of materials with potential use in the training of rehabilitation personnel. The Clearing House provides rehabilitation educators, state agency personnel, and other professionals nationwide with access to reports, journals, books, films, tapes, and other training aids. NCHRTM publicizes its collection and services through a quarterly newsletter which is read by more than 36,000 professionals in the field. Access to the printed materials in the collection is facilitated by a catalog which permits retrieval by both title and subject.

United States Department of Education
*Paul Gaines*
*Elizabeth Jo Heiliger*

### Facilities Resource Center

The Oklahoma Department of Humar Services awarded the National Clearing House of Rehabilitation Training Materials (NCHRTM) funding for the purchase of certain materials chosen by Oklahoma rehabilitation agencies. The materials are to be housed in the OSU facility and duplicated for the designated agencies upon request.

Oklahoma Department of Human Services
*Paul Gaines*

### Vocational-Technical Administrative Support Service Agreement

The terms of this continuing agreement require Oklahoma State University to provide the Oklahoma State Department of Vocational and Technical Education with administrative services.

Oklahoma State Regents for Higher Education
Oklahoma State Department of Vocational and Technical Education
*Kenneth H. McKinley*

### Oklahoma Education Research Symposium (OERS) IV

The theme of this concurrent session/poster presentation conference held in Edmond, Oklahoma, on December 4, 1987, was "Reflecting on Our Past to Inform Future Practice." The keynote speaker was Gary Sykes from Michigan State University who is associated with National Teacher Certification Assessment Research. Dr. Sykes addressed the topic of "The Reform of Teacher Assessment."

There were seven major emphases addressed in this conference. These included:

- classroom instructional processes;
- the nature of teaching and learning to teach;
- assessment/evaluation of students and teachers;
- certification issues;
- staff development;
- issues in rural education; and
- distance learning.

State of Oklahoma
*Kenneth H. McKinley*

# College of Engineering, Architecture and Technology

***The widely diversified research projects conducted in CEAT are indicative of the broad range of interests in a highly qualified and motivated faculty.***

During Fiscal Year 1988, the Office of CEAT Research Administration administered research projects exceeding a combined total of $7.7 million in research expenditures for the College of Engineering, Architecture and Technology.

The Office of CEAT Research Administration (CEATRA) functions as a service entity for the coordination and administration of all engineering research activity. The office works closely with the school heads to ensure that the overall research program continues to grow in the desired direction and to support OSU's primary function-quality instruction.

The widely diversified research projects conducted in CEAT are indicative of the broad range of interests and expertise inherent in a highly qualified and motivated faculty. Current research projects include basic research as well as practical applications to real-world problems. Research programs range from such topics as hydrotreatment of coal fluids, water quality studies, energy analysis, signal processing, web handling, and space kinematics to advisement on implementing mass transportation systems.

Research funding comes from two basic sources: outside agencies and the University. Sponsored research funds are generated from state and federal agencies and private industries. These monies, which comprise the bulk of research funding, are extremely important because they not only fund a portion of the professor's salary, but provide graduate students with the opportunity to gain professional research experience.

Faculty research is financed by the University to provide release time for professors to pursue research that is not yet externally sponsored. This "seed money" is particularly designed to give new faculty members the opportunity to develop their research ideas to the point that extramural funding may be obtained.

Both types of funding are essential for a strong graduate and professional program. Research projects provide an ideal training ground for engineering students by giving them the opportunity to learn marketable research skills under the guidance of professional researchers. Faculty members who are involved in research efforts are provided an opportunity to keep abreast of the latest development in their professional fields and, at the same time, are permitted to incorporate this information into their teaching/instructional programs.

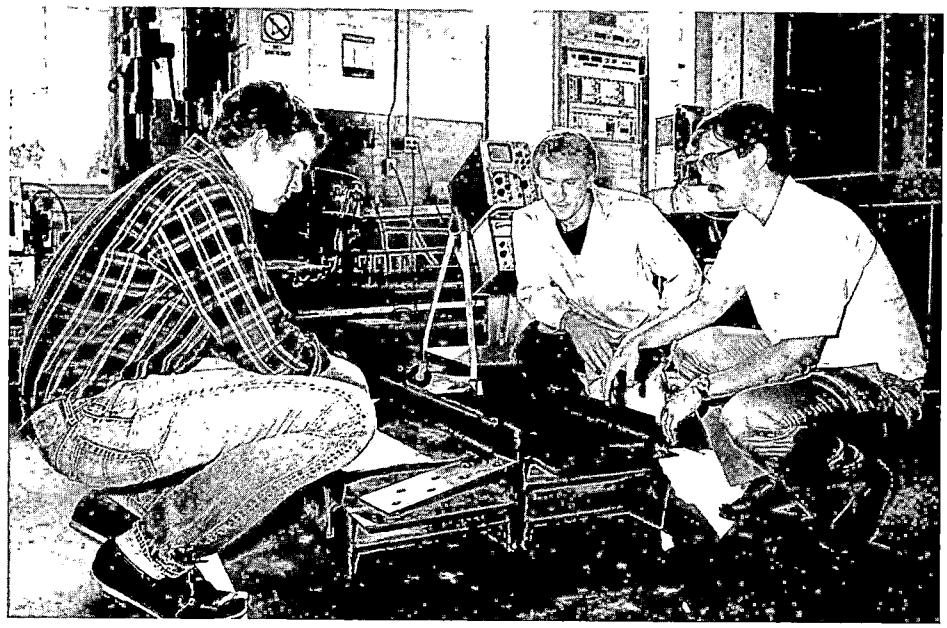
Since the 1960's, CEAT has been involved in consortia or cooperative research programs that provide benefits for both the University and industry/government agencies. Currently, these programs are being conducted in the Physical Properties Laboratory, Engineering Energy Laboratory, Web Handling Research Center, the Phase Behavior and Interfacial Tension in Carbon Dioxide Hydrocarbon Systems Consortium, Well-Log Data Analysis Center, and the Fluid Power Research Center. These research programs sharply focus on research areas that have the greatest potential impact on the industrial sector in Oklahoma and the nation, and have the greatest potential for contributing to future economic industrial growth. They provide special-

ized talent and facilities and a scope of study that would be economically impractical for any one company/government agency to undertake within its own organization. The research areas have been chosen so that Oklahoma State University will develop national visibility and a reputation for its work. Industrial and governmental agencies have provided the centers and laboratories with equipment and funds to facilitate research.

CEATRA provides research support services which include proposal preparation, editing, typing and mailing; financial monitoring and control of grants and contracts; soliciting financial support for research projects; and assisting with the promoting and publicizing of research activities in the College.

After a proposal is accepted, the office handles most of the administrative requirements set forth by the sponsor, thus enabling the faculty member to spend his/her time on professional research activities. The acceptance rate of proposals processed through CEATRA is approximately 66 percent.

CEATRA coordinates research activities for the following eight schools and seven interdisciplinary centers or laboratories associated with the College. Architecture *(V.R. Carter), Chemical Engineering (R.L. Robinson), Civil Engineering (R.K. Hughes), Electrical and Computer Engineering (J.E. Baker), General Engineering (B.L. Basore), Industrial Engineering and Management (C.B. Estes), Mechanical and Aerospace Engineering (L.L. Hoberock), Division of Engineering Technology (J.E. Bose), Fluid Power Research Center (J. Eleftherakis), Electronics Laboratory (T.G. Bertenshaw), Center for Local Government Technology (J.E. Shamblin), Engineering Energy Laboratory (R.G. Ramakumar), Eglin Field Office (J.F. Wolff), Robotics Design Center (L.L. Hoberock), and the Computer Integrated Manufacturing Center (J.H. Mize).



*Students study infrastructure research conducted at OSU by Dr. Farrel J. Zwerneman on bridge diaphragm fatigue failure.*

Each research project administered through the Office of CEAT Research Administration last year is listed by school and project title. Also included is a brief narrative about the project's purpose, the name of the supporting organization(s), the name(s) of the principal investigator(s) and supporting personnel.

*School heads and directors are shown in parentheses.

# Chemical Engineering

### CHENG/Thermodynamics Studies

Measurement of the phase behavior of crude oils and condensates, and computer simulation of the behavior of these oils in a processing environment are performed under this project.

Norsk Hydro
*R. C. Erbar* and *T. Seagraves*

### DOE Phase Equilibrium

Experimental studies are conducted on equilibrium phase compositions, phase densities and interfacial tensions in mixtures of the solute gases $CO_2$ or ethane in paraffinic, naphthenic and aromatic solvents, including real oils.

Supported by an industrial consortium of Amoco, ARCO, Chevron, Shell and Standard Oil.
*R. L. Robinson*
*K. Gasem*
*Y. Qin*
*N. A. Darwish*
*S. A. Schuessler*
*G. C. Tan*
*A. M. Raff*
*T. D. Wilson*

### Environmental Parameters for Organic Chemicals

The objective of the project is to develop the data base and correlation framework to estimate activity coefficients for organic chemicals in dilute aqueous solutions which can be used, in turn, to calculate environmental parameters such as Henry's Law constants and aqueous solubility.

University Center for Water Research
*J. Wagner*
*L. Funk*
*M. Montazar*

### GPA Acid Gases in Solvents

This project entails experimental measurement of equilibrium loadings at low partial pressure of hydrogen sulfide and carbon dioxide in water solutions of alkanolamines.

Gas Processors Association
*R. N. Maddox*
*E. Elizondo*
*M. Abu-Arabi*

### Interfacial Tensions Program

Measurements are being made on phase behavior and interfacial tensions in systems containing CO2 or ethane dissolved in various hydrocarbon liquids. Results have applications in enhanced oil production operations.

Consortium of Petroleum Producing Companies
*R. L. Robinson*
*S. Haji-Ahmad*

### NSF ESPCoR-Foutch

We are studying the performance of mixed-bed in exchange columns at ultra-low concentrations. Research includes experimentation and theoretical modeling. Verified models at low concentrations can be used to predict and improve industrial bed performance.

National Science Foundation
*G. L. Foutch*
*L. Carter*
*D. King II*
*C. Gilcrease*
*T. Yoon*
*E. Zecchini*

### NSF Phase Synthesis

In this project, specific peptides are being made using the Merrifield technique. The kinetics of the reactions are being evaluated in order to generate predictive models for large scale peptide production. The specific peptides produced in the laboratory are bradykinins, angiotensins, and endorphins.

National Science Foundation
*G. L. Foutch*
*D. Fuller*
*W. Chen*
*G. Tidwell*
*S. Wang*
*B. Scott*

### Phillips Kinetic Parameters

A new reactor has been developed by researchers at Phillips Petroleum Company for the production of certain chemicals. The purpose of this research is to determine the kinetic parameters for this reactor.

Phillips Petroleum Company
*G. L. Foutch* and *H. Chiang*

### Sandia Behavior Simulation

For this project, a computer model of an aluminum-air battery was developed. The model successfully describes the behavior of the system and can be used to predict behavior as variables in the system are changed.

Sandia National Laboratories
*R. C. Erbar* and *W. W. Paden*

### Slagging and Fouling Behavior of Blended Coals

Due to recent changes in state law, power plants in Oklahoma are required to burn at least ten percent Oklahoma coals in their boilers. Coal blending in power plants has resulted in many new operational problems for the electric power industry. The objective of this research is to investigate the process variables and coal impurities which result in slagging and fouling problems in commercial boilers.

University Center for Energy Research
*A. H. Johannes*
*S. Chen*
*C. Kongkatong*
*S. N. Ahmed*
*R. Smejkal*
*M. Seapan*
*J. L. Lo*
*Y. Tsai*
*Y. L. Chen*
*M.Landes*
*Y. Lee*
*S. Wang*
*H. Chen*
*C. Monnot*
*M. J. Gibson*

### Thermodynamic and Transport Properties for Continuous Mixtures

Laboratory facilities and techniques are being developed to acquire physical property data on undefined mixtures of petroleum liquids. Data are being used to describe composition in terms of continuous distribution functions to describe phase equilibria and transport properties.

University Center for Energy Research
*J. Wagner*
*K. Ravi*
*A. Zare*
*N. Duranni*

### UCER Liquid Fossil Fuel

For this project, different aspects of hydrotreatment catalyst deactivation were studied which included poisoning of catalysts by nitrogen compounds, suppression of coke deposition by titanocene dichloride, regeneration of spent catalysts by supercritcal fluid extraction and activity of a novel molybdenum nitride catalyst.

