



Cobleigh Hall: ChE occupies the 3rd and 4th floors.

**C**HEMICAL ENGINEERING WAS established at Montana State University (then known as the Montana State College of Agriculture & Mechanic Arts) in 1925 by the late William Cobleigh. John Beal joined the staff in the early 1930's and they operated a small department until 1942. During World War II, Cobleigh retired and Beal left for an industrial position. The department remained dormant until Lloyd Berg and Al Saner reactivated it in 1946. Returning war veterans made for rapid growth and in 1948 Montana State became the first ECPD accredited chemical engineering department in the Rocky Mountain region. Bob Nickelson, a 1951 Montana State graduate, completed a Ph.D. at Minnesota and joined the staff in 1956. Mike Schaer and Bill Genetti were obtained from Oregon State in 1965 and 1968 respectively. Giles Cokelet arrived from Cal Tech in 1968 and Phil McCandless was added to the staff in 1968 after completing his Ph.D.

## **MONTANA STATE**

LLOYD BERG

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at Montana State. In the 25 years since 1946, there have been only three staff resignations.

The staff has generally been industrially oriented with the bulk of the graduate programs attuned to industrial problems. In the 1950's Berg and his graduate students developed the world's first economical Diesel fuel desulfurizer for the Husky Oil Co., developed a benzene purification process for Jones & Laughlin Steel Co., and a synthetic coke process for Koal-Krudes. All Saner and his graduate students contributed to the development of FMC Corp's soda ash-from-trona process. In the 1960's Berg's students worked out the catalytic refining of shale oil into a petroleum substitute for Esso Research & Engr. Co.

Current research interests of the staff include:

- Berg: Liquefaction of western coals and lignites for Avco Corp.
- Nickelson: Desalination of water by reverse osmosis for OSW.
- Schaer: Sulfur emission detection equipment for Hoerner Waldorf Corp.; Low temperature fuel cells for NSF; Computer simulation of non-ferrous metal industries for Anaconda Co.
- Cokelet: Blood flow properties for NIH; Rheology of highly loaded suspensions for NSF; Static mixer studies for Kenics Corp.
- McCandless: Catalyst mechanism studies for Petroleum Research Fund; Separation of xylenes through membranes; Separation of terpenes by adduct formation; SO<sub>2</sub> recovery processes.
- Genetti: Fluidized bed heat transfer for Idaho Nuclear Corp.; High mass transfer studies for NSF.

In 1956 the Department awarded the first earned PhD degree in the state of Montana to Fred Baughman, now a Taylor Fibre Co. vice-president. Since then 36 additional PhD's in chemical engineering have been completed. Berg's 24 completed PhD theses have made him the state's most prolific doctoral advisor. Nickelson

**Lloyd Berg — his department leads Western States in per capita ChE production . . . enrollment increased 150%.**



with nine completed PhD theses ranks 4th at Montana State.

Hallmarks of a Montana State chemical engineer have been his ability to calculate correctly and his knowledge of chemistry and chemical processes. To this day, nine quarter credits of stoichiometry and nine credits of chemical processes are required. The senior design course has emphasized the potential for new process industries based on local resources and which will fit into the economy of Montana. Examples of industries which were established after first being examined for economic potential by the students are the bentonite plant at Glasgow, the barbecue briquet plant at Pablo, a coke plant at Red Lodge, an antimony plant at Thompson Falls, a tungsten plant at Dillon and a talc plant at Three Forks. The student reports have been influential in preventing the establishment of a number of schemes that appeared to be sure losers. The reports are sent to the State Planning Board and made available to the Chamber of Commerce concerned.

**A**FTER THE BIG YEARS following World War II when chemical engineering graduating classes had frequently reached twenty-five or more, enrollment dropped off. In 1961 the graduating class was sixteen and by 1962, it had dropped to twelve. Additionally, the quality of the graduating class in Chemical Engineering was no better than the entire senior class of the University. Ten percent of the chemical engineers would be in the upper ten percent of the class and so down. In order to stem this decline in quality and quantity, and industrial scholarship program for freshmen was begun.

