VOLUME XII

COLLEGE OF ENGINEERING

SCHOOL OF LAW

LONG RANGE PLANS

TABLE OF CONTENTS

TABLE OF CONTENTS
PAGE 2

SECTION I - COLLEGE OF ENGINEERING (CONTINUED)

SECTION II - SCHOOL OF LAW

SECTION I

COLLEGE OF ENGINEERING

COLLEGE OF ENGINEERING

LONG RANGE PLANS

Goals and Plans
of
The School of Engineering
TEXAS TECHNOLOGICAL COLLEGE

The School of Engineering at Texas Tech has always had as its Castor and Pollux, the twin ambitions of innovation and steady, unremitting progress. Through the years those of us associated with the School of Engineering have continuingly pressed for those programs which would elevate not only this school of the university, but the institution as a whole. We have prognosticated trends and advocated measures for meeting the necessities so obviously arising. Some fine achievements by the university have come out of these efforts. Now, however, as never before, we are confronted with a situation so critical that action must be taken, and taken boldly, if this university, for which all of us who have given our efforts, is to rise to that respected eminence for which all of us who care for it wish so devoutly. Tech now simply cannot afford anything but the maximum effort to expand graduate and research programs. It is apparent that the reputations of the distinguished universities of America rest upon the distinguished reputations of their faculty members. And that their reputations rest upon the outstanding research which they do.

Industry points out the crisis in engineering manpower, and the multidimensional aspects of the problem are admitted. It asks what can be done, and suggests a "total approach." To Texas Tech this means:

The opportunity exists to have a distinguished part in what must be a total national approach; and bringing this a step nearer in degree of meaning and responsibility: opportunity is not only knocking, but clamoring at Tech's door. That "tide in the affairs of men, which taken at the flood---" has risen to our very threshold.

The degree of exigency which obtains in regard to engineering manpower is dramatically pointed up by such actions as that of Deutsch and Shea, Inc. When a business will spend its hard dollars for expensive space in a publication of Fortune's stature, to plead for attention to this crisis, the time for remedial action has indeed arrived. A reduction of this concerned advertisement appears on the following page.

To demonstrate some aspects of the leadership of which Tech is capable, let us consider these "firsts":

1. Our Core Curriculum, inaugurated in 1955, has been the inspiration for other colleges, and recently the Coordinating Board adopted the concept statewide. At our own university it has been highly successful, leading, ultimately, to more and better students of engineering, through, among other factors, postponement of

How does a president tell his stockholders now the dangers of a technical manpower crisis in the 70's?

Give them the facts.

Engineering enrollments have inched up barely 1% in the past 10 years, while total male college enrollments have climbed an impressive 52%.

Though a record-breaking 1,478,000 freshmen marched off to college last Fall, fewer than 50,000 will receive engineering degrees when commencement rolls around in the '70's . . . at least 30,000 short of our annual needs.

Engineers, physicists, computer programmers, engineering technicians — almost every type of technical personnel—are in short supply with still greater shortages to come.

This is the technical manpower crisis we face: the dangerous disparity between the numbers of technical people we need and the numbers we are able to produce.

If this trend continues, it will reach crisis proportions in the 1970's.

Manpower musical chairs

For almost two decades, we've been playing musical chairs with technical talent: recruiting in St. Petersburg to staff St. Paul. But in 1967, for example, the average technical organization was able to recruit only 75% of the experienced technical people it sought. And last Spring, on one campus, 250 organizations were lined up to compete for 231 engineering and science graduates.

In the long run, this is a losing game. There is danger ahead: danger to your company — danger to the American economy.

Corporate growth: First casualty?

"The importance of technological innovation for economic growth," Fortune noted recently, "is one of the few things in this world that is beyond dispute by economists."

It is also the key to your company's profit position. In an innovation-oriented economy, your company's growth curve will be the first casualty of a technical manpower crisis. And you won't be alone.

Danger ahead—on a national scale

Almost every serious approach to meeting today's economic and social problems and tomorrow's vital needs centers around continued—and accelerated—technical progress: new jobs, new approaches to education, higher rates of production, urban renewal, pollution control, improved public transport, increased food production, competing in the world market, maintaining adequate defense capabilities, exploring new areas of science and technology.

But, without an adequate supply of technical manpower, our capacity to achieve these goals will be crippled.

Your son, the engineer?

The Russians graduate 138,000 engineers a year; one third of them are women. The Japanese graduated 201,983 engineers and scientists in 1966, 17% of their total college graduating classes. In 1967 the U.S. awarded just 36,000 bachelor degrees in engineering.

Your college-age son can give you some of the reasons. Most important, perhaps, is that American youngsters haven't been shown the vital roles that technical training can play in creating the better world at which they aim. And professional courses are not easy; they demand more time and work than many of today's students may be willing to give, and specialized preparation, beginning at the high school level.

So, asked about a technical career, many students retort, "Who needs it?"

And there are other factors, too, that detract from the image of a technical career today: the under-utilization of technical talent in some areas; the need for constant study to keep pace with new developments; the enforced nomadism as technical families follow jobs from region to region; the job instability in many industries; the limitations on rewards and advancement in purely technical pursuits.

Needed: A total approach

There are no quick or easy solutions: no instant engineers or pre-packaged physicists or off-the-shelf teams of technicians and other key support personnel. This is a difficult, multi-dimensional problem with roots deep in our culture and economy.

Right now, individual companies and organizations and schools are tackling some aspects of the problem. But this piecemeal approach is far from enough: what is needed is a total approach.

Deutsch & Shea urges the development of such a total approach: one that melds these scattered, individual activities into a coordinated effort. And one that moves beyond short-term, local solutions to deal with the problem in its entirety—on a long-range, national basis.

First step: A task force and a national symposium

Recognizing the urgency of this need, one organization, the Engineering Manpower Commission of the Engineers Joint Council, is taking a significant first step.

The EMC has created a national Task Force which is aiming toward a national symposium on the problem of technical manpower which will represent the business, technical, governmental, and academic communities. Its goal: to obtain a better understanding of the problem areas and develop specific recommendations on means to increase the engineering and technological manpower resources of the nation.

The symposium, to be planned for May, will cover such issues as:

Improving public understanding of engineering and technology and their vital relationship to the national welfare.

Creation of programs to attract minority groups and women to careers in technology.

Developing fresh approaches to attracting and keeping young people in engineering and technical occupations.

Improving the utilization of technical people in industry, in government, and in the military.

Developing better information on technical manpower to assist long and short-range manpower planning.

Your role: Action

When the technical manpower situation goes critical in the '70's, it is your company that will be forced to cut back its plans for growth and expansion. And your stockholders and employees who will feel the long-term impact of this technical "brainwane." What action can you take *now* to forestall this?

As an initial step, Deutsch & Shea suggests that you support the EMC Task Force in its effort to develop a national course of action:

Advise the Engineering Manpower Commission of your company's concern with meeting the technical manpower problem. (You can write the Commission at 345 East 47th Street, New York, N.Y. 10017.)

Contribute your personal ideas on creating a coordinated national technical manpower program.

Be prepared to volunteer material assistance from your company — man-hours and money — to implement the recommendations that result from the symposium.

The alternative is a grim one.

MEMBER AMERICAN ASSOCIATION OF ADVERTISING AGENCIES

Deutsch & Shea, inc.
Advertising
49 EAST 53 STREET, NEW YORK, N.Y. 10022

An advertisement appearing in Fortune February 1968

specialization decisions until a more responsible point in the student's intellectual and professional development has been reached.

2. The Department of Electrical Engineering at Tech has for many years provided outstanding leadership in Electrical Engineering education. Approximately eight years ago, a design laboratory for use by students at the undergraduate level was instituted, and although students found the laboratory concept considerably more demanding, it drew upon their originality and ingenuity so rewardingly that expanded facilities, with additional equipment, became a necessity. As a result of this success, many other universities, including, interestingly enough, MIT, have followed our lead. During the last few years a massive developmental effort in the Department has been under way in solid state electronics, plasma dynamics, and quantum electronics. Research in these areas has progressed far beyond out most optimistic anticipation, and during the past two and one-half years over 20 research grants and projects, amounting to approximately $200,000, have been received by the Department.

3. The Interdisciplinary Ph.D. in Engineering, a "first" in Texas, and instituted by Texas Tech, has now been initiated at three other universities.

4. The three-hour Freshman course in Engineering Analysis and Design inaugurated in 1966 has resulted in many Freshmen expressing far greater interest in engineering problems and their solution by use of high speed computers. Results are not fully conclusive, but we believe that much of the apathy on the part of Freshmen toward a career in Engineering has been dissipated.

5. Another "first," the off-campus Master of Engineering Degree Program, was approved January 15, 1968 by the Coordinating Board, and since has inspired extreme interest on the part of Texas universities, and inquiries as to methods of its implementation.

In the realm of Textile Engineering and Research, work is well under way on the extensive addition authorized by the Board. Much more effective liaison with industry; top leadership in this field; opportunity for the most effective research in this field so economically important to our region and our nation, are but a few of the advantages growing out of this authorization.

At present, instructional and research programs in the five basic sectors of Industrial Engineering are well balanced: Biotechnology and Human Performance; Quantitative Techniques; Manufacturing Science; Management Systems; and Decision Theory and Control Systems. Continuing growth is confidently anticipated.

History; Expansion: Development

In order to understand our relative position as a whole at the

present time, it is necessary to review a little of our history. It has been said that "those who forget history, repeat it," and we cannot afford, in terms of either time or money, to repeat the efforts of the past ten years in promoting Tech's development.

From its inception, in 1925, Texas Tech has endeavored to live up to the purposes and ideals specified for it in the Bill by which the Thirty-Eighth Legislature established it. At once a tradition of greater-than-expected enrollment was born, for the original faculty of two had immediately to be expanded to five, the following year to nine. Initially, the entire School of Engineering was housed in the now Industrial-Textile Engineering Building, with floor space of less than 10,000 square feet. Offices were created by hasty partitioning of some laboratories; classrooms by enclosure of the cloister on the south side.

The beginning of continuing progress for the School of Engineering occurred in 1928, when its first three graduates received their degrees, and when it occupied the first major addition to the original facilities: the West Engineering Building.

Four decades past this milestone, the School of Engineering occupies 250,000 square feet of space; anticipates graduating 250 students; has registered approximately 2500 undergraduate and graduate students during the year, and has increased its staff to more than 145 members.

The School of Engineering is a conjugate entity, purveying both architectural and engineering education. In this report, the two operational aspects will be discussed independently.

Architecture

The teaching of design is the core of instruction in the Department of Architecture, and embraces two major curricula. Concentration is upon the creative development of the student as an individual, through the expansion of his capacity for principled and disciplined thought, with professional orientation.

The Department of Architecture is fully accredited by the National Architectural Acrediting Board. At the last inspection, in 1966, the NAAB accepted the Inspection Committee's recommendation for continued accreditation for the usual period of five years.

On the drafting table, and well along in its development, is the new Architecture-Art Building, which will provide much needed space and new facilities. As stated in the "Eight Year Plan" submitted in May, 1964, to the Board of Directors by the School of Engineering, the Office of the Dean recommended the establishment of Architecture as an independent School by 1971. This date coincides with the completion of the new facilities, and the move from the present Architecture Building.

Supplying much needed effort in architectural research, the Department has emphasized programs in city planning, environmental design, and indigenous architecture of the Southwest.

Engineering

The School of Engineering has undergraduate programs in Agricultural, Chemical, Civil, Electrical, Industrial, Mechanical, Petroleum and Textile Engineering; and Engineering Physics. As measured by the Engineer's Council for Professional Development (ECPD), accreditation, and records of our students in other graduate schools and industry, our undergraduate program is a success. The accreditation status of the nine undergraduate degree programs are:

Curriculum	Date of Inspection	Accreditation Granted To:
Agricultural Engineering	1967	1971
Chemical Engineering	1965	1971
Civil Engineering	1965	1969
Electrical Engineering	1965	1971
Engineering Physics	1965	1971
Industrial Engineering	1965	1971
Mechanical Engineering	1965	1971
Petroleum Engineering	1965	1971
Textile Engineering	1965	1969

It may be noted that all departments except those of Civil and Textile Engineering have earned the highest accreditation. Civil Engineering was cited again for its lack of laboratories, and of graduate and faculty research. Textile Engineering problems stemmed from low enrollment and resultant limited faculty. Remedial steps have been taken in both departments, and it is anticipated that the filing of a progress report with ECPD in 1969 will result in a continuation of the accreditation of the two curricula through 1971, when all nine will be reinspected.

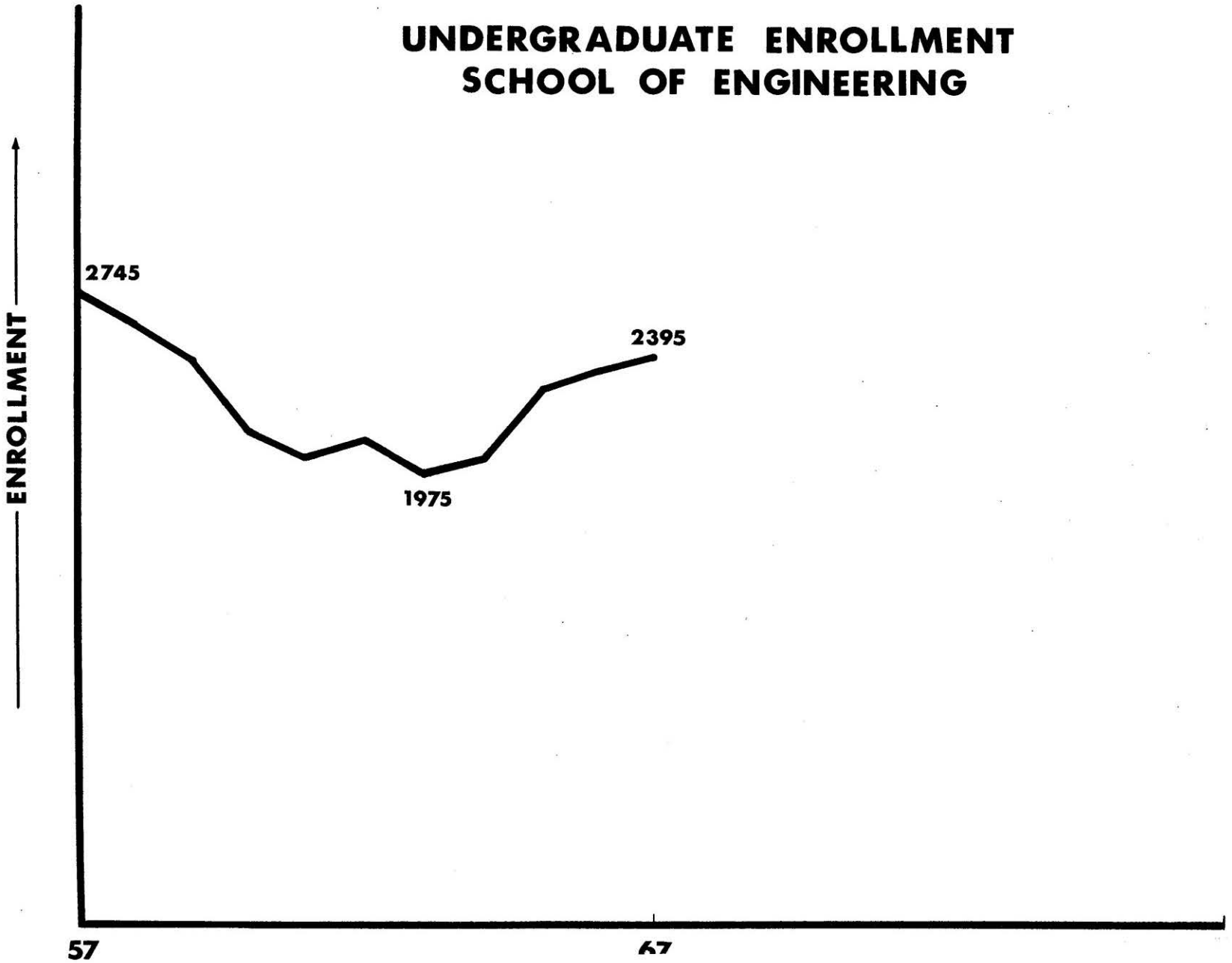
In remedial action, the Board already has approved construction of additional Civil Engineering laboratories, including a fluid dynamics laboratory on which construction is expected to begin in the near future.

Regarding Textile Engineering, increased emphasis is being placed upon research, distinguished new faculty members have been acquired, with resultant reawakened and enhanced interest on the part of students.

Size and growth of the undergraduate program are depicted in Figure 1.

Programs toward attainment of Master of Science and Doctor of Philosophy Degrees are offered by the Departments of Chemical, Civil, Electrical, Industrial, and Mechanical Engineering. There is, as well,

UNDERGRADUATE ENROLLMENT
SCHOOL OF ENGINEERING



an interdisciplinary program in Engineering at the Ph.D. level. The Master of Science Program was initiated in 1959; the Doctor of Philosophy, in 1964. A summary of graduate enrollment is shown in Figure 2.

Graduate programs leading to the Degree of Doctor of Philosophy are available to students in the conventional fields of chemical, civil, electrical, industrial, and mechanical engineering. In addition, a complex of interdisciplinary courses leading to the doctorate, and from which the student selects work from such areas as systems engineering, aerospace, electronics, transport phenomena, mechanics, thermal sciences, materials science, operations research, mathematics, or bioengineering studies, is offered.

Research programs are being developed in each of the broad fields of graduate study. The absence of a Ph.D. program prior to 1964 virtually precluded the development of significant research. In general, our initial doctoral students are just getting well into their research problems. Additional research will be generated by the results obtained.

At our stage of development, one of the most pressing problems is that of graduate student support. Unfortunately, our graduate stipends are not competitive, nor are there enough of them. This lack has been the greatest single impediment of growth of our graduate and research programs.

It is interesting to note the relative position of Texas Tech among the degree granting institutions as shown on the following three pages. (See Tables showing institutions granting Bachelor's, Master's, and Doctor's Degrees in Engineering.)

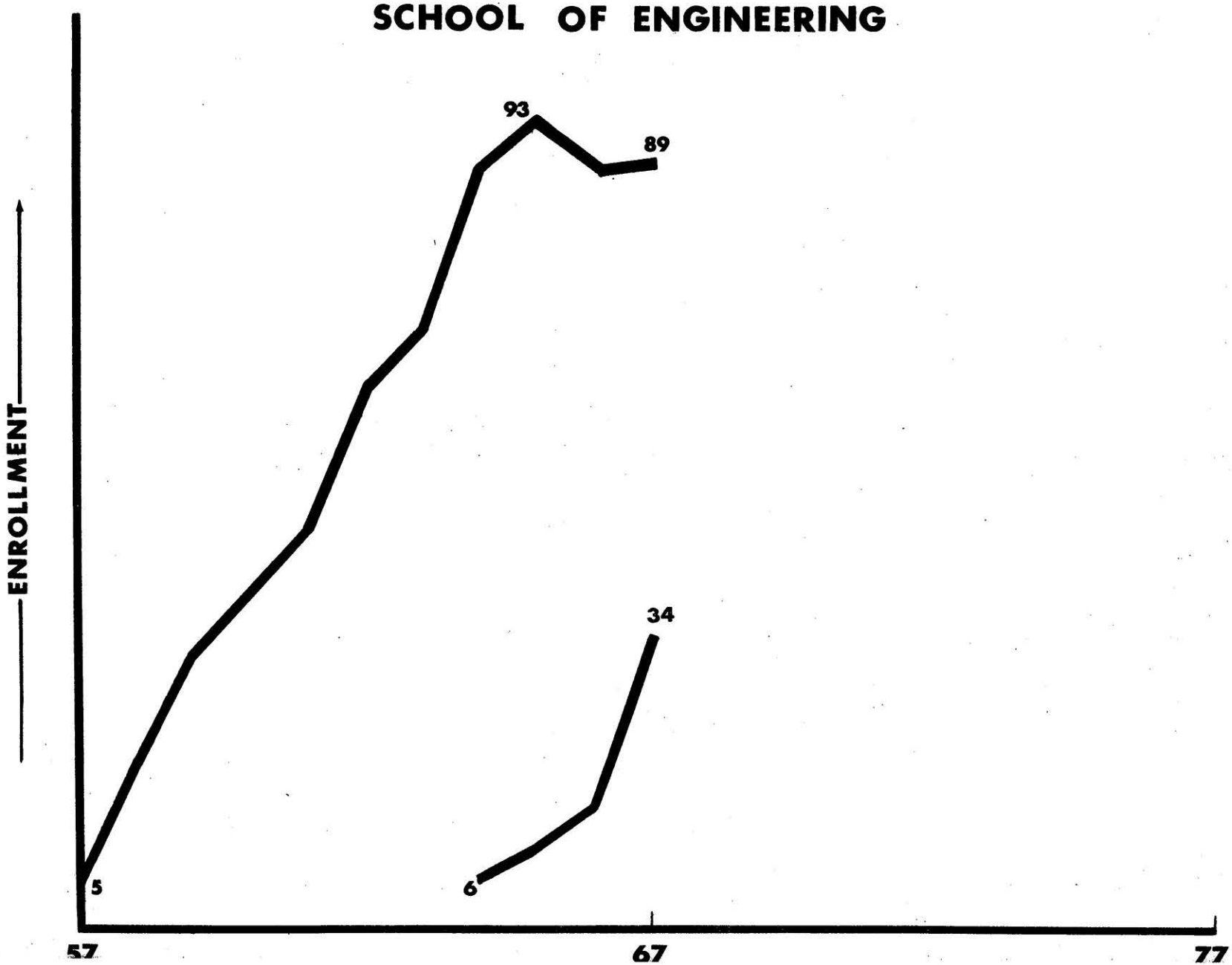
The history of faculty size and quality is presented in Figures 3 and 4. An indication of faculty improvement is the percentage of members holding doctoral degrees.

Two events improved our faculty recruiting position: the initiation of the Ph.D. program, and salary increases, in 1965; however, our salary position has dropped somewhat the last two years.

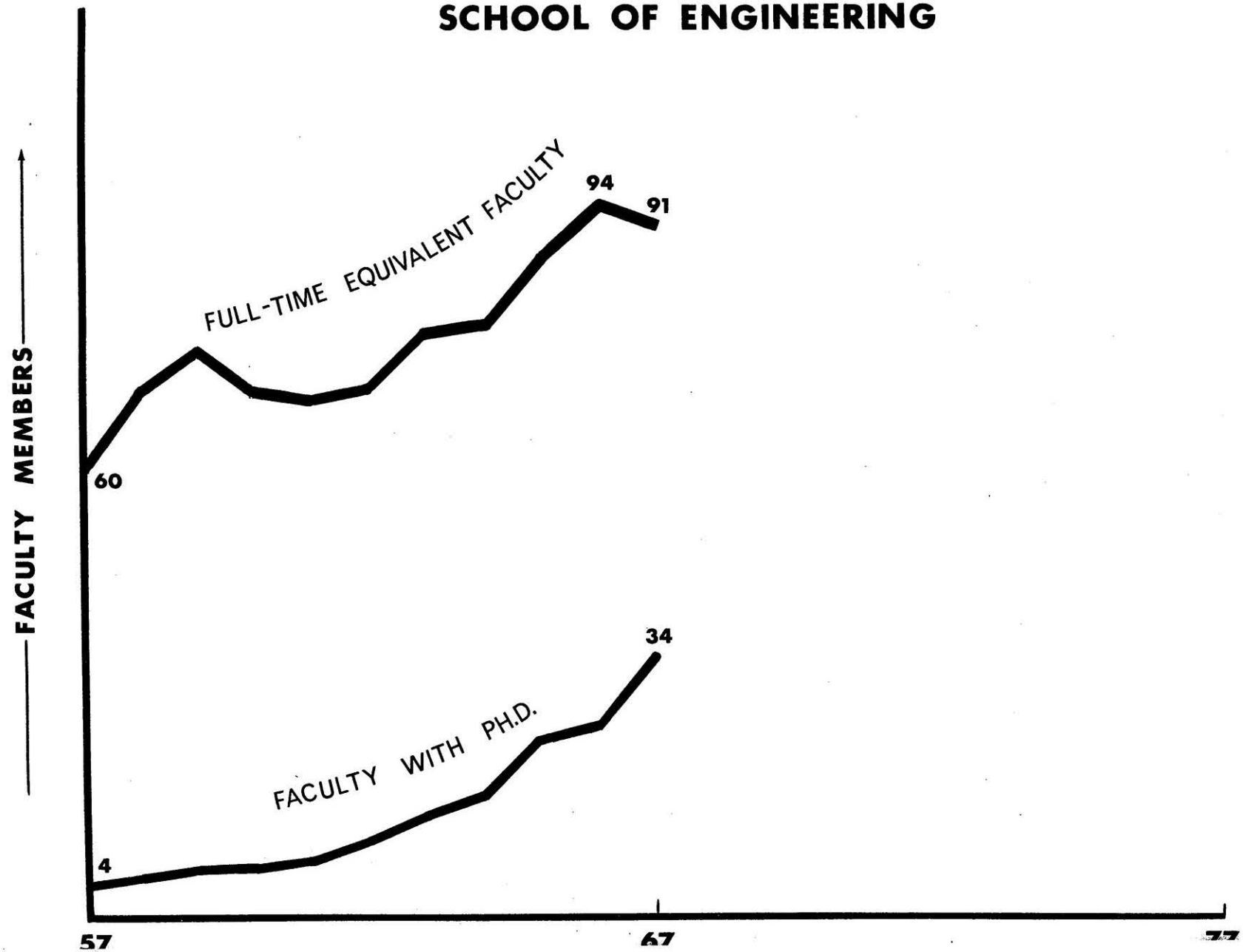
One of our primary problems is that a number of the members of our faculty are best suited for undergraduate instruction. This is a natural consequence of our history. The faculty and supporting staff, moreover, is not sufficiently large to make possible the rate of progress which now is mandatory. This will be discussed in more detail in connection with our future goals. Despite these facts, members of our faculty are to be commended for having achieved as much as they have in bootstrapping the graduate program under present circumstances, and for maintaining an excellent undergraduate program.