University Center for Energy Research
*M. Seapan*
*Y. N. Lee*
*R. Smejkal*
*Z. Guohui*
*S. Wongrassamee*
*C. Kongkatong*
*B. I. Noh*
*W. Mahorankit*

# Civil Engineering

### AFSC Structural Impulse Loads

This project involves an analytical and experimental study of the behavior of reinforced concrete subjected to high intensity impulse loading. The program includes the study and identification of the modes of failure of concrete members.

U.S. Air Force
*A. E. Kelly*
*J. Mao*
*C. A. Hong*
*R. Aithal*

**Concrete Fracture Project**

Oriented toward offshore structures, an experimental study will evaluate the fracture mechanism of concrete at great ocean depths.

Conoco, Inc.
*J. P. Lloyd*

**Construction Scheduling Analysis**

This project pertains to the development of a computer scheduling model and evaluation of equipment utilization for construction of earth fill dams.

U.S. Army Corps of Engineers
*G. Oberlender*

**CUFRAM Analysis for Lock and Dam No. 1, Red River Waterway, LA**

Analyses of the lock structure for Lock and Dam No. 1 were conducted to determine if the structure could withstand excessive silt loads. Comparisons of analyses results with field data were made.

USAE Waterways Experiment Station
*R. C. Donahey*

**Durability of Concrete Made with Marginal Aggregates**

The crushed stone from many quarries in Oklahoma is susceptible to freeze-thaw damage and cannot be used for highway construction. This study is evaluating techniques to improve the durability of concrete made with such aggregate. Results will help lower construction and/or maintenance costs.

Oklahoma Department of Transportation
*J. P. Lloyd*

**An Evaluation of Methods to Assess Pesticide Transport to Deep Water Table Aquifers Under Irrigation Conditions**

The leaching potential of select pesticide groups under base case, no-irrigation conditions are being compared by simulation modeling to the leaching produced under two different irrigation schemes. The first is defined as "standard" conditions and consists of applying water at regular intervals throughout the growing season, while the second irrigation approach assumes that water is only applied when soil moisture conditions reach a specific level.

University Center for Water Research
*W. F. McTernan*
*J. A. Kovach*
*E. D. Mize*

**An Evaluation of the Uncertainties Associated with Pesticide Transport to Groundwater as Well as with Current Assessment Techniques**

Monte Carlo-based uncertainty analysis is being applied to an assessment of pesticide contamination probabilities as well as some parallel laboratory studies evaluating basic transport properties.

The Oklahoma Water Resources Research Institute
*W. F. McTernan*
*J. A. Pereira*
*Z. Chen*
*R. G. Petricek*
*P. S. Ho*

**Fatigue Damage to Steel Bridge Diaphragms, IH40 at Weatherford, OK**

Experimental and analytical research is being conducted to determine the cause of diaphragm cracking on a steel bridge in Weatherford, OK. Once the cause is isolated, the problem can be corrected and the likelihood of the same problem occurring in other bridges can be assessed.

Oklahoma Department of Transportation
*F. J. Zwerneman*
*A. West*
*J. V. Leeuwen*

**IPA Boundary Element Methods**

This research seeks to develop software for analyzing groundwater seepage and plate deflections by boundary element methods.

USAE Waterways Experiment Station
*G. S. Gipson*

**IPA Computer Interaction**

This project provides continuing support in the development of computer applications to solve engineering problems, especially in structural mechanics, and the finite element method of analysis. This work is in support of the research and development work of the Waterways Experiment Station associated with the Office, Chief of Engineers sponsored project of Computer Aided Structural Engineering (CASE). Short courses in advanced techniques for computer solutions of scientific and engineering problems are also being developed and presented.

USAE Waterways Experiment Station
*W. P. Dawkins*

**IPA Reservoir Analysis**

Baseline water quality data will be collected from six reservoirs and two rivers in Oklahoma along with four rivers in Kansas.

U.S. Army Corps of Engineers
*J. N. Veenstra*

**IPA River Management**

This ongoing project provides assistance in the project management of the North Canadian River above Lake Overholser study in the reconnaissance level investigation of potential alternatives to resolve water resources problems. Major tasks include the research and review of previous studies in the project area, assistance in the formulation and evaluation of potential alternatives, and assistance in the preparation of the reconnaissance level report.

Tulsa District Corps of Engineers
*V. A. Mast*

**IPA Soil Analysis**

This project involves research and analysis of soil consolidation under centrifugal forces.

USAE Waterways Experiment Station
*D. R. Snethen*

**IPA Soil Failure Mechanisms**

This research provides an academic approach to research in determining block movements and feasible failure mechanisms in existing structures.

USAE Waterways Experiment Station
*D. R. Snethen*

**IPA Water Management**

This project entails developing project plans for a multipurpose reservoir and dam.

U.S. Army Corps of Engineers
*V. A. Mast*

**IPA Water Planning**

Release plans for five reservoirs are being developed to help mitigate fish kills that can occur in the tailwater of each dam. Field data collected at each dam will be used in a computer program to predict downstream water quality. Each computer prediction will be verified by collecting water samples during a test release from each dam.

U.S. Army Corps of Engineers
*J. N. Veenstra*

**OCAST Test System**

A research equipment grant from the Oklahoma Center for the Advancement of Science and Technology (OCAST) has permitted the acquisition of a high-force material test system, a triaxial test chamber, and an acoustic emission instrumentation package. The equipment will study the strength of concrete in a simulated ocean environment.

Oklahoma Center for the Advancement of Science and Technology
*J. P. Lloyd*

**ODOT Asphalt Project**

This research involves characterizing the phenomenon of depression cracking in asphalt pavement and determining the cause.

Oklahoma Department of Transportation
*D. R. Snethen*
*S. A. Ahmed*
*J. P. Sims*

**ODOT Bridge Assessment Project**

Scour depths were determined at eight overflow structures of I-35 on the Cimarron

River as a result of the October 1986 flood. Maximum scour depths ranged from 10 to 30 feet. A report was submitted to ODOT. Scour problems were also addressed at U.S. 75 near Bartlesville. The results are being reviewed by ODOT.

Oklahoma Department of Transportation
*A. K. Tyagi*
*A. Araujo*
*S. Dassappa*
*J. Sims*
*J. Martel*
*T. Starr*

### ODOT Concrete Analysis

During the past year this project, which is broad in scope, has focused on the performance of sawed contraction joints in concrete pavement. The goal is to make these joints more durable which will decrease maintenance costs and improve the rideability of rigid pavements.

Oklahoma Department of Transportation
*J. P. Lloyd*

### Public Health Risks from Pesticides in Groundwater

Risk assessments are being completed for pesticide contamination of Oklahoma's shallow water table resources.

Oklahoma Center for the Advancement of Science and Technology
*W. F. McTernan*
*L. Chen*
*K. Musser*
*T. Garner*

### UCER Boundary Elements

This project involves the development of 3-D boundary element software to analyze the storage of gaseous media within salt domes.

University Center for Energy Research
*G. S. Gipson*
*J. C. Ortiz*
*H. G. Walters*

### WES Optimal Water Distribution System Design

This project involved modifying and improving the computer program WDSOPT, which determines least cost designs of water distribution systems. An effort was initiated to incorporate reliability measures into the model so as to determine low cost reliable systems.

USAE Waterways Experiment Station
*K. Lansey* and *C. Basnet*

### WES Structural Systems

This research involves the generation of nonlinear soil-response curves for floodwall structures utilizing the special nonlinear plane strain finite element technique which was previously developed. The curves obtained will be put in a form suitable to be adapted to a design-oriented computer program for "soil-structure interaction"-type analysis.

USAE Waterways Experiment Station
*M. Oner*
*W. P. Dawkins*
*I. S. Hallal*

## Electrical and Computer Engineering

### Aircraft Model-Follower Design

This research project will examine modifications to the multiple-model adaptive flight control algorithm and apply several multiple-model adaptive control methods to models of an oblique wing aircraft.

Boeing Military Airplane Company
*M. T. Hagan* and *C. E. Goodner*

### Artificial Intelligence and Expert System Development

Artificial intelligence concepts and techniques are being applied to electronic product configurators and other company projects. Human expertise and experience is being imbedded in special software to enhance the productivity of company employees in manufacturing, marketing, service and corporate management.

Memorex Telex Corporation
*C. M. Bacon*
*P. Baker*
*J. Hensley*
*D. Bono*
*P. Niezgoda*
*F. Shabestari*

### CDC Pattern Recognition

Statistical pattern recognition theory is being used to develop a classifier for read/write heads used in the manufacture of disk drives.

Control Data Corporation
*J. W. Cartinhour* and *J. Huang*

### A Digital Control Loading System

The Digital Control Loading System is a subsystem of flight simulators that are currently designed and built by Flightsafety International. These highly sophisticated and complex systems are utilized in training pilots to fly a wide range of aircraft including airliners as well as helicopters. The digital control loading system is designed to give the pilot tactile feedback that accurately reproduces sensations experienced during actual flight.

Flightsafety International
*M. T. Hagan*
*Y. Hamalainen*
*C. Latino*
*N. Sammur*

### ECEN Signal Processing

This project is developing techniques for digital analysis and geologic identification from the electromagnetic measurements of oil well bore holes.

Mobile, Texaco, Amoco, Britoil, Cities Services, Phillips
*R. Yarlagadda*
*J. L. Lansford*
*D. P. Ragusa*
*Z. Al-Shaieb*
*R. G. Hayes*
*G. Li*
*J. Saar*
*A. Kusmanoff*
*J. K. Otto*
*V. A. Tigert*

### Engineering Energy Lab II

Studies are underway to explore the possibility of converting low-grade thermal energy directly to electricity, and on the application of knowledge-based expert systems for design of energy systems with multiple inputs and multiple outputs.

Oklahoma Gas & Electric Company, Public Service Company of Oklahoma, The Empire District Electric Company
*R. G. Ramakumar*
*W. L. Hughes*
*I. Abouzahr*

### Multiprocessor Research

Signal processing and communication algorithms for implementation on a special purpose concurrent computer are being developed. The goal is to produce a versatile real-time signal processing system using multiple digital signal processors in a parallel configuration.

Department of Defense
*K. A. Teague*
*L. Campbell*
*S. Tapp*
*R. Bentley*

### MOST Hypercube Systems

An Intel iPSC/2 hypercube topology computer system was purchased. The system consists of 32 high-speed processor nodes and is being used to support advanced research in signal processing, image processing, and machine vision.

Oklahoma Department of Commerce
*K. Teague* and *R. Daniel*

### NSA Speech Coding

This project is developing innovations and practical aspects of speech processing, coding, voice communications, channel simulation, digital signal processing and computer science.

The National Security Agency
*R. Yarlagadda*
*C. Kriel*
*J. Lansford*

### ONR Signal Processing

The ECEN hypercube computer system is being used to develop an interactive image processing system. Additional work includes the application of parallel superquadric description for machine vision, neural networks for image smoothing, parallel techniques for pattern recognition, image coding and parallel ray tracing.

Office of Naval Research (and DARPA) and Oklahoma Department of Commerce
*K. A. Teague*
*F. Esfahani*
*R. Daniel*
*M. Carter*
*J. Baek*

### ONR Signal Techniques

This project is developing techniques for the parallel implementation of $L_p$ and $L_1$ deconvolution methods of signal processing.

Office of Naval Research
*R. Yarlagadda*
*C. Kriel*
*A. Kusmanoff*

### PSO Interactive Systems

The goal of this project is to develop simple and easily-usable models for insolation in north-central Oklahoma based on the data collected by the PSO/OSU Insolation Monitoring Station located in Stillwater, OK.

Public Service Company of Oklahoma
*R. G. Ramakumar*
*C. Tan*
*I. Abouzahr*

### PTI Design Analysis

This project analyzed the design of three systems: the current design approach, an IBM/PC approach with partial message transfer, and an SCSI bus approach with partial message transfer.

PHI Technologies, Inc.
*C. G. Hutchens*

### Sandia Coding Project

Analysis and implementation techniques are being developed for test components in the areas of linear predictive coding, data synchronization and encryption. This effort supports the DOE SECOM communications system development program entitled SECOM IV.