The program as worked out probably fits only the special circumstances encountered at Montana State and is perhaps not widely applicable in toto. Some parts of it may be of general interest however. Montana State University serves

Table I. Scholarship Donors, 1970-71

COMPANY	NUMBER
Continental Oil Co. (1959)	4
Dow Chemical Co. (1959)	3
UOP Corp. (1959)	2
Hoerner Waldorf Corp. (1959)	4
FMC Corp. (1961)	2
3M Company (1962)	4
Union Carbide Corp. (1963)	1
Standard Oil Co. of Calif. (1963)	4
Shell Oil Co. (1963)	2
Monsanto Co. (1965)	4
Stauffer Chemical Co. (1966)	2
ITT Rayonier (1966)	2
Crown Zellerbach Fdn. (1968)	2
Idaho Nuclear Corp. (1968)	2
Humble Oil & Refining Co. (1968)	2
Vulcan Materials Co. (1968)	2
Procter & Gamble Co. (1968)	2
Pan American Petroleum (1968)	2
Atlantic Richfield Hanford (1969)	1
Anaconda Aluminum Co. (1970)	1
Mobil Oil Corp. (1970)	2
	—
	50

principally Montanans. Out-of-State enrollment is less than five percent. Montana contains about 680,000 people and is rather isolated from the urban centers of the United States. There are no other chemical engineering departments in the state. Costs at MSU are approximately \$400 for fees and \$1450 total for the school year. Starting twelve years ago with six \$250 scholarships, we now have twenty-three sponsors providing a total of fifty \$250 scholarships, Table I. The scholarships are awarded to high school graduates solely on merit and are paid in three equal installments during the college freshman year provided only that (1) the recipient be a full-time freshman chemical engineering student at Montana State, and (2) that he maintain a grade point average of 2.7 based on A = 4. The scholarships do not extend beyond the freshman year.

Table II shows what happened to the enrollment in that period. The enrollment of chemical engineers has kept pace with the University as a whole, 150%, while the College of Engineering was increasing by only 22%. In 1959, Engineering enrolled about a third of MSU's students; today it is only a sixth. We believe that the industrial scholarship program caused this increase. There is no other reason that we can suggest to account for it. The following will describe everything we do. We are not sure that everything in the program is effective; some things are probably worthless but we have not experimented to see what doesn't contribute to the program.



Anne Hazelton, Class of 1971, operates Cokelet's blood viscometer.

Table II—Enrollment Data at Montana State University

Year	University	Engineering	Chem. Engr.	ChE grads.
1959	3500	1200	106	19
1971	8675	1470	270	38
% Increase	150%	22%	150%	100%

Each November we send an announcement of scholarships to each of the approximately two hundred high schools in Montana. These are not as effective as you might think. A great many high school students say they never see the announcements. We believe that high school guidance counselors frequently don't like engineering. Perhaps this is because many of them started as engineers in college, did poorly, switched to and graduated in Education and now are in guidance. Secondly, they seem to take pride in the total dollar amount of scholarships won by their graduates. Thus, they will usually advise a Montana high school graduate to accept a \$1500 scholarship from a large out-of-State university even though it means that his parents have to put up an additional \$1500 per year. About five years ago, our Engineering College brought two groups of thirty guidance counselors to the campus for a two-day, expense paid conference on careers in engineering. We haven't been able to detect the slightest effect of these conferences on engineering enrollment.

WINTER 1972

TABLE III—Production of Chemical Engineers in the Western United States.

School	B.S.	M.S.	Ph.D.
Univ. of Washington	53	11	3
Calif.—Berkeley	43	13	7
Montana State	38	2	4
Colorado Mines	30	6	2
New Mexico	27	2	2
Oklahoma State	26	8	6
South Dakota Mines	26	6	
Brigham Young Univ.	25	2	1
New Mexico State	23	2	
Oregon State	22	3	3
Nebraska	22	3	1
Utah	21	17	3
Colorado	20	5	1
Kansas	19	10	8
Oklahoma	21	6	2
Washington State	15		
North Dakota	16	3	
Stanford	14	13	8
Idaho	14	12	1
Calif.—Davis	13	3	2
Calif.—Santa Barbara	13	5	
Wyoming	13	2	
So. Calif.	12	15	4
Kansas State	10	3	1
San Jose State	9	4	
Denver	9	4	5
Tulsa	9	4	
Cal. Tech	6	8	6

Accompanying the scholarship announcement are application forms for the student to submit if he wants to be considered. From our point-of-view, the most meaningful item is his rank in high school class. If high, we check by telephone call or transcript and make an offer. Offers frequently are made as early as November to applicants who rank in the upper tenth of the class of a large high school. Accompanying the offer

TABLE IV.—Ranking of Western States in Production of Chemical Engineers.

State	1970 Population	Chem. Engr. Production	Per 10 <sup>6</sup>
1. Montana	682,000	38	55
2. New Mexico	998,000	50	50
3. Utah	1,061,000	46	43
4. Wyoming	332,000	13	39
5. South Dakota	681,000	26	38
6. Colorado	2,178,000	59	27
7. North Dakota	611,000	16	26
8. Oklahoma	2,498,000	56	23
9. Idaho	698,000	14	20
10. Washington	3,353,000	68	20
11. Arizona	1,752,000	30	17
12. Nebraska	1,468,000	22	15
13. Kansas	2,222,000	29	13
14. Oregon	2,056,000	22	11
15. California	19,715,000	110	6
16. Nevada	481,000	0	0



TABLE V.—Honor Roll at Montana State University, Autumn Quarter 1970.