Facilities within the School of Engineering, except in the Department of Electrical Engineering, may be said to be satisfactory--for the

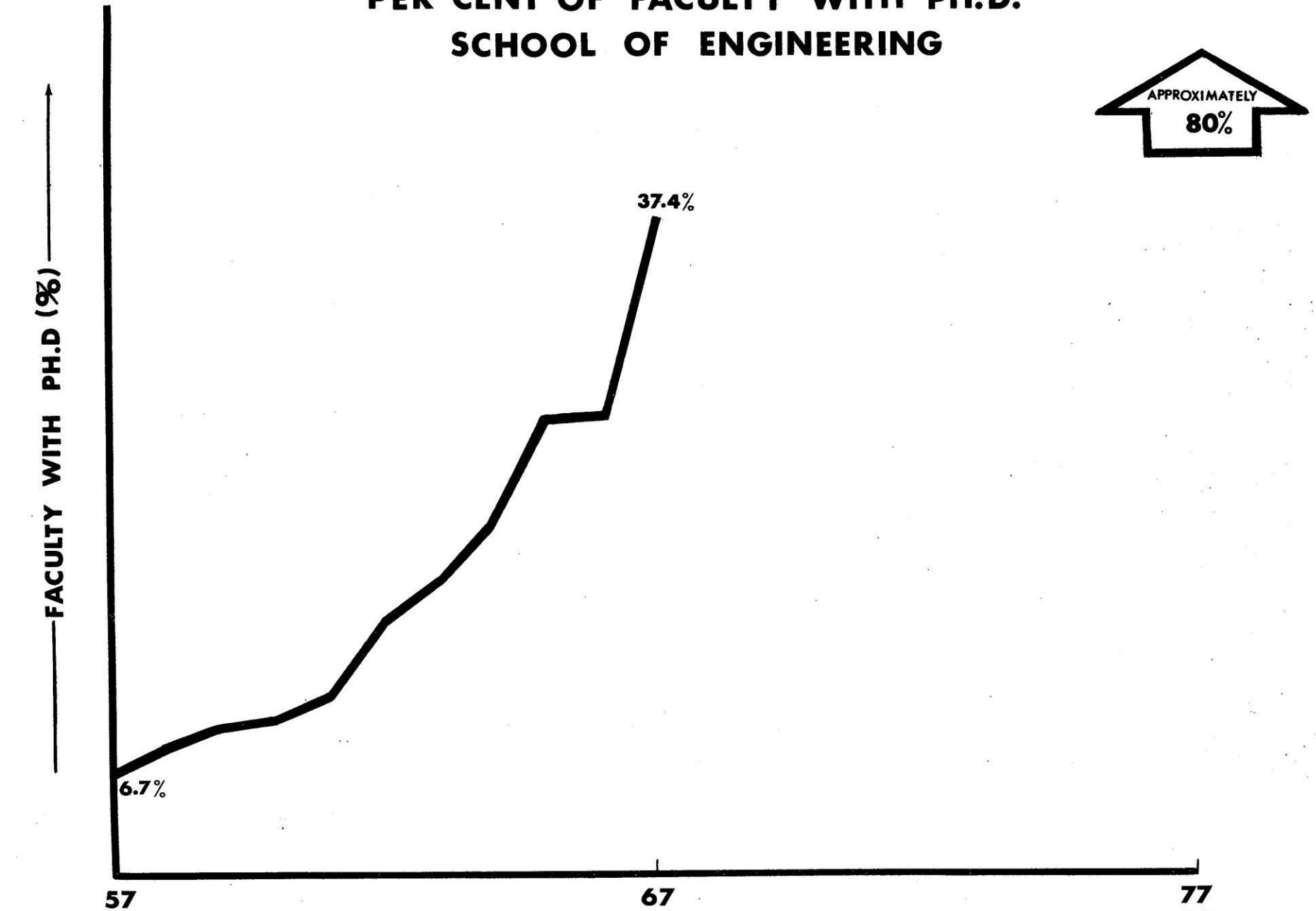
M.S. AND PH.D. ENROLLMENT
SCHOOL OF ENGINEERING



CURRENT FACULTY
SCHOOL OF ENGINEERING



PER CENT OF FACULTY WITH PH.D.
SCHOOL OF ENGINEERING



BACHELOR'S DEGREES IN ENGINEERING

(One-Year Period Ending June 1966)

(Institutions With At Least One ECPD-Accredited Curriculum)

No.	Percent of Inst.	Institution	No. of Degrees	Percent of Degrees
1	0.6	Purdue U.	945	3.0
2	1.1	U. of Illinois	754	5.3
3	1.7	Georgia Inst. of Tech.	623	7.3
4	2.2	U. of Michigan	615	9.2
5	2.8	Newark Coll.	603	11.1
6	3.4	Pennsylvania St. U.	578	13.0
7	3.9	No. Carolina St. U.	534	14.6
8	4.4	U. of Missouri (Rolla)	532	16.3
9	5.0	U. of Calif. (Berkeley)	509	17.9
10	5.6	Virginia Poly. Inst.	488	19.4
11	6.1	U. of Minnesota	479	21.0
12	6.7	Drexel Inst. Tech.	459	22.4
13	7.2	CUNY City Coll.	451	23.8
14	7.8	U. of Wisconsin	429	25.2
15	8.3	U. of Washington	418	26.4
16	8.9	Auburn U.	416	27.8
17	9.4	Northeastern U.	416	29.0
18	10.1	Mass. Inst. of Tech.	414	30.4
19	10.6	U. of Florida	396	31.6
20	11.1	Rensselaer Poly. Inst.	389	32.9
21	11.7	Cornell U.	385	34.0
22	12.2	Iowa St. U.	372	35.2
23	12.8	Michigan Tech. U.	370	36.4
24	13.4	U. of Texas	366	37.6
25	14.0	Ohio St. U.	361	38.7
26	14.5	U. of Tennessee	328	39.7
27	15.1	Texas A and M U.	327	40.8
28	15.6	Illinois Inst. of Tech.	324	41.8
29	16.2	Poly. Inst. of Brooklyn	316	42.8
30	16.8	U. of Maryland	297	43.7
31	17.3	U. of Cincinnati	285	44.6
32	17.9	U. of Notre Dame	266	45.4
33	18.4	Oklahoma St. U.	260	46.2
34	19.0	Lehigh U.	257	47.0
35	19.6	U. of Colorado	255	47.9
36	20.1	Manhattan U.	249	48.7
37	20.7	U. of Pittsburgh	247	49.4
38	21.2	UCLA	247	50.2
39	21.8	Michigan St. U.	237	51.0
40	22.3	U. of Detroit	234	51.7
41	22.9	Carnegie Inst. of Tech.	227	52.4
42	23.4	U.S. Air Force Academy	223	53.1
43	24.0	Worcester Poly. Inst.	221	53.8
44	24.6	U. of Nebraska	220	54.4
45	25.1	Kansas St. U.	216	55.1
46	25.7	Marquette U.	216	55.9
47	26.2	U. of Missouri (Columbia)	209	56.5
48	26.8	Louisiana St. U.	205	57.1
49	27.3	Case Inst. of Tech.	204	57.8
50	27.9	Johns Hopkins U.	204	58.4
51	28.4	Mississippi St. U.	204	59.0
52	29.0	New York U.	201	59.7
53	29.6	U. of Oklahoma	200	60.3
54	30.1	Oregon St. U.	200	61.0
55	30.7	U. of Puerto Rico	200	61.6
56	31.2	St. Louis U.	199	62.2
57	31.8	San Jose St. Coll.	198	62.8
58	32.4	Clarkson Coll. of Tech.	195	63.4
59	33.0	U. of Alabama	194	64.0
60	33.5	New Mexico St. U.	194	64.7
61	34.0	U. of Arizona	191	65.2
62	34.6	Villanova U.	191	65.9
63	35.1	Texas Tech. Coll.	189	66.4
64	35.8	Colorado Sch. of Mines	187	67.0
65	36.3	Clemson U.	186	67.7
66	36.9	U. of Kansas	181	68.2
67	37.4	U. of Utah	180	68.8
68	38.0	Washington St. U.	179	69.3
69	38.5	U. of Arkansas	175	69.9
70	39.1	U. of Kentucky	174	70.4
71	39.7	Stevens Inst. of Tech.	174	71.1
72	40.2	West Virginia U.	169	71.5
73	40.8	No. Dakota St. U.	161	72.0
74	41.3	U. of Dayton	157	72.5
75	41.9	Fairleigh Dickinson U.	154	73.0
76	42.5	SUNY at Buffalo	152	73.4
77	43.0	Wayne St. U.	149	74.0
78	43.6	U. of Wyoming	149	74.4
79	44.1	Cleveland St. U.	147	74.9
80	44.7	Stanford U.	147	75.3
81	45.2	U. of Maine	145	75.8
82	45.8	Tufts U.	144	76.2
83	46.4	Lowell Tech. Inst.	140	76.7
84	46.9	Ohio U.	140	77.1
85	47.4	Northwestern U.	137	77.6
86	48.0	U. of Houston	134	78.0
87	48.6	Arizona St. U.	132	78.4
88	49.1	So. Dakota Sch. of M. and T.	132	78.8
89	49.7	Calif. St. Coll. at L.A.	131	79.2
90	50.3	Cooper Union	131	79.6
91	50.8	Montana St. U.	131	80.0
92	51.4	U. of Massachusetts	130	80.4
93	52.0	U. of Idaho	129	80.9
94	52.5	U. of Southern Calif.	126	81.2
95	53.0	Calif. St. Coll. at Long Beach	125	81.7
96	53.6	U. of New Mexico	124	82.0
97	54.1	Tennessee Tech. U.	123	82.4
98	54.7	Vanderbilt U.	123	82.8
99	55.3	Rutgers St. U.	122	83.2
100	55.9	Arlington St. Coll.	120	83.6
101	56.4	Lamar St. Coll.	117	84.0
102	57.0	So. Dakota St. U.	117	84.3
103	57.5	Columbia U.	116	84.7
104	58.1	Louisiana Poly. Inst.	116	85.0
105	58.7	U. of Rhode Island	114	85.4
106	59.2	U. of Hawaii	113	85.8
107	59.8	Washington U.	112	86.1
108	60.3	Youngstown U.	112	86.4
109	60.9	U. of Connecticut	110	86 8
110	61.4	U. of Toledo	109	87.1
111	62.0	Colorado St. U.	108	87.5
112	62.6	U. of Iowa	107	87.8
113	63.1	Syracuse U.	106	88.1
114	63.7	Lafayette Coll.	105	88.5
115	64.2	U. of Louisville	105	88.8
116	64.8	Rose Poly. Inst.	101	89.1
117	65.3	U.S. Naval Postgraduate Sch.	100	89.4
118	65.9	Princeton U.	95	89.8
119	66.4	U. of Virginia	92	90.0
120	67.0	Utah St. U.	92	90.3
121	67.6	U. of Miami	91	90.6
122	68.1	Rice U.	90	90.9
123	68.7	U. of Delaware	90	91.1
124	69.2	U. of New Hampshire	87	91.4
125	69.8	Southern Methodist U.	86	91.7
126	70.3	Brigham Young U.	85	92.0
127	70.9	Bucknell U.	83	92.2
128	71.5	Virginia Military Inst.	82	92.5
129	72.0	U. of Pennsylvania	81	92.8
130	72.6	Duke U.	78	93.0
131	73.1	Howard U.	73	93.2
132	73.7	Bradley U.	72	93.4
133	74.3	San Diego St. Coll.	70	93.7
134	74.9	U. of North Dakota	70	93.9
135	75.4	Pratt Inst.	68	94.1
136	76.0	U. of Calif. (Davis)	68	94.3
137	76.5	U. of Southwestern La.	68	94.6
138	77.1	Valparaiso U.	67	94.8
139	77.7	George Washington U.	65	95.0
140	78.2	PMC Colleges	65	95.1
141	78.8	U. of Texas at El Paso	61	95.3
142	79.3	San Fernando Valley St. Coll.	60	95.6
143	79.9	SUNY Coll. of Ceramics	56	95.7
144	80.4	U. of Santa Clara	56	95.9
145	81.0	Brown U.	54	96.0
146	81.6	U. of So. Carolina	53	96.2
147	82.1	Dartmouth Coll.	52	96.4
148	82.7	Union Coll.	52	96.6
149	83.2	U. of Bridgeport	52	96.7
150	83.8	Sacramento St. Coll.	51	96.9
151	84.3	U. of Tulsa	51	97.0
152	84.9	Wichita St. U.	51	97.2
153	85.4	U. of Mississippi	50	97.3
154	86.0	Air Force Inst. of Tech.	49	97.5
155	86.6	Norwich U.	49	97.7
156	87.1	U. of Akron	49	97.8
157	87.7	Calif. Inst. of Tech.	48	98.0
158	88.2	Catholic U. of America	47	98.1
159	88.8	Citadel Military Coll.	46	98.2
160	89.3	U. of Nevada	45	98.4
161	89.9	U. of Vermont	44	98.6
162	90.5	Fresno St. Coll.	41	98.7
163	91.0	Seattle U.	40	98.8
164	91.6	Tulane U.	40	99.0
165	92.1	Ohio Northern U.	33	99.0
166	92.7	Montana Coll. of M. S. and T.	31	99.1
167	93.3	U. of Denver	31	99.2
168	93.9	U. of Rochester	31	99.3
169	94.4	Gannon Coll.	26	99.4
170	95.0	Harvard U.	24	99.5
171	95.5	Merrimack Coll.	24	99.6
172	96.0	Tuskegee Inst.	23	99.7
173	96.6	U. of Alaska	22	99.7
174	97.2	SUNY at Stony Brook	20	99.8
175	97.8	U. of Georgia	19	99.8
176	98.3	Swarthmore Coll.	18	99.9
177	98.9	Webb Inst. of Nav. Arch.	16	100.0
178	99.4	Harvey Mudd Coll.	10	100.0
179	100.0	Antioch Coll.	5	100.0
		Total	31,788	

MASTER'S DEGREES IN ENGINEERING

(One-Year Period Ending June 1966)

(Institutions With At Least One Bachelor's ECPD-Accredited Curriculum)

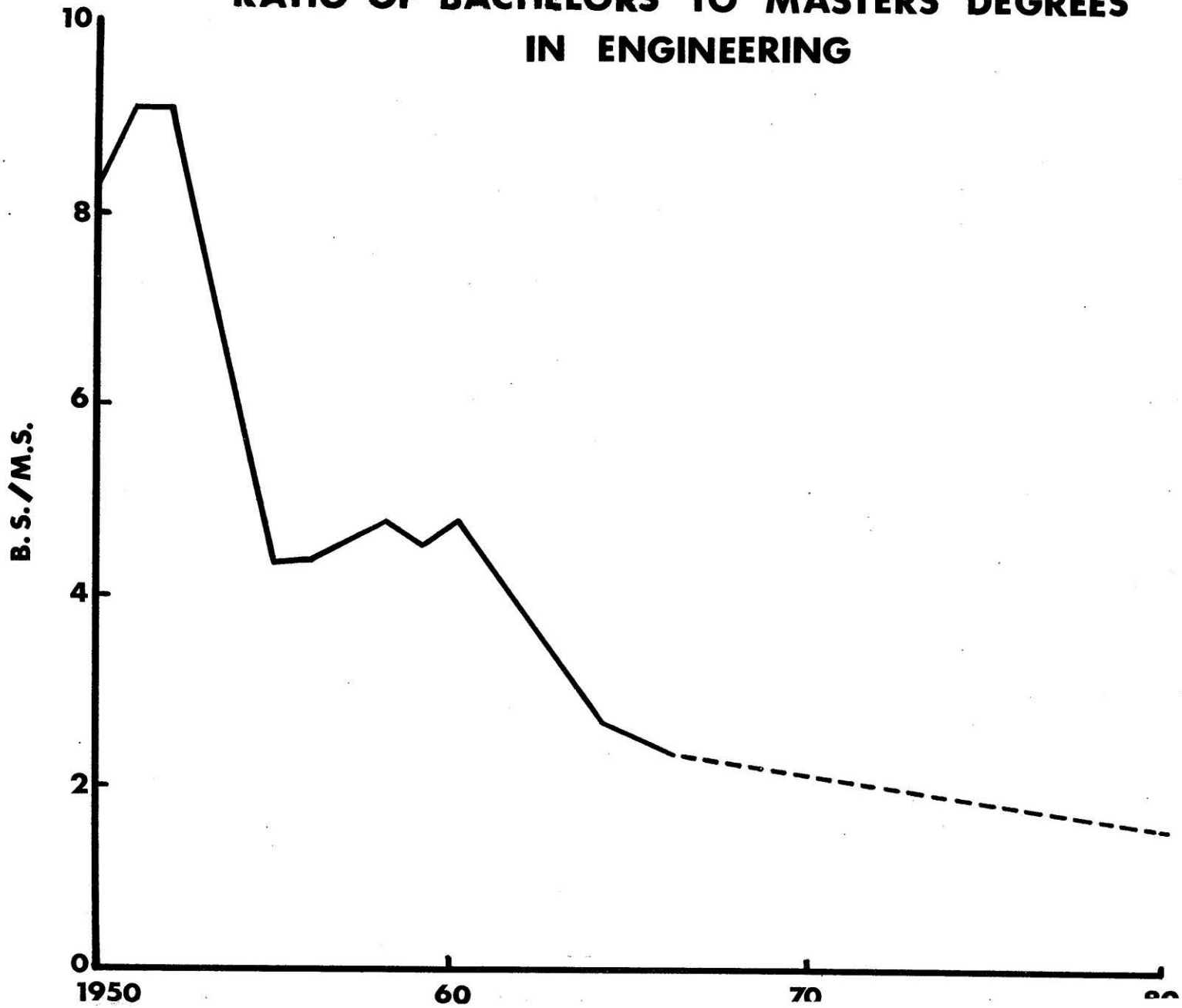
No.	Percent of Inst.	Institution	No. of Degrees	Percent of Degrees
1	0.6	Mass. Inst. of Tech.	570	4.3
2	1.2	U. of Southern Calif.	509	8.2
3	1.9	Stanford U.	467	11.7
4	2.6	U. of Calif. (Berkeley)	466	15.2
5	3.2	Purdue U.	437	18.5
6	3.8	New York U.	420	21.7
7	4.4	U. of Michigan	375	24.5
8	5.1	Cornell U.	336	27.0
9	5.8	U. of Illinois	309	29.4
10	6.4	Northeastern U.	295	31.6
11	7.0	Poly. Inst. Brooklyn	263	33.6
12	7.7	UCLA	243	35.5
13	8.3	Air Force Inst. of Tech.	240	37.3
14	9.0	Columbia U.	225	39.0
15	9.6	Oklahoma St. U.	220	40.6
16	10.2	U. of Wisconsin	208	42.2
17	10.9	Ohio St. U.	185	43.6
18	11.5	Newark Coll.	177	45.0
19	12.1	Drexel Inst. of Tech.	175	46.3
20	12.8	U. of Washington	171	47.6
21	13.4	Pennsylvania St. U.	170	48.8
22	14.1	U. of Missouri (Rolla)	168	50.1
23	14.7	U. of Pennsylvania	160	51.3
24	15.3	U. of Minnesota	155	52.5
25	16.0	U. of Florida	149	53.6
26	16.7	Georgia Inst. of Tech.	146	54.7
27	17.3	Stevens Inst. of Tech.	141	55.8
28	17.9	U. of Connecticut	136	56.8
29	18.6	Illinois Inst. of Tech.	131	57.8
30	19.2	Southern Methodist U.	130	58.8
31	19.9	Rensselaer Poly. Inst.	124	59.7
32	20.5	Carnegie Inst. of Tech.	123	60.7
33	21.1	U. of Texas	120	61.6
34	21.8	U. of Tennessee	117	62.5
35	22.4	Case Inst. of Tech.	110	63.3
36	23.0	Syracuse U.	106	64.1
37	23.7	Northwestern U.	105	64.9
38	24.3	U. of Missouri (Columbia)	104	65.7
39	25.0	Princeton U.	102	66.4
40	25.6	U. of Colorado	101	67.2
41	26.2	Texas A and M U.	101	68.0
42	26.9	CUNY City Coll.	100	68.7
43	27.6	No. Carolina St. U.	100	69.5
44	28.2	Calif. Inst. Tech.	97	70.2
45	28.8	Iowa St. U.	97	71.0
46	29.4	George Washington U.	94	71.7
47	30.1	U. of Arizona	93	72.4
48	30.8	U. of Oklahoma	93	73.1
49	31.4	U. of New Mexico	89	73.7
50	32.0	Kansas St. U.	88	74.4
51	32.7	Virginia Poly. Inst.	88	75.1
52	33.3	U. of Pittsburgh	86	75.7
53	34.0	Wayne St. U.	84	76.4
54	34.6	Lehigh U.	78	77.0
55	35.2	Arizona St. U.	76	77.5
56	35.9	San Jose St. Coll.	76	78.1
57	36.5	U. of Kansas	76	78.7
58	37.1	U. of Santa Clara	76	79.3
59	37.8	West Virginia U.	74	79.8
60	38.4	Michigan St. U.	69	80.3
61	39.1	U.S. Naval Postgraduate Sch.	66	80.8
62	39.7	U. of Notre Dame	66	81.3
63	40.3	Louisiana St. U.	64	81.8
64	41.0	Washington U.	64	82.3
65	41.7	U. of Cincinnati	62	82.8
66	42.3	U. of Iowa	58	83.2
67	42.9	U. of Alabama	56	83.6
68	43.6	U. of Kentucky	53	84.0
69	44.2	Harvard U.	52	84.4
70	44.9	Utah St. U.	51	84.8
71	45.5	Catholic U. of America	50	85.2
72	46.1	U. of Nebraska	50	85.6
73	46.8	Texas Tech. Coll.	49	85.9
74	47.4	U. of Maryland	48	86.3
75	48.0	Colorado St. U.	46	86.6
76	48.7	U. of Virginia	45	87.0
77	49.3	Auburn U.	44	87.3
78	50.0	SUNY at Buffalo	44	87.7
79	50.6	U. of Delaware	43	88.0
80	51.2	U. of Maine	43	88.3
81	51.9	U. of Massachusetts	43	88.6
82	52.6	U. of Utah	43	89.0
83	53.2	U. of Rhode Island	42	89.3
84	53.8	Oregon St. U.	41	89.6
85	54.4	Johns Hopkins U.	40	89.9
86	55.1	U. of Toledo	40	90.2
87	55.8	Mississippi St. U.	39	90.5
88	56.4	Rice U.	39	90.8
89	57.0	Clemson U.	37	91.0
90	57.7	U. of Idaho	37	91.3
91	58.3	Worcester Poly. Inst.	36	91.6
92	59.0	Colorado Sch. of Mines	34	91.9
93	59.6	No. Dakota St. U.	34	92.1
94	60.2	U. of Rochester	34	92.4
95	60.9	U. of Wyoming	34	92.6
96	61.5	U. of Arkansas	33	92.9
97	62.1	Rutgers St. U.	32	93.1
98	62.8	Washington St. U.	32	93.4
99	63.4	Bradley U.	31	93.6
100	64.1	Louisiana Poly. Inst.	31	93.8
101	64.7	Montana St. U.	31	94.0
102	65.3	New Mexico St. U.	31	94.3
103	66.0	Villanova U.	31	94.5
104	66.7	San Diego St. Coll.	30	94.8
105	67.3	U. of Calif. (Davis)	30	95.0
106	67.9	Clarkson Coll.	27	95.2
107	68.6	Brigham Young U.	26	95.4
108	69.2	Brown U.	26	95.6
109	69.9	Michigan Tech. U.	26	95.8
110	70.5	Union Coll.	26	96.0
111	71.1	Houston U.	23	96.2
112	71.8	Tulane U.	23	96.3
113	72.4	Tufts U.	22	96.5
114	73.0	U. of Akron	21	96.7
115	73.7	U. of Bridgeport	20	96.8
116	74.3	U. of Nevada	20	97.0
117	75.0	Vanderbilt U.	20	97.1
118	75.6	St. Louis U.	19	97.3
119	76.2	U. of Detroit	19	97.4
120	76.9	Duke U.	18	97.5
121	77.6	Lowell Tech. Inst.	17	97.7
122	78.2	U. of Alaska	17	97.8
123	78.8	U. of Tulsa	17	97.9
124	79.4	So. Dakota St. U.	16	98.0
125	80.1	U. of No. Dakota	16	98.2
126	80.8	So. Dakota Sch. of M. and T.	15	98.3
127	81.4	U. of New Hampshire	15	98.4
128	82.0	U. of Denver	14	98.5
129	82.7	U. of Hawaii	14	98.6
130	83.3	Manhattan Coll.	12	98.7
131	84.0	Ohio U.	12	98.8
132	84.6	Bucknell U.	11	98.9
133	85.2	Dartmouth Coll.	10	98.9
134	85.9	Marquette U.	10	99.0
135	86.5	Montana Coll.	10	99.1
136	87.1	Wichita St. U.	10	99.2
137	87.8	Seattle U.	9	99.2
138	88.4	Tuskegee Inst.	9	99.3
139	89.1	SUNY at Stony Brook	8	99.4
140	89.7	U. of Dayton	8	99.4
141	90.3	U. of Miami	8	99.5
142	91.0	U. of Mississippi	8	99.5
143	91.7	U. of So. Carolina	8	99.6
144	92.3	Lamar St. Coll. of Tech.	7	99.7
145	92.9	SUNY Coll. of Ceramics	6	99.7
146	93.6	U. of No. Carolina	6	99.8
147	94.2	U. of Louisville	5	99.8
148	94.9	Webb Inst. of Nav. Arch.	5	99.8
149	95.5	U. of Georgia	4	99.8
150	96.1	Calif. St. Coll. (Long Beach)	3	99.9
151	96.8	Rose Poly. Inst.	3	99.9
152	97.4	Sacramento St. Coll.	3	99.9
153	98.0	U. of Puerto Rico	3	99.9
154	98.7	U. of Vermont	3	100.0
155	99.3	Pratt Inst.	2	100.0
156	100.0	Tennessee Tech. U.	2	100.0
		Total	13,225	

DOCTOR'S DEGREES IN ENGINEERING

(One-Year Period Ending June 1966)
(Institutions With At Least One Bachelor's ECPD-Accredited Curriculum)

No.	Percent of Inst.	Institution	No. of Degrees	Percent of Degrees
1	1.0	Mass. Inst. of Tech.	173	7.5
2	2.0	U. of Calif. (Berkeley)	114	12.5
3	3.0	U. of Illinois	114	17.5
4	4.0	Stanford U.	106	22.1
5	5.0	Purdue U.	95	26.3
6	5.9	U. of Michigan	74	29.5
7	6.9	U. of Texas	65	32.3
8	7.9	Northwestern U.	62	35.0
9	8.9	Cornell U.	55	37.4
10	9.9	Oklahoma St. U.	53	39.7
11	10.9	U. of Pennsylvania	50	41.9
12	11.9	Ohio St. U.	49	44.1
13	12.9	U. of Minnesota	49	46.2
14	13.9	Carnegie Inst. of Tech.	48	48.3
15	14.9	Iowa St. U.	46	50.3
16	15.8	Calif. Inst. Tech.	43	52.2
17	16.8	Princeton U.	43	54.1
18	17.8	U. of Wisconsin	41	55.8
19	18.8	New York U.	39	57.5
20	19.8	Columbia U.	35	59.1
21	20.8	Poly. Inst. of Brooklyn	35	60.6
22	21.8	Texas A and M U.	34	62.1
23	22.8	Harvard U.	32	63.5
24	23.8	U. of Washington	31	64.8
25	24.8	Georgia Inst. of Tech.	30	66.1
26	25.7	No. Carolina St. U.	30	67.5
27	26.7	U. of Florida	29	68.7
28	27.7	Rice U.	28	69.9
29	28.7	Case Inst. of Tech.	27	71.1
30	29.7	Michigan St. U.	27	72.3
31	30.7	Lehigh U.	24	73.3
32	31.7	Pennsylvania St. U.	24	74.4
33	32.7	UCLA	23	75.4
34	33.7	Illinois Inst. of Tech.	22	76.4
35	34.7	Iowa St. U.	21	77.3
36	35.6	Syracuse U.	21	78.2
37	36.6	U. of Maryland	21	79.1
38	37.6	Rensselaer Poly. Inst.	19	79.9
39	38.6	Virginia Poly. Inst.	19	80.8
40	39.6	U. of Oklahoma	18	81.5
41	40.6	Johns Hopkins U.	17	82.3
42	41.6	U. of Arizona	17	83.0
43	42.6	U. of Colorado	16	83.7
44	43.6	U. of New Mexico	16	84.4
45	44.6	U. of Delaware	15	85.0
46	45.5	Kansas St. U.	14	85.7
47	46.5	Colorado Sch. of Mines	13	86.3
48	47.5	U. of Rochester	13	86.8
49	48.5	U. of Tennessee	13	87.4
50	49.5	Brown U.	12	87.9
51	50.4	Colorado St. U.	12	88.4
52	51.4	U. of Connecticut	12	89.0
53	52.4	U. of Kansas	12	89.5
54	53.4	U. of Notre Dame	12	90.0
55	54.4	U. of Southern Calif.	12	90.5
56	55.4	U. of Utah	12	91.0
57	56.4	Washington U.	12	91.6
58	57.4	Stevens Inst. of Tech.	11	92.1
59	58.4	SUNY at Buffalo	10	92.5
60	59.4	U. of Virginia	10	92.9
61	60.3	Vanderbilt U.	10	93.4
62	61.3	U. of Missouri (Columbia)	9	93.8
63	62.3	U. of Missouri (Rolla)	9	94.2
64	63.3	U. of Pittsburgh	9	94.5
65	64.3	Oregon St. U.	8	94.9
66	65.3	Arizona St. U.	7	95.2
67	66.3	West Virginia U.	7	95.5
68	67.3	Catholic U. of America	6	95.8
69	68.3	U. of Cincinnati	6	96.0
70	69.3	Newark College of Engineering	5	96.2
71	70.2	Rutgers St. U.	5	96.5
72	71.2	Tulane U.	5	96.7
73	72.2	U. of Calif. (Davis)	5	96.9
74	73.2	U. of Houston	5	97.1
75	74.2	George Washington U.	4	97.3
76	75.2	Mississippi St. U.	4	97.5
77	76.2	U.S. Naval Postgraduate Sch.	4	97.6
78	77.2	U. of Alabama	4	97.8
79	78.2	U. of Arkansas	4	98.0
80	79.2	Utah St. U.	4	98.2
81	80.1	Worcester Poly. Inst.	4	98.3
82	81.1	Duke U.	3	98.5
83	82.1	Montana St. U.	3	98.6
84	83.1	U. of Idaho	3	98.7
85	84.1	U. of Nebraska	3	98.9
86	85.1	U. of Rhode Island	3	99.0
87	86.1	Auburn U.	2	99.1
88	87.1	Clemson U.	2	99.2
89	88.1	New Mexico St. U.	2	99.3
90	89.1	Northeastern U.	2	99.3
91	90.0	SUNY Coll. of Ceramics	2	99.4
92	91.0	Texas Tech. Coll.	2	99.5
93	92.0	U. of So. Carolina	2	99.6
94	93.0	Wayne St. U.	2	99.7
95	94.0	Clarkson Coll. of Tech.	1	99.7
96	95.0	Dartmouth Coll.	1	99.8
97	96.0	Louisiana St. U.	1	99.8
98	97.0	U. of Denver	1	99.9
99	98.0	U. of Louisville	1	99.9
100	99.0	U. of Maine	1	100.0
101	100.0	Washington St. U.	1	100.0
		Total	2,292	

RATIO OF BACHELORS' TO MASTERS' DEGREES IN ENGINEERING



4. There is a need for greater emphasis upon the socio-humanistic sector of learning as it relates to engineering.

5. Continuing, off-campus, education of engineers after formal college, is a pressing need.

6. The general "goal for the next decade" will be in the development of graduate engineering education (see Figure 6).

The effects of the Goals Report considering the ECPD position on it, on Texas Tech and its School of Engineering will be perhaps less than expected from the magnitude of the effort which was expended in its preparation. Most of its recommendations are in agreement with the plans of the School which had already been formulated. Individual and discernible program areas, as opposed to a single engineering program, are encouraged. Flexibility in the development of engineering programs is not only permitted but considered desirable and essential. Care must be exercised, however, in assuring that the use of flexibility results neither in loss of quality in the program nor loss of identity as an education for engineering.

The Future

Goals, plans and needs of the individual departments within the School of Engineering have already been submitted by the departmental chairmen. Hence, this report deals primarily with new and developing programs which cut across departmental lines and strengthen each of the individual discipline programs within the School.

Projected undergraduate enrollment is shown in Figure 7. Estimates are based upon two different sets of data: (1) national trends in engineering education, and (2) composite figures concerning enrollment at Texas Technological College as supplied to the Coordinating Board, Texas College and University System. (See Figures 10, 11, and 12).

A major job of the School of Engineering during the next decade is to expand the spectrum of engineering and technological skills and education of its products. The development of graduate and research programs already begun will be continued and accelerated. Program quality at this level is very critical since graduates will be in the very forefront of progress, planning and directing technological developments.