Sandia National Laboratories
*R. Yarlagadda* and *M. Wilcox*

### Supply Line Testing of Digital CMOS Circuits

Investigations are underway on the feasibility of observing single open and short faults as excess current on the supply line of digital CMOS circuits. Multiple faults may also be observed.

Rome Air Development Center
*L. G.Johnson*
*K. S. Hsu*
*D. Liu*

### Telex Support Program

The goals of this project are to guide Memorex/Telex in the technical aspects of the local area network market—specifically, including the IEEE 802 standard gateway and bridge design, statistical network monitor and management, and data security.

Memorex/Telex of Tulsa
*C. G. Hutchens*
*S. Joseph*
*H. Ju*
*S. Jalaladdine*

### Weaver Demodulation Circuit Design

The goal of this project is to design an ultrasound detection circuit based on the Weaver demodulation technique which will result in improved depth of field resolution.

Amoco Production Company
*C. G. Hutchens*

## Industrial Engineering & Management

### ATT/CIM Program

The purpose of this project is to develop a new approach to the modeling of advanced manufacturing systems using object-oriented programming. This approach will facilitate the development of a family of simulation models which will provide a comprehensive methodology for designing and evaluating advanced manufacturing systems.

AT&T Foundation
*J. H. Mize*
*T. Beaumariage*
*J. W. Nazemetz*
*C. Karacel*
*P. Farrington*

### Autovidrio, S.A. (Ford Glass) Post-Production Audit

A unique double sampling scheme for post-production audit of automotive glass has been developed. This computerized audit scheme is based on the Limiting Quality concept, and utilizes a zero acceptance number on the first sample. Specific performance measures are generated, including average total inspection and average outgoing fraction nonconforming.

Autovidrio, S.A. (Ford Motor Company)
*K. E. Case* and *L. Raiman*

### EADC Program

This project includes conducting energ audits of small and medium-sized industri firms to determine their energy demand an costs; documenting plant practices; identif ing sources of energy consumption; an recommending areas for profit improvemer through energy management.

University City Science Center/U.S. Depar ment of Energy
*C. B. Estes*
*K. Kraft*
*M. Hanna*
*B. Vengatesh*
*W. C. Turner*
*S. Seah*
*M. Thomas*
*J. St. Pierre*
*S. Hong*
*S. Moses*

### OPA Energy Audits

All state buildings operated by the Okla homa Office of Public Affairs are beinç closely researched by the team to find way to reduce energy costs. Many exciting state of-the-art energy management ideas ar being examined.

Office of Public Affairs and the Governor' Office
*W. C. Turner*
*S. Moses*
*M. Rahman*
*J. Wong*
*K. Kraft*
*M. Duffer*
*B. Eaton*

### OSDH Systems Design

Information systems are being devel oped for expenditure reporting of local fund and for environmental health quarterl reporting. These systems are for use at th county health department level as well as i the Oklahoma State Department of Health

Oklahoma State Department of Health
*M. Branson* and *J. Weeks*

### OSU Hazard Communication

A model hazard communicatio (employee right to know) program wa developed for Oklahoma State University

Oklahoma State University
*W. C. Turner* and *D. Blackshare*

### OSU Performance Analysis

The goal of this project was to evaluat ergonomic aspects of trash handling by OS janitorial staff. Study of dumpster design t eliminate back and/or traumatic injury wa performed.

Oklahoma State University
*J. W. Nazemetz* and *G. McLain*

### PCHD Technical Assistance

Technical assistance is provided to Payne County Health Department to increase the effective utilization of personal computers.

Payne County Health Department
*M. Branson* and *J. Prather*

### UCER Continuous Flow Process Manufacturing

Statistical process control filters have been designed to operate in conjunction with continuous process PID control algorithms. These filters include the X-bar chart, Moving Average chart, and Individuals/Moving Range chart. This work is of interest in the process industries such as chemicals, refining, mining, foods, etc.

University Center for Energy Research
*K. E. Case* and *J. R. English*

### UCER Industrial Partners

A proposal to develop an industrial consortium for joint research in energy, water and hazardous materials/waste was developed. This program would involve OSU and participating industry.

University Center for Energy Research
*W. C. Turner*

## Mechanical and Aerospace Engineering

### AFSC Hydraulic Technology

A feasibility study is currently being conducted to determine the use of Critical Volume Reservoirs (CVR) in military vehicles. Analytical and experimental studies are being carried out to completely specify CVRs for current production and prototype vehicles.

U.S. Army
*J. G. Eleftherakis* and *W. Rapheal*

### ASME Machine Dynamics

Research study was conducted to identify research opportunities in machine dynamics. Six areas were identified: kinematics, robotics, dynamics of multi-body system, modeling simulation, experimental methods, computers, computational techniques and AI.

American Society of Mechanical Engineers
*A. H. Soni* and *D. P. Sathyadev*

### Basic Fluid Power II

This is a subscriber membership program which provides information and research of general interest to the sponsors.

Various Industries
*J. G. Eleftherakis* and *I. T. Hong*

### CDC Gimbal Styles

This project was an experimental and analytical evaluation of the flying height characteristics of read/write heads above a Winchester disk surface.

Computer Data Corporation
*J. K. Good* and *R. K. Brown*

### DPI Design Manual

This project developed a hydraulic design manual with special emphasis on contamination control theory and application.

Designers & Planners, Inc.
*I. T. Hong*

### Dynamic Analysis of Walls and Roofs

Building walls and roofs were categorized according to thermal response characteristics for the purpose of heating/cooling load calculations. This was a part of an ASHRAE project, RP472.

Ayres-Sowell Assoc., Fullerton, CA
*F. C. McQuiston* and *S. M. Harris*

### ED Facilities and Equipment Grant

Under this program, funds were provided for renovation of space to house the Robot Design Lab, Manufacturing Processes Lab, and Biomechanics Lab. Funds were also provided to purchase equipment for the research programs involved.

U.S. Department of Education
*K. N. Reid* and *L. L. Hoberock*

### EPRI Heat Exchanger Vibrations

This project conducted visualization and measurements of flow instabilities in multi-row tube bundles; measurement of lift forces on displaced tubes; and observation of flow-induced vibrations of tubes in closely spaced arrays.

Electric Power Research Institute
*P. M. Moretti* and *M. Cheng*

### GE Physical Modeling

The goals of this ongoing project are to investigate and characterize the mechanical properties of modeling materials in terms of their behavior at different temperatures and strain rates. In addition, a physical modeling facility and techniques suitable for full- or half-scale instrumented modeling of various shapes and configurations for forging, extrusion, and ring rolling operations are being developed.

General Electric
*D. R. Durham*

### GPI Rating Analysis

The goals of this research are to develop an interactive, computer-aided analysis program to assist in the rating of large rotation bearings and to analyze the material process used and recommend new and/or improved materials and processes.

Gear Products, Inc.
*T. A. Cook*
*C. Weakley*
*C. E. Price*
*U. Moeker*

### MAE Web Handling Center

The mission of this unique Center is to conduct fundamental engineering research in the specific area of problems relating to the running and handling of materials in continuous strip (web) form through process machines. In addition, a key objective of the Center is to transfer fundamental information underlying the design of web handling machines and processes to practitioners in Oklahoma and throughout the nation.

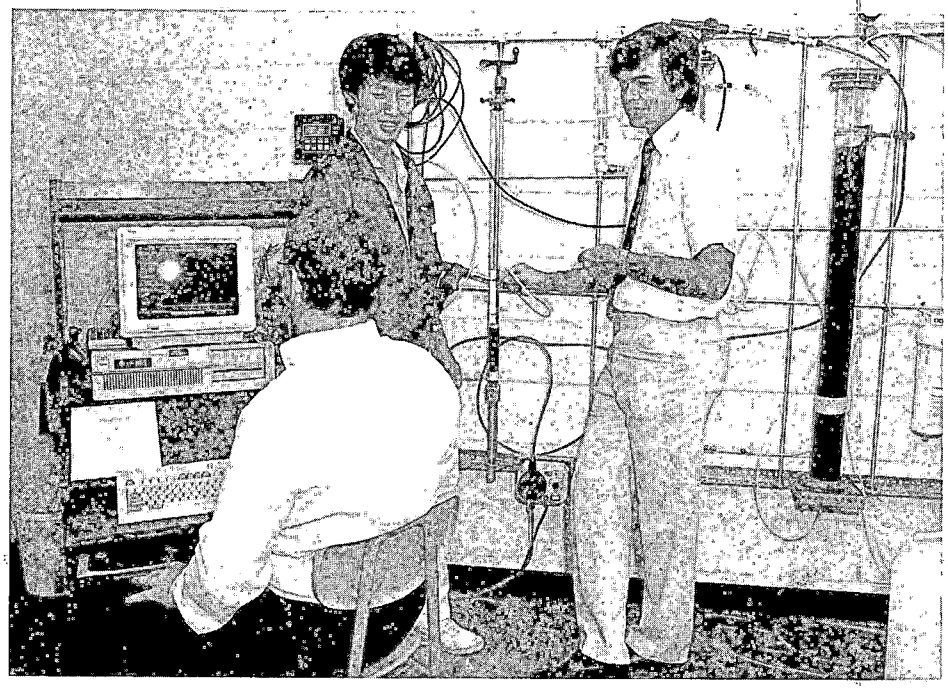
Foundations:
National Science Foundation
Kerr Foundation
Noble Foundation
Industrial Sponsors:
Beloit
Eastman Kodak
E.I. DuPont
Fife
IBM
Mead
3M
Mobil Chemical
Polaroid
Union Camp
Valmet-Appleton
Xerox
*K. N. Reid*
*J. K. Good*
*J. J. Shelton*
*D. R. Durham*
*R. L. Lowery*
*F. O. Thomas*
*B. A. Feiertag*
*J. Mize*
*G. Young*

### Projects, Principal Investigators, and Associates

**Mechanical Behavior of a Web During Winding**
Principal Investigators: *J. K. Good* and *J. J. Shelton*
Project Associate: *Z. Wu*

**Mathematical Modeling of Air Entrainment in Web Handling Applications**
Principal Investigator: *F. O. Thomas*
Project Associate: *M. Basheer*

**Aerodynamics Analysis of Discrete Webs**
Principal Investigator: *F. O. Thomas*
Project Associate: *T. Scott*



*Dr. Gary Foutch, chemical engineering professor, discusses a mixed-bed ion-exchange experiment with his graduate students.*

**Measurement of Radial Modulus of Elasticity**
Principal Investigator: *R. L. Lowery*
Project Associates: *Y. B. Chang* and *Seung-Woo Rhee*

**On-Line Tension Measurement**
Principal Investigator: *R. L. Lowery*
Project Associate: *M. Bradley*

**Web Stresses Induced by Spreading Devices**
Principal Investigator: *J. K. Good*
Project Associates: *G. Kliewer/M. Magill/R. Delahoussaye*

**Web Material Effects on Wrinkling Instability—Experimental and Computer Analysis**
Principal Investigator: *D. R. Durham*
Project Associates: *S. Robertson* and *D. Pierce*

**Web Wrinkling—Prediction and Failure Analysis**
Principal Investigator: *J. K. Good*
Project Associate: *K. Metzinger*

**Dynamic Interaction of Web Spans**
Principal Investigator: *G. E. Young*
Project Associates: *J. J. Shelton* and *B. Fang*

**Control of Web Handling Processes Incorporating Uncertainty and Delay**
Principal Investigator: *G. E. Young*
Project Associates: *J. J. Shelton* and *C. Kardamilas*

**Distributed Control of Tension in a Web Handling System**
Principal Investigator: *K. N. Reid*
Project Associates: *J. J. Shelton* and *K. H. Shin*

**Dynamic Coefficient of Traction Between Web Media and Rollers**
Principal Investigator: *J. K. Good*
Project Associate: *K. Ducotey*

Ft34On-Line Information Retrieval Systems
Principal Investigator: *J. H. Mize*
Project Associates: *D. Roisum* and *D. Spurrier*

**Surface Stress as a Cause of Troughing in Free Spans of Webs**
Principal Investigator: *J. J. Shelton*

**Out-of-Plane Dynamics of a Moving Web**
Principal Investigator: *P. M. Moretti*
Project Associates: R. L. Lowery and D. G. Lilley

**Tension Distribution Across a Web**
Principal Investigator: *S. Y. Liang*

**The Measurement of Stresses During Roll Winding**
Principal Investigator *J. K. Good*
Project Associate: *D. A. Roisum*
23 graduate research assistants

**NSF EPSCoR - Durham (25)**

This reserach is to investigate the behavior of investment cast austenitic stainless steel, CF3M, to improve the methods of developing fracture toughness of cast products.