Engineering Dept.	Undergraduate Enrollment	Honor Roll					Total	
		Freshman	Sophomore	Junior	Senior			
Chemical	250	28	20	14	11	73	29.1%	
Civil	274	18	4	10	8	40	14.7%	
Electrical	289	20	11	11	13	55	19.0%	
Mechanical	267	15	12	3	10	40	15.0%	
Industrial	58	0	0	4	5	9	15.5%	

goes the Departmental brochure, newspaper publicity about recent graduates, and a montage of chemical engineering problems taken from *Chemical Engineering* and the *Wall Street Journal*.

During the year we try to keep up a fairly steady stream of publicity in the State newspapers. When the recruiter of a sponsoring company comes to the campus, we take his picture with the freshman scholars. As the scholarships are accepted, a publicity story is sent to the newspaper serving the scholar's home town. We find that it invariably is used. Small town papers will even include the scholar's picture.

How well has the program worked? Table III shows that Montana State University is exceeded only by the University of California—Berkeley and the University of Washington in the Western U.S. as a producer of chemical engineers. From a per capita standpoint, Table IV shows that Montana ranks first in the West in production of chemical engineers. What about quality? Table V shows that the chemical engineers far exceed the other engineers at MSU in proportion of the class on the honor roll, this in spite of the fact that the Chemistry Department is at the very bottom at MSU in average grade given the students. Each year the Montana Society of Engineers selects one graduating engineer from MSU as "Outstanding Engineer". For three of the past four years, the recipient has been a chemical engineer although chemical engineers are only about

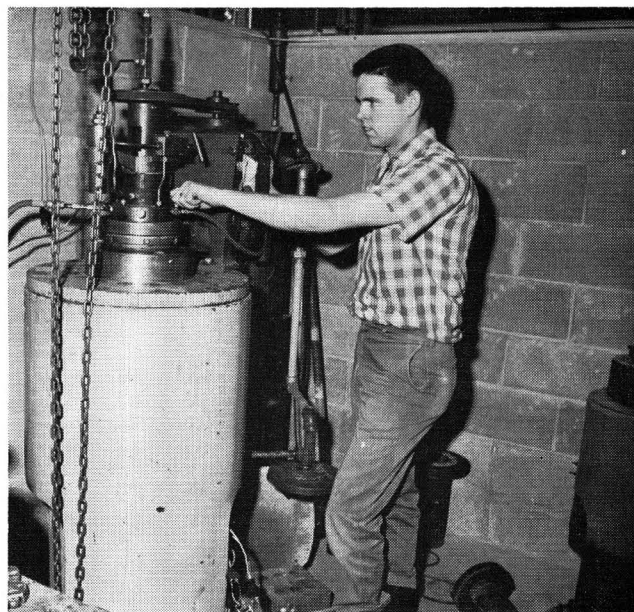
a fifth of the College of Engineering. Montana State has an organization called *Septemviri*, a group selected as the seven outstanding men on campus. The chemical engineers were represented in this group as follows: 1972-2, 1971-1, 1970-1, 1969-2, 1968-1; this despite chemical engineers being less than three percent of MSU's 8500 student body.

How does industry regard MSU's chemical engineers? Table VI shows the placement of the Class of 1971 compared with the national average for chemical engineers as reported in *Chemical & Engineering News*, Nov. 1, 1971. Seventy-six percent of MSU's chemical engineers were employed full-time in chemical engineering positions compared to only 45.8% nationally. None were unemployed compared to the national 12.8%.

The results of this twelve year program of industrial scholarships to freshmen chemical engineering students seem to indicate that it is an effective means of increasing both the quantity and quality of the graduating class. The details of administration should be tempered to fit the particular circumstances of a specific school. □

TABLE VI—Placement of Chemical Engineers, Class of 1971.

	National Average	Montana State University	
		Number	Percent
Full-time employed	45.8%	29	76
Part-time employed	9.6	0	0
Employed outside field	5.0	3	8
Unemployed	12.8	0	0
Grad. asst. Post-doc.	9.9	5	13
Other grad. study	2.9	0	0
Grad. study other fields	2.2	0	0
Military	10.0	1	3
Peace Corps, etc.	0.9	0	0
		38	100



Jack Olson, PhD 1969, operates coal hydrogenation equipment.