The difference between the supply of and the demand for engineers is continually increasing and the supply of persons qualified to do the technological work which must be done is becoming increasingly critical. The solution to this particular problem does not lie in turning out fewer but more highly educated and sophisticated engineers. The engineering process requires manpower with a broad spectrum of

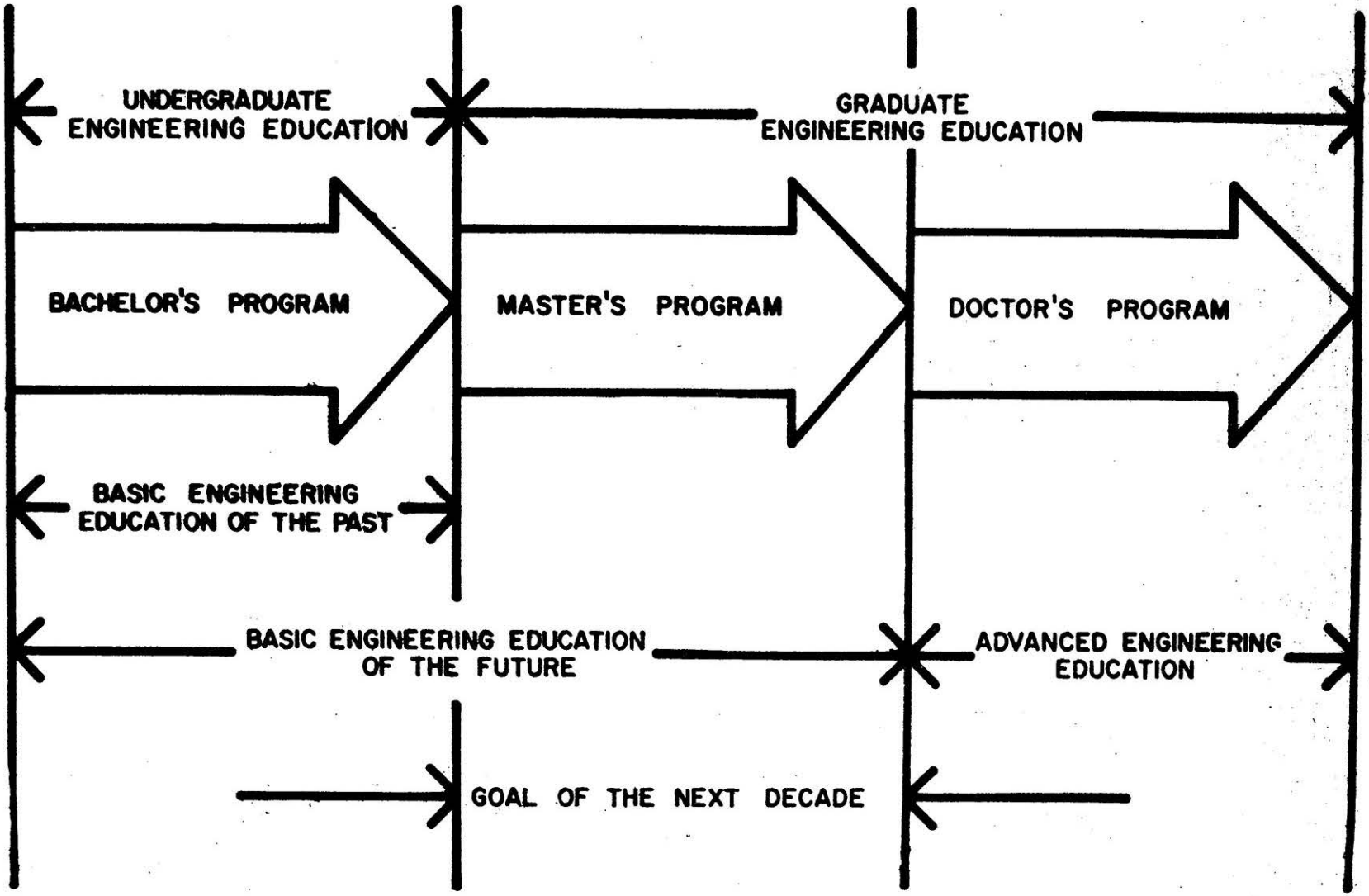
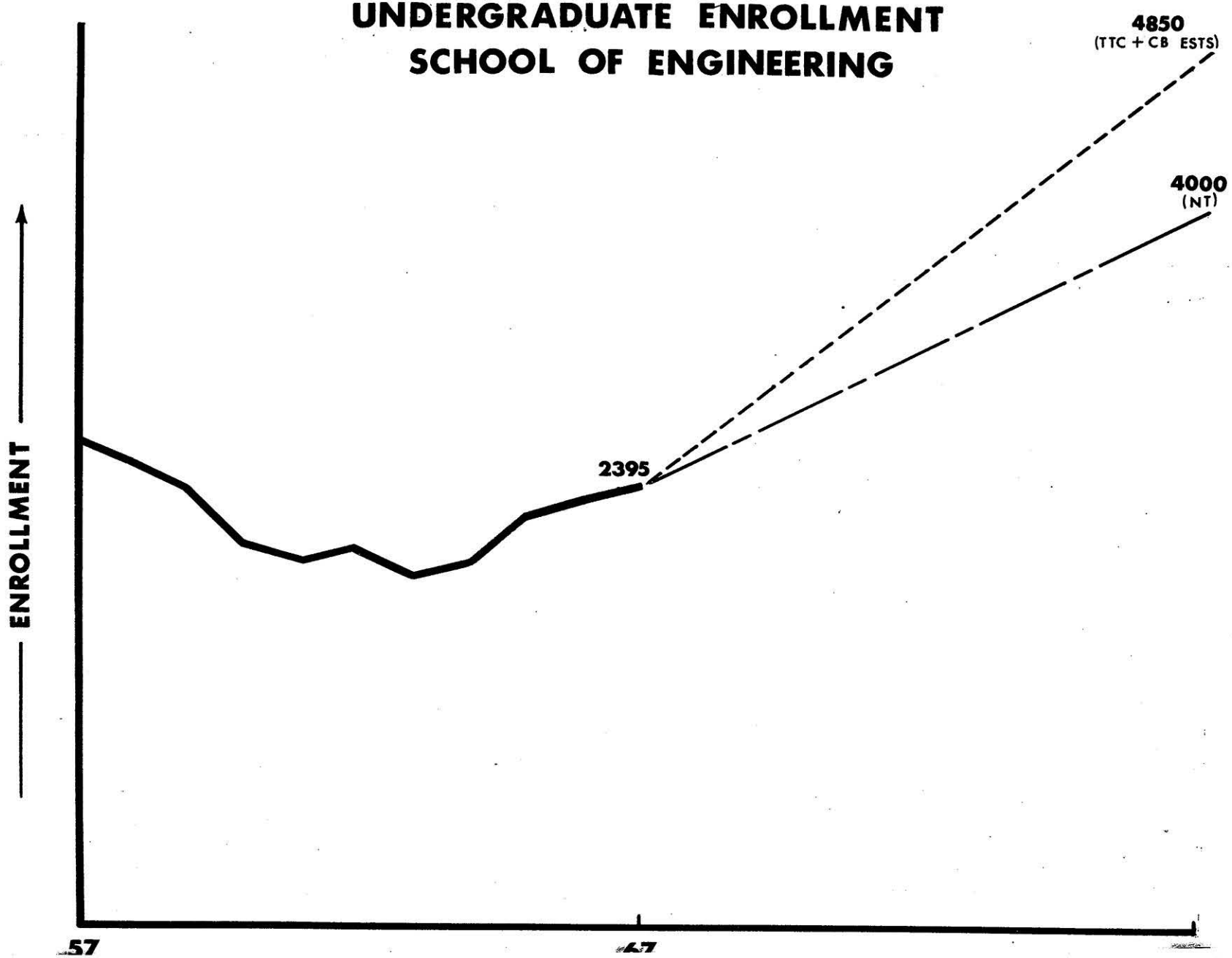
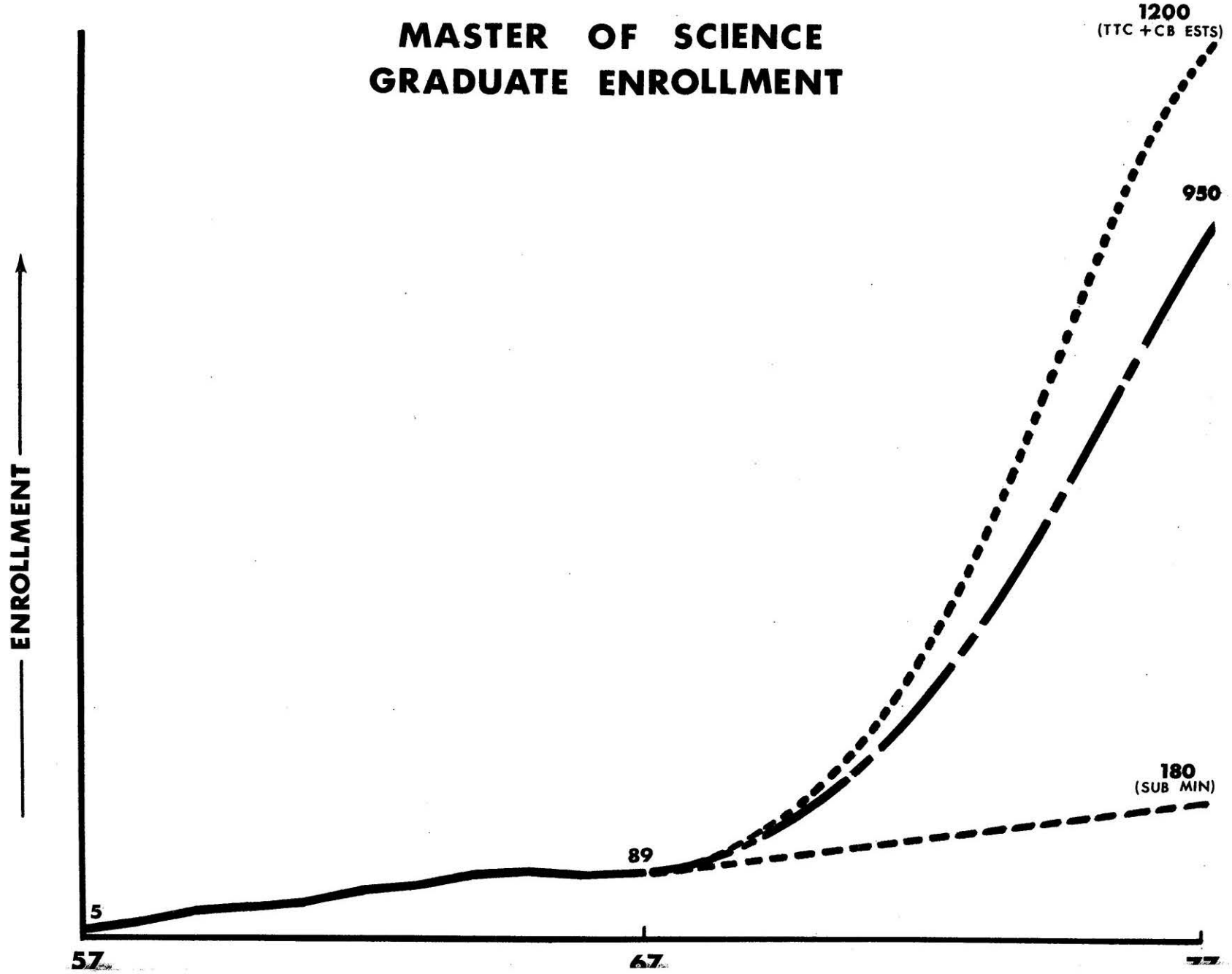

UNDERGRADUATE
ENGINEERING EDUCATION
GRADUATE
ENGINEERING EDUCATION
BACHELOR'S PROGRAM
MASTER'S PROGRAM
DOCTOR'S PROGRAM
BASIC ENGINEERING
EDUCATION OF THE PAST
BASIC ENGINEERING EDUCATION
OF THE FUTURE
ADVANCED ENGINEERING
EDUCATION
GOAL OF THE NEXT DECADE

FIGURE 6

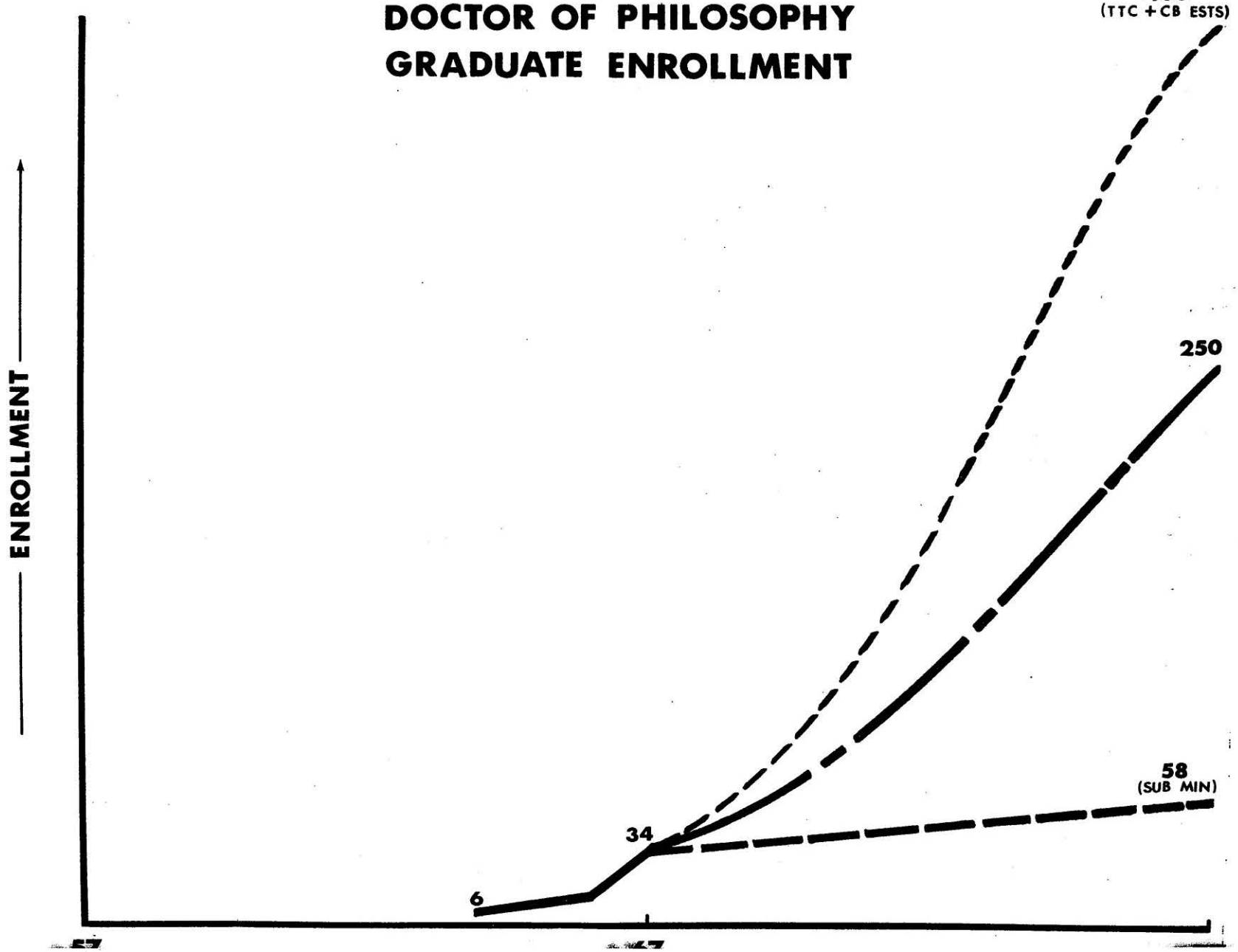
UNDERGRADUATE ENROLLMENT
SCHOOL OF ENGINEERING



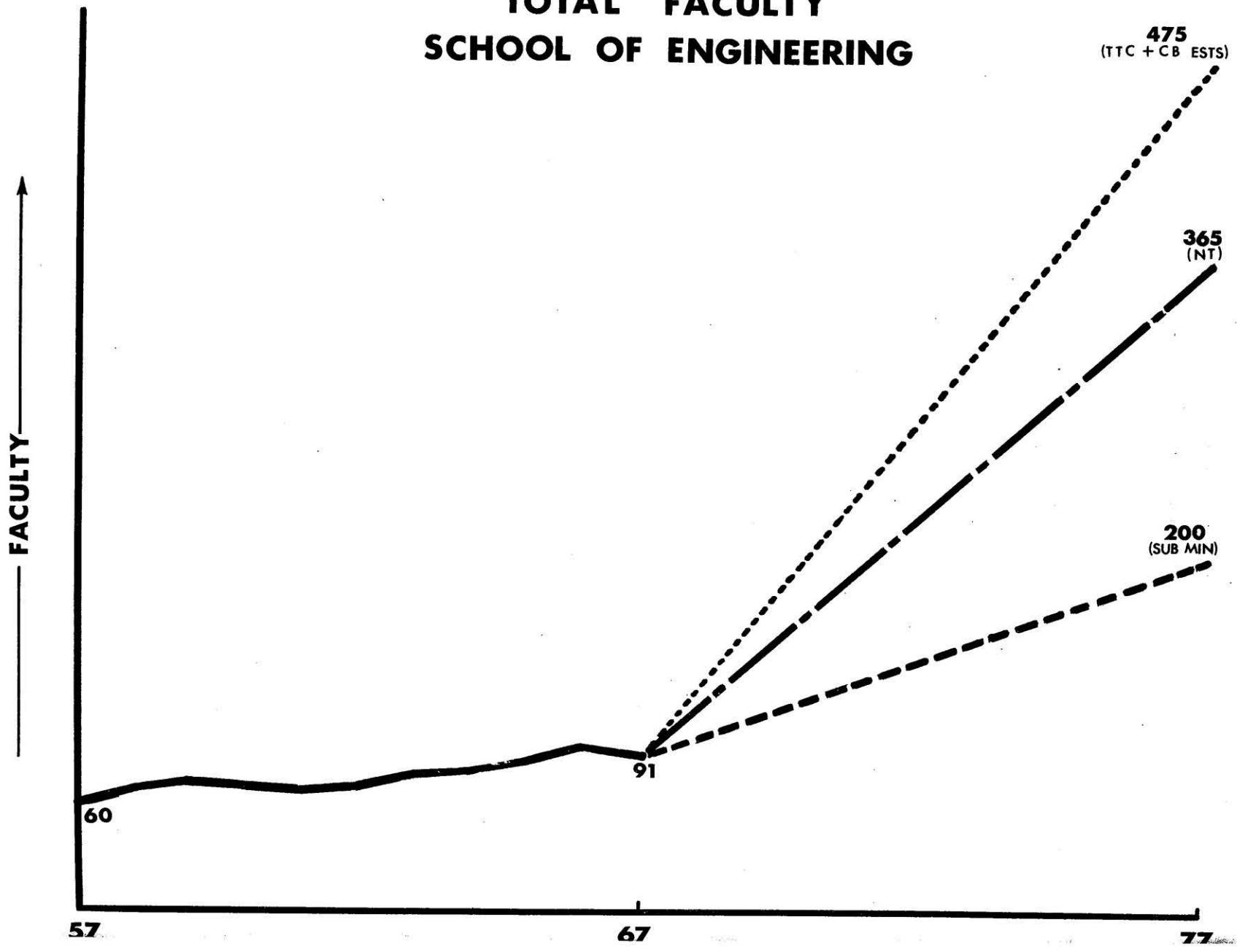
MASTER OF SCIENCE
GRADUATE ENROLLMENT



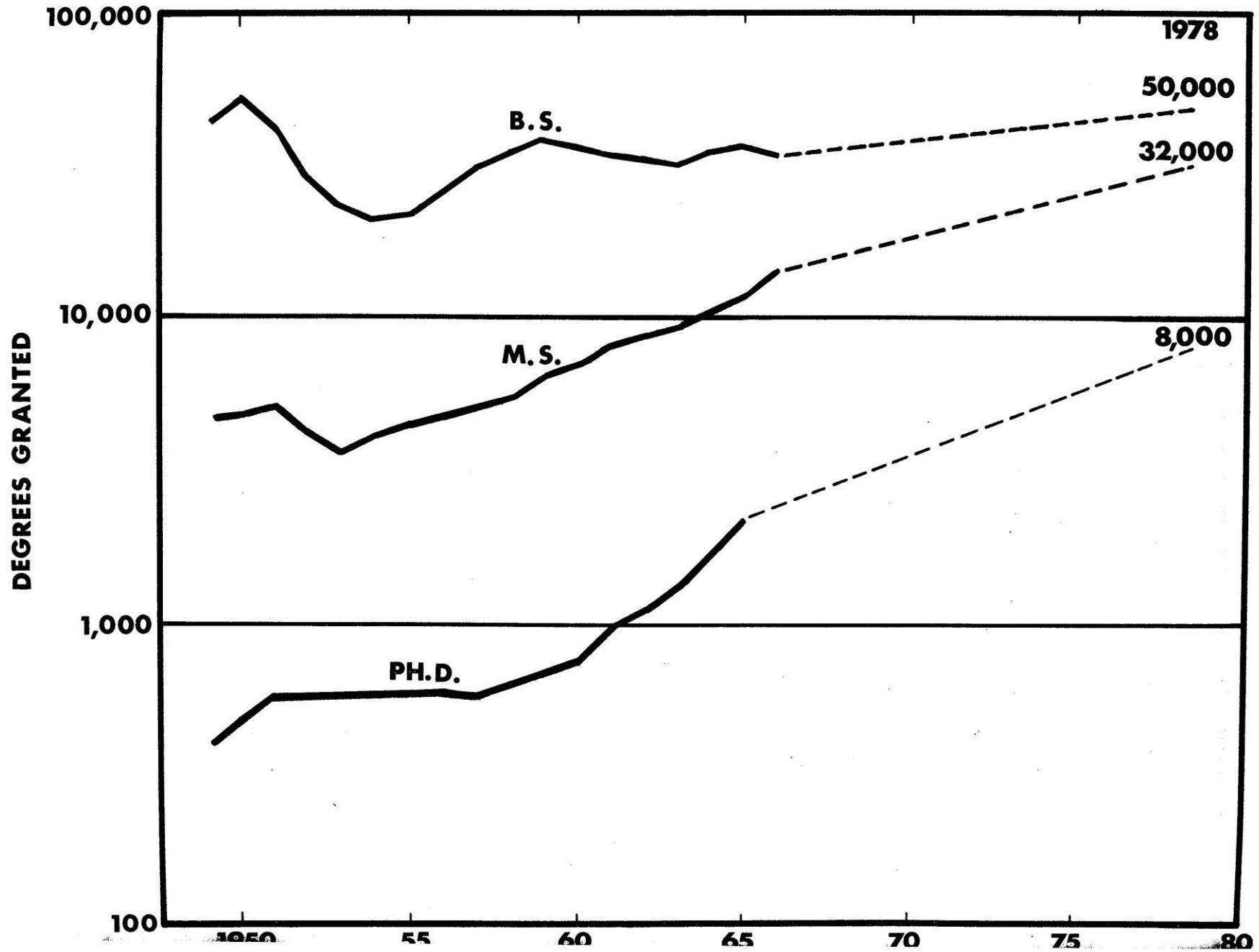
DOCTOR OF PHILOSOPHY GRADUATE ENROLLMENT



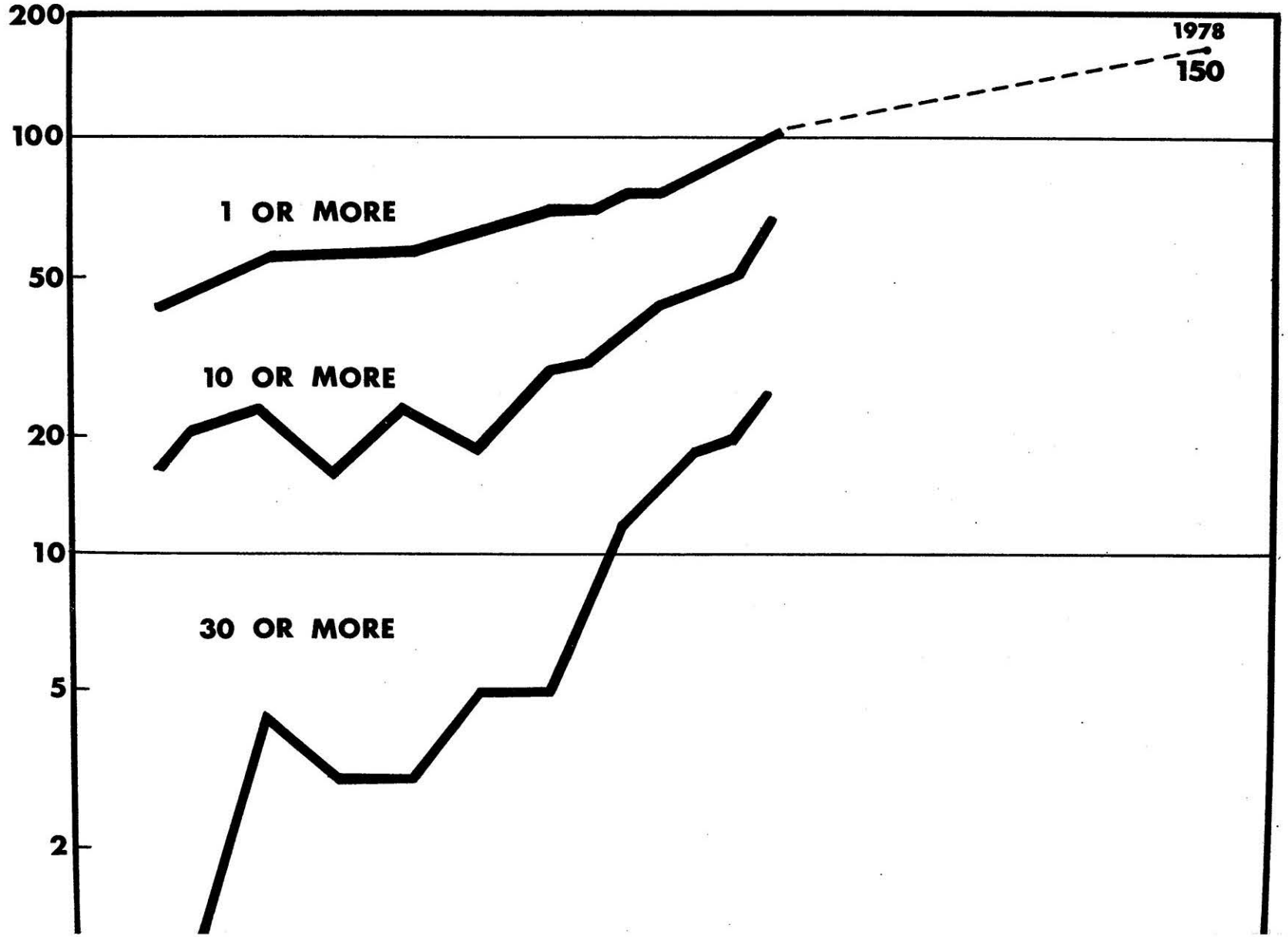
TOTAL FACULTY
SCHOOL OF ENGINEERING



ENGINEERING DEGREES IN THE UNITED STATES



NUMBER OF INSTITUTIONS AWARDING VARIOUS NUMBERS OF DOCTORS' DEGREES IN ENGINEERING



undergraduate level. Roughly speaking, the Departments of Engineering have approximately 80,000 square feet of laboratory space; the Department of Architecture, approximately 40,000 square feet.

The facility situation in the case of the graduate program in engineering is far more serious. Expanded activity within the Department of Electrical Engineering and the Graduate School, as well as growth of the undergraduate operation, primarily at the upper level, has created a most critical space problem. Indeed, without exception, every department is short of space for both teaching and research. In many instances graduate teaching assistants do not even have desks, much less office areas for the counseling of students. It presently appears that the sophomore non-major laboratories will have to be discontinued, and a severe restriction placed upon use of the student design laboratory for the junior and senior electrical engineering majors. For several years now, it has been our hope that the space currently occupied by the Department of Architecture would be released upon their move to new quarters, and that the Department of Electrical Engineering would be able to move into it. Should this eventuate, space now occupied by Electrical Engineering would be available for the development of Engineering Analysis and Design, in the present Electrical Engineering Building.

Accreditation of undergraduate engineering programs has been the responsibility of the Engineers' Council for Professional Development. To date, there has been no accreditation of graduate programs. Our curricula have been strongly affected by the accreditation criteria. Growth of undergraduate engineering enrollment over the years has been about six per cent per year, and is expected to remain about the same. Figures of eleven per cent for Master's Degrees, and twelve per cent for Doctor's, are reasonable.

A study of engineering education by the American Society for Engineering Education has been going on since 1961. It has resulted in the recently published report on Goals of Engineering Education. This report will have a great impact upon engineering education in the United States, and, specifically, at Texas Tech. The more significant factors insofar as Tech is concerned are summarized thus:

1. There will be a tremendous increase in post-baccalaureate education of engineers, resulting in the first professional degree being conferred at the graduate level. (See graph of Ratio of B.S. to M.S. Degrees in Engineering-Figure 5).

2. Accreditation will be expanded to include graduate programs. The basic philosophy of expected procedures is reflected in the statement, "---every college ought to be judged on the basis of its stated goals, and how well it reaches these goals."

3. Engineering is of such breadth that graduate training will include not only research, but design and systems functions.

skills and educational backgrounds, including not only the highly creative and perceptive individuals (to which advanced degrees are usually associated) but a larger number of able individuals who understand and are able to use creatively existing technology. The work of this latter group does not in general require nearly so high a level of mathematical skills and depth of understanding as the former. The technical institutes which have come into being during the past can partly fill the manpower shortage. However, these technical institute programs provide skills at the lower end of the manpower quality spectrum and the potential of their graduates is severely limited. There now exists a critical shortage of manpower possessing technological skills and a good educational background but not necessarily high sophistication in mathematics and engineering sciences. It is believed that the supply of potential professional engineering manpower is limited by the fraction of the population with high aptitude for advanced mathematics. Thus there exists a large pool of high quality technical manpower which is now eliminated from engineering programs because of mathematical aptitude.