National Science Foundation
*D. R. Durham*

**OSU Chilled Water Study II**

Work has continued on the computer model to predict performance of the chilled water distribution system. Performance of the system is presently hindered by deposit buildup in air-handler coils. Engineering North on the OSU campus has been modified and is presently performing at near optimum. Additional buildings will be modified in the near future and performance monitored.

OSU Physical Plant
*J. D. Baker* and *J. Bogert*

**Sandia Impact Loads**

The purpose of this research is to develop a digital simulation of the drive trains used in two-axis solar trackers. Using the simulation code, researchers perform parametric studies to determine the magnitudes of the various impact loads that occur in the drive train.

Sandia National Laboratories
*T. A. Cook*

**TSF Program**

This program is a subscriber membership which provides information and research in the area of tribological fluids, both mineral-based and synthetic, which is of general interest to the sponsors.

Various Industries
*J. G. Eleftherakis*
*P. Taylor*
*I. T. Hong*
*P. Rogers*

**UCC Energy Control Systems**

The objective of this project was to organize meetings and seminars of industrial and academic experts to recommend long-range goals and priorities to the Department of Energy and Oak Ridge National Laboratory for research in intelligent machines for unstructured, energy-related environments.

Union Carbide Corporation
*K. N. Reid*

**Volvo Actuator Systems**

This project studied the modern control theory and its application to hydraulic control systems. The adaptive control and learning control principles were investigated.

Volvo Company
*I. T. Hong*
*T. Ito*
*Y. M. Goh*

## Technology

**AFSC Battlefield Obscurants**

A program was developed based on theoretical and empirical relationships to evaluate the effects of variable wind vectors on smoke obscuration predictions. Excellent agreements between trial data and program prediction data were obtained. The COMBIC

nodel was modified to generate new obscu-ation effectiveness data for use with ıicrocomputers. A program was developed ɔ quickly access and sort the data.

oint Technical Command Group/Munitions :ffectiveness and the Smoke Aerosol Work-ıg Group
*1. D. Smith*
*:. D. Latino*
*1. W. Bateman*
*?. G. Ketchum*
*(. D. Honeycutt*
*:. P. Tucker*

**:PA Feasibility Study—Drilling Fluid ıs a Plugging Agent**

A facility is being constructed to ɔxperimentally evaluate mud as a plugging ıgent when subjected to peripheral injection rom disposal or water flood wells. Evalua-ion will be done under various scenarios.

J.S. Environmental Protection Agency
*M. D. Smith*
*I. Mayberry*
*3. Day*
*3. F. Stewart*
*3. Holloway*
*.. Rogers*
*?. Perry*
*3. Buchholz*

**:PRI Gound Coil Project**

A soil and rock classification manual has ɔeen developed to be used in conjunction with the design of heat pump, ground heat exchangers. Design values for soil and rock :hermal conductivity and diffusitivity are ɡiven.

:lectric Power Research Institute
*J.E. Bose*

**NRECA Heat Pump Manual**

The development of an Installation Guide for Closed-Loop/Ground Source Heat Pump Systems has been completed. Sections include heat pump operation, building heat-ing and cooling loads, ground heat exchanger design, performance checking, and anti-freeze solutions.

National Rural Electric Cooperative Associ-ation, Washington, D.C.
*J. E. Bose*
*D. Adams*
*F. McQuiston*
*F. Eckhart*
*B. Weaver*

**Technology Jordanian Project**

Civil engineering technology teachers from Jordan received additional training in their specialty and worked closely with OSU professors to develop teaching materials and abilities.

Fourth World Bank
*R. F. Neathery*
*G. R. McClain*
*C. L. Martin*
*D. J. Bayles*
*G. D. Oberlender*
*J. C. Scheihing*

**Technology Pakistan Project**

The purpose of the project was to upgrade and update the technical skills of 52 polytechnic teachers from Pakistan. This was accomplished by placing the teachers in regularly scheduled classes on an audit basis, involving them in laboratory work and in specially designed classes, and by industrial visits.

Ministry of Education of Pakistan
*L. D. Jones*

## Eglin Field Office

**AFSC Effectiveness Manual XI-Eglin**

This contract provides methodology and computational support in technical and analytical studies directed by a tri-service steering committee for munitions effectiveness. It also provides the publishing capability for the initial and revised copies of the various publications resulting from the coordinating group's efforts.

U.S. Air Force
*J. F. Wolff* and various other professional and technical personnel

## Electronics Laboratory

**BAC Aircraft Instrumentation**

Research is being conducted to develop a conceptual model of a smart aircraft instrumentation display. The display is to be self-contained and capable of reading mail from a high-speed fiber optic bus.

Boeing Aircraft Co.
*T. Bertenshaw*

**Engine Cell Investigation**

The chief innovative feature of the design for this project is that the test cells will be able to take all the test results and assist the operator in the decision-making process with respect to pass-fail criteria. If a serious problem should exist with the engine under test, the microcomputer will notice it sooner and react faster, having the ability to shut down the testing process so as to prevent possible serious damage to the new engine. In addition, a data base will be available to management personnel that can be utilized for personnel productivity measurement and pass-fail statistical analysis.

Mercury Marine
*S. I. KraemerlS. L. Hill*

**SVC Rocket Systems**

This project is to design, develop, test, deliver and provide ground support for a PCM telemetry system to be flown on an AIRES sounding rocket in support of upper atmosphere research under the auspices of the U.S. Air Force.

Space Vector Corporation
*T. Bertenshaw*

**Telemetry Instrumentation**

This project is to provide design, development, fabrication, integration and ground support for the telemetry requirements of the Air Force Geophysics Lab in upper atmospheric research.

Air Force Geophysics Laboratory
*T. Bertenshaw*

## Extension

**IPA Management Study**

The goals of this project are to observe and evaluate maintenance procedures at Corps of Engineers Recreation project sites and to make recommendations for improved productivity and cost savings.

U.S. Army Corps of Engineers
*J. E. Shamblin*

**ODOT Fabric Project**

This research conducted field installations and evaluations, and prepared a manual and slide/tape program for local road supervisors on installation of geotextiles on rural unpaved roads.

Federal Highway Administration
*J. HopkinslD. HarnlylJ. PadenlD. Wright*

**ODOT Safety Training**

This project provided one-day seminars to ODOT maintenance personnel. Seminars covered proper traffic control in maintenance zones. Examinations were given and results were submitted to ODOT.

Oklahoma Department of Transportation
*J. Hopkins*
*S. Viner*
*J. Paden*
*D. Wright*

**ODOT/RTAP Program**

This project provided technical assistance, training and technology to rural

towns and counties in the area of transportation systems.

Federal Highway Administration through the Oklahoma Department of Transportation
*J. E. Shamblin*
*D. Wright*
*J. Hopkins*
*J. Paden*

**OHSO County Program**

This project assisted counties in identifying hazardous site locations on county roads and developed corrective actions to be taken.

Oklahoma Highway Safety Office
*J. Hopkins*
*D. Harnly*
*J. Paden*
*D. Weston*
*D. Wright*

**OHSO Traffic Control**

For this project, a handbook was developed that graphically depicts proper signing in maintenance zones on county roads and city streets. Five thousand pages of the handbook were printed under the contract.

Oklahoma Highway Safety Office
*J. D. Paden*
*J. Hopkins*
*D. Wright*

**Oklahoma Civil Defense Training**

Hazardous material training is provided to emergency responders in Oklahoma in order to improve communities' abilities to respond to hazardous materials emergencies as per SARA Title III.

Oklahoma Civil Defense
*N. J. Trench*

**SAI Education Training**

This project provided technical assistance and training to county officers and deputies in the offices of County Assessor, County Commissioners, County Clerk, County Treasurer and Court Clerk.

Office of the State Auditor & Inspector
*J. E. Shamblin*
*J. Hopkins*
*C. Maule*
*D. Wright*
*D. Weston*
*J. Paden*
*G. Holland*
*T. Lyons*
*D. Harnly*
*D. Willett*

**Rockwell International Cable**

This project is for the full scale burning of telecommunication cable configurations to simulate actual installations in order to draw conclusions about the flammability and smoke generation characteristics. This project was conducted for the Collins Transmission System Division, Richardson, TX.

Rockwell International
*N. J. Trench*

**Rockwell International Component**

Fire Service Training tested 456 telecommunication component parts in order to draw conclusions about the flammability characteristics. The UL 94 needle flame test and the oxygen index test were used. This project was conducted for the Collins Transmission System Division, Richardson, TX.

Rockwell International
*N. J. Trench*

**Rockwell International Flammability**

This project is to test telecommunication component parts in order to draw conclusions about the flammability characteristics. The UL 94 needle flame test and the oxygen index test are used. This project was conducted for the Wescom Division, Downers Grove, IL.

Rockwell International
*N. J. Trench*

# College of Home Economics

***Some research in home economics is designed to provide results directly to families and some to groups serving families.***

The College of Home Economics is involved in research that studies the family in the context of an individual household and/or community perspective. The focus is on issues related to family both from an experimental and applied research methodology approach and contributes knowledge in areas of concern to families and to programs and businesses serving families. Research projects in fiscal year 1988 focused on one or more of the following areas: Consumer Economics and Family Resource Use (2 projects); Individual and Family Environments (7 projects); Physiological Health and Development (15 projects); Community Services and Public Policy—5 projects).

These projects were conducted by 25 faculty members in home economics with the support of 14.12 FTE graduate assistants and associates.

Cooperative relationships among research, cooperative extension, university extension and resident instruction contribute to relevance of the research results. Research projects are planned with counsel from professionals, business personnel and selected lay persons. Networks of communication include the cooperative extension service, educational systems at all levels, government agencies, business, industry, and private industries. Some research is designed to provide results directly to families and some to groups serving families such as educators, extension home economists, health related personnel, human services professionals, policymakers, and persons in business and industry.

Financial support for the research in home economics for fiscal year 1988 was from state, federal and private funds. The Oklahoma Agricultural Experiment Station supports research in six projects. These projects related to two of the national research initiatives: Interrelationships of Food and the Nutritional and Health Status of People, and Rural Family and Community Well Being. These projects include research in human nutrition, housing and affordability, family resource management and functional clothing design.

Other types of research within the College of Home Economics focus on Creativity, Child Development and Training Programs, Child Abuse, Employability of Women and Labor Availability, Functional Clothing and Merchandising, Historic Clothing, Food Safety, and Preferences and Management in the Food Service Industry.

Sources of support for the projects listed include the American Crystal Sugar Company, American Home Economics Association Foundation, Agricultural Research Service, College of Home Economics, Cooperative State Research Service, Department of Human Services, Department of Mental Health, Department of Commerce, Oklahoma 4-H Foundation, Oklahoma Extension Homemakers Council, Oklahoma Pecan Commission, Provesta Corporation, Small Business Administration, State Department of Vocational/Technical Education, University Center for Energy Research, University Center for Water Research, and the United States Department of Agriculture.

# Clothing, Textiles and Merchandising

### The Clothing and Textiles of Oklahomans, 1850 to 1920

The *Oklahoma Indian and Pioneer Papers*, a 116 volume compilation of interviews with approximately 8,000 early Oklahoma settlers, is being searched for information pertaining to the production and use of clothing and textile products. Emphasis has been given to ascertaining the methods by which the settlers used available resources to overcome deprivation, and methods by which they attempted to maintain respectability and fashionability despite isolation and adversity. The collected data are being computer filed and cross-referenced, which will facilitate retrieval and analysis of such a large body of information. Preliminary results provide unique insights into early domestic life in Oklahoma, and at the conclusion of the project, the collected data will provide a variety of analysis opportunities.

State of Oklahoma
*L. Richards*
Graduate Assistant: *S. Putnam*

### The Relative Importance of Saleability Cues in Making Unit Purchase Decisions

A study is being conducted to determine the relative importance of saleability cues in making unit purchase decisions. Saleability cues include quantitative and qualitative cues. Survey and experimental research designs will be used.