Consistent with Coordinating Board recommendations a program will be developed within the next five years leading to a four year bachelor's degree with emphasis on technology. It is intended that this be a high quality program, equally demanding as the professional engineering programs, but with emphasis shifted from mathematics and advanced science to technical and human skills. Student enrollment in this program is expected to be somewhat at the expense of engineering enrollment but enrollment will come largely from those who now reject, or are rejected by, engineering because of its advanced science and mathematics requirements. Some new faculty with special capabilities will be required. However, it is believed that the abilities of many of the current faculty can be effectively utilized in the program.

Part of our responsibility as Engineers is the interpretation of technology. This requires training in those socio-humanistic sectors relating to technology. There is great opportunity for a program of liberal technology for the accomplishment of this. Simply to require random courses in the humanities, with no follow-up in the student's education relating technological activities to humanistic considerations, is not sufficient. A converse aspect of this same problem is the general inability of nontechnical people to handle technologically related problems of society. We believe that the School of Engineering can provide a great service to non-engineers through a liberal, interpretive program of technology. Much research and experimentation in the realm of engineering education are needed. (Projections of graduate enrollment are shown in Figures 8 and 9).

In addition to developing strong graduate study and research programs along more or less traditional lines, we believe we should develop those oriented toward design, and others in, for lack of a better term, systems engineering. The design programs would be

developed within existing departments and along interdisciplinary lines. The program designated "systems engineering" is another most important interdisciplinary activity. It includes research management, systems design and management, and various other socio-technical studies. There is great need for people trained in the broad systems management areas, with, in addition, a high degree of technical competence.

A joint effort with NASA, HUD, Transportation, HEW, and Industry, whereby a student would spend two years on the Campus for his course work, serve a year's internship off-campus, then return to the Campus to write his dissertation, is envisioned as part of this systems engineering program. Similar arrangements with Industry in connection with our Design Program may be desirable.

It is the strong belief that graduate and undergraduate programs are mutually beneficial and that in order to maximize such mutual benefit the large majority of the engineering faculty must be involved in both undergraduate and graduate work. It is recognized that a number of the members of the faculty are not interested in or suited for graduate work. Best utilization of the talents of the faculty as a whole dictates that in the immediate future, some faculty members concentrate on graduate work in order to maintain a balanced operation. However care must be taken to prevent separation of the faculty into undergraduate and graduate categories.

The development of an excellent faculty <u>of sufficient</u> size to cover the myriad aspects of a strong graduate program, while maintaining the quality of our undergraduate program, is of primary concern.

First in a process to achieve this is the creation of an additional engineering department, Engineering Analysis and Design. The main purpose is to get a critical-mass of quality faculty members together. Second, is to generate truly interdisciplinary activities. Third is to develop management of research, including university research. It is anticipated that faculty members in the sectors of Engineering Analysis and Design will also be active in existing departments with joint appointments. The Engineering Analysis and Design program has been approved by the Coordinating Board.

In addition to serving as a focal point for faculty development, interdisciplinary studies, and systems engineering, the arrangement will provide a locally defined "center of excellence," serving as an example to other departments; afford spin-off; and allow joint appointments and trial programs.

As Platt so appropriately states in his book, "The Step to Man": "A group of fifteen good men in one department can produce many times as much research as the same group in five departments of three men each at five different schools. Even separation of a department into different but adjacent buildings may cause a considerable loss of research power."

The immediate problem is to obtain an excellent, vigorous faculty; next, to develop a distinguished faculty, with consulting and adjunct professorships.

The creation of a productive research environment is an essential. It depends in great measure upon the faculty development already discussed. There are other factors to be considered, however, such as: (1) Graduate students and their adequate support; (2) facilities (3) supporting services, and (4) supporting staff. A systematic analysis of these factors, and specific recommendations followed by action, should be pursued. There is great opportunity for effectively increasing our assets, through nontraditional methods of facilities management and talent pooling.

To continue its programs of instruction and research, and to cope with the growth which is inevitable, the Department of Industrial Engineering must expand its laboratory facilities in the sectors of Biotechnology, Human Performance, and Manufacturing Science. This can be effected when the west wing of the Industrial-Textile Engineering Building is vacated by Textile Research. At that time, it will be possible to locate the Biotechnology and Human Performance Laboratories in that wing, and expand the Manufacturing Science Laboratories into the east wing, after some remodeling.

In a truly interdisciplinary project, Themis, which takes advantage of the unusual talents which we have in the realm of biomechanics and human performance, and systems management, within the Department of Industrial Engineering, the opportunity is provided to develop a center of excellence in human engineering. The sum of one-quarter million dollars per year--this, however, subject to negotiation--offers a fair approximation of the magnitude of the funding necessary to the project, and an indication of its scope. If this project is to be successful-and the stakes are high-it must have full institutional support.

Under a grant in the amount of $98,000 from the National Cotton Council, a systems analysis of the cotton industry has been undertaken. Duration of the contract is through December 31, 1968. This research was organized through the Department of Industrial Engineering, and is being pursued by a team comprised of Industrial and Textile Engineers and Agricultural Economists. The analysis will treat of problems affecting the entire cotton industry, from producer to mill. Under particular examination are marketing costs, handling, baling, and ginning practices. Objectives are to develop immediately applicable improvements, and, at longer range, to evolve an analytical and predictive model system, in order to pinpoint areas needing improvement, reductions in cost, etc.

Another area of increasing development is occurring in Textile Engineering and Research. The Textile Research Center is the outgrowth of the service provided by the Textile Engineering Department

in its early years. Research in the Textile Research Laboratories has improved the growing, harvesting, ginning, and utilization of cotton. In addition to the 1,000 spindle pilot spinning plant, a testing laboratory for measuring the properties of cotton fibers, yarns and fabrics, and a room for the weaving of fabrics for experimental purposes has been available. This testing laboratory has evaluated the properties of cotton fibers for research organizations and governmental agencies in Texas and other parts of the country, providing a continuing service to agricultural and textile interests. Thousands of samples are tested annually and the results employed to improve varieties planted, cultivation practices during growth, and harvesting and ginning techniques.

In the past, primary interest has been accorded cotton research. Today, plans being discussed include extensive wool and mohair research, although certainly not at the expense of that in cotton, which, rather, will receive emphasized attention.

We believe that attention to the following objectives of the TRC program will result in the rendering of valuable services to the textile manufacturing and natural fibers industries of the state:

1. Development of new and improved techniques in the processing of cotton, wool and mohair, as well as blends of these and synthetic fibers.

2. Evaluation of the properties and processing characteristics of natural fibers supplied by organizations which are studying growth and harvesting procedures.

3. Provision of facilities and skilled personnel for assistance in the training of students of Textile Science and Engineering.

4. Assistance to the textile industry of Texas in solving problems of manufacturing, from the processing of new stock, to the procedures in finishing.

A breakthrough of decided economic significance is anticipated in the fields of both natural fibers and blends of these, as relating to chemical finishing and dyeing, desired results being achieved much faster than can be accomplished by natural genetic change.

A Market Advisory Committee has been formed of successful and distinguished members of industry to offer guidance to the Textile Research Center. A meeting was held in Dallas, on May 7, for a detailed discussion of its function and objectives. A representative of the Swedish Institute of Textile Research, Dr. Marianna Karrholm, Deputy Director of Research for the Institute, was welcomed to our state and provided information concerning an interesting apparel manufacturing study and other research projects in progress. Her visit is evidence of our continuing endeavor to attract research

specialists from other recognized textile laboratories to Texas for consultation, such visits should be rewardingly informative, particularly to apparel manufacturers.

On April 3, at a meeting of over 900 leaders of industry throughout the state, Governor Connally made special reference to the fact that a considerably greater development of existing industry in the state could come about through cooperation between the various industries and the colleges and universities of the state, in pursuance of research. As an example, he cited the textile industry, and the developments which are occurring in the Textile Research Center at Texas Tech. He drew attention to new blends of cotton, wool and mohair, and showed samples furnished by the Textile Research Center. For approximately five minutes he dwelt upon developmental efforts being made by TRC, and upon the foresightedness evinced by the administration at Texas Tech in pursuing this program which can effectively enhance the industrial development of the state.

In addition to textile research, in which the talents of people from many engineering and scientific areas will be brought to bear simultaneously on problems of great importance, two other interdisciplinary areas, biomedical engineering and environmental control will be stressed.

Texas Tech will be in a very favorable position to establish a biomedical engineering program if, as is expected, a medical school is established in Lubbock. Such a program is inherently interdisciplinary in nature. Progress will require the cooperation and interaction of people in many areas: medicine, engineering and the biological and physical sciences. This will not come about without strong efforts to bring people together and definite programs being worked out which will not only permit but require cooperation.

Initiative for such a program will fall largely on engineers rather than physicians. It is imperative that a competent biomedical engineering research staff be assembled before the opening of the medical school. These staff members will be competent to teach in their base areas as well as do research and teach biomedical courses. Graduate students are expected to be drawn from many undergraduate discipline areas. The supply of people with interests and backgrounds in this area is critically limited. Recruitment of good faculty nucleus will be necessary before developing persons with other backgrounds to a level of biomedical research competence.

Environmental control involves in its broadest sense a very wide range of socially important areas including air and water pollution control, waste disposal, weather and water resources and even urban planning. It is believed that some of the most significant technical advances of the next decade will be made in this sector. While some research progress is being made in water resources and waste disposal at Texas Tech, a more concentrated interdisciplinary effort must be

exerted if we are to take advantage of the opportunities and discharge our responsibilities.

As an adjunct to Graduate training and research, guidelines are being drawn for a Research Park in Lubbock. Located upon approximately 150 acres in the northwestern part of the campus, it could be the magnet for drawing major industries to Lubbock and this region. These industries would lease parts of this land for the erection and maintenance of laboratories and use facilities at Tech in furthering their research. Already approved by the Board and by the 60th Legislature, implementation is now under way.

Designed for small research laboratories which are sectors of various industries, the park will not include the industrial plants themselves. For a nomial fee Tech library, computer and other special facilities will be available to them, through these laboratories. With the shortage of trained Engineers and scientists prognosticated, industry and business should naturally gravitate to the centers where there is a concentration of them, the universities, even to the point of establishing plants somewhere in or near Lubbock. Tech Research Park will be a very strong factor in the greater industrialization of Lubbock and its environs; in the accelerated economic growth which will follow.

One of the most pressing space needs of the School of Engineering is that for an Executives' Conference Room. Plans have been under way for the past two years for the development of two and three day executive conferences, in which presidents, vice-presidents and directors of research in business and industry of the Southwest, would be brought to the Campus to take part in intensive seminars, allowing them to update their information in the new technologies. Probably no greater return could be made on any investment by the College, than that brought about by the supplying of such an executive conference room.

Ceaseless efforts have been expended over the past five years, with the gratifying result that Texas Tech has been designated as the location of the 1972 annual meeting of the American Society for Engineering Education. Taking place during the third week of June, this annual meeting will bring to the Texas Tech campus from 3,000 to 4,000 of the top engineering educators and business leaders of the nation.

The Degree of Master of Engineering was approved for Texas Tech by the Coordinating Board on January 15, 1968. Its purpose is to enable practicing engineers to continue their professional training while employed. The benefit of this program to industry is obvious. Celanese Chemical Company promptly noted this development by referring to the program in its national advertising. To Texas Tech, the program means an estimated increase of 225 student-semester hours of engineering instruction at the graduate level, or an increase of over thirty per cent in the number of student-semester hours offered, as compared with that offered in the Fall of 1967.

To implement these plans of working with industry on the Master of Engineering Degree, the Flying Professors Program was begun in the Fall of 1966. In this program, chartered planes transport engineering professors to the Borger-Pampa and Midland-Odessa locales once a week for fifteen weeks. Meetings are held in reserve training centers, high schools, or junior college classrooms. This method of bringing students and professors together for continuing engineering education is far from ideal. For the professor, it represents a full eight-hour day from the time he leaves for the airport, until he reaches home that night. For the student, it represents an effort to absorb one week's graduate-level instruction in three hours--after a full day's work for his employer.

The future solution to this problem is the utilization of the Western Information Network (WIN), a two-way, closed-circuit television system interconnecting the participating institutions of this region and providing, among other things, the flexibility of course offerings so desperately needed right now, and in the future.

Following are enrollment figures for the Borger-Pampa, Midland-Odessa areas.

	Borger		Pampa		Midland-Odessa	
	Courses	Enrollment	Courses	Enrollment	Courses	Enrollment
Fall 1966	1	31	2	40		
Spring 1967	1	31	2	38	2	17
Fall 1967	2	31	2	31	1	12
Spring 1968	2	22	1	11	1	18

Recent changes in the role and scope of Texas Technological College (both locally and state-wide) will demand operational changes in the School of Engineering. Of fundamental importance is the selection of clearly defined goals which will strengthen the broader goals of the university. It is proposed that a planning and control system, including operationally meaningful objectives derived from the goals, be implemented. The problems to be solved in attaining our goals are those characteristic of transition from the status of an undergraduate school to that of a university.

There are certain unique aspects of engineering. Its professional nature must reflect in the education of engineers; consequently, undergraduate and graduate education in engineering must the responsibility of engineers. Engineering research has not only the traditional mission of interpreting and adding to knowledge, but must solve problems and include design. A role of university research which is all too frequently overlooked is that of training researchers and, in the case of engineering, designers as well.

The School of Engineering is aware of its role as a responsible agency whose business it is to satisfy the need for continuing education in engineering, to provide proper continuing programs in the various sectors of the profession.

It can coordinate research, information retrieval-analysis-distribution, and teaching, in such a way that the engineering community is served adequately.

In pratical terms, such programs can effectively utilize:

1. An on-campus, academically coordinated, adult education center, suitable for teaching short courses, conducting seminars, etc., to groups gathered on campus for short periods of time.

2. An information network linked to library and research facilities, and industrial complexes, by various means, including closed-circuit television systems located in an adult education center.

3. Off-campus programs, requiring either professional displacement throughout the engineering community, or adequate electronic linkage of such instruction with the engineering community.

4. Adequate incentive arrangements between industry and academia, providing the climate for financial and moral support in the perpetuation of any and all programs.

Passed by the Legislature, and signed into law by the Governor last spring, was the Act creating the Western Information Network Association. Twelve West and Northwest Texas state-supported institutions of higher education are participants in WIN. Funds were not requested concurrently with the creation of the Association. Since appropriations at that Session were being made for only one year, WIN's strategy was to utilize that year for development of a plan and sequence of implementations; for preparation of a request for a budget which would finance this implementation; and for information of legislative leaders regarding the merits of WIN, and its financial needs, prior to the Special Session this summer. While funds appropriated for WIN for 1968-69 were less than requested and deemed necessary for rapid development, they were sufficient for initial developmental work. Such work is now underway with the objective of making WIN operational in 1969-70. This has all been accomplished.

Meeting on the campus annually is the Southwestern Petroleum Short Course. This is a mutual effort on the parts of the petroleum industry of the Southwest, and Texas Tech, through the latter's Department of Petroleum Engineering, to provide adequate instruction and a permanent record of technological advances in petroleum production, by means of annual meetings and publications of their proceedings. The Short Course is a technical conference devoted solely to problems relating to the

lifting of petroleum from within the earth. The Course was instituted in 1953, under the title of the West Texas Oil Lifting Short Course. As the depth and scope of technical content increased, the name was changed appropriately. Today the mailing list of the Short Course contains in excess of 2500 addresses, while over 8500 bound copies of the Annual Transactions have been distributed and more than 12,000 reprints of papers have been ordered, printed, and distributed. Every indication is given that this Short Course will continue its service indefinitely into the future.

In assessing our position, which at this point is mandatory, we must never lose sight of the fact that the primary objective of a university is to inculcate within the student the intellectural tools with which he may earn a living in our extremely complex society. The university enjoys a unique role as not only the guardian of knowledge, but the only broad and encompassing channel through which it is purveyed from generation to generation. There is no other entity within our culture designed to fill this role.

In meeting this awesome obligation, the university must take advantage of those situations offering an opportunity to return to society, in the form of applied research, a handsome return for its tax dollar investment. An excellent example of this is the work of the Textile Research Center, which already is benefiting the regional economy so handsomely, and which will be able to do this on a far greater scale when the addition to its facilities is completed.

There is conclusive evidence that the truly great industrial developments in America have occurred in and around universities. There is direct evidence now, moreover, that in such industrial development the major impetus is felt at those universities where large numbers of Ph.D.'s in Engineering are available for direct entry into industry. As the ad we have mentioned indicates, industry needs engineers desperately. And to progress at an adequate rate, it must have doctoral engineers, engineers of the highest talent.

Attention has already been drawn to the advertisement in Fortune Magazine, which so dramatically points up the demand for <u>Engineers</u> of the highest talent.

Consider for a moment the almost stupifying accomplishments upon whose thresholds engineering now stands. As an example, consider the laser. Never in the history of man has a scientific invention gone from mental concept to working hardware, to worldwide practical application, in so incredibly short a time, as has the laser. The embryonic idea was conceived only eleven years ago. The first working model was built only eight years ago. Today, lasers are used in surgery, welding, drilling, communications, surveying and weaponry. They are common items of technological hardware, available by mail order, just as are Bunsen burners or microscopes.

At this point in time, when the opportunities to make of Tech the great and respected institution we know that it can be, are we to shy away from our chances; blind ourselves to needs we can fill; stop our ears against the knock which is said to be heard but once? This is our opportunity to pull ourselves up out of the undergraduate College category. This is our chance to pull ourselves up to that eminence upon which, perhaps, some less deserving citadels of higher learning rest, drawing in the lucrative contracts; attracting the nation's best brains; gaining the greatest academic plaudits. We all wish leadership and distinction for Tech. We have put too much of our lives into this blossoming university to enjoy nipping its progress in the bud.

We struggled for the development of the Ph.D. in Engineering, and it was authorized by the Coordinating Board. It would appear totally pointless, so to struggle to achieve an ideal, only to have it fade away from lack of support. Considering the subject very carefully, it becomes painfully evident that if we accept the fact that we are going to be operating upon a subminimal basis, then we must also accept the parellel fact that we cannot continue the graduate program in engineering at all.

Here is another unvarnished truth to which we must face up:

Texas Tech cannot be all things to all people.

It is the heavy responsibility of the Coordinating Board and Texas Tech's Board of Directors, of choosing in what sectors Tech shall distinguish itself, it indeed the wherewithal for distinguishing itself at all, is forthcoming.

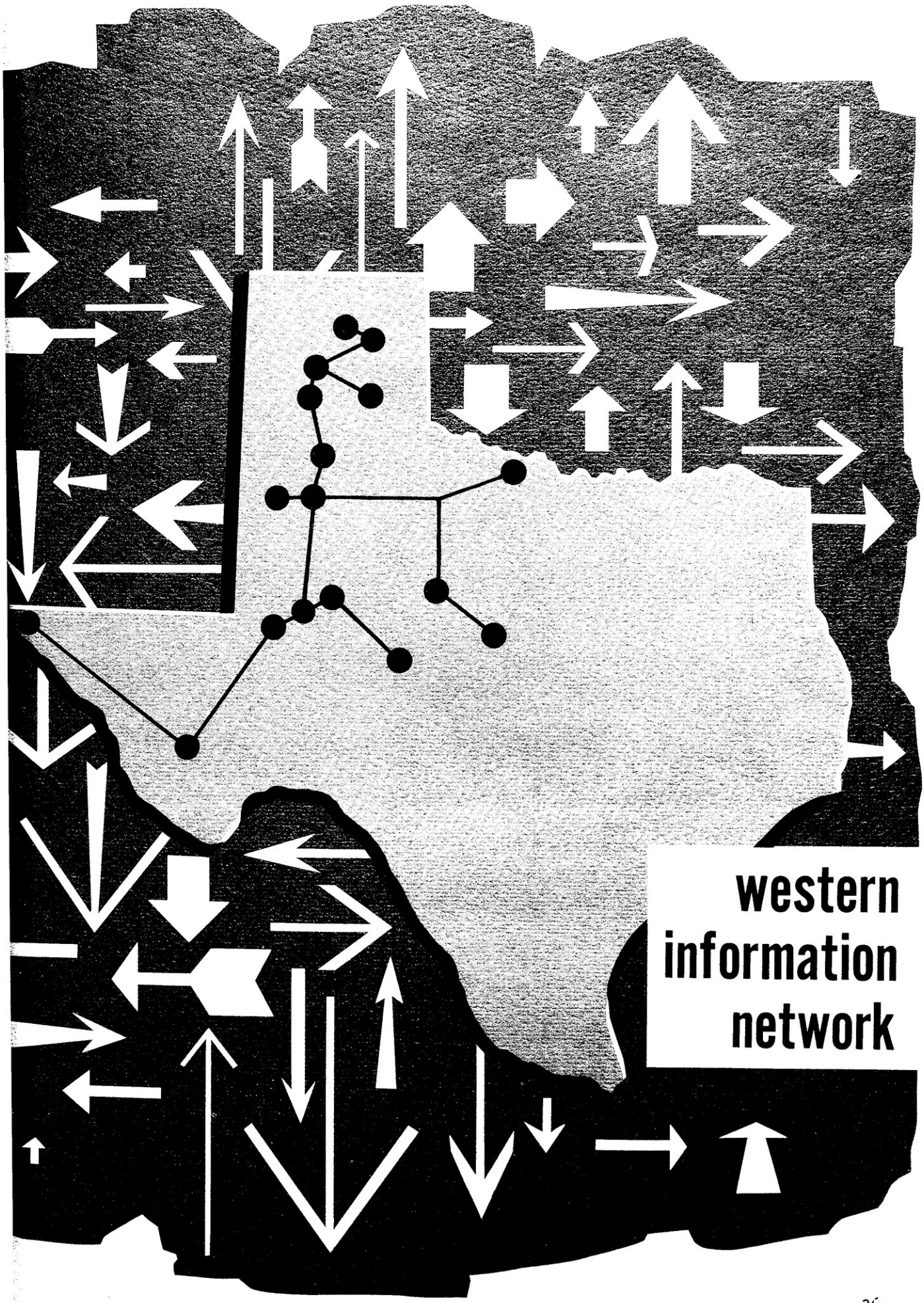
Any truly significant reputation which Tech may earn will be achieved by research pursued in the agricultural sciences, the physical sciences and engineering. This is not to depreciate the need for good programs in all other academic provinces of the Campus; or to imply that these other provinces do not make a cogent contribution to the university's standing as a whole--as a balanced, well rounded educational institution. It is merely to state a patent fact: that the real measure of Texas Tech must be taken in the three sections just mentioned.

As evidence of the great resources of engineering talent and creativity upon which we can draw, we append a compilation of publications, papers presented, and research pursued by members of the faculty of the School of Engineering during the past 18 months! In less than a year and one-half, the faculty has published 102 papers, presented 125 professional talks and lectures, and has under way 130 research grants and contracts, funded and not funded. Truly, this represents an astounding record of development in our graduate engineering training and research.

It is for use in the sectors mentioned above that outside money is available. It is in these realms that reputations are to be made.

Tech should be a part of the action; it should garner its share of the laurels.

We must take advantage of our opportunities. A university cannot, any more than can any other living entity, stand still. Its movement must be forward or back, up or down. Dead center cannot be maintained, nor would any of us which to maintain it. Let us go forward with alacrity and determination, so that Tech's bright future may be assured; our own futures kept free of the bitterness engendered by lost opportunity.


western
information
network

The Western Information Network is a cooperative endeavor of eighteen of the institutions of higher learning in the vast West Texas region. Its goal is to provide business, industry, communities and educational institutions with an effective system for communication and information transfer.

The intent is to forge combined efforts of institution
learning into one tremendous force of maximum quality, achie
institutional enrichment, enhanced relationships between indus
and colleges, and greatest public service.

Primary operations of the Western Information Network will be through a multi-channel, two-way communication system including closed circuit television, which will link classrooms, libraries, computer facilities, and information retrieval systems at the eighteen points, into one immense knowledge-dynamics system which all may use most efficiently, economically, and effectually.

The system will greatly enhance cooperative interchange between education and industry, immeasurably expanding it at minimum cost. With the staggering increase in volume of all categories of information, and the great broadening in the scope of educational demands and goals, a manageable system for meeting these needs must be devised. New procedures and new ideas will inevitably find expression in such a conjoined venture.

The creation of this communication network will provide

institutional enrichment

to the institutions of higher learning . . .
instantaneous interchange of faculty and students . . . graduate opportunities for faculty development . . . extensive programmed instruction capability . . . special lectures . . . outstanding short courses . . . improved professional status and enhanced quality of teaching . . . expanded library resources . . . sharing of information retrieval systems . . . increased computational capabilities . . . special knowledge of scholars and researchers transmitted to soaring numbers of students . . .

business and industry

to business and industry . . .
a practicable answer to the essential process of continuing education . . . closer association with institutions of higher learning . . . effective multi-computer utilization . . . rapid information retrieval . . . expanded graduate work . . . rapid dissemination of the end products of research in all fields, tremendously simplified and speeded, resulting in economic growth, higher employment, and an improved competitive position in world markets . . .

public service

to the communities . . .
local accessibility of studies for elementary and secondary educators . . . greatly enhanced library facilities . . . improved knowledge and practice in the realms of public health, first aid and safety . . . ready availability of technical courses leading to certificates . . . specialized subject matter . . . job training programs . . . improved means for career scholarship . . . increased potential for industrial development . . . greater opportunity for institutions and communities to work together to their common advantage.

PARTICIPANTS

Network facilities and operations for the state-supported institutions are provided by Western Information Network Association, an agency of the State of Texas, created in 1967, House Bill 692, 60th Legislature.

Network facilities and operations for the private institutions are provided by Western Information Network, Inc., a non-profit corporation.

abilene christian college
abilene

amarillo college
amarillo

angelo state college
san angelo

clarendon college
clarendon

frank phillips college
borger

hardin-simmons university
abilene

howard county junior college
big spring

howard payne college
brownwood

lubbock christian college
lubbock

midwestern university
wichita falls

mcmurry college
abilene

odessa college
odessa

south plains college
levelland

sul ross state college
alpine

texas technological college
lubbock

the university of texas at el paso
el paso

wayland baptist college
plainview

west texas state university
canyon

A

COMPILATION OF

PUBLICATIONS, PAPERS PRESENTED AND RESEARCH

BY

MEMBERS OF FACULTY

SCHOOL OF ENGINEERING

1966 - 1968

DEPARTMENT OF CHEMICAL ENGINEERING
PUBLICATIONS, PAPERS PRESENTED, AND RESEARCH

DR. ARNOLD J. GULLY, Professor and Chairman

PUBLICATIONS:

"Catalytic Dehydrogenation of Cyclohexane: A Transport Controlled Model"
Accepted for publication AICHE Journal, (with R. R. Graham and F. C. Vidaurri)

"The Engineer and Technician: Their Similarities and Differences"
Chem. Engr. Prog. 63, No. 5, pp. 26-29, 1967.

PAPERS PRESENTED:

"Engineers and Technicians: Similarities and Differences"
61st National Meeting of the American Institute of Chemical Engineers, Houston, Texas, February, 1967.

"Industrial Internships for Chemical Engineering Educators"
ASEE Meeting, Louisiana State University, April 15, 1967.

"A Supplemental Water Supply for Lubbock Industries Thrcugh Water Reuse"
8th Industrial Water and Wastewater Conference, Texas Tech, June 6, 1968.

RESEARCH:

"Removal of Acid Gases and Oxides of Nitrogen from Spacecabin Atmospheres"
National Aeronautic and Space Administration contract (with Dr. R. M. Bethea) - $38,170

"Development of Mathematical Models of Reaction Systems Using Adiabatic Methods"
Texas State Organized Research - $1,650

DR. JOHN R. BRADFORD, Professor

PUBLICATIONS:

"The Third Level of Education"
The Texas Techsan, April 1967

"Continuing Education in Texas and the Impact of the Educational Television" (To be published) Dallas, Texas, October 1967

"Engineering Education Study Committee for the State of Texas"
Report (To be published) 1968

PAPERS PRESENTED:

"Expanded Role for the Textile Research Center
Second Natural Fibers Symposium, Texas Tech, November 18, 1967

SPEECHES:

"Waste Water -- Asset or Liability"
8th Industrial Water and Wastewater Conference
Lubbock, Texas, June 6, 1968

"Textile Research"
Texas Sheep and Goat Raisers Annual Meeting
Kerrville, Texas, April 5, 1968

"Growth Potential -- Apparel and Related Finished Products"
Governor's First Annual Industrial Conference
Austin, Texas, April 3, 1968

"Continuing Education in Texas and the Impact of Educational Television"
Annual Board of Directors Meeting: Southwest Center for Advanced Studies, Dallas, Texas, October 25, 1967

"Textile Research Program at Texas Tech"
Textile Congress
Basle, Switzerland, October 4, 1967

"Textile Research"
Natural Fibers Study Committee Meeting, Y-O Ranch
Kerrville, Texas, December 28, 1967

Dr. John R. Bradford, Professor (continued)

"Geography Can be Fun"
West Texas Pilot Study Group, Texas Small Schools Association
South Plains Junior College, Levelland, Texas, March 21, 1968

RESEARCH

"Activation Analysis in Fluid Flow"
State Research Funds 1967-68

DR. A. G. OBERG, Professor

PAPERS PRESENTED:

"Dehydration of Acetonitrile by Salting-Out in a York-Scheibel Liquid-Liquid Extractor"
American Chemical Society, Chemical Engineering Section
Albuquerque, New Mexico, November 30, 1966

MASTER'S THESIS, Supervised:

"Liquid-Liquid Extraction (System not as yet chosen)

RESEARCH:

"Desalting of Naturally Occurring Waters"

DR. J. A. RENARD, Professor

PUBLICATIONS:

"Ternary Systems Equilibrium Water-Acetonitrile-Salts"
Journal of Chemical and Engineering Data, 11 No. 2, 169-171 (1966)

"Ternary Systems: Water-Acetronitrile-Salts: Novel Method for Plait Point Determinations"
with H. R. Heichelheim
Journal of Chemical Engineering Data, 12, No. 1, 33 (1967)

DR. J. A. RENARD, Professor (continued)

"Ternary Systems Water-Acetronitrile-Salts: Mathematical Correlation of Tie-lines. Novel method for Tie-Lines Determination"
with H. R. Heichelheim
Submitted for publication, Journal of Chemical Engineering Data, 1968

PAPERS PRESENTED:

"Teaching of Chemical Engineering Design"
American Chemical Society, Division of Industrial and Engineering Chemistry
Miami Beach, Florida, April, 1967

MASTER THESIS supervised:

"A Study of Interfacial Tension in Ternary Systems"
1966. F. O. Prochaska and Renard

"Separation of Copper by Foam Fractionation"
1966. W. N. Killebrew and Renard

RESEARCH:

"Water-Miscible Organic Solvents-Salts-Water"
Texas State Organized Research - $2,440.