State of Oklahoma
*L. Jolly*
Graduate Assistant: *C. Anthony*

### Reducing Pesticide Exposure of Applicators Through Improved Clothing Design and Care

A two-phase study was conducted to evaluate six flame resistant fabrics on their pesticide barrier protection and flame protection properties in order to initiate research aimed at developing protective clothing for aerial applicators. A follow-up study is now underway to determine changes in the flame protection properties of the same six test fabrics that have been pesticide-contaminated.

Oklahoma Agricultural Experiment Station
*D. Branson*
Graduate Assistant:*S. Weinzier*

### Limiting Pesticide Exposure Through Textile Cleaning Procedures and Selection of Clothing

This 5-year study was completed and two regional bulletins have been written. One summarizes the laboratory studies including pesticide penetration and decontamination work; the other summarizes the survey data on growers' attitudes and practices regarding pesticide use and clothing. Articles have also been published this year.

Oklahoma Agricultural Experiment Station
*D. Branson*
Graduate Assistant: *S. Weinzier*

*Dr. Donna Branson and research assistant Sharon Weinzierl review results of pesticide residue afte laundering clothing.*

### Development of Prototype Protective Gloves for Pesticide Users

The problem of wearing protective gloves and the resulting thermal stress including elevated skin temperature and increased sweat rate was examined. An experimental study designed to investigate the use of psychophysical methods fc measuring moisture sensation was cor ducted in an environmental chamber. Thes results are being used to plan future studie

State of Oklahoma
*D. Branson*
Graduate Associate and Graduate Assistan
*M. Sweeney* and *C. Staubus*

### Decision-Making Criteria for Successful Retail Buyers

The Center for Apparel Marketing an Merchandising (CAMM) is conducting nationwide survey of apparel buyers of sm retail businesses concerning the decisio making process when making merchandis

ınd vendor selections. The data will provide ıformation regarding the relative importance ıf various selection variables and informaion sources when making purchase decisions. The relationship between selection ıriteria and perceived satisfaction with store ıerformance is also being examined.

State of Oklahoma
*.. Good*
Graduate Associate:
*I. Arbuthnot*

**Small Business Administration Management Counseling**

The Center for Apparel Marketing and Merchandising (CAMM) conducts case studies of small apparel retail businesses in conjunction with undergraduate classes which are divided into teams. Recommendations are made concerning merchandising and management strategies which the retailer might implement. Four cases are completed each year through contractual arrangement with the Small Business Institute of SBA.

U.S. Small Business Administration, Small Business Institute.
*.. Good*
Graduate Associates: *J. Arbuthnot* and *J. Volpp*

## Family Relations and Child Development

**4-H Incentives Project**

We are developing a 4-H game that can be used to help 4-H members and adults better understand the 4-H program and the relationship between the different components of the program. The project is also investigating the effects of 4-H rewards on the retention of 4-H members in Oklahoma.

Oklahoma 4-H Foundation
*I. Weber* and *J. McCullers*
Graduate Associate and Graduate Assistant:
*S. Forbes* and *D. Daniels*

**Creation of a Database of Child and Parent Measures at the Child Development Laboratories**

A database was established providing for longitudinal data collection for children attending the OSU Child Development Lab School. Primary measures included cognitive and personality measures from the children and parental attitude measures from the parents. This database will allow for retrospective as well as concurrent research in the CDL.

State of Oklahoma
*I. Moran* and *D. Couchenour*
Graduate Associate and Graduate Assistant:
*I. Dance* and *P. Zarpoush*

**Identifying Correlates of Creative Potential**

Refinement of theoretical model depicting creative potential in preschool children continued. Major studies involved the exploration of gender differences in creative potential from 4 to 9 years of age, a developmental study of children's visual and tackle exploration of materials in relation to ideational fluency, and the relationship of creativity to language function and structure of activities in the preschool classroom.

State of Oklahoma
*J. Moran*
Graduate Assistant and Graduate Associate:
*S. Gilliland* and *E. Bruce*

**Oklahoma Training for Child Care Careers**

Development and pilot testing of training materials for caregivers working in day care centers and family day care homes throughout Oklahoma. Evaluation of training impact shows improved job performance and attitude enhancement as well as knowledge and skills increase among caregivers.

Oklahoma Department of Human Services
*B. Stratton*

**Payne County Child Abuse Prevention Project**

The purpose of the research is to determine if a relationship exists between self esteem, knowledge of child development, behavioral expectations of children, and the potential for child abuse among an adolescent parent and expectant parent population. The data are in the process of being analyzed and results are not yet available.

State of Oklahoma
*A. Fulton* and *K. Murphy*
Graduate Assistants and Graduate Associates:
*D. Ingram*
*L. Pickard*
*J. Garthoeffner*

**Rewards and the Internalization of Values**

Work continued on the adverse effects of rewards on moral reasoning in adults, the learning process in children, and on the internalization of values within youth programs. This work is being related to a theoretical view being developed by the principal investigator and his colleagues based on the concept of reward-produced regression.

State of Oklahoma
*J. McCullers*
Graduate Assistants: *S. Putnam* and *C. Swiacki*

**Establishment of the Marriage and Family Diagnosis Research Laboratory**

Development of a research facility capable of using state of the art marriage and family diagnostic instruments with couples and families seeking family therapy. Identification and procurement of new assessment tools and the completion of pilot studies developing theoretically based diagnostic batteries uniquely qualified to provide therapeutic information on the most difficult family problems. The Laboratory will eventually be available to contract for diagnostic services to local and regional therapy centers.

State of Oklahoma
*D. Fournier*
Graduate Associates: *B. Rogers* and *C. Anderson*

## Food, Nutrition and Institution Administration

**Effect of Fiber on Gastrointestinal Function in Man**

Insufficient consumption of dietary fiber has been implicated in numerous human disorders including cardiovascular disease and cancer. The function of fiber in the digestive tract and its health effects, however, are poorly understood. The objective of this research is to elucidate the effects of dietary fiber source differing in chemical composition and physical properties on digestion in humans. Studies are being conducted to evaluate digestibility, passage time and fermentation of fiber in pigs and human subjects consuming various types of dietary fiber.

Oklahoma Agricultural Experiment Station
*C. Hanson*
Graduate Assistants and Technicians:
*K. Burch*, *F. Katkhordeh* and *M. Trail*

**MOST (More Oklahoma Science and Technology) Research Equipment Grant**

These research equipment matching funds were used for the purchase of fiber analysis equipment for determining soluble and insoluble fiber, cellulose, hemicellulose, and lignin in food and digests samples.

Oklahoma Department of Commerce, Division of Science and Technology
*C. Hanson*

**Sugar Beet Pulp: A Dietary Fiber for Human Consumption**

The objectives of this research were to help clarify the effects of consumption of vegetable fiber on gastrointestinal function. The effect of sugar beet fiber on intestinal passage rate, blood lipids and cholesterol levels and on digestibility of minerals was evaluated in pigs and human subjects. Oxalic acid excretion in urine of human subjects consuming beet pulp and effect of beet

fiber on intestinal bacterial function also was examined.

American Crystal Sugar Company
*C. Hanson*
Graduate Assistants and Technicians:
*M. Trail*
*K. Burch*
*F. Katkhordeh*

**Quality Assurance in Fruits and Vegetables: Post-Harvest Treatments to Delay Vegetable and Fruit Deterioration**

The influence of waxing, mechanical sorting and cold storage on the quality, shelf life and nutritional value of turnips were studied. Waxing of turnips resulted in improving appearance, increasing shelf life, reducing moisture losses and maintaining the nutritional value of turnips. Mechanical injury resulting from dropping the turnips in and out of the mechanical sorter was responsible for some discoloration. This discoloration was due to the oxidation of phenolic substances to quinones.

Cooperative State Research Service
*L. Ebro* and *I. Wahem*

**Investigation of Oil Extraction Methods for Use in Oklahoma Pecans**

Extensive literature search indicated supercritical-fluid extraction should be investigated in addition to the present n-hexane extraction method developed by the present researchers.

Oklahoma Pecan Commission
*M. Walters* and *S. Knight*
Graduate Associate: *T. Smith-Nwobilor*

**Sugar and Sweeteners in Processed Foods and Drinks: A Pilot Study of the Nutrition and Consumer Behavior Trends for the Mid-1980s**

The purpose of this research was to survey a sample population (Oklahoma Extension Homemakers Association and American Home Economics Association) on issues related to food safety, nutrition, types of processed foods and drinks, purchasing selection criteria, attitudes, behavior in the marketplace, perceived pricing relationships, overall health awareness and beliefs with respect to sugar and alternative sweeteners. The findings of this study provided increased understanding of the factors influencing consumer behavior in the selection of foods and beverages containing sugar and sweeteners.

State of Oklahoma, American Home Economics Association Foundation
*E. Winterfeldt*
*J. Leong*
*J. Stewart*
Graduate Assistant:
*D. Zink*

*Dr. Barbara Stoecker and graduate assistants Nancy Cheng, Carol Seaborn and Marie Campbell examine guinea pigs used in a trace mineral study.*

**Snack Foods: Consumer Preferences, Attitudes, Interests, and Opinions from a Diet-Health Perspective**

This research was conducted to determine the level of nutritional awareness, purchasing behavior, psychological mood status, environmental influences, and needs relative to the consumption of snack foods by university students and by individuals residing in standard metropolitan areas.

State of Oklahoma, American Home Economics Association Foundation
*J. Leong* and *J. Stewart*
Graduate Associate and Graduate Assistant:
*D. McClellan* and *A. Beaty*

**Factors Influencing the Use of Beef on Cyclical Menus in Hospital Foodservice**

This research was conducted to determine the influencing factors which facilitated the use and inclusion of beef and beef related products on hospital cafeteria and patient menus.

State of Oklahoma
*J. Leong*
Graduate Associate:
*Y-M. Zhang*

**Impact of Insulated Bulk Food Modules on Sensory and Microbiological Quality of Foods in a Conventional Foodservice Environment**

This research was conducted to assess the heat and cold retaining capabilities of insulated bulk food carriers, and to identify those factors affecting food quality. The primary objective was to determine the cold and heat temperature variabilities over time, and to determine its impact on microbiological quality.

State of Oklahoma
*L. Ebro* and *J. Leong*
Graduate Associate: *J. Wu*

**Consumer Preferences and Characteristics: Demand for Beef, Wheat Products, Fruits and Vegetables, Sugar and Snacks**

This research was conducted to determine the consumption patterns, food habits, nutritional awareness, purchasing criteria, attitudes and opinions, and demand for specific food products. There is a positive association between specific dietary goals and selection of the basic food groups.

State of Oklahoma, AHEA Foundation (Kraft Foods)
*L. Ebro*
*J. Leong*
*J. Stewart*
*B. Brown*
Graduate Associate and Graduate Assistants:
*D. McClellan*
*L. Hasenauer*
*J. Galloway*
*R. Blair*
*D. Zink*

**Human Food Uses for Dried Yeast Protein**

Nutrition supplements containing Provesteen dried torula yeast were developed and tested. A Nigerian staple food was enriched with dried torula and rated fo

ɔceptability by Nigerian students enrolled : OSU.

rovesta Corp. of Phillips Petroleum Co.
. *Knight*
ıraduate Associates and Graduate Assistants:
. *Stokes*
*1. Waters*
. *Nwobilor*
. *Smith-Nwobilor*
. *Collins*

**rovesteen-T as a Nutrient Enhancer**

Preliminary findings indicate that a high uality pasta can be made from a blend of )klahoma hard red winter wheat and the ried Provesteen torula yeast. Characteris-cs of this pasta are being determined as ell as its steam table characteristics.

'rovesta Corp. of Phillips Petroleum Co.
*. Knight*
ıraduate Associates and Graduate Assistants:
*. Stokes*
*1. Waters*
*.Smith-Nwobilor*
*. Collins*
*1. James*

**:hromium Status: Effects of Drugs ınd Pregnancy**

Aged rats fed a dose of $^{51}$chromium vith vitamin C had significantly more $^{1}$chromium in blood and urine than ınimals fed the $^{51}$chromium with a calcium-ontaining antacid. Retention of $^{1}$chromium was also significantly higher in ieveral tissues from rats given vitamin C than rom those given antacid.

State of Oklahoma and Oklahoma Agricultural Experiment Station
*3. Stoecker*
Graduate Assistant:
*V-Z. Cheng*

**nteractions of Chromium and Ascorbate in Absorption and Metabolism**

Type of dietary carbohydrate (starch, ıucrose, fructose, or glucose) fed to mice ıffected absorption/retention of chromium in ıll tissues assayed. Starch consistently ncreased the chromium compared to the ıimple carbohydrates. Uptake of $^{51}$chro-nium in guinea pigs was significantly ncreased by prior chromium. Depletion of :hromium status did not significantly alter uri-ıary excretion of chromium. Absorbate depletion did not impair $^{51}$Cr absorption.

J.S. Department of Agriculture Competitive Research Grants Program
*3. Stoecker*
Graduate Assistants:
*C. Seaborn*
*V-Z. Cheng*
*M. Campbell*

**Role of Chromium as a Trace Mineral in Energy Metabolism**

Specialized pieces of equipment neces-sary for ultratrace mineral studies in experimental animals were built or pur-chased.

University Center for Energy Research
*B. Stoecker*

**Productivity in Foodservice Organizations**

This study verified the use of productivity ratios and other performance criteria (effec-tiveness, efficiency, quality, quality of work-life, innovation and profitability) over a two-quarter period in hospital foodservice departments. By using the ratios and per-formance indexes suggested and taking into consideration the variables and conditions present within their own operations, foodser-vice administrators will be able to use this study as a model for analysis of individual departmental performance trends.

State of Oklahoma
*L. Ebro*
Graduate Assistants:
*P. Czajkowski* and *T. Ervin*

## Home Economics Education and Community Services

**Training of the Mentally Disabled in Hospitality Industry/Developing Model Training Instruments**

The program was developed and designed to render effective and compre-hensive service for the mentally/physically disabled as they were prepared for competi-tive employment.

Oklahoma Department of Mental Health
*M. Hopkins* and *B. Bokorney*

**Residential Care Home Service Providers Training**

A training manual on "in-service training techniques" for residential facilities opera-tors/staff was developed, tested and implemented. Also, an audio-visual program on residential care homes and their opera-tion was prepared.

Oklahoma Department of Mental Health
*M. Hopkins*

## Housing, Interior Design and Consumer Studies

**Development and Implementation of a Self-Assessment Questionnaire for Employability of Women**

Changes in women's lives such as divorce, widowhood, children in college or desire to work outside the home often result in the need or desire to enter or reenter the labor force. The research based self-assessment questionnaire will help identify skills and training expertise and/or deficien-cies of women on an individual by individual basis. Results of the questionnaires will be used in conjunction with employment semi-nars targeted toward women to assist in determining their employment options and potential training needs.

Oklahoma Extension Homemakers Council Research and Development Grant
*C. Peck* and *D. Goss*
Graduate Assistant:
*S. James*

**Employability of Women**

This study of employability of women is to take midlife women data, already gener-ated by the Women and Pensions project, and add the older women's cohorts to the existing data set to expand the data base and facilitate the link between work histories, employability and pensions for women.

State of Oklahoma
*C. Peck*
Graduate Assistants:
*B. Charlet* and *S. James*

**Supply and Demand for Water: The Economic Determination of Price**

This project involves communities in Oklahoma experiencing water supply prob-lems. Efforts are directed toward develop-ing a methodology of setting water utility rates. An econometric model has been developed to identify the effects of alterna-tive rate structures for the participating com-munities.

University Center for Water Research
*C. Peck*
Graduate Assistants:
*Y. Tabeda*
*T. Jangda*
*K. Anderson*

**Availability of Labor for Horticultural Crops in Southeast Oklahoma**

The project measures the availability of labor for vegetable crop production and har-vest in southeast Oklahoma. Efforts are directed toward identifying the wage neces-sary to attract area residents into the labor market and thereby aid in economic development of the region.

Oklahoma Agricultural Experiment Station
*C. Peck*
Graduate Assistant:
*P. Donovan*

**Impact of Utility Averaging on Residential Users**

Energy consumption and cost differ-ences between averaging and non-averaging utility billing plan users were assessed using data which were obtained from a major Oklahoma utility company. Residents' square footage and land valua-

tion data were collected and analyzed to determine the relationship of size of homes, economic well-being indicators, and utility billing option. Future study recommendations were formulated and submitted to the major utility company.

State of Oklahoma
*M. Weber* and *S. Williams*
Graduate Assistant:
*S. Routh*

**S-194 Southern Region Housing Research: Barriers and Incentives to Affordable Housing**

Selected rural communities were investigated through mail surveys, census statistics, and site case studies to provide insight into the provision and access to housing. Variables of interest include barriers and incentives to housing knowledge, availability, and affordability; these encompass personal values, societal economic, technical, and locational factors.

Oklahoma Agricultural Experiment Station and State of Oklahoma
*M. Weber* and *G. Brewer*
Graduate Associates:
*N. Nealeigh* and *M. Ha*

**Design Review Process and Testing for Program Awareness**

The purpose of the study assesses the competencies important to the success of the interior design major. Correlation between various aspects of the educational program and creativity were assessed. The creativity tests included the Torrance Test, How Do You Think? Creative Personality Test, and the Betts Test of Mental Imagery. The relationship between the various aspects of creativity are being evaluated with grade point average and ACT scores.

State of Oklahoma
*M. Weber*
Graduate Assistant: *C. Kimball*

**Socio-Economic and Structure Dimensions of Adequate Housing Perceived by Rural Families**

The decision process of rural families relating to major decisions about housing purchases and/or housing renovations is an important factor in the availability of housing stock in rural America. A housing decision framework has been developed related to socio demographic variables for the family decision process. This model is currently being tested in eight rural communities in Oklahoma yet has future implications for the decision process in the housing purchase for rural Oklahoma.

Oklahoma Agricultural Experiment Station
*M. Weber*
Graduate Assistant: *N. Nealeigh*

# College of Veterinary Medicine

***Veterinary research aims to solve problems in the prevention, control and treatment of diseases of all animals, including diseases that are directly or indirectly transmissible from animals to man.***

Society vests responsibility for the health of all vertebrate animals except man in the profession of veterinary medicine. People depend heavily upon animals for many needs. Food-producing livestock and aquatic animals convert vegetation to human foods and useful fibers. Pets give humans love, companionship and devotion which contribute to human health. Zoo animals, recreational animals and wildlife contribute to the quality of our lives. Animals are indispensable in the biomedical research that leads to better and longer human lives and better animal health care.

Veterinary research aims to solve problems in the prevention, control and treatment of diseases of all animals, including the diseases that are directly or indirectly transmissible from animals to man. This is a broad and unique research mission. No other health profession has such a wide range of research missions.

The opportunities for veterinary and biomedical research are greater today than at any other time in history. Techniques of recombining DNA, DNA/RNA hybridomas, gene insertion and embryo splitting, coupled with powerful new analytical hardware and software present unprecedented opportunities to understand, diagnose, control and treat diseases and to enhance animal health and productivity.

## Food Animal Research

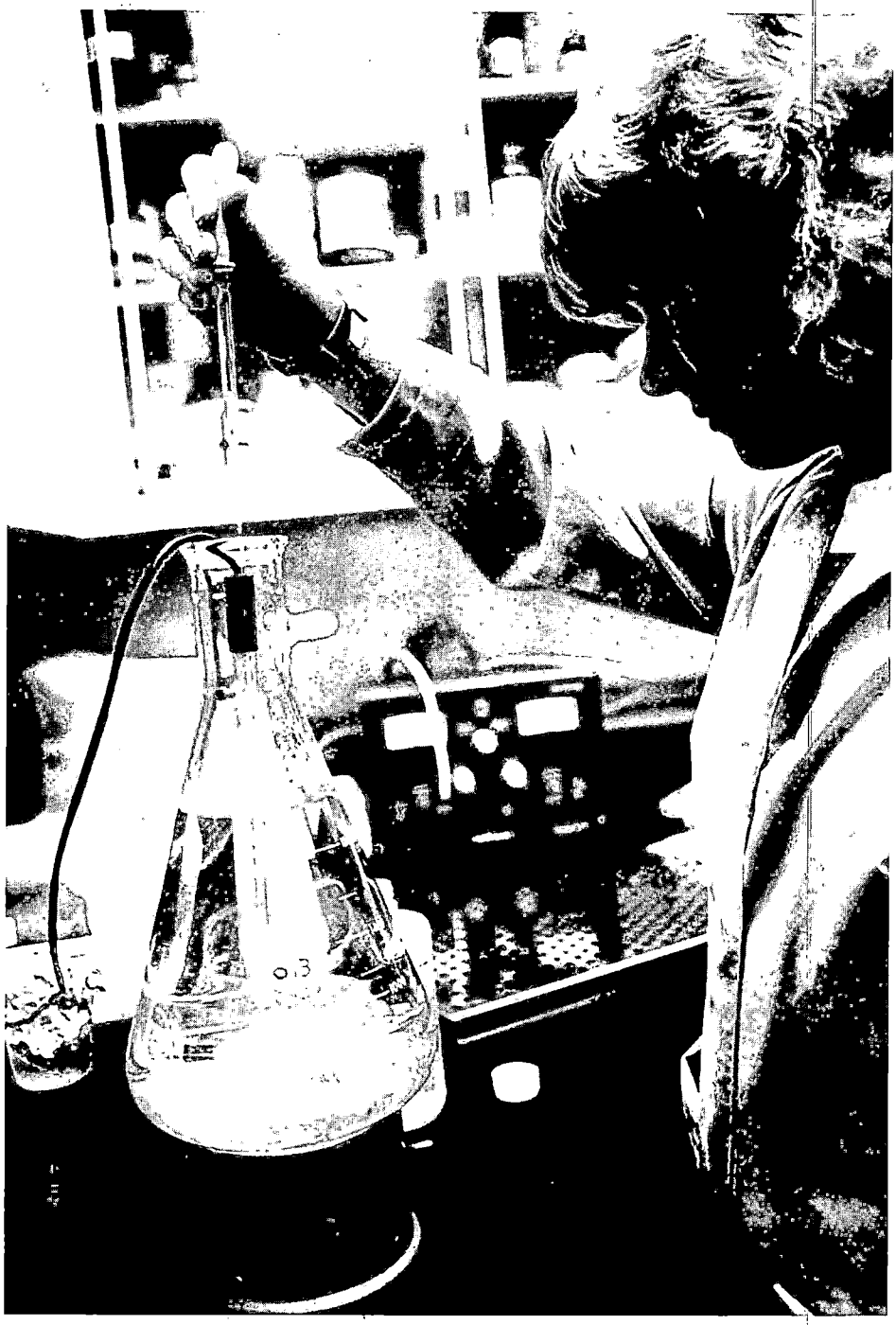
New technologies in biomedical research will generate more new developments in food animal health and production in the next 15 years than in all of history to this point. Veterinary research is rapidly developing an understanding of disease in terms of interactions of the animal and its total environment. New techniques allow rapid and accurate diagnoses in the field.

Researchers on the bovine respiratory disease project have developed a model for studying the interactions of bacterial invaders and the host's defense mechanisms. These studies have contributed significantly to a better understanding of the disease and response mechanisms.

Most vaccines contain the organisms that cause the disease, either killed or attenuated to reduce the risk of inducing disease. Attenuated organisms are still capable of causing disease, and killed organisms generally do not stimulate a vigorous immune response. OSU researchers are working to produce bioengineered subunit vaccines to protect cattle against both bovine respiratory disease, or shipping fever, and brucellosis, or Bang's disease. Subunit vaccines contain only that part of the organism that stimulates a protective immune response and are incapable of producing disease.

In the future, veterinary scientists at OSU will use modern bioengineering techniques to produce virus-vectored vaccines. With recombinant DNA technologies, it will be possible to insert genes that code for several protective subunits into the genetic apparatus of a virus known to "turn on" the patient's immune system. In this way, it will be possible to "piggy back" protection against several infectious agents in a single virus-vectored vaccine known to be safe and highly effective.

*Anaplasma marginale* is a parasite of red blood cells of cattle, causing the disease called anaplasmosis. The disease causes severe losses in affected cattle. Ticks transmit the disease from affected to uninfected cattle. Through electron microscopy and other modern biological techniques, OSU researchers have characterized distinct developmental stages of the anaplasmosis organism in red blood cells and within the tick vector. The research has gained international acclaim, and Dr. Katherine M. Kocan has been a visiting scientist at the International Laboratory in Animal Diseases in Nairobi, Kenya, and at the Veterinary Research Institute in Ondersteport, South Africa. Veterinary hemoparasitologists have joined with entomologists to develop integrated research approaches to eliminating vector-borne diseases.