DR. H. R. HEICHELHEIM, Associate Professor

PUBLICATIONS:

"Methane"
Encyclopedia of Chemical Technology, 13
Interscience Publishers, New York, 1967

"Ternary Systems: Water-Acetonitrile-Salts"
with J. A. Renard
Journal of Chemical Engineering Data, 12, No. 1, 33 (1967)

"Ternary Systems Water-Acetonitrile-Salts"
with J. A. Renard
Submitted for publication, J. Chem. Engr. Data, 1968

RESEARCH:

"Gas Compressibilities by the Burnett Method"
Dupont Faculty Fellowship - $2,200

DR. H. R. HEICHELHEIM, Associate Professor (continued)

PROPOSED RESEARCH

"Rate and Mechanism of Contaminant Production in Spacecraft"
with Dr. R. M. Bethea
Submitted to NASA, Feb. 1968

DR. R. M. BETHEA, Assistant Professor

PUBLICATIONS:

"Contaminant Collection and Identification", Chapter 4 in
NASA TM X-1325
NASA-Langley Research Center, Hampton, Virginia
Dec. 1966. With I. C. Anderson and R. A. Bruce

"Preliminary Analysis of Contaminants Evolved from Some
Prospective Space Cabin Materials"
LWP-462. NASA-Langley Research Center, Hampton, Virginia
August 1967. With R. L. Turner

"Simplified Procedure for the Interpretation of Infrared
Spectra"
Submitted for publication, Journal of Chemical Engineering
Education December 1967

"Simplified Interpretation of Mass Spectra"
Submitted for publication, Journal of Chemical Engineering
Education April 1968

RESEARCH:

"Determination of Contaminant Production Rates and Mechanisms
for Manned Spacecraft Materials"
Texas State Organized Research - $10,250

"Analysis of Trace Quantities of Acidic Gases by Combined
Techniques"
With Dr. A. J. Gully
National Aeronautic and Space Administration Contract

"Infrared Analysis Techniques for Ternary Systems"
Departmental Research

"Gas Chromotographic Analysis of Oxygenated Organic Compounds in
the Presence of Water"
Departmental Research

DR. R. M. BETHEA, Assistant Professor (continued)

"Reduction and Analysis of Gas Chromotographic Data by Digital Computer Techniques"
Departmental Research

PROPOSED RESEARCH:

"Contaminant Production Rates and Mechanisms from Materials of Construction in Artificial Life-Support Environments"
with Dr. H. R. Heichelheim. $64,472.00.
Submitted to NASA, February 1968.

DEPARTMENT OF CIVIL ENGINEERING

PUBLICATIONS, PAPERS PRESENTED, AND RESEARCH

DR. K. R. MARMION, Professor and Chairman

PUBLICATIONS:

"Report of the Committee on Hydrology, Appendix E"
with G. A. Whetstone
The Galveston Bay Work Plan, Water Resources Research
Program Committee, October, 1966

"Can Recharged Water be Recovered?"
Presented to Fifth West Texas Water Conference,
Texas Technological College, Lubbock, Texas, February, 1967
Published in Proceedings of the Fifth West Texas Water
Conference February, 1967.

"An Analysis of Water Needs for Arid and Semi-Arid Lands"
with Dan M. Wells
Accepted for publication in Proceedings, International Symposium
on Increasing Food Production in Arid Lands

PAPERS PRESENTED:

Chairman and speaker for "Sea-Water Intrusion, Artificial Recharge
and Surface Water-Ground Water Relationships"
Third American Water Resources Conference
San Francisco, California, November 8, 1967

RESEARCH:

"Variation of Urban Runoff Quantity and Quality with Duration and
Intensity of Storms"
Funded by Water Resources Center - $1,500

DR. G. A. WHETSTONE, Professor and Acting Chairman

PUBLICATIONS:

"Appendix E", The Galveston Bay Work Plan
Report of the Committee on Hydrology, p. 75-117.
Water Resources Research Program Committee
with Keith R. Marmion, October, 1966

"Potential Re-Use of Effluent as a Factor in Sewerage Design"
Paper 31C, Water Reuse Symposium, American Institute of Chemical Engineers, National Meeting, Houston, Texas (February, 1966).
Reprinted in Chemical Engineering Progress, Symposium Series, No. 78 (1967): pp. 255-257.

Discussion of Eastman's "Municipal Wastewater Reuse for Irrigation," Proceedings, ASCE, V. 94, No. IR-1, p. 167-168 (1968).

"La Reutilisation des eaux usees, telle qu'elle est actuellement edudiee aux Etas-Unis." Accepted for publication in La Technique de l'Eau (Bruxelles).

Discussion of "Homestake Trans-Divide Water Supply Project"
Accepted for publication in the Journal of the Pipeline Division, ASCE.

PAPERS PRESENTED:

"Development of Professional Interests in Engineering Students"
presented to Regional Meeting, ASCE Faculty Advisors, Albuquerque, New Mexico, September 29, 1967.

RESEARCH:

"Separation of Concrete Aggregate Where Specific Gravity of Desirable and Undesirable Components is the Same"
Funded by Janes-Prentice Company, Slaton, Texas - $3,000

"Interbasin Water Diversions" (Proposed)
Funding pending by Water Resources Center - $1,500

DR. D. M. WELLS, Associate Professor

PUBLICATIONS:

Galveston Bay Work Plan, with thirty faculty members from Texas Tech, University of Texas, and A & M University, October, 1966.

"A Plan for the Management of Galveston Bay", Proceedings of the Eleventh Annual Conference on Water for Texas, Texas A & M University, College Station, Texas, November, 1966.

"Water Problems in Texas: Research Needs". Proceedings of the Fifth West Texas Water Conference, Texas Technological College, Lubbock, Texas, February, 1967.

"Estimating the Effects of Return Flows", with E. F. Gloyna, Journal, American Water Works Association, V. 59, No. 7, July, 1967.

Industrial Water Supply and Waste Water Renovation - A Feasibility Study - with M. E. Davenport, A. J. Gully, L. J. Phillips, J. O. Bartholomew, J. L. Chance, and D. V. Hayes, Report to the Board of City Development, Lubbock Chamber of Commerce, (58 pp.), Sept. 1967

"The Galveston Work Plan - A New Approach to the Investigation of Coastal Lagoons," Proceedings, International Symposium on Coastal Lagoons, Mexico, D. F., November 28, 1967.

Treatment of Textile Mill Effluent in a Model Activated Sludge Plant, with Herman M. Clay, Jr., Report to the Board of City Development, Lubbock Chamber of Commerce, (39 pp.), February, 1968.

"Feedlot Design and Management for Pollution Control," with W. Grub, R. C. Albin, and T. R. Owens, accepted for publication in Proceedings, 1968 Beef Cattle Conference. April 23, 1968, presented to the Beef Cattle Conference in Lubbock.

PRESENTATIONS:

"Present and Future Municipal and Industrial Water Requirements", Talk delivered to Wheeler Chamber of Commerce, Wheeler, Texas, September 19, 1967.

"An Analysis of Water Needs for Arid and Semi-Arid Lands," with Keith R. Marmion. To be presented in Monterrey, Mexico, April 26, 1968, and accepted for publication in Proceedings, International Symposium on Increasing Food Production in Arid Lands.

DR. D. M. WELLS, Associate Professor (continued)

PRESENTATIONS (continued)

"A Supplemental Water Supply for Lubbock Industries through Water Reuse," with A. J. Gully. Presented in Lubbock, Texas to Eighth Industrial Water and Wastewater Conference, June 6, 1968, and accepted for publication in Proceedings of the Eighth Industrial Water and Wastewater Conference.

"Removal of Organic Matter in Reconditioning Cotton Textile Waste for Reuse," with Herman M. Clay, Jr. To be presented in Lubbock, Texas, June 6, 1968, to "Present and Future Municipal and Industrial Water Requirements."

"The Use of Municipal Wastewater for Groundwater Recharge" To be presented at a symposium on the Use of Municipal Effluent for Irrigation, July 30, Louisiana Polytechnic Institute, Ruston, Louisiana.

RESEARCH:

"Industrial Water Supply and Waste Water Renovation in Lubbock, Texas - A Feasibility Study"
Funded by Board of City Development, Lubbock - $15,000

"Investigation of Methods of Removing Nitrates from Groundwater"
Funded by Lubbock Chamber of Commerce/Board of City Development - $750

"Treatment of Textile Mill Effluent in a Model Activated Sludge Plant
Funded by Board of City Development, Lubbock - $750

"Effect of Unlined Treated Sewage Storage Ponds on Water Quality in the Ogallala Formation"
Funded by Office of Water Resources Research - $40,498

"Investigation of Cattle Feedlot Management Systems to Reduce Water Pollution"
Funded by Federal Water Pollution Control Administration - $15,000
Pending from FWPCA and Texas Water Quality Board - $81,500

DR. D. M. WELLS, Associate Professor (continued)

PROPOSED RESEARCH:

"Mathematical Management Model, Unconfined Aquifer"
with High Plains Underground Water District
Funding pending by Office of Water Resources Research - $100,000

"Investigation of Pollutional Effects of Utilizing Playa Lake Water for Recharging the Ogallala"
Funding pening by Federal Water Pollution Control Administration - $100,000

C. H. KEHO, Associate Professor

PRESENTATIONS:

"A Survey of Recent Trends and Basic Theory in Blast Design"
Presented as guest lecturer to OCD-DOD course in Environmental Engineering, January, 1968, Lubbock.

"A History of the Development of an Understanding of Frost Action", Seminar, North Caroline State University, March, 1967.

"A Review of the Literature Pertinent to Low Amplitude Variable Frequency Excitation of Fine Grained Triaxial Specimens"
Seminar, North Carolina State University, Raleigh, November, 1966.

C. M. PARRISH, Associate Professor

PUBLICATIONS:

"Improved Design of Fluid Networks with Computers:
ASCE Journal of the Hydraulics Division, HY2, March 1967

PRESENTATIONS:

"Computer Programs"
Structural Engineering Seminar, Texas Tech
To be presented April 26, 1968.

C. M. PARRISH, Associate Professor (continued)

Research:
"Non-Linear Network Synthesis"
Funded from C. E. Department funds

A. J. SANGER, Associate Professor

PRESENTATIONS:

"Matrix Algebra - Beam Stiffness"
Structural Engineering Seminar, Texas Tech
To be presented April 26, 1968.

"Plane Trusses"
Structural Engineering Seminar, Texas Tech
To be presented April 26, 1968

AHMED Y. ABDEL-RAZAQ, Assistant Professor

PUBLICATIONS:

"A Numerical Solution of the Equations of Motion as Applied to Surface Flow" Technical Report No. 36, Engineering Experiment Station, New Mexico State University, 1966 (with J. W. Hernandez).

"A Solution to the Surface Runoff Problem"
Published in the Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division.
Vol. 93, No. HY6, November, 1967.

PRESENTATIONS:

"Numerical Solution of a Partial Differential Equation"
Presented to Texas Section, ASCE, Abilene, Texas, November 1967.

RESEARCH:

"Instantaneous Unit Hydrograph by Laplace Transform
Funded by Water Resources Center - $2,000

DR. C. V. GIRIJAVALLABHAN, Assistant Professor

PUBLICATIONS:

"Finite-Element Method Applied to Problems in Soil Mechanics" Journal of the Soil Mechanics and Foundations Division, ASCE March, 1968

"Application of the Finite-Element Method to Problems in Soil and Rock Mechanics", a report to American Petroleum Institute, Division of Production, Project 67H, January, 1967

"Finite-Element Method Applied to Problems in Stresses and Deformations of Soil", a report to National Aeronautics and Space Administration, January, 1967

PAPERS PRESENTED:

"Application of the Finite-Element Method to Soil Mechanics" presented to the Texas ASCE Section Annual Meeting in Austin in October, 1966

"Stress-Strain Relationships in Nonlinear Continuum" lecture presented to NSF Summer Institute on Continuum Mechanics at Virginia Polytechnic Institute, Blacksburg, Virginia, on August 29, 1967

"Difficulties in Using Iterative Methods for Solving Nonlinear Soil Problems, Especially in Sandy Soil", lecture presented to the Civil Engineering faculty and graduate students at University of Texas, Austin, on April 9, 1968

"Finite-Element Method Applied to Problems in Soil Mechanics" presented to National Meeting of Engineering Mechanics Division of ASCE, Raleigh, N. C., November, 1967

"Finite-Element Methods Applied to Soil Mechanics" Presented to Department of Civil Engineering, University of Texas, November, 1967

RESEARCH:

"Application of the Finite-Element Method to Solve Plasticity and Plasticity Problems in Particular to Soil Mechanics Problems", no funds.

DR. K. C. MEHTA, Assistant Professor

PRESENTATIONS:

"Structural Concrete with Nylon Fibers"
Presented to Annual Convention of the American Concrete Institute, Toronto, Canada, April 3, 1967

"Matrix Analysis of Continuous Beams - Computer Program"
To be presented to Structural Engineering Seminar, Texas Tech, April 26, 1968

"Analysis of Fallen Light Towers at Jones Stadium"
Presented to High Plains Branch, ASCE, Lubbock, Texas
December, 1967 (with Kenneth White)

RESEARCH:

"Stress Distribution in Folded Plate Structures"
Funded by Texas Technological College - $4,300

J. R. MCDONALD, Assistant Professor

PRESENTATIONS:

"Matrix Analysis of Rigid Frames - Computer Program"
Structural Engineering Seminar, Texas Tech
To be presented April 26, 1968

RESEARCH:

"Inelastic Behavior of Multistory Frames"
Funds: None

F. P. WAGNER, Part-time Instructor

PRESENTATION:

"Failure of Avenue Q Bridge"
High Plains Branch, ASCE, Lubbock, Texas
June, 1967

K. R. WHITE, Instructor

PRESENTATION:

"Analysis of Fallen Light Towers at Jones Stadium"
Presented to High Plains Branch, ASCE, Lubbock, Texas
December, 1967 (with K. C. Mehta)

DEPARTMENT OF ELECTRICAL ENGINEERING
PUBLICATIONS, PAPERS PRESENTED, AND RESEARCH

DR. R. H. SEACAT, Professor and Chairman

PUBLICATIONS:

"The Synthesis of Orthogonal Filters by the Use of Sturm-Liouville Equations"
Proceedings Fourth Allerton House Conference, October 1966
(with M. E. Parten)

"The Synthesis of Orthogonal Filters by the Use of Sturm-Liouville Equations"
Proceedings SWIEEECO 1967
(with M. E. Parten)

"The Use of Sensitivity Analysis to Insure System Stability"
Proceedings 1st Asilomar Conference on Circuits and Systems, November 1967 (with L. Judd and D. R. Fannin)

"An Application of Topological Methods to Networks Containing Ideal Transformers"
Proceedings 1st Asilomar Conference on Circuits and Systems, November 1967 (with L. B. Masten)

"Sensitivity Methods for Insuring Stability of Nonlinear Systems"
Proceedings SWIEEECO, April 1968, Houston, Texas
(accepted with D. R. Fannin and L. F. Judd)

"An Application of Topological Methods to Networks Containing Ideal Transformers"
Proceedings of SWIEEECO, April 1968, Houston, Texas
(with L. B. Masten)

"A Method of Specifying Parameter Changes to Insure the Absolute Stability of Nonlinear Systems"
Proceedings of 11th Midwest Symposium on Circuit Theory, May 13-14, 1968, Notre Dame, Indiana (accepted with D.R. Fannin and L.F. Judd)

PAPERS PRESENTED:

"The Synthesis of Orthogonal Filters by the Use of Sturm-Liouville Equations"
Proceedings Fourth Allerton House Conference, October 1966
(with M. E. Parten)

DR. R. H. SEACAT, Professor and Chairman (continued)

PAPERS PRESENTED: (continued)

"The Synthesis of Orthogonal Filters by the Use of Sturm-Liouville Equations"
Proceedings SWIEEECO 1967 (with M. E. Parten)

"Evolution of an Electrical Engineering Curriculum"
Dallas Section, IEEE, March 1968, Dallas, Texas

"Electrical Engineering at Texas Tech"
Faculty Seminar, Arlington State College, December 1967

"Topology and Modelling Non-linear Control Systems"
A three day seminar at Holloman Air Force Base
(with D. R. Fannin and Larrie Judd and L. B. Masten)

"Sensitivity Methods for Insuring Stability of Nonlinear Systems"
SWIEEECO, April 1968
(with D. R. Fannin and L. F. Judd)

"An Application of Topological Methods to Networks Containing Ideal Transformers"
SWIEEECO, April 1968, Houston, Texas
(with L. B. Masten)

"The Three E's in Freshman Engineering Courses"
Texas A & M University, March 1968, Gulf SW Sec. Meeting, ASEE (with L. F. Judd)

"The Use of Sensitivity Analysis to Insure System Stability"
November 1967 (with L. Judd and D. R. Fannin)

"An Application of Topological Methods to Networks Containing Ideal Transformers"
November 1967 (with L. B. Masten)

"Loop Filter Synthesis"
Collins Radio Company, Dallas, Texas
August 1966 (with L. G. Schmidt)

RESEARCH:

"The Effect of Control Parameters on ASM Terminal Guidance Testing"
Holloman AFB - $40,000

"A Study of the Parameters Influencing the Selection of a Useful Signal from Signals Having Similar Characteristics"
AFTAC - $24,000

DR. R. H. SEACAT, Professor and Chairman

RESEARCH: (continued)

"The Design of Digital Filters
Collins Radio Co. - $2,400

DR. JOHN P. CRAIG, Associate Professor

PUBLICATIONS:

"Output Polarization Rotation Sensitivity of a He-Ne Laser"
SWIEEECO Record, April 1968 (with W. G. Guion)

"Stark Broadening of Singly Ionized Nitrogen Lines"
Submitted to Physical Review (with N. W. Jalufica)

PAPERS PRESENTED:

"Output Polarization Rotation Sensitivity of He-Ne Laser"
Houston, Texas, April 1968 (with W. Guion), SWIEEECO

RESEARCH:

"Investigations of a Plasma Gun"
State Supported - $8,737

DR. WILLIAM PORTNOY, Associate Professor

PUBLICATIONS:

"A Monolithic Single Ended X-Band Mixer Circuit"
IEEE Journal of Solid State Circuits, SC-3, 31 (1968)
(with H. M. Leedy)

"An X-Band Balanced-Mixer Integrated Circuit"
1966 International Solid-State Circuits Conference Digest of
Technical Papers 9, 22 (1966) (with T. M. Hyltin)

PAPERS PRESENTED:

"Microwave Diodes"
South Plains Section IEEE

TOM STENIS, Associate Professor

PAPERS PRESENTED:

"Engineering Counseling of Freshmen"
Gulf Southwest Section Meeting, ASEE
Texas A&M University, March 1968

DR. DAVID K. FERRY, Assistant Professor

PUBLICATIONS:

"Microwave Emission from InSb and InAs"
Bull. Am. Phys. Soc. 11, 754, 1966
(with R. W. Young and A. A. Dougal)

"Input Power Induced Thermal Effects Related to Transition Time Between Avalanche and Second Breakdown in Silicon P-N Junctions"
IEEE Trans. on Electron Devices ED-13, 627, 1966
(with A. A. Dougal)

"Frequency Range of the Microwave Emission from InSb"
Zeitschrift für Naturforschung 22 a, 576, 1967

"Negative Resistance and Galvanomagnetic Effects in Inhomogeneous Bulk Semiconductors"
Verhand. Deutsch. Phys. GmbH. V1-2, 79, 1967

"Negative Resistance and Galvanomagnetic Effects of Hot Electrons in Inhomogeneous Bulk Semiconductors"
To be published in Solid State Electronics
(with H. Heinrich)

"Hot Carrier Current Oscillations in n-Type Germanium"
Applied Physics Letters 11, 126, 1967
(with H. Heinrich)

"Avalanche Magnetoplasma Production and Instabilities in InSb"
Bull. Am. Phys. Soc. 13, 258, 1968
(with H. Heinrich)

"Effect of Magnetic Fields on Impact Ionization Rates and Instabilities in InSb"
To be published in Physical Review
(with H. Heinrich)

DR. DAVID K. FERRY, Assistant Professor (continued)

PUBLICATIONS: (continued)

"Recent Advances in Semiconductor Microwave Sources"
Proceedings SWIEEECO, p. 6B, 1968

"More Microwave Emission from InSb"
To be published in Bull. Am. Phys. Soc.
(with W. A. Porter and W. G. Guion)

PAPERS PRESENTED:

"On the Microwave Emission from InSb and InAs"
American Physical Society
Mexico City, August 29-31, 1966
(with R. W. Young and A. A. Dougal)

"Anomalous Microwave Emission from Bulk Semiconductors"
Conference on Physics of Semiconducting Compounds
Swansea, Wales, G.B., September 21-23, 1966
(with R. W. Young and A. A. Dougal)

"Microwave Emission from InSb and InAs"
Seminar at Boltzmann Institut für Festkorper Physik
Vienna, September 28, 1966

"Negative Resistance and Galvanomagnetic Effects in
Inhomogeneous Semiconductors"
European Meeting, German Physical Society
Bad Nauheim, Germany, April 19-22, 1967
(with H. Heinrich)

"New Semiconductor Microwave Sources"
South Plains Chapter IEEE
Lubbock, Texas, October 9, 1967

"Avalanche Magnetoplasma Production and Instabilities in InSb"
Am. Phys. Soc. Plasma Physics Meeting, Austin, Texas
November 8-11, 1967, (with H. Heinrich)

"Recent Advances in Semiconductor Microwave Sources"
Southwestern IEEE Conference, Houston, Texas, April 17-19, 1968

"More Microwave Emission from InSb"
American Physical Society, Los Alamos
June 17-19, 1968
(with W. A. Porter and W. G. Guion

DR. DAVID K. FERRY, Assistant Professor (continued)

RESEARCH:

"Microwave Generation and Amplification in Semiconductors"
NSF - $15,000

"Specialized Research Equipment in Physical Electronics"
NSF - $8400

"Anomalous Microwave Emission from Bulk Semiconductors"
State Supported - $2,600

DR. MARION O. HAGLER, Assistant Professor

PUBLICATIONS:

"Infrared Maser Diagnostics of a Dynamical Deuterium Plasma Produced in a 30-kJ θ-Pinch"
Bull. Am. Phys. Soc. 11, 731, 1966
(with H. N. Roberts and A. A. Dougal)

"Resonant Faraday Rotation in a Magneto-Plasma-filled Optical Resonator"
Bull. Am. Phys. Soc. 12, 192, 1967
(with A. A. Dougal)

"Nonuniqueness of the Debye Length"
Bull. Am. Phys. Soc. 12, 193, 1967
(with D. G. Swanson)

"Investigation of the Output Polarization of a Laser Immersed in an Axial Magnetic Field"
Submitted for Publication (with A. A. Dougal)

"Vector Kirchoff Analysis of Plane Diffraction Gratings"
(Submitted for publication (with A. A. Dougal)

"Controlled Thermonuclear Fusion - Some Recent Developments"
Region III, IEEE Conference, New Orleans, La.,
April 22-24, 1968

PAPERS PRESENTED:

"The Design of Antennas with Standing Waves in the Near Zone"
SWIEEECO, Houston, Texas, April 1968

DR. MARION O. HAGLER, Assistant Professor (Continued)

PAPERS PRESENTED: (continued)

"Controlled Thermonuclear Fusion - Some Recent Developments"
Region III, IEEE Conference, New Orleans, La., April 22-22, 1968

"Electrical Characteristics of Tornadoes"
South Plains Chapter, IEEE, Lubbock, Texas

RESEARCH:

"Experimental and Theoretical Investigations of Turbulent Plasma Heating"
NSF - $15,000

"Laser Experiments for Undergraduate Electrical Engineering Students"
NSF - $17,004
(with M. Kristiansen)

DR. M. KRISTIANSEN, Assistant Professor

PUBLICATIONS:

"Evaluations of Faraday Shielded Stix Coils for Ion Cyclotron Resonance Heating of Plasma" (with N. B. Dodge and A. A. Dougal)
Rev. Sci. Inst. 37, 1455, November 1966

"Wave Propagation and Plasma Heating Near Harmonics of the Ion Cycletron Frequency" (with A. A. Dougal)
Bull. Am. Phys. Soc. 12, 831, 1967

"Plasma Heating and Wave Propagation at Harmonics of the Ion Cyclotron Frequency" (with A. A. Dougal)
Proc. II European Conf. on Controlled Fusion and Plasma Physics, Stockholm, Sweden, August 14-18, 1967
(Also to appear in Plasma Physics)

"Inexpensive, High Vacuum, High Voltage, Electric Feedthrough" (with J. G. Melton and A. A. Dougal)
Rev. Sci. Inst. 38, 840, 1967

"Investigations of RF Energy Couples for Resonant Plasma Heating" (with J. Hipp)
Proceedings of 1968 Southwestern IEEE Conference, p. 5B.

"Experimental Investigations of Harmonic Ion Cyclotron Wave Propagation and Attenuation" (with A.A. Dougal), Physics of Fluids 10, 596 (1967)

DR. M. KRISTIANSEN, Assistant Professor (Continued)

PUBLICATIONS: (continued)

"Current Investigations of High Power RF Heating of Magnetoplasma" (with J. E. Cato)
To appear in Proceedings of 1968 IEEE Region III Conference

"Controlled Thermonuclear Fusion -- Some Recent Developments" (with M. O. Hagler) - To appear in Proceedings of 1968 IEEE Region III Conference

"The Use of Hamilton's Modified Principle to Solve Nonlinear Control Problems" (with M. O. Hagler and L. G. Clark)
Submitted to the 23rd Annual ISA Conference Record, New York City, October 28-31, 1968

"Stop-and-Pass Bands for Harmonic Ion Cyclotron Waves" (with A. A. Dougal) Submitted to Physics of Fluids

"High Power rf Plasma Heating and Wave Propagation near the Ion Cyclotron Resonance Frequency" (with A. A. Dougal)
Bulletin - American Physical Society, Series II, 11, 545, 1966

"Waves Propagating Above the Ion Cyclotron Frequency (f_c) and Attenuating Near Harmonics of f_c" (with A.A. Dougal)
Bulletin - American Physical Society, Series II, 11, 716, 1966

PAPERS PRESENTED:

"Current Investigations of High Power R-F Heating of Magnetic Plasma" (with J. E. Cato)
Region III IEEE Conference, New Orleans, Louisiana, April 1968

"Controlled Thermonuclear Fusion -- Some Recent Developments" (with M. O. Hagler), Region III, IEEE Conference, New Orleans, La., April 1968

"Plasma Heating and Wave Propagation at Harmonics of the Ion Cyclotron Frequency"
Second European Conference on Controlled Fusion and Plasma Physics, Stockholm, Sweden, August 1967

"Foreign Student Problems"
Gulf Southwest Section Meeting ASEE, Texas A&M University, College Station, Texas, March 1968

DR. M. KRISTIANSEN, Assistant Professor (continued)

RESEARCH:

"Basic Problems in High Power RF Heating and Confinement in Magnetoplasmas"
Grant from Coordinating Board, Texas College and University System - $34,900

"Theoretical and Experimental Investigations of RF Plasma Heating"
National Science Foundation - $19,800

"Wave Propagation and Oscillations in Solid State Plasmas"
State Supported Research - $15,867

"Mode Coupling and Low Frequency Oscillations in Magnetoplasma"
Sigma Xi Grant-in-Aid of Research - $500

"Theoretical and Experimental Investigations of Harmonic Ion Cyclotron Wave Propagation and Plasma Heating"
U. S. Atomic Energy Commission - $12,000

Specialized Equipment Grant
Varian Associates - $3,000

Specialized Equipment
Hewlett-Packard - $3,700

"Laser Experiments for Undergraduate Electrical Engineering Students" (with M. O. Hagler)
National Science Foundation - $17,004

DR. D. L. VINES, Assistant Professor

PUBLICATIONS:

"Semiconductors in Protective Relaying Circuits"
Electric Power Institute, Texas A&M University, 1966

"Semiconductors in Protective Relaying Circuits -- For the Technician"
Electric Power Institute, Texas A&M University, 1966

DR. D. L. VINES, Assistant Professor (Continued)

PAPERS PRESENTED:

"Popov's Stability Criterion Applied to an Air Conditioning System"
To be presented at the 23rd ISA Conference and Exhibit, New York, October 1968 (with James Cato and William Guion)

"Liquid Level Stability via the Circle Criterion"
To be presented at the 23rd ISA Conference and Exhibit New York, October 1968 (with Robert Passmore)

"Telemetry in a Lightning Infested Area"
National Telemetering Conference
Houston, Texas, April 1968

"A Method to Measure the Acceleration Sensitivity of Hydrophones"
Southwest IEEE Conference, Houston, Texas, April 1968

"Concepts of Problem Solving"
American Society of Engineering Education,
Texas A&M University, College Station, Texas, March 1968

"Acceleration Sensitivity Measurements for Hydrophones"
Fourth National ISA Marine Sciences Instrumentation Symposium,
Cocoa Beach, Florida, January 1968

RESEARCH:

"Investigations of Piezoelectric Crystals"
State Supported Research - $9,500

"Reliability Indicators"
Texas Instruments - $6,500

"Central Nervous System Involvement in Kinesiological Performance"
(with D. Jordan and I. Lipschitz)
ICASALS - $750

"Seismological Research"
Texas Tech Water Resources Institute - $600

ALONZO F. ADKINS, Instructor

PAPERS PRESENTED:

Presented a Seminar at Texas Power and Light concerning the applications of digital computers in the utility industry. Summer 1967

PUBLICATIONS:

"Load Flow Analysis" Transactions of Southwest Institute of Electrical and Electronic Engineers Conference, April 1966 (with R. H. Seacat and Albert A. Smith)

DEPARTMENT OF INDUSTRIAL ENGINEERING
PUBLICATIONS, PAPERS PRESENTED AND RESEARCH

DR. R. A. DUDEK, Professor and Chairman

PUBLICATIONS:

"Development of a Heuristic Algorithm for the n Job, m Machine Sequencing Problem"
Submitted to Management Science (co-author).