*Veterinary scientists are active members of the university's biotechnology faculty with a special mission to find improved technologies for the diagnosis, prevention, and control of animal diseases.*

## Equine Research

The horse industry in Oklahoma has come to the forefront of the state's recreational pursuits and economy. Oklahoma, with about 500,000 horses, has more horses per square mile than any other state in the nation. The Oklahoma horse industry generates state revenues of at least $1 billion, rivaling the cattle and wheat industries as the state's largest agricultural enterprise.

The horse's popularity as an athlete and companion has focused the attention of OSU scientists on equine medicine and surgery, nutrition, disease prevention, growth and development, physical fitness, and reproduction. Scientists in veterinary medicine, animal science, and engineering are using integrated approaches to the problems of any horse that uses speed, strength, endurance and surefootedness in its sport.

Scientists at the Oklahoma Center for Equine Research at OSU will engage in interdisciplinary research to apply anatomy and physiology, pathology, nutrition, engineering, genetics and management to definitions of fitness and conditioning for maximum health and performance. Equine extension specialists in veterinary medicine and animal science take the new research information to horsemen and veterinarians throughout the state.

## Biomedical Research

Biomedical research using animal models of human health and disease is an important part of veterinary medicine's research mission. One of the studies funded by the National Institutes of Health is designed to characterize sperm-cell enzymes and to define their role in fertilization. This investigation aims to contribute to the development of safer, more effective methods of regulating fertility. A related study evaluates fluorescent staining of sperm cells as a means to predict their fertilizing capacity. Dr. Charlotte Ownby has been awarded a National Institutes of Health Research Career Development Award to enhance her expertise in the study of snake venoms and antivenoms. Pathologists are characterizing liver lesions

and associated changes in blood chemistry as a result of chemical intoxication in animal models.

## Companion Animal Research

Sixty-one percent of U.S. households have a pet. Over 134 million animals (excluding fish, of which there are billions) reside in America's homes. Pets are an important part of our culture. The American public demands veterinary services for its pets that are comparable to the world's most sophisticated health services that they themselves receive. Veterinarians play an increasingly important role in family health and well-being as health professionals learn more about the human/companion animal bond. Veterinary research has produced discoveries that have been adapted to the delivery of human medical and surgical care. In addition, veterinary research provides answers to the health problems of wildlife, zoo animals, aquatic animals, laboratory animals and exotic species kept as pets.

A study of the alpha motor neuron pools of the spinal cord supplying the forelimb muscles of the dog is important to the localization of spinal cord injuries. The pH-dependence of protein binding of antibiotics is investigated to determine if the phenomenon extends the plasma half-life of antibiotics in fish. The Oklahoma Department of Wildlife Conservation supports a survey of health problems in Oklahoma deer herds and evaluation of these problems through experimentation to quantitate individual animal responses. Veterinary researchers are investigating simpler, more accurate tests to diagnose brucellosis in dogs. Studies are underway to identify the parameters which differentiate between prerenal azotemia not associated with hypoadrenocorticism, and azotemia due to acute renal failure in dogs. Radiotelemetry transmitters have been placed in American river otters in a trial of the feasibility of rehabitation of otters in Oklahoma.

## Medicine & Surgery

### Equine Tendon Repair—*In Vitro* Comparison of Suture Techniques Using Polydioxanone Tape

In tendon repair, the suture material must possess tensile strength for optimal repair, as well as the ability to be absorbent. Polydioxanone tape possesses these characteristics. Researchers are studying the best possible repair technique that would include a suture pattern that resists gap formation, permits blood flow, and utilizes a suture material which does not contribute to sepsis. Several suture patterns will be studied to determine which pattern can be expected to perform well *in vivo*.

College Seed Grant
*H. W. Jann*
*L. E. Stein*
*R. Lowery*

### Use of an Anti-Progesterone Compound (RU-486) to Synchronize Embryo Donor and Recipient Ewes

Current methods of synchronizing the estrous cycles of donor and recipient animals produce relatively good synchrony of estrus, but successful transfers (birthing rate) vary from 40 to 70 percent. Findings suggest that a failure to synchronize the intrauterine environment and stage of embryo development, even though estrus was synchronized, may cause the low birthing rate following synchronized embryo transfer. We will determine if administration of an anti-progesterone (RU-486) to cyclic ewes on day 2 (day of estrus is day 0) for five days will extend the interestrous interval. We will then determine the effect of RU-486 on early embryonic development when administered to pregnant ewes for five days beginning on day 2 after mating or embryo transfer.

College Seed Grant
Heifer Project International
*G. L. Morgan*
*R. D. Geisert*
*M. T. Zavy*

## Parasitology, Microbiology and Public Health

### The Molecular Specificity of Immunity to Feline Herpesvirus Respiratory Infections

Feline herpesvirus (FHV1) is one of the major causes of feline respiratory disease. The goal of this study is to gain better understanding of the immune response to FHV1 in cats. Understanding the specific viral antigen/host immune system interactions which produce a protective immune response will permit the development of more effective vaccines and treatments for FVR.

Companion Animal Fund
*R. Eberle*
*C. J. Baldwin*
*F. Roberts*
*R. W. Fulton*
*D. Mosier*

### Rapid Identification of B Virus Infections

The purpose of this research is to develop a new diagnostic test system for *Herpesvirus simiae*, B virus, that can be used to clearly identify infected animals and humans exposed to this deadly virus. The new diagnostic test will eliminate differentiation problems caused by cross reactivity with related human and simian herpesviruses, and does not require live B virus preparations. The new test then can be performed at a greater number of facilities across the country without the need for high level biocontainment.

Oklahoma Center for the Advancement of Science and Technology
*R. Eberle*

### Ehrlichiosis as a Public Health Problem in Oklahoma

Oklahoma Tick Fever (OTF), a syndrome similar to Rocky Mountain Spotted Fever (RMSF) but in which patients are negative to RMSF laboratory tests, is a new public health problem in Oklahoma. The high prevalence of canine ehrlichiosis in Oklahoma and the serologic evidence of *Erlichia canis* infection among negative RMSF suspects lead researchers to believe some OTF patients suffer from a disease similar to or identical with canine ehrlichiosis.

Oklahoma Center for the Advancement of Science and Technology
*S. A. Ewing and B. W. Rohrbach*

### Dose Titration Study—Feline Natural Infestations BRL 38705

This study will evaluate the effectiveness of BRL 38705, a praziquantel-type anthelmintic, against naturally acquired infections of *Dipylidium caninum* and/or *Taenia taeniaeformis* in cats.

Beecham Laboratories
*A. A. Kocan*

### Identification of Immunodominant Antigens of *Brucella abortus* Recognized by Bovine T Lymphocytes

Despite use of *B. abortus* Strain 19 (S19) vaccine as a successful avenue of inducing resistance against brucellosis in cattle, this disease persists as a regional problem in the United States. Researchers plan to define the dominant TH lymphocyte immunogens through which the bovine host is protected from brucellosis with S19. S19-derived antigens will be investigated because this strain of *B. abortus* is capable of inducing a protective immune response in most cattle. Identification of the subunits of *B. abortus* with respect to their functional immunogenicity will be made, thus allowing appropriate selection of immunogens for a subunit vaccine.

American Veterinary Medical Association
*J. H. Wyckoff III and A. W. Confer*

### A Pharmacokinetic Study of Recombinant Bovine Alpha-1 Interferon in Cattle Following Various Routes of Administration

This study will determine the absorption, distribution, and elimination of recombinant bovine alpha-1 interferon. Bronchial fluids and serum will be collected after interferon has been administered by various routes including intramuscular, intravenous, and intranasal. The effects of interferon on the host defense mechanisms will be determined using *in vitro* assays for lymphocyte blastogenesis.

Genentech, Inc.
*R. W. Fulton*

### Seasonal Changes of Gastrointestinal Parasitisms and Parasite Control Strategies

Nematodes, flukes and tapeworms cause sheep production losses in the United States that exceed $98 million annually; by extrapolation, these gastrointestinal parasites may be responsible for a $1 million loss to the Oklahoma sheep industry. Although the life cycles of most economically important ruminant parasites are known, certain specific modifying factors essential to effective control programs are unknown.

This study will determine if hypobiosis occurs in Oklahoma gastrointestinal parasites; determine seasonal changes in strongyle populations of pastures and in sheep in Southwestern Oklahoma; forecast the incidence of parasitisms based upon the findings of the study; and evaluate the parasite control programs.

Oklahoma Agricultural Experiment Station
*H. E. Jordan and J. Whiteman*

### Protocol to Evaluate a Strategic-Timed Treatment Schedule with Fenbendazole to Determine its Effect on the Performance of Cow/Calf Herds in Oklahoma

This investigation will evaluate, under commercial field conditions, a treatment schedule designed to achieve seasonal control of internal parasites using Fenbendazole.

Hoeschst-Roussel Agri-Vet Co.
*A. A. Kocan*

### *P. Haemolytica* Cytotoxin: Molecular Studies of Pathogenesis and Immunogenicity

In an integrated, multidisciplinary approach to the prevention, control and treatment of pneumonic pasteurellosis, this research will 1) clone and express the cytotoxin gene of *Pasteurella haemolytica* in *Eschericia coli*, 2) biochemically and immunologically characterize the rDNA-produced cytotoxin (r-cytotoxin) and compare it to purified native cytotoxin (n-cytotoxin), 3) determine if vaccination with r-cytotoxin affords protection in calves against experimental pneumonic pasteurellosis, and 4) construct a cytotoxin-deficient (tox-)mutant of *P. haemolytica* and test its immunogenicity and pathogenicity in calves.

USDA Special Grant
*M. J. Gentry*
*R. C. Craven*
*A. W. Confer*

### Interferon and Host Defense Mechanisms

Various biologics, including viral and bacterial immunogens, have not been adequately successful in lessening economic losses in cattle with shipping fever. Several viruses cause respiratory infections in calves, often in combination with stress, predisposing cattle to more severe bacterial disease, especially pneumonic pasteurellosis. This research will determine the effects of interferon (IFN) and interleukin-2 (IL-2) on the immune system, the induction of 2-5 oligoadenylate synthetase following treatment with IFN and IL-2, and define IFN pharmacokinetics in cattle.

USDA Formula Grant
Hoffman La Roche
*R. W. Fulton*
*A. W. Confer*
*E. C. Short*

### Elucidation of the Cell-Mediated Immune Response in *Brucella abortus* Strain 19-Immunized Cattle

Little is known about the dominant antigens that stimulate functional resistance to *Brucella abortus* or about the mechanisms of functional immunity to *B. abortus* in cattle. This research will begin to approach solutions to these barriers to long-term brucellosis-free status in the nation's cow herd. We will characterize T-lymphocyte subpopulations and interactions in the *in vitro* antigen-driven lymphoproliferative response to *B. abortus* antigens corresponding to the outer membrane of the bacterium involved in cell-mediated immunity.

College Seed Grant
USDA Cooperative Agreement
*J. H. Wyckoff III and A. W. Confer*

### Use of DNA Hybridization to Determine Latent IBR Virus Infection in Pulmonary Tissues

Calves infected with infectious bovine rhinotracheitis (IBR) virus have an increased susceptibility to infection with *Pasteurella haemolytica*. This synergism between IBR virus and *P. Haemolytica* has been attributed to a defect in alveolar macrophage function. The synergism has been observed for as long as 30 days after viral infection, suggesting a latent viral infection. This study attempts to detect viral DNA in lung tissues by DNA hybridization using biotinylated IBR DNA probes. Such probes could be used to quantitate the amount of viral DNA present and, perhaps, to determine the cell types harboring the virus in latent forms.

College Seed Grant
*J. M. d'Offay*

### Effects of Interferon on Bovine Lymphocyte MHC Antigen Expression and Enzyme Activity

In addition to its antiviral effects, interferon (IFN) has immunomodulatory effects. Major histocompatability complex (MHC) antigens are pivotal in the interaction of various effector cells of the immune response among each other and with pathogenic invaders. Changes in the expression of MHC antigens may explain some of the effects of IFN on virus-infected cattle. We will determine the *in vitro* effects of IFN on bovine MHC-encoded antigen expression and IFN-induced enzymatic activity and will examine the role of macrophages in these phenomena.