"A Heuristic Algorithm for Sequencing n Technologically Ordered Jobs Through m Machines with Passing Permitted"
The Institute of Management Sciences XIV International Meetings, Mexico City (August 1967) (co-author)

"Cutting Fluid Lubricity and Surface Roughness in Turning"
The International Journal of Production Research, Vol. 5, No. 4 1967 (co-author)

"Make Span Sequencing on m-Machines"
The Journal of Industrial Engineering, Vol. XVIII, No. 1 January 1967 (co-author)

"A General Algorithm for Solution of the n Job, m Machine Sequencing Problem of the Flow Shop"
Journal of Operations Research, Jan-Feb., 1967 (co-author)

PAPERS PRESENTED:

"A Heuristic Algorithm for Sequencing n Technologically Ordered Jobs Through m Machines with Passing Permitted"
TIMS XIV International Meetings, Mexico City, Mexico
August 22, 1967

"Biomechanics and Human Performance: Present and Future"
AIEE Region Conference, Session Presentation, Omaha, Nebraska
November 18, 1966

"Biomechanics for the Layman"
Telecast Presentation, Community Close-up, KCBD-TV, Lubbock, Texas, November 1967

DR. R. A. DUDEK, Professor and Chairman (Continued)

PAPERS PRESENTED: (continued)

"Biotechnology - Principles and Practice"
Presentation to Sunrise Optimists Club
February 19, 1967

"Biomechanics - Principles and Research"
Symposium at the University of Nebraska
February 1967

"Graduate Industrial Engineering Education"
Chief Industrial Engineers Symposium, National AIEE Conference,
Tampa, Florida, May 1968

"Peripheral Color Vision Investigations"
Work Physiology Symposium
Rochester, New York, October 18-21, 1966

RESEARCH:

"Continuation of Sequencing Research"
NSF Grant - $30,000

"Engineering Training Services"
Western Electric Company, Inc. Contract - $21,240

(Proposed Research)

"Operations Under Stressful Situations Based on Individual
Performance and Training"
Project THEMIS, submitted to Director of Defense Research
and Engineering, Department of Defense.
Total funds - $1,069,299 for three years.

"Optimal Agricultural Use of Groundwater Subject to Depletion"
Submitted to the Office of Water Resources Research
Total funds - $128,669 for two years.

"Sequencing Research"
Submitted to the National Science Foundation
Total funds - $107,941 for two years.

(Unsponsored Thesis Research)

"An Investigation of the General Sequencing Problem Subject to
Certain Job Shop Restrictions"
Charles F. Zurla, Jr., June 1968

(Unsponsored Thesis Research) (continued)

"Optimization of Multi-Period Stochastic Inventory Systems"
Mohammed Mushtaq, June 1967

"Effects of Lighting and Background with Common Signal Lights on Human Peripheral Color Vision"
George M. Colton, June 1967

"An Investigation of an Algorithm for Decomposition of Large Angular Linear Programs"
Charles Cavanaugh Hancock, Jr., June 1967

(Unsponsored Dissertation Research)

"An Analysis of the Reliability of Tool Life Prediction"
Brian Kerry Lambert
August 1967

"An Investigation of the Conditions of Optimal Flow Shop Sequences"
Milton L. Smith
June 1968

DR. M. M. AYOUB, Associate Professor

PUBLICATIONS:

"Experimental Determination of an Optimal Foot Pedal Design"
Journal of Industrial Engineering, Vol. XVIII, No. 9, 1967

"The Sensitivity of Sampling Inspection Parameters to Inspector Error"
Submitted to Technometrics, April 1968

PRESENTATIONS:

"Biomechanics and Safety"
Presented to the Safety Institute at Fort Worth, Texas
November 1967

"Industrial Biomechanics - What is It?"
Presented to the Regional AIIE Meeting at Fort Worth, Texas
November 1967

"Men and Machines"
Presented to the Annual Safety Supervisors Meeting
Odessa, Texas, February 1968

DR. M. M. AYOUB, Associate Professor (Continued)

RESEARCH:

"The Functional Relationship of the Physiological Optimum and the Moment of Inertia of a Moving Limb in an Industrial Task"
Funded by State of Texas - $12,212

"Dynamics of the Center of Mass of the Arm Tool Aggregate for Three Dimensional Moves"
Funded by State of Texas - $8,700

(Proposed Research)

Research Associate and Program Coordinator on THEMIS Project

(Unsponsored Thesis Research)

"A Behavioral Analysis of an Assembly-Line Inspection Task"
Richard V. Badalamente, June 1968

"A Biomechanical Investigation of the Possibility of Relating Static and Dynamic Work by Means of a Common Parameter"
Tarek M. Khalil, June 1968

"Effect of Forearm Muscles by the Downward Pull of Suspended Cylindrical Hand Tools"
Peter LoPresti, June 1968

"An Analysis of a One-Handed Assembly Task"
John B. Sotman, June 1968

"A Study of Depth Perception Within the Binocular Peripheral Field of Vision"
Richard H. Crockett, Jr.
January 1968

"The Effects of Noise Variables on Reaction Time and on Sensorimotor Performance"
Walter Lawrence Clark
August 1967

"An Investigation of the Effects of Two Types of Inspector Error on Sampling Inspection Plans"
Kenneth Alan McKnight
June 1967

DR. M. M. AYOUB, Associate Professor (Continued)

(Unsponsored Dissertation Research)

"The Quantification of Human Effort and Motion for the Upper Limbs by Means of an Exoskeletal Kinematometer"
Jerry D. Ramsey
August 1967

DR. C. L. BURFORD, Associate Professor

RESEARCH:

"Investigation of Economic Models"
Funded by State of Texas - $3,467

(Unsponsored Thesis Research)

"An Analysis of Economic Alternatives Under Inflation and Productivity"
Stanley H. Johansen, June 1968

"An Investigation of the Job-Shop Sequencing Problem"
Stanley G. Warren, January 1968

"A Heuristic Algorithm for Assembly Line Balancing"
John Pellek, June 1967

"An Investigation of the Effects of Incoming Quality and Inspection Rate on Inspector Accuracy"
John Kenneth Sosnowy, June 1967

DR. J. D. RAMSEY, Assistant Professor

PUBLICATIONS:

"The Exoskeletal Kinematometer for Measuring Work"
Submitted to the Journal of Industrial Engineering

"The Quantification of Human Effort and Motion for the Upper Limbs"
Accepted by International Journal of Production Research

PRESENTATIONS:

"Biomechanics for the Layman"
Telecast Presentation, Community Close-up, KCBD-TV
Lubbock, Texas

DR. J. D.RAMSEY, Assistant Professor (continued)

RESEARCH:

(Proposed)

"Evaluation of Electromyography as a Criterion for Work Design"
Submitted to State of Texas - $16,658

Research Associate on THEMIS PROJECT.

(Unsponsored Thesis Research)

"The Effects of Noise Variables on Reaction Time"
James C. Scott, June 1968

"Numerical Identification in the Peripheral Vision as an Aid to Work Place Design"
Hirum E. West, June 1968

"Measurement of Human Movement by Photogrammetry Techniques"
Mahmoud A. Ayoub, August 1968

"The Effects of Colored Lighting, Illumination Intensity Level, and Color of Work Place on a Fixed Inspection Task"
Robert W. Tedder, August 1968

DR. B. K. LAMBERT, Assistant Professor

PUBLICATIONS:

"Single Point Tool, Orthoyonal Cutting Force Equations as a Function of Cutting Speed, Feed, Depth of Cut, and Side-Rake Angle"
Accepted by the International Journal of Production Research

RESEARCH:

(Proposed)

"Probabilistic Tool Life Equations"
Submitted to the State of Texas - $12,694

R. E. BOCHE, Assistant Professor

PUBLICATIONS:

"A Simulation in Plant Ecology"
Proceedings of the American Federation of Information Processing Societies, Spring Joint Computer Conference, Atlantic City, N.J. April 1968

"A Formula for Balance Due at Intermediate Points of an Amortization Schedule"
The Engineering Economist, Vol. 13, No.3, Spring 1968

"Some Algorithms for Allocation of Environmental Resources Determining Plant Growth"
Symposium on Physiological Systems in Semi-Arid Environments Sponsored by the University of New Mexico and the National Science Foundation, Albuquerque, N. M., Nov. 1967

PRESENTATIONS:

"Steps in the Development of Simulation Models for Plant Growth"
Southwest Regional Meeting, ACM, El Paso, Texas, May 1967

"Computing With Interval Arithmetic"
Texas Tech College Symposium on Error Control in Digital Computations, April 1967

RESEARCH:

"Simulation Models of Plant Growth"
Funded by ICASALS - $100

(Proposed)

"Simulation in Plant Physiology and Ecology"
Funded by State of Texas - $3,500

W. D. SANDEL, Associate Professor

RESEARCH:

"Systems Analysis of Cotton Industry"
Funded by Cotton Producers Institute - $98,000

W. D. SANDEL, Associate Professor (continued)

(Unsponsored Thesis Research)

"Industrial Development of Semi-Arid Lands of the Southwest United States"
Scott K. Pilkington, August 1968

DR. H. F. MARTZ, Assistant Professor

PUBLICATIONS:

"Empirical Bayes Estimation in Multiple Linear Regression"
Submitted to Journal of the American Statistical Association

"Some Aspects of Empirical Bayes Estimation in Simple Linear Regression"
Submitted to Bismetrica

PRESENTATIONS:

"Estimation of a Bivariate Density Function"
Presented to the Virginia Academy of Sciences
May 2-3, 1967

"Empirical Bayes Estimation in Multiple Linear Regression"
Presented at the Eastern Regional Meeting of the American Statistical Association at Blacksburg, Va., April 8, 1968

RESEARCH:

(Proposed)

"Stochastic Considerations in Formulating an m-Job, n-Machine Scheduling Algorithm"
Submitted to State of Texas - $6,056

"Probabilistic Tool - Life Equations"
Submitted to the State of Texas - $12,694

(Unsponsored Research)

Multivariate Empirical Bayes Regression Analysis"
In preparation, to be submitted to the Journal of the American Statistical Association

DR. H. F. MARTZ, Assistant Professor (continued)

(Unsponsored Research - continued)

"A stochastic Model for the Optimal Replacement of a Deteriorating Component System"
Submitted for presentation at the 34th National Operations Research Society of America Meeting, November 1968

DR. G. K. HUTCHINSON, Associate Professor and Director of Computer Center

PUBLICATIONS:

"An Interference Prediction Model"
(with R. A. Wall) IEEE, Transactions on Electromagnetic Compatibility, Vol. EMC-8, No. 3, September 1966

PRESENTATIONS:

"Some Problems in the Simulation of Multiprocessor Computer Systems"
Presented to the International Federation of Information Processing Conference on Simulation Languages
Olso, Norway, May 1967

"Some Aspects of On-Line Information Retrieval"
Presented at Symposium on Information Problems in the Natural Sciences, Mexico City, December 20, 1967

"The Job Shop Problem in Computer Scheduling"
To be presented at TIMS Meeting, June 1968

RESEARCH:

"Application of the Feedback Principle to Programmer Education"
Funded by NSF - $14,700

(Proposed)

Computer Center NSF Grant - $100,000

DEPARTMENT OF MECHANICAL ENGINEERING
PUBLICATIONS, PAPERS PRESENTED, AND RESEARCH

R. L. MASON, Professor

RESEARCH:

"Thermal Environmental Engineering"
Proposed workshop, estimated participants' fees - $3,000

DR. M. E. DAVENPORT, Associate Professor

RESEARCH:

"Nonequilibrium Thermodynamic Processes - Gas Flow"
Funded by Texas State Organized Research - $13,967

"Industrial Water Supply and Waste Water Renovation in Lubbock, Texas - A Feasibility Study"
Funded by Board of City Development, Lubbock, Texas - $15,000

DR. D. P. JORDAN, Associate Professor

PUBLICATIONS:

"Film and Transition Boiling"
Accepted by Advances in Heat Transfer, Vol. 5

"Analog Simulation of an Aircompressor and Accumulation System" - Accepted by EAI Users publication.

RESEARCH:

"Climatic Conditioning of the Existing Buildings in the Texas College and University System"
Coordinating Board Research Grant - $16,960

"Development of Analog Computer Slaving Mechanism"
Funded by Texas State Organized Research - $4,000

"Studies in Environmental Kinesiology: Central Nervous System Involvement in Kinesiological Performance"
Funded by ICASALS - $500

DEPARTMENT OF PETROLEUM ENGINEERING
PUBLICATIONS, PAPERS PRESENTED, AND RESEARCH

W. L. DUCKER, Professor and Chairman

PAPERS PRESENTED:

"Estimation of Gas Flow in Burning Well"
Presented in Federal Court, Western Division - Texas
Pecos, Texas, April, 1968
Related paper (Co-author with J. D. Larue, Dallas, Texas)
to be submitted for publication to Society of Petroleum
Engineers of AIME.

RESEARCH:

"Activation Analysis in Fluid Flow"
Summer 1967 (Possible publication upon completion of project)
Financed by State Funds - Project 191-8601.

PHILIP JOHNSON, Associate Professor

PUBLICATIONS:

"An Investigation of the Effect on the Mechanism of Hydraulic Formation Fracturing in the Water Injection of a Sandface Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origin"
Research Report (Co-author with D. A. Crawford), Nov. 1967
Financed by State Funds - Project 191-5408

"An Investigation of the Effect on the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sandface Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origin"
Research Progress Report No. 2 (Co-author with D. A. Crawford)
December 1967, Financed by State Funds - Project 191-5408.

RESEARCH:

"Application of Well Stimulation and Water Recharge in the Ogallala Formation" (jointly with D. A. Crawford)
Financed by State Funds - Project 191-8609

D. A. CRAWFORD, Assistant Professor

PUBLICATIONS:

"An Investigation of the Effect on the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sandface Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origin"
Research Report (Co-author with Philip Johnson), Nov. 1967
Financed by State Funds - Project 191-5408

"An Investigation of the Effect of the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sandface Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origin"
Research Report No. 2 (Co-author with Philip Johnson)
December 1967, Financed by State Funds - Project 191-5408

PAPERS PRESENTED:

"Present Methods of Engineering Instruction in Todays' Universities"
Presented at Society of Petroleum Engineers of AIME Symposium, Anadarko Basin Section, Liberal, Kansas, April 8, 1967

RESEARCH:

"Application of Well Stimulation and Water Recharge in the Ogallala Formation" (jointly with Philip Johnson)
Financed by State Funds - Project 191-8609

DEPARTMENT OF TEXTILE ENGINEERING AND TEXTILE RESEARCH CENTER

PUBLICATIONS, PAPERS PRESENTED AND RESEARCH

C. C. WILSON, Professor and Chairman, Director

PRESENTATIONS:

"Mill Requirements for High Plains Cotton"
Cooperative Association of Farmers, Ginners, etc.
Lubbock, Texas, September 1967

DR. W. H. MARTIN, Professor and Associate Director

PRESENTATIONS:

"Cotton Research Program of the Textile Research Center at Texas Tech"
Presented to Blacklands Farmers' Association
Hillsboro, Texas, January 18, 1968

"Clothing, Comfort and Climate"
Presented to ASEE, Los Angeles, California
June 22, 1968

"Improving the Markets of Cotton Through Research and Promotion"
Presented to Womens' Cotton Promotion Association
Woodrow, Texas, November 1967

"Textile Drying Operations"
Presented to Southern Textile Research Conference,
Hilton Head Island, South Carolina, May 17, 1968

HARRY ARTHUR, Assistant Director

PRESENTATIONS:

"Scope of Work of the Textile Research Center"
Presented to Members of Plains Cotton Growers, Inc.,
Whiteface, Texas, October 1967;
Womens' Cotton Promotion Club, Petersburg, Texas, Dec. 1967; and
Cotton Improvement Association, Stamford, Texas, April 1968

M. EARL HEARD, Professor and Coordinator of Research

PRESENTATIONS:

"Textile Research on Natural Fibers"
Presented to Natural Fibers Symposium
Texas Tech, Lubbock, Texas, August 5, 1967

"Expanded Research Program on Cotton Fiber at Textile Research Center"
Presented to joint meeting of four regional agricultural cooperatives, August 1967

"Opportunities in Research and Product Development"
Presented to Second Natural Fibers Symposium
Texas Tech, Lubbock, Texas, November 18, 1967

RESEARCH: Textile Research Center

Research Projects: 1966-67

Contracting Agency: Cotton Research Committee of Texas

"Measurement of Fiber Properties and Related Data on the 1966 Cotton Crop"

"Evaluation of Cotton Quality by New Fiber Testing Instruments"

"Cooperative Quality Control Program with Textile Mills in Texas"

"Evaluation of the Fiber Qualities and Spinning Potentials of New Varieties of Texas Cotton"

"The Effects of Harvesting Treatments and Dates on Fiber Properties, Spinning Performance, Seed Grade, Yields and Net Income for Locket 4789 Cotton"

"Effect of Crosrol Pressure on Spinning Performance and Product Quality on Cottons of Various Lengths"

"A Preliminary Study of Blending Low, Medium, and High Micronaire Cottons"

"A Study to Determine the Effect of Aging on the Spinning Characteristics of Cotton which Fluoresce Under Black Light"

Research Projects: 1966-67 continued

"A Study of the Effect of Yarn Twist on Woven Fabrics for Interlinings"

Contracting Agency: Market Quality Research Division, A.R.S., United States Department of Agriculture

"Development of a Formula for Correcting End Breakage Rate to Nominal Yarn Size"

"The Effects of Weathering on Fiber Color, Processing Performance and Product Quality on Southwestern Cottons"

Contracting Agency: Plains Cotton Growers, Inc.

"Effect of Skip-Row Planting on Processing Performance and Product Quality of Cotton Grown on the High Plains of Texas"

"Evaluation of Fiber Properties, Spinning Performance and Product Quality of Various Varieties of High Plains Cottons"

Contracting Agency: Cotton Producers Institute of the National Cotton Council

"More Effective Packaging, Handling and Compressing Baled Cotton Lint"

PROGRESS REPORTS AND EXPERIMENTAL DATA SUBMITTED ON THE FOLLOWING PROJECTS:

"Measurement of Fiber Properties and Related Data on the 1966 Cotton Crop"

"Evaluation of Cotton Quality by New Fiber Testing Instruments"

"Cooperative Quality Control Program with Textile Mills in Texas"

"Evaluation of the Fiber Qualities and Spinning Potentials of New Varieties of Texas Cotton"

"Effect of Crosrol Pressure on Spinning Performance and Product Quality on Cottons of Various Lengths"

"A Preliminary Study of Blending Low, Medium, and High Micronaire Cottons"

PROGRESS REPORT AND EXPERIMENTAL DATA
SUBMITTED ON THE FOLLOWING PROJECTS: (continued)

"A Study to Determine the Effect of Aging on the Spinning Characteristics of Cotton which Fluoresce Under Black Light"

"A Study of the Effect of Yarn Twist on Woven Fabrics for Interlinings"

"Development of a Formula for Correcting End Breakage Rate to Nominal Yarn Size"

"The Effects of Weathering on Fiber Color, Processing Performance and Product Quality on Southwestern Cottons"

"Effect of Skip-Row Planting on Processing Performance and Product Quality of Cotton Grown on the High Plains of Texas"

"Evaluation of Fiber Properties, Spinning Performance and Product Quality of Various Varieties of High Plains Cottons"

"More Effective Packaging, Handling and Compressing Baled Cotton Lint"

RESEARCH REPORT:

"The Effects of Harvesting Treatments and Dates on Fiber Properties, Spinning Performance, Seed Grade, Yields and Net Income for Locket 4789 Cotton"

RESEARCH PROJECTS: 1967-68

Contracting Agency: Cotton Research Committee of Texas

"Measurement of Fiber Properties and Related Data on the 1967 Texas Cotton Crop"

"Evaluation of Cotton Quality by New Fiber Testing Instruments"

"Evaluation of the Fiber Qualities and Spinning Potentials of New Varieties of Texas Cotton"

"Cooperative Quality Control Program with Textile Mills in Texas"

"A Study of the Effect of Yarn Twist on Woven Fabrics for Interlinings"

RESEARCH PROJECTS: 1967-68 (continued)

"A Study to Determine the Effect of Aging on Spinning Characteristics of Cottons Which Fluoresce Under Black Light"

"A Study to Determine the Building and Equipment Requirements for a Textile-Chemical Research Facility"

Contracting Agency: Southern Utilization Research and Development Division, U. S. Dept. of Agriculture

"Investigations for Mechanical Processing and Blending Techniques in Order to Increase Utilization of 'Discount' Cottons"

Contracting Agency: Western Utilization Research and Development Division, U. S. Dept. of Agriculture

"Determination of the Optimum Conditions for Using the Cotton Processing System to Produce Yarns Which are Blends of Wool and Cotton"

Contracting Agency: Market Quality Research Division, A.R.S., United States Department of Agriculture

"The Effects of Weathering on Fiber Color, Processing Performance and Product Quality on Cotton Grown in Arizona"

"Effect of Gin Cleaning and Conditioning on Spinning Performance and Product Quality on Southeastern High Quality Cotton"

Contracting Agency: Plains Cotton Growers, Inc.

"Evaluation of Fiber Properties, Spinning Performance, and Product Quality of Various Varieties of High Plains Cottons"

Contracting Agency: Cotton Producers Institute of the National Cotton Council

"More Effective Packaging, Handling, and Compressing Baled Cotton Lint"

Contracting Agency: Locket Seed Farms

"A Study to Determine the Spinning Limits of Locket 4789 Cotton Grown in Different Locations"

Contracting Agency: Plains Cotton Cooperative

"Effect of Storing Seed Cotton in Bales Before Ginning on Spinning Performance and Product Quality"

PROGRESS REPORTS AND EXPERIMENTAL DATA
SUBMITTED ON THE FOLLOWING PROJECTS (continued)

"Measurement of Fiber Properties and Related Data on the 1967 Texas Cotton Crop"

"Evaluation of the Fiber Qualities and Spinning Potentials of New Varieties of Texas Cotton"

"The Effects of Weathering on Fiber Color, Processing Performance and Product Quality on Cotton Grown in Arizona"

"Evaluation of Fiber Properties, Spinning Performance, and Product Quality of Various Varieties of High Plains Cottons"

"More Effective Packaging, Handling, and Compressing Baled Cotton Lint"

DEPARTMENT OF

ARCHITECTURE

Department of Architecture

School of Engineering

1 September 1968

DEPARTMENT OF ARCHITECTURE

I. Historical Summary:

The Department of Architecture in the School of Engineering at Texas Technological College dates from 1925-26 with the listing of one faculty member and two available degrees, Bachelor of Science in Architecture and Bachelor of Science in Architectural Engineering in the supplement to the annual catalog for that year. The 280 students in Engineering included 33 registered for Architecture, although a complete curriculum was not established until 1927-28. Both of the initial degree plans required four years.

The Department title was changed to Architectural Engineering in 1928-29 as the degree in Architecture was suspended. The designations of Department of Architecture and Department of Architectural Engineering were used interchangably until 1932-33 when the title became Department of Architecture and Allied Arts with three four year curricula; one in Architecture, one in Architectural Engineering, and one in Commercial Art. The curricula in Architecture and Commercial Art were both expanded to five years in 1934 with the curriculum in Architectural Engineering remaining at four years, following the national trend at that time. Provisions were made in both five year programs for the conferring of Bachelor of Arts degrees at the completion of four years. The faculty had increased to a total of five.

The designation Architectural Engineering was discontinued in 1940 and the degrees retitled Bachelor of Architecture, Design Option and Bachelor of Architecture, Construction Option, both as five year programs. The Commercial Art was continued as a five year curriculum retaining provision for a Bachelor of Arts degree at the end of four years. This pattern continued with steady growth and only minor variations until 1951, when the Bachelor of Commercial Art was changed to Bachelor of Advertising Art and Design. The faculty at this time numbered ten.

Accelerating growth was experienced during the middle fifties with the major emphasis on consolidation and strengthening of basic programs and securing recognition in the profession. Initial accrediting of both curricula in Architecture by the National Architectural Accrediting Board was awarded in the fall of 1957 and has been maintained to date.

To stimulate interest and follow the more usual pattern, the program in Advertising Art and Design was redesigned in 1958 to reduce the completion time to four years and one summer. The two five year curricula in Architecture remained essentially stable, although realignments of areas of instruction to permit broader selection of electives and to strengthen professional content were effected. Steady growth by 1960 brought the total faculty to twenty-one full time and part-time members and a student enrollment almost too large for the new building which was completed in December 1960.

The instructional pattern was realigned in Fall 1967 when the curriculum in Advertising Art and Design and the Department of Applied Arts were combined to form a new Department of Art in the School of Arts and Sciences. Orderly transfer of students and faculty into this new Department took place during the fall and spring of 1967-68. The Department title was changed once again to the Department of Architecture.

Tabulation of enrollment and budget patterns over the past ten years indicates steady and healthy growth. Allowance must be made in both enrollment and budget figures for the shift of faculty and students to form the new Department of Art in 1967. Because of the virtual impossibility of separating salary figures for the two segments of the faculty prior to 1967, budget figures and enrollment patterns are not directly comparable.

Degrees awarded through 1967

Bachelor of Architecture	481
Bachelor of Arts	112
Bachelor of Advertising Art and Design	123
Bachelor of Commercial Art	7
Total Undergraduate Degrees	723

Instructional staff, Assistant Professor or above
(Listing is in approximate order of appointment.)

Edgar G. Shelton
Florian A. Kleinschmidt (1)
Robert I. Lockard
Weldon L. Bradshaw (1)
Edna H. Houghton (2)
John D. Hale
Maurice R. Des Marias
Elizabeth S. Sasser (3)
Sarah Agatha Turner
Richard Duran
Nolan E. Barrick (3)
Roderick Parkinson (2)
Richard K. Tracy
Clarence A. Bunn
James I. Clark
Edmund M. MacCollin
Eugenia M. Morse (3)
John J. Deans
Carl John Childers, Jr. (3)
Christopher Cyoni
John H. Kohn
Paul K. Goeldner (3)
James D. Howze (2)
Joseph Lav. Skorepa (3)
Lawrence Wodehouse
Gordon C. McCutchan (3)
Arthur Dudley Thompson (3)
Guillermo Vidaud (3)
Terrell B. Warren (3)
William A. Stewart (3)
Raymond Brogniez (3)
Paul D. Hanna, Jr. (2)
Willard B. Robinson (3)
Edward L. Verkler, Sr. (3)
Walter L. Calvert (3)
Billy W. Felty (3)
Hugh Gibbons (2)
H. V. Greer (2)
Jean T. Smith (3)
Robert D. Troy (3)

(1) Retired
(2) Shifted to Art Department Faculty 1967-68
(3) Currently on Faculty in Architecture

Publications

Barrick, Nolan E.
"The Library and How It Grew", Ex Libris, publication of the Friends of the Library, Texas Technological College.

Gibbons, Hugh
Works included in Contemporary American Drawing, published by Prentice-Hall, Inc.

Greer, Hiram V.
Numerous pieces of graphic art published in leading publications in the United States and countries abroad (these include India, Britian, France, Germany, Belgium, Japan and others.)

Kreneck, Lynwood
Illustrations published monthly since 1963 in 28 issues of Texas Parade Magazine, published by Von Boeckman Jones, 750 Camar, Austin, Texas.

Lockard, Robert Ivan
Brush Tips in Watercolor, a forty minute educational sound-color film, 1956 (with Troy A. Lockard).

McCutchan, Gordon
"An Experiment in Architectural Education through Research", Texas Engineering Experiment Station publication (with W. W. Caudill).

Parkinson, Roderick
"The Challenge in Counseling for Art Education", Texas Trends in Art Education, November, 1956, pp. 18-19.

"Differential Perspectives and Organizational Success in an Art Association", Proceedings of the Southwestern Sociological Association, 13 (1964); 109-117 (with Walter J. Cartwright).

"Don't Be a Litterbug -- Be a Sculptor", Ford Times, August 1961; later republished by permission in The Little Red School House, a Wisconsin publication for public school teachers of art.

Robinson, Willard B.
"Frontier Architecture: Father Ravalli and the Design of the Coeur d' Alene Mission of the Sacred Heart", Idaho Yesterdays, Vol. III, No. 4, Winter, 1959.

"Nineteenth Century Business Blocks in Helena, Montana Prior to 1893", Journal of the Montana Historical Society.

A book on The Architectural History of Structures for Defense in North America; the collection of material on defense structures for an exhibition at the Amon Carter Museum of Western Art, Fort Worth. Research sponsored by the Amon Carter Museum of Western Art. (In progress).

Sasser, Elizabeth S.

"On Saturday We Draw", School Arts Magazine, December 1951, Vol. 51, No. 4.

"Parents Need to Know", School Arts Magazine, January 1952, Vol 51, No. 5.

"Historic Design", School Arts Magazine, June 1952, Vol. 51, No. 10.

"Children's Art Show", School Arts Magazine, October 1952, Vol. 52, No. 2.

"Masks in Action", School Arts Magazine, October 1952, Vol. 52, No. 2.

"Burlap Beasts", School Arts Magazine, February 1953, Vol. 52, No. 6.

"Art Circus", School Arts Magazine, May 1953, Vol. 52, No. 9.