Solvay Resident Grant
Noble Foundation Fellowship
*L. Perino and R. W. Fulton*

## Pathology

### Immunity in Bovine Brucellosis

Bovine brucellosis continues to be a regional problem. Current studies indicate that the resistance of cattle to brucellosis is through cell-mediated immunity (CMI). Objectives include determining and studying the stimulation of strong CMI responses in cattle vaccinated with nonliving *Brucella abortus* antigens; studying lymphokines as stimulators of CMI to *B. abortus*; characterizing the T-lymphocyte subpopulations and interactions in the *in vitro* Brucella-specific antigen-derived lymphoproliferative response to nonliving *B. abortus* antigens; and comparing the responses to and mechanisms of resistance induced by nonliving *B. abortus* antigens with those induced by Strain 19.

USDA/ARS
*A. W. Confer*
*J. H. Wyckoff III*
*R. W. Fulton*

### Ultrastructural Studies of Degenerative Myelopathy of German Shepherd Dogs

A progressively unsteady gait in middle- to old-aged German Shepherds is a well characterized clinical problem. Presently there is no effective treatment. Researchers are studying the description and characterization of the histopathological and the ultrastructural alterations associated with degenerative myelopathy.

College Seed Grant
*D. A. Mosier and C. J. Baldwin*

### Respiratory Infections of Single and Multiple Etiology

Bovine respiratory disease is the greatest single cause of economic loss among stocker and feeder cattle. Researchers on this project have developed a reliable and faithful model for studying the pathogenesis and immune mechanisms involved in the production of lung lesions. The investigation aims to develop means of control or amelioration of the economic loss to the cattle industry and consumers by production of effective antigens from *Pasteurella spp.* and determine the most effective routes of administration of immunogens to produce effective resistance.

Oklahoma Agricultural Experiment Station
*A. W. Confer*
*R. J. Panciera*
*R. W. Fulton*

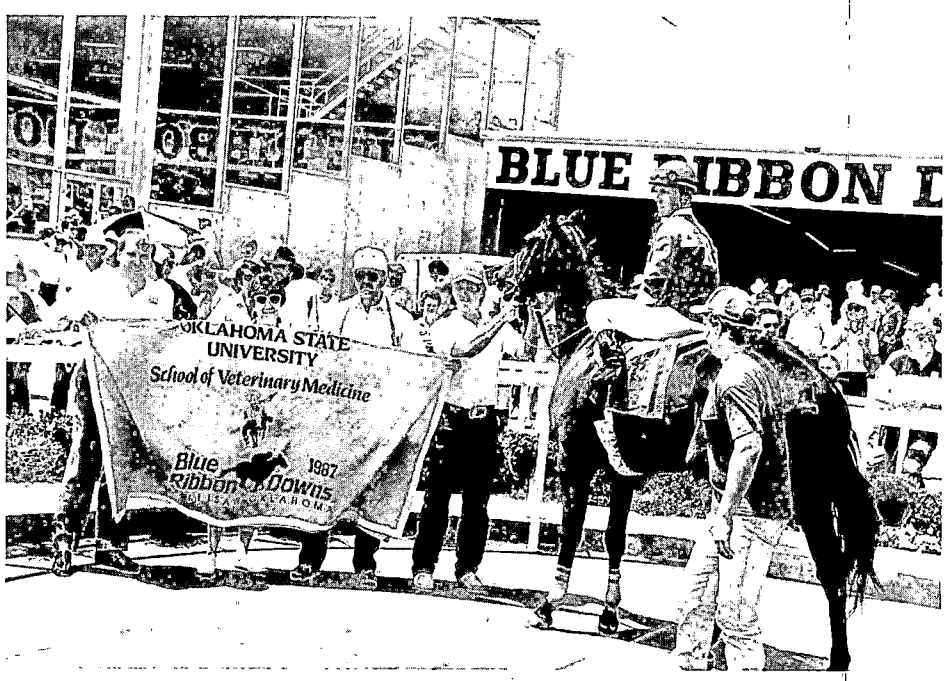
### Vaccination for Brucellosis: Field and Laboratory Studies

An investigation of the protection afforded cattle by a cell-surface protein isolated from *Brucella abortus*. Other studies include enhanced diagnosis through the use of a fluorometric immunoassay, effects of bovine and human interferon on cell-mediated immunity and potential adjuvant effects of levamisole on Strain 19 vaccine.

USDA/ARS Cooperative Agreement
The Kerr Foundation
*A. W. Confer*
*J. H. Wyckoff III*
*R. J. Morton*
*R. W. Fulton*

### *Brucella abortus* Antigen Expression by Recominant Plasmids in *Escherichia coli*.

To study isolation methods for *Brucella* DNA and RNA and determine whether *B. abortus* carry plasmids. To make a gene library of *B. abortus* cloned in *E. coli* and screen the library for expression of *B. abortus* antigens. Select the genes that are expressing outer membrane proteins that may be immunogenic. Subclone (reclone) these genes in an expression vector and place them under control of a strong promoter region to enhance their expression by




*The horse industry is one of Oklahoma's growth industries. Scientists in the Colleges of Veterinary Medicine and Agriculture have formed the Oklahoma Center for Equine Research to address the problems of equine athletes.*

induction. Use an immunoassay to confirm the increase in protein production. Isolate and purify several of these proteins in preparation for potential vaccine production and challenge experiments.

USDA/ARS Cooperative Agreement
*J. A. Bantle*
*M. Sanborn*
*A. W. Confer*
*R. J. Morton*
*R. C. Essenberg*
*B. L. Deyoe*

### Infectivity of Developmental Stages of *Anaplasma marginale* Isolated from *Dermacentor andersoni*.

Several morphologic stages of *Anaplasma marginale* have been identified throughout its developmental cycle in the tick, *Dermacentor andersoni*. Experiments will determine which of these stages are infective for susceptible cattle. Once infective stages are identified, they will be used as an inoculum for cell culture. Cultivation of *A. marginale* in cell culture would enable production of an improved vaccine. The various stages of *A. marginale* identified in the tick will also be collected and used as inoculums in attempts to artificially infect ticks with *A. marginale* by percutaneous injection. Artificial infection of ticks will aid in studies of the developmental sequence of *A. marginale* in ticks, as well as comparative studies of the various isolates of the organism in the tick host.

Oklahoma Agricultural Experiment Station
*K. M. Kocan*
*S. A. Ewing*
*J. A. Hair*

### Characteristics of an Immunogenic Carbohydrate-Protein Subunit of *P. haemolytica*

This project will separate and characterize the antigenic proteins and carbohydrates in *Pasturella haemolytica* carbohydrate-protein membrane, purified leukotoxin, and capsular carbohydrate. The study will determine which antigenic components of CPS are important for the induction of resistance against pneumonic pasteurellosis.

USDA Special Grant
*A. W. Confer*
*R. J. Panciera*
*A. J. Mort*

### Evaluation of Cytochrome P-450 Induction in the Wild Cotton Rat as a Monitor of Environmental Contamination

Simple quantitation of toxic substances in water and soil and comparison to levels of toxins known to cause disease in laboratory animals is an imperfect method to determine the levels of hazardous substances in the environment. Moreover, toxicity in the natural environment is usually the result of exposure to complex mixtures of toxins with additive effects. "Aged" toxins in the environment may be more hazardous than technical-grade toxins. Our goal is to develop a reliable indicator of environmental toxicity hazards by evaluating hepatic cytochrome P-450 in the cotton rat (Sigmodon hispidus), a very common field rodent in Oklahoma.

College Seed Grant
University Center for Water Research
*C. W. Qualls, Jr. and R. Lochmiller*

## Physiological Sciences

### Effects of Clonidine, ST 1974 and ST 2130 on Chickens Reared under Heat Stress

In this study, the investigator is searching for compounds that will relieve heat stress in broilers and stimulate more efficient production.

Boehringer-Ingelheim
*S. Sangiah*

### Identification of Cartilage Growth Plates in Axis of Dog

This proposal will provide fundamental new information about the histological and histochemical composition of vertebrae that can be used in the interpretation of the pathophysiology of dens dysplasia and other developmental and growth abnormalities of the vertebral column in young dogs and children. Researchers are determining the position, orientation, and morphological characteristics of the cartilage growth plates in the axis, especially those contributing to growth of the dens.

College Seed Grant
*A. G. Watson and L. E. Stein*

### Metalloproteases of Mammalian Spermatoza

The objective is to elucidate the physiological roles of sperm metalloproteases in reproductive processes. The results of these studies, which will characterize sperm metalloproteases with respect to their physiocochemical and biochemical properties and subcellular location, will contribute to development of improved methods for fertility regulation.

U.S. Department of Health and Human Services, NIH
*B. A. Lessley*

### Antiserum Treatment of Venom-Induced Necrosis

A Research Career Development Award. Salary support for five years will enable the investigator to develop her research career around the improvement of the antiserum treatment of hemorrhage and myonecrosis induced by snake venoms.

U.S. Department of Health and Human Services, NIH
*C. L. Ownby*

### Factors Influencing the Use and Dosage of Erythromycin in the Therapy of *Rhodococcus equi* (*Corynebacterium*) Pneumonia of Foals

*Rhodococcus* pneumonia is a serious disease in foals of 6 weeks to 4 months of age. While it is not a common form of pneumonia in foals, it is a serious, debilitating disease

when it does occur. A limiting factor in the use of combined erythromycin and refampicin therapy is a lack of knowledge of these drugs in combination in the foal. This study will establish the most appropriate dosage for erythromycin based on the drug's pharmacokinetics when combined with refampicin. Preliminary data of the metabolism of erythromycin in the horse will be generated.

CEVA Laboratories, Inc.
*G. E. Burrows*

### Identification of Growth Factors to Stimulate Intrinsic Tendon Fibroblast Proliferation

Surgical treatment of severed tendons too often results in poor repair, i.e., restricted joint movement, loss of strength, and rupture. This study will produce preliminary data on intrinsic tendon cell growth characteristics *in vitro* to be used to develop new approaches to the successful treatment of tendon and ligament injuries. We hope to directly stimulate intrinsic cell populations with local applications of growth factors and to test pre-stimulated autologous tendon fibroblast populations to augment the healing process.

College Seed Grant
*L. E. Stein*

### Interactions Between Hypothermia and Drugs

Hypothermia produces deleterious effects on several bodily functions, sometimes leading to death in animals and man. There is little known about the effects of hypothermia and drugs administered therapeutically or accidentally. This investigation will determine the effects of hypothermia on the contractile responses of isolated smooth-muscle systems to drugs that modify the contractility of smooth muscle *in vitro*.

College Seed Grant
*S. Sangiah*

## Veterinary Medicine General

### Laboratory Animal Resources

The Laboratory Animal Resources Unit is a centralized, coordinated service and support unit based in the College of Veterinary Medicine. It serves the entire Oklahoma State University Stillwater campus. The Unit is responsible for the husbandry and health care of laboratory animals used in research and teaching. Advice and guidance are provided in such areas as animal procurement, species selection, restraint, experimental techniques, spontaneous disease and normal biological values. Of primary concern is compliance with state and federal regulations pertaining to the proper care of laboratory animals.

*J. E. Breazile*
*S. J. Barron*
*Staff*

### Oklahoma Animal Disease Diagnostic Laboratory

The Oklahoma Animal Disease Diagnostic Laboratory provides accessible and accountable diagnostic service for Oklahoma veterinarians and animal owners in all 77 counties. Early detection of diseases provides the starting point for reducing their incidence and threat. The Laboratory promotes and protects the health and economic welfare of Oklahomans, supports the teaching and research missions of the College of Veterinary Medicine, and conducts self-supported research aimed at developing more precise test procedures for diseases commonly encountered, as well as for emerging diseases that may produce catastrophic losses, *e.g.*, malignant catarrhal fever, parvovirus disease and toxicoses related to oilfield wastes and agricultural chemicals.

*D. E. Goodwin and Staff*

### Electron Microscopy Laboratory

The Electron Microscopy Laboratory, housed in the Department of Physiological Sciences, serves the research needs of the entire Oklahoma State University Stillwater campus and is available to qualified researchers from any publicly supported college or university in Oklahoma. Both transmission and scanning electron microscopes, as well as X-ray analysis, are available, and the Laboratory offers preparation of samples and operation of the microscopes by experienced personnel.

*D. Rex and Staff*

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