"The New Emphasis on Texture", School Arts Magazine, September 1954, Vol. 54, No. 1.

"Talk-Pictures", American Childhood, September 1954.

"Papier Mache Figures", The Instructor, October 1954.

"Cut Paper Heads", The Instructor, April 1955.

"Watching a Mural Grow", Arts and Activities, 1959.

"Fresco Painting", The Peter Hurd Mural, The Museum Journal, West Texas Museum Association, Vol. I, 1957.

Critical Bibliography of Art in "Background Materials", Chapter I of The Sixteenth Century (ed. Alexander Schutz), which is Volume II of A Critical Bibliography of French Literature, ed. D. C. Cabeen (Syracuse University Press, 1956).

Review of Jean Jacquot (ed.), Les Fetes de la Renaissance (Paris: Editions du Centre National de la Recherche Scientifique, 1956), The Romanic Review, 50 (1959)

Review of Jean Jacquot (ed.), Fetes et Ceremonies au temps de Charles Quint (Paris: Editions du Centre National de la Recherche Scientifique, 1960), The Romanic Review, 64 (1963).

"The Bookplate and the Emblem", Ex Libris, Vol. I, No. I, publication of the Friends of the Library, Texas Technological College, 1966.

"Books in Architecture: A Friends' Purchase", Ex Libris, Vol. II, No. 2, publication of the Friends of the Library. Texas Technological College, 1967.

The Architecture of Ancient Peru, A Study of Architecture in an Arid Land (In progress) accepted for publication by ICASALS.

Skorepa, Joseph
Basic Design book (In progress).

Thompson, Virginia
Designs, layouts, etc. published in The New York Times newspaper and book supplement section, Time magazine, Publisher's Weekly, Publisher's trade magazines, various newspapers throughout the nation (Dallas, Fort Worth, Lubbock, New York, Boston, Washington, D.C., New Orleans)

Troy, Robert
Lima Peru, A Study of Housing in An Arid Costal Region (In progress), funded by the American Institute of Architects and the M. D. Anderson Foundation through the Texas Architects Foundation, accepted for publication by ICASALS.

Enrollment tabulation:

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967
Architecture Majors	266	296	309	343	351	391	410	514	526	510
Advertising Art and Design Majors	75	107	117	149	148	157	180	194	231	-

Budget Summary:

	1958-59	1959-60	1960-61	1961-62	1962-63
Teaching Salaries	100,100	102,400		134,991	154,375
Administrative Salary	1960.00(1)	1960.00(1)		2,300(1)	2,390(1)
M.E.&T.	2850.00	2850.00		5,600	5,600

	1963-64	1964-65	1965-66	1966-67	1967-68
Teaching Salaries	186,300	204,980	291,445	292,557	239,150(2)
Administrative Salary	5,420	6,810	6,900	7,320	8,160
M.E.&T.	8,000	8,050	8,050	8,050	8,050

(1) Salary for Secretary divided equally between Department budget and Supervising Architect budget.

(2) Nine Faculty members shifted to Art Department and removed from this budget.

II. Current Status:

The Department of Architecture, a Department within the School of Engineering, is the largest of four Texas State-supported Schools of Architecture specifically designated by the Coordinating Board and has over the past several years ranked among the largest five or six schools of Architecture in the U.S.A. from standpoint of undergraduate headcount enrollment. According to 1966-67 statistics (the latest available), the total enrollment of 757 for both Architecture and Advertising Art and Design majors was the largest in the country. Based on the 526 Architecture majors alone, the Department was surpassed only by the University of California at Berkeley, the University of Illinois at Urbana, and California State Polytechnic College at the University of Oregon. A slight drop of enrollment of about 3% in the fall of 1967 was in line with the national pattern. The size relationship was probably about the same for 1967-68 as for the previous year.

Undergraduate Enrollment by Class Designation, Fall, 1967

Freshman	196
Sophomore	110
Junior	78
Senior (4th and 5th years)	126
Total	510

Faculty Data and Distribution

	1967-68		1968-69	
Professors	4	$12000-$17000	6	$11300-$17850
Associate Professors	6	10000- 11700	6	10400- 12300
Assistant Professors	6	9200- 10320	7	8500- 10600
Assistant Professors (P-T)	1	3000	1	3000
Instructors	6	7100- 7700	4	7200- 7700
Instructors (P-T)	4	814.66- 3500	2	3500

Space Data:

Space available until 1967 for instruction in Architecture and Allied Arts was badly overcrowded. The establishment of the new Department of Art in 1967-68 reduced the total departmental enrollment theoretically, but did not alter the teaching space needs. The same course work is still being taught in the same spaces previously used, and this will continue of necessity until the completion of the new building in 1970.

Our current space is operating well above design capacity and the area per student is far too low. A generally used standard for this type of studio instruction is approximately 100 square feet per student. Our average at present is about one-half of that figure. In addition, special course work must be scheduled in areas not necessarily compatible to the work or the equipment needed, because there is simply no other available space, and basic design laboratories have been deleted because of the lack of space to take the numbers in the freshman level.

We anticipate that the undesirable factors of crowding and unfortunate scheduling will be largely alleviated with completion of the new building. Until that time, the following tabulation indicates the space currently available for the Department of Architecture and those segments of course work in the Department of Art formerly located in the Department. All figures are net assignable space.

Architecture Building	30,502.5 sq.ft.
X-30	1,919.9 sq.ft.
X-3	1,945.6 sq.ft.
X-4	1,506.2 sq.ft.
Sub total	35,874.2 sq.ft.
Space in other buildings utilized for Architecture classes regularly	4,974.5 sq.ft.
Total	40,848.7 sq.ft.

Research Activities:

Thompson, Dudley

"Agricultural Production in Urban Places", 1963, Columbia University

Research on the historical development and future of land usages along the borders between the U.S.A. and Mexico from California to Texas. (In progress.)

Troy, Robert

Study of solar energy in relationship to environmental design. (In progress).

Warren, Terrell

The investigation and conversion of local and native materials to products useful in building: Clay for ceramic products and cotton and cotton by-products. (In progress).

Extension and Adult Education

The activity of the Department in extension or adult education activities in recent years has been minimal. Members of the faculty have been available for public appearances, seminars, panel discussions, lectures, etc. largely of professional nature, but no organized activity has been conducted by the Department. Expansion of this area is greatly desired and is a part of our plan over the next five and ten year periods.

Total Departmental Budget

	1967-68	1968-69
Teaching Salaries	$239,150.00	$256,225.00
Administrative Expense	8,160.00	8,160.00
M E & T	8,050.00	7,870.00
Research (State funds	1,400.00	0
Research (other funds)	374.24	0
	$257,134.24	$272,255.00

III. Objectives, Goals and Predictions

It is difficult to predict the direction Architectural education will take the next ten years. Pressure is building nationally for expansion from the five year program to a very broad six year program. This would be the first significant change in Architectural education for thirty years.

A survey of graduates of the Department of the last ten years indicates an average time of 5.8 years for completion of our current curricula, which must be followed by three years apprenticeship prior to professional licensing. It is undesirable to extend this time period, but the demand to broaden curricula to include more of the humanities and to incorporate technical aspects such as Computer Programming, automated specifications, study of "systems", etc., will likely force us into the six year pattern. The recent "Princeton Study" sponsored by the American Institute of Architects and the Association of Collegiate Schools of Architecture indicates this direction as almost inevitable.

In-depth study of this subject among others by the Curricular Study Committee of our Department over the past year did not result in a specific recommendation, although the indications of need for significant changes are evident, both in the time element involved and the teaching techniques to be employed.

The expansion of junior colleges in Texas will perhaps slow the rate of growth, but will provide substantial strength to our curriculum at the upper levels. This shift will likely increase the number of graduates from a lower total enrollment. Changes in techniques of practice will alter educational direction, and the liklihood of expanding the program to six years in lieu of the present five makes predictions hazardous. Introduction of graduate work could alter the trend.

For purposes of enrollment pattern, it is presumed that we will find it desirable to start a shift to a six year program in 1971. Estimated enrollment for the six year plan is shown in parenthesis. While the average percentage relationship of Architecture majors to College head count enrollment for 1959 through 1967 was 3.14%, the general slope of the curve seems to be slightly downward. Our study of patterns of enrollment of better schools indicates a "leveling-off tendency" as size increases.

Enrollment Data and Predictions

	College enrolled (Fall)	Architecture Majors	%	
1959	8866	296	3.34	
1960	9178	309	3.37	
1961	10212	343	3.37	
1962	11183	351	3.16	Average 3.14
1963	12036	391	3.25	
1964	13827	410	2.94	
1965	16305	514	3.16	
1966	17768	526	2.96	
1967	18646	510	2.74	
1968	19391	523	2.7	
1969	20631	505	2.7	
1970	21986	592	2.7	
1971	23336	619 (675)	2.65	
1975	28928	750 (875)	2.6	

Faculty Needs

Direct faculty requirements will approximate one for each 20 majors (head count). Upper level students require lower ratio and more specialists. The six year program will require additional faculty since more classes will meet simultaneously. A general estimate of faculty needs follows.

	1968	1969	1970	1971	1972	1973	1974	1975
Majors	523	555	592	675	730	785	835	875
Faculty (FTE)	24.5	28	30	34	38	43	47	50

(Begin 6 year program 1971)

Space Needs

Every attempt to project space needs through 1975 was incorporated in the programming of the new Architecture Building. It is expected that our program will have been accurate enough to avoid serious space shortages.

Personnel (non-teaching) Needs

The clerical and technical staff will have to be enlarged. We need <u>now</u> a technician and part-time secretary in addition to our present personnel. Increase of activities in research and experimentation will further accentuate this requirement. By 1975 and certainly by the end of the ten year period ahead, the following personnel will likely be required <u>in addition</u> to our present staff.

Assistant Librarian	1
Clerical/Filing	2½
Technician	1
Visual Aids Librarian	1

It would be futile to attempt budget predictions except to point out that the professional aspect and developments in the field of Architectural education lie increasingly in the areas of "high priced hardware". We are only beginning to move in the direction the sciences have been moving for some time, and the costs will escalate far more rapidly than has been the case in the past.

Our initial objective and goal has always been to develop a graduate who can take his place in the professional world of Architecture. We consider it neither necessary nor desirable to alter this basic objective since we are of necessity tied very closely to the profession. There is little liklihood of major shift unless significant realignment within the professional practice of Architecture occurs.

We shall make every effort to continue strengthening the professional training without sacrificing the overall educational concept as we have done in the past. Our additional objectives over the next five years are as follows.

1. The establishment of a separate, autonomous School of Architecture and Urban Design in keeping with the national trend.

2. The inauguration of graduate study in Urban Design, Architecture, and the History of Architecture, with strong emphasis in the latter category on the regional aspects of the Southwest and Spanish colonial influences. This phase is only casually covered in schools now in existence, and could well provide a unique feature to strengthen graduate work.

3. Expansion of research and experimental work in the fields of structural, mechanical and electrical aspects of building design in conjunction with other departments in the School of Engineering with the view of providing better technical, professional consultants.

4. Increased study in the use of construction "systems" and the role of the computer in techniques and applications to design and programming.

5. The establishment of the Department as a central repository for retrieval systems of specification and technical data to serve the needs of the Department and the professions of Architecture and Engineering.

6. The expansion of use of Visual Aids and Special Devices. We are currently experimenting with the use of cartridge film and tape equipment for individualized instruction similar to the Foreign Language technique currently used. To our knowledge, no application of this technique is currently available in the Visual Arts.

The attainment of the foregoing would likely extend beyond the five year span. Additional goals for the second five years of a ten year plan are:

1. The expansion of community service and special projects. The Department has engaged modestly in such service activities over the past few years in the execution of extensive plans for Lubbock, Brownfield, El Paso, and other areas as educational projects. We are currently establishing contact for the development of a new community plan in Australia. This work is stimulating and valuable to the student, and increases the public image of the Department and provides useful stimulus in the expansion of the economy of the areas involved.

2. The inauguration of continuing education in Architecture. This is becoming increasingly of concern to the profession, although little has been accomplished. Short courses, seminars, and perhaps special courses offered by extension and correspondence should be made available to graduates and professionals in preparation for registration exams or general upgrading of capacities and interests.

3. Collaboration with other departments on the campus in the expansion of high level instruction in interior design, landscape Architecture and fields closely related to Architectural practice both in the regular course work and field of continuing education.

4. Expansion of Closed Circuit and Video-Tape TV applications. Great potential exists in development of special films and micro-projection techniques fo architectural models by TV Video-Tape exploration.

DEPARTMENT OF

CHEMICAL ENGINEERING

DECADE PLAN

for

DEVELOPMENT IN CHEMICAL ENGINEERING

Department of Chemical Engineering
School of Engineering
Texas Technological College

Lubbock, Texas
August 15, 1968

TABLE OF CONTENTS

LIST OF TABLES

DEPARTMENT OF CHEMICAL ENGINEERING
SCHOOL OF ENGINEERING
TEXAS TECHNOLOGICAL COLLEGE

PLAN FOR DEVELOPMENT
1968-1978

INTRODUCTION

The Department of Chemical Engineering, in keeping with the objectives of the College, is pledged to provide its major student with a basis for a satisfying and useful life as an active citizen in the community, and to cultivate in him an open, searching and inquiring attitude of mind. In addition, it recognizes as its major responsibility the provision of opportunities for the student to achieve proficiency in the fundamentals of chemical engineering. As a part of the engineering community it recognizes its obligations in the creation and perpetuation of knowledge in the area of chemical engineering.

The state supported educational institutions have the responsibility not only of providing educational opportunities for its students but also of producing the trained and educated personnel needed in the state. Chemical engineering, a professional education program, has a special role in Texas in this regard. The following quotation from Texas 90* indicates the importance of the chemical industry to the economic development of the state:

*Texas 90 - Economic Profile of Texas to 1990 (1968). Bureau of Business Research at the University of Texas (Under contract from the Coordinating Board, Texas College and University System).

"In the past decade chemical manufacturing and oil refining have added more new revenue to the Texas economy than have any other industrial activities. There is every reason to believe that these two industries will lead all other Texas manufacturers in value added by 1990, as they do today. Together they grew from $1.6 billion in 1958 to $2.7 billion in 1963, in terms of value added by manufacture. Indeed, these two industries accounted for about half the total gain in Texas manufacturing value between 1958 and 1963.

"The chemical industry leads all other Texas manufactures in the value it adds to its raw materials. And virtually no other simple statement can be made about it. For the chemical manufactures are the most infinitely complex of modern industries.

"Texas chemical plants are particularly notable for the variety of their outputs. This diversity of products especially petrochemicals, is one of the healthiest aspects of the industry in regard to future growth. It is certain that many of the building blocks for chemicals yet to be developed commercially are already in production or can readily be produced by Texas plants.

"The industry is astonishingly flexible and highly responsive to new research and development findings. It must be so because of the intense competition in chemical marketing. The cost of competing in this market and maintaining efficiency in it are high, plant investment per worker is enormous, and obselescence is rapid. On the other hand, high expenditures in response to technological change help keep the value of output per production worker in Texas well above the national average for the industry.

"Additional factors supporting the future of the industry in Texas are favorable market geography and access to adequate supplies of petroleum-based feedstocks and such inorganic raw materials as salt, lime, and sulfur."

If the chemical industry is to develop, it must have the required manpower and chemical engineering is dominant in the manpower needs of Texas industry. The imbalance between supply of and demand for chemical engineers has grown progressively worse since the early sixties. New chemical process construction is now being delayed in some companies by the shortage of technical manpower. The criticality of the supply situation is revealed in the change in the Chemical Engineering starting salary rates. While this rate has increased rather steadily at 4-5% per year since the end of World War II, it has increased at 7-8% per year in 1967 and 1968.

Superimposed upon the responsibilities of chemical engineering in the development and operation of chemical processes to meet the needs of society are new roles just becoming prominent. These include pollution control, biomedical engineering, ocean engineering, water reuse and biochemical engineering. It is obvious that the supply of chemical engineers must be increased greatly if progress is to be made at the desired rate. The primary duty of the chemical engineering department is to educate larger numbers of chemical engineers to assume greater roles requiring increased technical competence, creativity and social awareness. Essential to this accomplishment are a strong undergraduate program, an effective graduate program and the involvement of the faculty in research and engineering progress.

Included in this report are data and discussions of departmental history, current status and goals for the future.

ORIGIN AND DEVELOPMENT OF THE DEPARTMENT OF CHEMICAL ENGINEERING

The field of Chemical Engineering was recognized by Texas Technological College soon after its opening in 1925. Before 1928, the Department of Chemistry was offering basic courses in chemical engineering. However, these were offered to the student as preparatory towards transfer to other institutions which offered degrees in the field. These were taught by Dr. W. T. Read, the Department Head.

By the Fall of 1928, certain courses in chemistry and plant design were substituted for some of the prescribed courses in the Mechanical Engineering curriculum, thus preparing the students for employment in the chemical phases of industry and manufacturing fields. This curriculum lead to the degree of Bachelor of Science in Mechanical Engineering with a Chemical Engineering option.

Beginning with the Fall term of 1932-33, the Department of Chemistry became the Department of Chemistry and Chemical Engineering under Dr. R. C. Goodwin's supervision, and the degree of Bachelor of Science in Chemical Engineering was offered to the students.

For the next few years the responsibility for the teaching of the chemical engineering courses was in the hands of the following men who had had their training in this field:

Dr. Valerie Schneider (1934 - 1948) (M. I. T.)

Dr. A. G. Oberg (1936 to date) (University of Colorado)

Dr. Encel H. Dodge (1948 - 1951) (Washington University)

and Dr. Roger F. Detman (1948 - 1951) (L. S. U.)

Several master's degrees were granted during this period. An initial appropriation of $50,000 was obtained in 1950 and was used to secure the equipment for a unit operations laboratory. This equipment was installed in the basement of the chemistry building.

Through the efforts of Professor Oberg, the Student Chapter of the American Institute of Chemical Engineers was installed in 1938.

During the years between 1951 and 1959 Professors Oberg and Renard (Professor J. A. Renard, Ingenieur-Chimiste, University of Nancy, France, 1951 to date) had the responsibility of teaching the courses in chemical engineering and of upgrading the training of the students to conform with the standards set up by the national organization of the American Institute of Chemical Engineers. Significant steps taken during this period may be summarized as follows:

Completion of the Unit Operations Laboratory

Installation of the Unit Processes Laboratory

Development of courses in "Unit Processes", "Process Development" and "Chemical Engineering Plant Design."

Installation of the Process Instrumentation Laboratory

Installation of the nuclear subcritical assembly, and the nuclear radiations laboratory (under Dean Bradford's direction).

Addition of courses in nuclear technology, nuclear chemical engineering, and radio-chemistry (under Dean Bradford's supervision).

In 1960, chemical engineering was separated organizationally from the Department of Chemistry and Chemical Engineering in the School of Arts and Sciences and the Department of Chemical Engineering was established in the School of Engineering. The new Chemical Engineering Building was occupied in 1961 and all chemical engineering facilities and operations were transferred to the new space.

Dr. Hubert H. Heichelheim (University of Texas) was added to the staff in the Fall of 1961.

Dr. Arnold J. Gully (L.S.U.) joined the staff as Department Chairman in the Fall of 1963.

The Department received accreditation in 1965 by the Engineers Council for Professional Development (and the American Institute of Chemical Engineers) after it was inspected by a group appointed by the organization, and received approval of its staff and curriculum for a six-year period (the maximum conferred by E.P.C.D.).

Dr. Robert M. Bethea (Iowa State University) joined the staff in 1966.

As a means of acuqiring undergraduate instructional facilities in analog computing and analytical instrumentation which could not be

financed from regular appropriations the Department in 1967 solicited help from the Chemical Industry and the National Science Foundation. Contributions from industry to date total approximately $10,000 in cash and equipment valued at $12,700 with eighteen companies contributing to the program. The National Science Foundation made a grant of $9,000 to the Department. As a result of the solicitation the Department facilities have been significantly improved and the continuing interest and support of industry in the overall educational program of the department has been cultivated.

The chemical engineering program leading to the degree of Doctor of Philosophy was initiated in 1964 and the first doctoral student in Chemical Engineering, Mr. F. C. Vidaurri, was awarded the Ph.D. Degree in June of 1968. Since the Department was established as an autonomous unit, there has been a continual effort to balance instruction (which had been the dominant role previously) with research. The Ph.D. program gave impetus to this effort with the first research contract (Langley Research Center, NASA) being awarded to the Department in 1967.

The off-campus graduate program in engineering which is intended to provide continuing educational opportunities for professional engineers employed in West Texas industries was started in 1966. Since these industries are basically chemical, the program is chemical engineering oriented. Chemical engineering courses have been given

through extension at Borger, Pampa and Midland-Odessa. The off-campus program becomes a part of the regular academic effort of the School in the Fall of 1968.

Chemical Engineering graduates of Texas Tech have achieved positions of prominence in industrial and academic responsibility. Among the more illustrious are:

Joe E. Gilliland, Head, Process Development in Special Chemicals, Ozark-Mahonning Company (Tulsa, Oklahoma).

Gerald L. Farrar, Engineering Editor, Oil and Gas Journal (Tulsa, Oklahoma).

William W. Akers, Chairman of the Department of Bioengineering, Rice University (artificial heart development with Dr. Debake)

Duffer B. Crawford, Head of Cryogenic Division, M. W. Kellogg Company

Carroll Claitor, Supervising Engineer, Air Products Company

Walter R. Studhalter, Program Manager, Aerospace Advanced Engineering Program, Rocketdyne (North American Aviation Co.)

Carl Burleson, General Superintendent, Light Hydrocarbons, Dow Chemical Company (Freeport, Texas)

Dysart E. Holcomb, Director of Research, United Gas Corporation (Shreveport, La.)

Howard Hurmence, Vice President, Allied Chemical Company, (Morristown, N. J.)

John F. Ball, Director of the Bureau of Mines Laboratory (Laramie, Wyoming)

John Sheehan, Vice-President, Shell Oil Company (New York)

Paul B. Crawford, Director of Research, Texas Petroleum Research Committee

Vernon J. Yeakley, Manager of Project, Chinese Petroleum Corporation and Pacific Gulf Oil Limited (Taiwan, Republic of China)

J. M. Shoults, Production Superintendent, Vulcan Materials Company

R. P. Davison, Professor of Chemical Engineering, Department of Chemical Engineering, Texas A & M University

Kenneth G. Beane, Superintendent, Manufacturing Division, Texaco Company (Port Arthur, Texas)

Harold Yeager, Vice-President and General Manager of Operations Division, Mallinkrodt Chemical Company (St. Louis, Msssouri)

John R. Bradford, Dean of Engineering, Texas Technological College

Statistical Data and Information on the Faculty

Data on enrollments and degrees granted in Chemical Engineering are given in Table I. Inspection of these data shows no uniform trend corresponding to the general steady increase in overall college enrollments. Wide variations are evident but the assignment of causes to these variations is difficult and efforts so far have yielded little more than personal opinions.

Budgetary information on the Department since its establishment in 1959 is given in Table II.

The faculty listing following includes only those who have been members of the faculty of the Department since its establishment in 1959. Chemical engineering members of the faculty of the Department of Chemistry and Chemical Engineering prior to this time are referred to in the preceding subsection of this report.

Publications of the faculty are given in the form of a separate listing for each member in Appendix A.

TABLE I

Enrollments and Degrees Granted

ACADEMIC YEAR BEGINNING	ENROLLMENTS		DEGREES		
	Undergraduate	Graduate	B.S. in Ch.E.	M.S. in Ch.E.	Ph.D.*
1956	176	--	18	--	--
1957	221	--	19	--	--
1958	245	6	33	--	--
1959	204	7	39	5	--
1960	161	4	24	1	--
1961	181	9	28	5	--
1962	156	--	24	4	--
1963	158	6	22	1	--
1964	149	6	22	3	--
1965	211	6	23	3	--
1966	234	7	30	1	--
1967	224	12	24	4(est.)	1

*Program authorized in 1964.

TABLE II

Budgets*

YEAR	FACULTY SALARIES	MAINTENANCE Equip. & Travel	OTHER	TOTAL
1959-1960	$ 22,300	$ 6,900	$ 700	$ 29,900
1960-1961	29,300	6,900	3,700	39,500
1961-1962	27,800	9,000	10,620	47,420
1962-1963	35,500	6,900	11,100	53,500
1963-1964	42,000	18,540	11,100	71,640
1964-1965	44,550	18,540	11,300	74,390
1965-1966	58,255	18,540	12,320	89,115
1966-1967	69,810	18,540	12,320	100,670
1967-1968	74,245	20,000	14,520	108,640

*Budgets do not include funds for organized research nor summer session budgets.

FACULTY

DEPARTMENT OF CHEMICAL ENGINEERING

Arnold Jarvis Gully, Chairman and Professor, 1963. B. S., Auburn, 1947; M.S., Louisiana State, 1950; Ph.D., 1951.

Robert Morrison Bethea, Assistant Professor, 1966. B.S., Virginia Polytechnic Institute, 1957; M.S., Iowa State, 1959; Ph.D., 1964.

John Ross Bradford, Professor and Dean of the School of Engineering, 1943, 1955. B.S. in Chemical Engineering, Texas Technological College, 1942; M.S. in Chemical Engineering, 1948; Ph.D., Case Institute of Technology, 1953; Registered Professional Engineer (Ohio, Texas).

James Edmund Halligan, Assistant Professor (Appointment September, 1968). B.S. in Chemical Engineering, Iowa State University, 1962; M.S. in Chemical Engineering, 1965; Ph.D., 1967.

Hubert Reed Heichelheim, Associate Professor, 1961. B.S., Notre Dame, 1953; M.S., 1956; Ph.D., Texas (Austin), 1962.

George F. Meenaghan, Professor and Chairman Designate (Appointment January 1, 1969). B.S., Virginia Polytechnic Institute, 1952; M.S., 1954; Ph.D., 1956.

Aaron Gustaf Oberg, Professor, 1936, 1949. B.S., Colorado, 1929; M.S., 1933; Ph.D., 1935.

Jules Alexander Renard, Professor, 1951, 1964. Licencie en Sciences Chimiques, U. Paul Pastur (Belgium), 1925; Ingenieur-Chimiste, U. of Nancy (France), 1934.

CURRENT DEPARTMENTAL STATUS

The data included in this section are for the 1967-1968 academic year.

Enrollments

Enrollment data were derived from departmental records and may not agree with figures from other sources. The undergraduate enrollment breakdown is based on expected year of graduation rather than accumulated credit hours.

TABLE III

Current Enrollment

UNDERGRADUATES (Fall Semester 1967)		GRADUATES	
Freshmen	77	Pre-Masters	10
Sophomores	89	Post-Masters	2
Juniors	32		
Seniors	24		

Faculty

Since there has been no termination of faculty since the establishment of the Department, the information on faculty given in the preceding section is still current. In addition to faculty with professorial rank, the equivalent of 1.2 men is employed as teaching assistants.

Space

Space utilized in chemical engineering research and instruction is confined to the Chemical Engineering Building. A breakdown of the space, exclusive of corridors, rest rooms, etc., follows:

CLASSROOMS	AREA, SQ. FT.
Ch.E. 101	693
Ch.E. 103	420
Subtotal	1,113
UNDERGRADUATE LABORATORIES	
Unit Operations	2,667
Analytical Instrumentation	590
Properties and measurements	735
Design	1,288
Analog computing	168
Subtotal	5,448
Departmental Shop	882
Research Laboratories	
Ch.E. 105	451
Ch.E. B-3-A	462
Ch.E. 202	312
Ch.E. 213	406
Subtotal	1,631
OFFICES	
Departmental	140
Faculty (7)	956
Teaching assistant carrels (3)	272
Subtotal	1,368
TOTAL	10,442

Extension and Service Activities

Current organized service and extension activities of the Department consist mainly of participation in the off-campus graduate continuing education program in engineering. This program, which is chemical engineering oriented, represents an experimental attempt to provide continuing education for professional engineering in West Texas. The need is great, the demand is high and the problems challenging. At least one off-campus chemical engineering course has been taught by Chemical Engineering faculty each semester since the program was initialed. The demand for chemical engineering courses is much greater than the Department can handle with current staff limitations. This demand has been partially satisfied by faculty from other departments, particularly Mechanical Engineering, teaching chemical engineering courses.

Research Activities

Research activities, while still not at the desired level, have grown to the state of general respectability. An atmosphere of active and confident inquiry exists in the Department. Each faculty member is engaged to some extent in research and/or creative engineering work. Research projects now active are listed below as either organized (specifically funded) or departmentally supported (supported from general departmental funds) research.

ORGANIZED RESEARCH

1. "Water-Miscible Organic Solvents-Salts-Water Systems."

   Principal Investigator: J. A. Renard
   Support Source: State Organized Research Funds.

   Budget: $2,440 Account No. 191-8605

2. "Determination of Contaminant Production Rates and Mechanisms for Manned Spacecraft Materials."

   Principal Investigator: R. M. Bethea
   Support Source: State Organized Research Funds

   Budget: $10,270 Account No. 191-5435

   Subprojects:

   a. "Computerized Reduction and Analysis of Gas Chromatographic Data."

      Research Assistant: P. Craig Bentsen

   b. "Design and Evaluation of a system for The Analysis of Contaminants in Simulated Spacecraft Atmospheres."

      Research Assistant: Richard E. Lane

3. "Development of Mathematical Models of Reaction Systems using Adiabatic Methods."

   Principal Investigator: A. J. Gully
   Support Source: State Organized Research Funds

   Budget: $1,650 Account No. 191-5434

   Subprojects:

   a. "Kinetics of Methylcyclopentane Reactions on Platinum-on-Alumina Catalysts."

      Research Assistant: F. C. Vidaurri

   b. "Rates of Deactivation of Platinum-on-Alumina

Catalysts in Reforming Reactions."

Research Assistant: Norman P. Nunn

4. "Removal of Acid Gases and Oxides of Nitrogen from Space Cabin Atmospheres."

Principal Investigator: A. J. Gully
Associate Investigator: R. M. Bethea
Support Source: National Aeronautics and Space Administration Grant No. NASI-7584.

Budget: $38,170 Account No. 391-3302

Subprojects:

a. "Reactions of Atmospheric Contaminants with Solid Basic Materials."

Research Assistant: R. R. Graham

b. "Catalytic Reduction of Oxides of Nitrogen."

Research Assistant: R. R. Graham

c. "Adsorption of Atmospheric Contaminants."

Research Assistant: W. F. Howard

d. "Analytical Methods for Atmospheric Contaminants."

Research Assistant: M. C. Meador

5. "Activation Analysis in Fluid Flow."

Principal Investigator: John R. Bradford
Research Associate: W. L. Ducker
Support Source: State Organized Research Funds

Budget: $11,100 Account No. 191-8601

Departmentally Supported Research

1. "Study of P-V-T Relationships in Gases."

   Principal Investigator: H. R. Heichelheim
   Research Assistant: D. V. Hayes

2. "Correlation of phase Relationships in Water-Organic Solvents - Salts Systems."

   Principal Investigator: H. R. Heichelheim

3. "Infrared Analysis Techniques for Water-Acitonitrile - Salts Systems."

   Principal Investigator: R. M. Bethea
   Research Assistant: S. C. Cannon

4. "Performance Characteristics of a York-Schiebel Extractor."

   Principal Investigator: A. G. Oberg
   Research Assistant: D. G. Bresler

5. "Chromatographic Analysis of Oxygenated Organic Compounds in Water."

   Principal Investigator: R. M. Bethea
   Research Assistant: W. K. Lee

Budget

The instructional budget for the 1967-1968 academic year totals $108,640.00. Details are given in the Appendix. The organized research budgets, which have been listed separately in the preceding section total $63,630.00 of which $25,460.00 is derived from State funds.

DEPARTMENTAL GOALS

The establishment of goals is an essential part of the continuing program development and improvement efforts in the Department of Chemical Engineering. The reader is referred to the Department's "Eight Year Plan for Development" prepared in 1964. This report is in reality an extension of that paper recognizing the developments which have taken place since its preparation.

Goals are not broken down into specific five and ten year ones. Rather overall objectives are specified and the periods of emphasis are designated.

The major specific objectives of the Department of Chemical Engineering in the next decade are:

1. To continually improve the undergraduate program with regard to curriculum, teaching effectiveness, and rate of production of Bachelor degrees. (continuing)

2. To develop a structured Master of Chemical Engineering program. (First five years).

3. To initiate a graduate program in biochemical (including biomedical) engineering. (First five years).

4. To develop existing graduate programs in chemical engineering in enrollment, continuity of research programs, educational quality and program prestige. (Continuing).

5. To make interdisciplinary programs a reality. (First five years).

6. To develop professional aspects of the program

through closer liaison with industry. (Continuing).

Graduate Program

The major growth and development in the Department will be in the graduate area. Trends in this direction which have been evident for some time were given impetus in the ASEE "Goals of Engineering Education Final Report" (1968). This report states:

> "What seems to be happening is that from every quarter-practicing engineers, employers of engineering talent and students themselves - pressure is being exerted to raise the level of basic engineering education and to include in the preparation for general engineering practice not merely additional undergraduate courses but at least a year of training at the graduate level - in short, to increase the generally accepted academic requirements for entry into the engineering profession. There is little doubt that during the next decade we will witness a rapidly developing consensus that the master's degree should be considered the basic professional degree in engineering."

While there is still considerable controversy surrounding that report and much disagreement as to what should be considered "basic" engineering education, it is agreed that there is a trend toward more graduate work in engineering. Data supporting the existence of this trend are abundant. The Department of Chemical Engineering feels that this trend represents progress and should be encouraged. Also it is believed that for approximately 35% of the students entering engineering practice, the Master's Degree now represents a near optimum level of academic attainment. A considerably smaller percentage (10-15%) should

pursue a higher degree. On the basis of these percentages and projected undergraduate enrollments, the graduate on-campus enrollment in Chemical Engineering should grow to 25-35 within the not too distant future.

It is generally felt throughout engineering education circles that graduate work should be increased and emphasized. We agree that this applies to chemical engineering at Texas Tech if the institution is to fulfill its role as a major university. Indeed it is felt that a successful graduate program is essential to a first-class undergraduate program. However, the purposes, programs and requirements are not nearly so clear-cut as they are in the physical sciences, social sciences and the humanities. While in these areas there is general agreement that the major objective is to prepare students for careers in research and/or teaching, such is not always true in engineering. If the best undergraduate engineering students are to go to graduate school, then limiting our objectives to preparation for research or teaching eliminates these best students from engineering careers in design, technical management, process engineering, etc. Such areas of endeavor, which are essential in our economy, require capabilities, including creativity, at least as great as those in research and teaching. Thus our program should be sufficiently flexible to prepare students for such careers. How this can be effectively accomplished is not readily evident. This is only one of the problems which must be faced and solved in the immediate future in the development of first-class graduate programs.

In order to achieve the educational objectives of various

students who will be in graduate study, four somewhat different programs are believed necessary. These are: (1) a structured non-research program leading to the Master of Chemical Engineering Degree, (2) the research oriented Master of Science in Chemical Engineering program, (3) the Ph. D. in Chemical Engineering program, and (4) the interdisciplinary Ph. D. program in engineering. The last three programs are authorized with major current emphasis being on Numbers 2 and 3. The structured non-research program leading to the Master of Chemical Engineering Degree is not intended to replace the B. S. program but will be one designed to make most effective use of the time of the student whose educational objective is the Master's Degree and whose professional objective is a non-research career in Chemical Engineering.

The off-campus Master of Engineering program already authorized will require major involvement of Chemical Engineering faculty since most of the students in that program are Chemical Engineering majors. A beginning has been made and a continual improvement will be required if this pioneering effort is to reach its potential.

Much of the course work at the graduate level will be common to all degree programs. Some special courses will be required to meet the individual needs of students.

The interdisciplinary Ph. D. program will be most difficult of effective accomplishment. Greater cooperation between academic departments will be essential. Special courses of wide interest and

without unduly inhibiting prerequisites must be developed in the various areas. The faculty as well as students must become more interdisciplinary through joint participation in research and course work. No detailed blueprint for accomplishment is offered but it is probable that the interdisciplinary program will most effectively evolve from an initially multi-disciplinary one.

No detailed enumeration of course offerings here is considered appropriate. They will vary with student needs and faculty specialties. Unnecessary proliferation of courses, however, will result in degradation of overall program quality.

Biochemical Engineering

In most systems with which chemical engineers have been involved in the past, physical changes predominate and changes resulting from biological processes have been given little more than passing recognition. The future holds great promise for accomplishment in the application of chemical engineering principles to biological processes. Such application will require a much better understanding of biochemical reactions and the physical phenomena accompanying the processes. Among the potential applications are synthesis and modification of foods, control of human body functions through artificial means and effective solution of the growing waste disposal problem.

Biochemical engineering is inherently interdisciplinary at this stage of development. Progress will require the cooperation and

interaction of people knowledgable in many areas. This will not come about without strong efforts to bring these people together and definite programs being worked out which will not only permit but require cooperation.

Texas Tech will be in a very favorable position to initiate a biomedical engineering program if a medical school is established in Lubbock which seems likely. Initiative for such a program will fall largely on engineers rather than physicians. It is imperative that a competent biomedical engineering research staff be assembled before the opening of the medical school. These staff members will be competent to teach in their base areas as well as do research and teach biomedical courses. Graduate students will be drawn from many undergraduate discipline areas. The supply of people with interests and backgrounds in this area is critically limited. A good faculty nucleus in this area will be necessary before developing persons with other backgrounds to a level of biomedical research competence.

Dr. George Meenaghan, who will join the Chemical Engineering faculty as Professor and Department Chairman in January of 1969, will be of great value in initiating the biochemical engineering program.

Research

The development of research capabilities, including personnel, facilities and support is considered the most crucial undertaking of the Department in the years immediately ahead. Considerable progress has

been made in faculty and student interest, facilities, support and results. Much greater progress lies ahead if the departmental objectives are to be achieved.

Research and other forms of creative activity are the life blood of an academic program. It is the goal of the Department that each faculty member be involved in research, graduate instruction and undergraduate instruction. Such involvement will go a long way in assuring continuous improvement in courses, an increasing rate of generation of ideas, an atmosphere of excitement and inquiry and the generation of knowledge so necessary in improving the image and prestige of the Department.

Effective research requires continuing programs in which expertise is accumulated and the carryover of background from one project to another is significant. Such programs must be well conceived if they are to be meaningful and compliment the overall academic program. Major areas in which research is in progress are:

1. Thermodynamics, including phase equilibria and PVT work.
2. Heterogeneous kinetics and catalysis.
3. Analytical methods development.
4. Atmospheric contaminant control.
5. Mass transfer operations.

The interests and capabilities of added faculty members will be important factors in the establishment of new areas. Some of the more

promising areas for future research are:

1. Transport operations.
2. Biochemical and biomedical engineering.
3. Uncertainty in systems design.
4. Water reuse.
5. Natural and synthethic fibers.

Many of these areas are suitable for interdisciplinary attacks and such cooperation is to be encouraged.

The off-campus graduate program offers the opportunity for the faculty to engage in significant research and creative engineering not feasible on campus. Industry offers the opportunity for engineering analysis and synthesis work which can be of real value to academic engineering programs. The facilities, supporting personnel and background available in industry will permit industrial (graduate students employed in industry) and academic faculty to interact synergistically in engineering developments.

Research Support Requirements

While it is believed that good research, particularly in chemical engineering, can be supported largely from external sources, the programs must be underwritten by the College. State research funds are extremely important for use by new faculty members in initiating research. Considering the time spent in preparation of proposals for federal support a high support yield on these proposals is essential.

State funds are likely to yield considerably higher rates of return if the supported projects are well concieved.

Preparation of research proposals, which has considerable educational value in itself, must be a continuing effort if research is to be carried out at the desired level. Proposals which have a reasonable chance of success will be submitted to appropriate supporting agencies. Possible sources of support for the type programs envisioned are: (1) State support, (2) National Aeronautics and Space Administration, (3) National Institute of Health, (4) Petroleum Research Fund, (5) Private industry and (6) National Science Foundation. Essentially all work done will be applied or applicable; this characteristic should be stressed rather than apologized for in research proposals. Most agencies are most interested in this type research and it is well suited to engineering graduate programs.

The amount of research support considered adequate for the type work envisioned is estimated to be $12,000/year per graduate student. If an inflation rate of 6% per year is assumed, which seems reasonable, then this same level of support will cost almost $21,500/year per on-campus graduate student ten years hence. The required support estimates do not include overhead and are believed to be conservative, considering that 1/3 of the faculty's time during the regular nine months session will be devoted to research. This level is considered minimal.

The research activities associated with off-campus graduate work will be largely financed by supporting companies. The major

college expenses associated with these activities will be faculty time.

Faculty and Staff Requirements

It is evident that for implementation of the type program envisioned, additional faculty members will be required. New faculty members will be required to handle the increased undergraduate teaching load, to balance research with instruction, to teach additional graduate courses, both on and off-campus, and to initiate new programs. Estimates of faculty requirements for the next ten years are based on expected enrollments and the belief that a near-optimum balance of overall departmental faculty effort will consist of 1/2 time (6 semester hours) in organized instruction, 1/3 time research and 1/6 time in counseling and other activities. Since course work load can be estimated with reasonable accuracy, the estimated load will be used as a basis for faculty requirements.

Undergraduate Instruction

With the anticipated growth in enrollment multiple sections of course offerings will be required to keep class size within limits for effective learning. Many required courses are now offered in one section per year. It is estimated, on the basis of current curriculum requirements and projected enrollments that the academic year undergraduate teaching load will total 129 semester hours of lecture courses and 38 semester hours laboratory within ten years.

Graduate Course Work

In order to obtain the necessary flexibility and breadth of program coverage, a minimum of four on-campus graduate courses per semester will be required. Not included are research and individual instruction courses. Of the graduate students currently in the off-campus program in Midland-Odessa, Borger and Pampa, 65 have chemical engineering oriented degree programs. This number at these particular locations will probably remain fairly constant for about six years and then drop to a lower but rising level. As the industrial development of West Texas continues and as the off-campus program develops (hopefully through WIN), the program will be extended to other locations (Amarillo, Lubbock, Big Spring, for instance). The total enrolled in chemical engineering oriented off-campus programs should at least stay at the current level and may reach 100. Eight graduate chemical engineering courses per year is the estimated off-campus demand. It is obvious that the off-campus work is a major part of the chemical engineering graduate program. The chemical engineering staff is inadequate to handle this program, even at currently accepted load levels.

Total graduate course load is estimated to be 48 semester hours per academic year.

Research and New Programs

The new programs (systems analysis and synthesis, biochemical

biomedical engineering programs) envisioned are basically interdisciplinary. Thus the Chemical Engineering Department will be only one of the instruction and research contributors to the programs.

The research to instruction ratio desired is 2:3. Faculty requirements are estimated accordingly.

Total instructional load at the end of ten years is estimated to be 215 semester hours per academic year. Full-time faculty, exclusive of teaching assistants required to handle this load is estimated to be 18. To achieve this faculty level, and program success is contingent upon its achievement, will require the net addition of 13 men. Over half of these should be added within the next five years.

Supporting Staff

If the program is to be operated efficiently, supporting nonfaculty personnel additions will be essential. To handle the work load associated with a productive research and academic program the following additional personnel will be required.

Administrative Assistant	1
Secretary	2
Technician	2

Faculty Quality and Development

Program quality and prestige is dependent almost entirely upon the quality of the faculty. A good faculty, poor curriculum, poor administration and poor facilities will still likely produce high quality

education. The best curriculum, best facilities and poor faculty will produce poor quality education. Thus a high quality faculty is the most essential ingredient of an academic program. The success of the chemical engineering program will be highly dependent upon the selection of new faculty members and the continual growth and development of all faculty members.

The present faculty constitutes a good nucleus on which to build an outstanding faculty. New appointments should be made only to individuals with proved outstanding ability in creative activities. New appointees should be thoroughly reviewed before hiring and before tenure on the faculty is granted. In the recruitment of such outstanding individuals, nationwide contacts, industrial and academic, must be cultivated. Authorization should be sufficiently flexible to permit hiring new personnel whenever the time becomes opportune.

Productive professional engineering experience should be considered a necessary qualification for most new appointees. While lack of such experience may be sufficiently compensated for by other outstanding qualifications to justify appointment, such a lack should be considered a serious deficiency.

Development of faculty must be a continuing process. Such development may take place in many ways but is unlikely if the individual's responsibility is limited to teaching the same course material year after year. Effective avenues to professional develop-

ment of chemical engineering faculty are engagement in research and creative engineering, consulting, industrial practice, self-study, taking formal upgrading courses either on or off campus, teaching new courses, etc. It is felt that each faculty member should be engaged in research and that from time to time he should involve himself in other activities so necessary in an engineering educational program. The administration should not only make professional development possible by reduced teaching loads, they should take steps to assure that it takes place.

Space and Facilities

Lack of facilities may seriously inhibit development of the graduate program in chemical engineering. With reference to the Chemical Engineering Building to which current activities are confined, the limit has been reached in conversion of undergraduate laboratory space to research space. Research space is now being used at near capacity and offices are full. Storage space is already overcrowded. Additional space, in particular research laboratory and office space, is essential to growth.

On the basis of anticipated graduate enrollment, increased faculty additions and increased involvement of faculty in research, 40,000 square feet of additional space will be needed within the next ten years. The space within the Chemical Engineering Building will be inadequate and limit development within three years. Additional space

must be built or converted to chemical engineering use within the next three years.

Enrollments

If enrollment statistics of the past are extrapolated into the future, the supply of manpower trained in the discipline becomes continuously more critical. Enrollments for the past ten years are shown in Table I. While there is evidence of some increase within the last few years, it may not be significant. Certainly the enrollment increase in chemical engineering has not been equal to overall college increases. This is true nationwide and in all major engineering disciplines.

The need for increased enrollments is critical and steps for its accomplishment are essential. This applies to both the undergraduate and graduate levels. By diligent work on the part of the faculty and administration, enrollments can be increased, if a high quality program is provided. Thus it is important to set and work toward enrollment goals.

The data in Table I indicates clearly that the retention of students in chemical engineering is low. This alarmingly low retention rate is undoubtedly due to many factors, the major one being misplaced students. However, there is a high probability of increased retention without lowering standards by improved curriculum, instruction and student counseling. Counseling is of considerable importance not only

to student retention but to the effectiveness of the overall program. The counseling program initiated during the last two years should be continued and made more effective.

Projected enrollments are given in Table IV below:

TABLE IV

Faculty and Enrollment Projections

Year	Professorial Faculty	Undergraduate	ENROLLMENTS Masters Off-Campus	Masters On-Campus	Doctoral
1967	5.3	224	---	10	2
1968	6.2	224	65	4	4
1969	8.6	235	65	6	4
1970	9.6		85	10	6
1971	11.6		90	12	6
1972	13.6		100	16	7
1973	14.6		50	18	9
1974	14.6		55	20	10
1975	15.6		60	21	10
1976	15.6		65	22	11
1977	16.6		70	23	11
1978	17.6	350	75	24	12

APPENDIX A: Publications of the Faculty

ARNOLD JARVIS GULLY

"Sewage Chlorination, Emergency B.O.D. Reduction and Odor Control." Sewage and Industrial Wastes, Vol. 23, No. 1, 106 (1951).

"Desiccant-Refrigerant Moisture Equilibria." Refrigerating Engineering, Vol. 62, No. 4, 62 (1954).

"Deethanizer Performance Evaluation." Refining Engineer, C-34, May, 1959.

"Partial Enthalpy Chart for Light Hydrocarbons." Refining Engineer, C-3, July, 1959.

"Hydrogenation of Catalytic Cracking Charge Stocks." Chapter 4, Vol. VII, Advances in Petroleum Chemistry and Refining, Interscience Publishers (1963).

"Engineer and Technician--Similarities and Differences." Chemical Engineering Progress, Vol. 63, No. 5, 26-29 (1967).

"Dehydrogenation of Cyclohexane: A Transport Controlled Model." (with R. R. Graham and F. C. Vidaurri), A.I.Ch.E. Journal, Vol. 14, No. 3, 473-479 (1968).

"A Supplemental Water Supply for Lubbock Industries Through Water Reuse." Proceedings Eighth Industrial Water and Wastewater Conference, Texas Water Pollution Control Association, Lubbock, Texas, June 6, 1968.

"Gas Chromatography: Effect of Sample Size on Height of Equivalent Theoretical Plate and Retention Volume." Anal. Chem. 31: 1211-1214 (1959). (With M. Smutz)

"Effect of Flow Rate on Optimum Sample Size for Minimum Values of Retention Time and HETP." Gas Chromatography, H. J. Noebels et al., eds. Academic Press, Inc., New York, 1961. Chapter I. (With T. D. Wheelock)

"Scale-up of Gas Chromatography Columns." J. Chromatog. 9: 21-27 (1962).

"Gas Chromatography of the C_1 to C_4 Nitroparaffins." Anal. Chem. 31: 1834-1836 (1959). (With T. D. Wheelock)

"Gas Chromatograph of the C_1 to C_4 Nitroparaffins: Isothermal vs. Linear Temperature Programming." Anal. Chem. 33: 832-839 (1961). (With F. S. Adams, Jr.)

"Gas Chromatograph of the C_1 to C_4 Nitroparaffins: Ramp Function Temperature Programming." J. Chromatog. 8: 532-534 (1962). (With F. S. Adams, Jr.)

"Vapor Phase Butane Nitration: Product Analysis by Parallel Column Gas Chromatography." J. Chromatog. 10: 1-8 (1963). (With F. S. Adams, Jr.)

"Single Detector and Forecolumn Trap for Series Gas-Chromatography Analysis." J. Chromatog. 13: 361-364 (1964). (With L. A. Robbins and T. D. Wheelock)

"Gas Chromatographic Analysis of Simulated Spacecraft Atmospheres." J. Gas Chromatog. 3: 115-130 (1965). (With J. C. Christianson and R. J. Sokol)

"Contaminant Collection and Identification." Proceedings of the Conference on Langley Research Related to the Apollo Mission. NASA SP-101, 1965, pp. 333-343. (With I. C. Anderson and R. A. Bruce) NOTE: The proceedings of this conference are classified confidential. The title is unclassified.

"Simplified Procedure for the Interpretation of Infrared Spectra." Accepted by J. Chem. Eng. Educ.

"Simplified Interpretation of Mass Spectra." Accepted by Chem. Eng. Educ.

"Gas Chromatography Analysis of Aliphatic Oxygenated Compounds in the Presence of Water." Accepted by J. Gas Chromatog. (With W. K. Lee)

"Digital Computer Assisted Identification of Unknown Gas Chromatographic Samples." Accepted for presentation at the 8th Annual Conference on Applied Gas Chromatography, ASTM, Cinn., September 24, 1968. (With P. C. Bentsen)

JOHN ROSS BRADFORD

"Over-all Plate Efficiency of Commercial Hydrocarbon Fractionating Columns as a Function of Viscosity." Trans. A.I.Ch.E., Vol. 39, No. 3, June 25, 1943 and Petroleum Refiner, October, 1943.

"Vapor-Liquid Equilibrium Constants for Benzene, Toluene, and Methylcyclohexane." Ind. and Eng. Chem. 36: 1144 (1944).

"Radioisotopes in Industry." Reinhold Publishing Company, New York, 1953.

"Chart of the Isotopes." Harshaw Chemical Company, Cleveland, Ohio, 1953.

"Industrial Applications of Radioisotopes." Report to Industry, Case Institute of Technology, Cleveland, Ohio, May, 1953.

"Lithographic Press Ink Distribution Studies by Radiotracer Techniques." Proceedings of the Sixth Annual Conference, Technical Association of the Graphic Arts.

"Putting the Atom to Work." Case Alumnus Magazine, Case Institute of Technology, Cleveland, Ohio, March, 1954.

"Atomic Energy in the Graphic Arts." Productionwise, Vol. 5, No. 6, June, 1955.

"Atomic Energy in the Graphic Arts." The American Pressman, Vol. 65, No. 11, October, 1955.

"Radiotracer Studies of Analytical Methods for Styrenated Oil Acids and Esters." Analytical Chemistry, Vol. 28, 906, May, 1956.

"Survey of Recent Tracer Applications in Industry." Atomic Energy Law Reports, Report 143, March 14, 1958.

"Use of Radioisotopes in Industry." Proceedings of Third Annual Conference on Automatic Control, University of Oklahoma Press, April, 1958.

"Tomorrow's Engineers." The Texas Techsan, April, 1958.

"A Scientific Versus Practical Approach to Engineering Education." Proceedings of the Eleventh Annual College-Industry Conference. Relations with Industry Division of American Society for Engineering Education, University of Houston, January, 1959.

"A Need to be Filled." The Texas Techsan, February, 1961.

Contributing author, "Handbook of Chemistry and Physics." Cleveland, Ohio: Chemical Rubber Publishing Company. (Annual publication)

"Engineering--the Next Decade." The Texas Techsan, August, 1962.

"Engineering Education in Texas--The Next Decade." Texas Professional Engineer, December, 1962.

"Are We Closing the Door on Engineering Education?" Texas Professional Engineer, September, 1963.

"... for the Education of the Boy...." Texas Professional Engineer, August, 1964.

"Engineers in Management." Texas Professional Engineer, August, 1965.

"Pasó por Aquí." The Texas Techsan, November, 1965.

"Continuing Education." Address to American Institute of Petroleum Engineers, Amarillo, Texas, 1966.

"Continuing Education: WIN Program." Address, Southwest Center for Advanced Studies, 1967.

"The Future of Cotton Textiles Research." Report to the Texas Legislature, Texas Tech Board of Directors, et al., 1967.

"Report." Coordinating Board of Texas College and University System, Austin, Texas, 1967.

"Report." Board of Directors, Texas Technological College, 1968.

"Ways to Stimulate Research." Report, Subcommittee, Texas Coordinating Board.

"Remarks." Hearing, Natural Fibers Committee, Austin, Texas, 1968.

"Growth Potential--Textiles." Address, Governor's Conference, Austin, Texas, 1968.

"Engineering in the Future World." Study for the State of Texas on Engineering Education, 1968.

"Waste Water--Liability or Asset?" Address, Eighth Annual Water and Waste Water International Conference, Lubbock, Texas, 1968.

JAMES EDMUND HALLIGAN

"The Profile of a Separating Droplet." Accepted by J. of Col. and Int. Sci. (With L. Burkhart)

"Determination of the Profile of a Growing Droplet." J. A.I.Ch.E., Vol. 14, No. 3, 411, May, 1968. (With L. Burkhart)

"Approach to Steady-State of a Two Stage Mixer-Settler Extractor." J. Chem. Eng. Educ. 3: 11 (1965). (With M. Smutz)

"Prediction of the Approach to Steady-State of a Mixer-Settler Extractor." Separation Science, 2: 173-190 (1966). (With M. Smutz)

HUBERT REED HEICHEIMEIM

"Ternary Systems: Water-Acetonitrile-Salts," J. Chem. Eng. Data, Vol. 12, No. 1, 33-35 (1967). (With J. A. Renard)

"Methane," Encyclopedia of Chemical Technology, 2nd Edition, Vol. 13, John Wiley and Sons, New York, 1967.

"Ternary Systems: Water-Acetonitrile-Salts." Accepted for publication J. Chem. Eng. Data. (With J. A. Renard)

"An Analytical Method for Determining Second Virial Coefficients from Intermediate Pressure Compressibility Data." J. Chem. Eng. Data, 5: 343-47, No. 3 (1960). (With W. N. Zaki, K. A. Kobe, and J. J. McKetta, Jr.)

"Compressibility Factors of 2,2-Dimethylpropane (Neopentane)." J. Chem. Eng. Data, 7: 507-09, No. 4, (1962).

"Thermodynamic Properties of 2,2-Dimethylpropane (Neopentane)." Chem. Engr. Progress Symposium Series 59, No. 44, 23-9 (1963). (With K. A. Kobe, I. H. Silberberg and J. J. McKetta, Jr.)

GEORGE FRANCIS MEENAGHAN

An Introduction to Chemical Engineering. Reinhold Publishing Corp., New York, New York, 1959. College Textbook Series. (With C. E. Littlejohn)

"Evaluation of Waste Stabilization Pond Performance." Proceedings 3rd Industrial Waste Treatment Conference, Houston, Texas, 1962. (With F. C. Alley)

"Photosynthesis: A Major or Minor Role in the Waste Stabilization Pond Process." Proceedings 14th Oklahoma Waste Conference, Stillwater, Oklahoma, 1963. (With F. C. Alley)

"Electrochemical Preparation of Boron." Bulletin No. 115, Engineering Experiment Station, Blacksburg, Virginia.

"Biological Treatment of Textile and Sanitary Wastes from a Fiberglass Plant." 38th Annual WPCF meeting in Atlantic City, New Jersey, 1965. (With S. H. Thomas and P. W. Pharis)

"A New Look at Waste Stabilization Ponds." The South Carolina Engineer, 16, 26 (1965).

"Kinetics of a Photosynthetic Gas Exchanger with Laminar Flow During Low Intensity Illumination." Chemical Engineering in Medicine and Biology, 447-94. D. Hershey, ed., Plenum Press, New York, New York, 1967.

AARON GUSTAF OBERG

"The 8-Quinolinol-5-Sulfonic Acid Chelates of Some Rare Earth Metal Ions." J. Phys. Chem., Vol. 62, 700-702 (1958).

"Liquid-Liquid Extraction." Chemical Engineering, Vol. 70, No. 15, 119 (1963).

"Ternary Systems: Water-Acetonitrile-Salts. Phase Equilibria Data." J. Chem. Eng. Data, Vol. 10, No. 2, 152-155, April, 1965. (With J. A. Renard)

JULES ALEXANDER BENARD

"Ternary Systems: Water-2-Chloroethanol-Salts and Water-Tetrahydrofurfuryl Alcohol-Salts. Phase Equilibria Data." J. Chem. Eng. Data, Vol. 7, No. 1, April, 1962, pp. 203-205.

"Ternary Systems: Water-Acetonitrile-Salts. Phase Equilibria Data." J. Chem. Eng. Data, Vol. 10, No. 2, 152-155, April, 1965. (With A. G. Oberg)

"Ternary Systems: Water-Acetonitrile-5 Salts. Phase Equilibria Data." J. Chem. Eng. Data, Vol. 11, No. 2, 169-171, April, 1966.

"Ternary Systems: Water-Acetonitrile-4 Salts. Phase Equilibria Data." J. Chem. Eng. Data, Vol. 12, No. 1, 33-35, January, 1967. (With H. R. Heichelheim)

"Ternary Systems: Water-Acetonitrile-Salts." J. Chem. Eng. Data. Accepted for publication. (With H. R. Heichelheim)

APPENDIX B: Departmental Budget 1967-1968

SCHOOL OF ENGINEERING

CHEMICAL ENGINEERING	Item	1966-1967	1967-1968
Professor			
Arnold Jarvis Gully, Chairman	1	$ 16,800.00	$ 13,750.00(a)
John Ross Bradford	2	6,000.00(b)	(b)
Aaron Gustaf Oberg	3	12,285.00	13,050.00
Jules Alexander Renard	4	11,500.00	12,240.00
Associate Professor			
Hubert Reed Heichelheim	5	-0-	11,700.00
Assistant Professor			
Robert Morrison Bethea	6	10,350.00	10,080.00(c)
Hubert Reed Heichelheim	7	10,400.00	-0-
Bert Wilkins, Jr.	8	-0-	6,000.00(d)
Part-time Instructor			
Theron Scott Johnston	9	843.32(e)	-0-
Teaching Assistant			
Peter Craig Bentsen	10	-0-	1,200.00
Douglas George Bresler, Jr.	11	1,000.00	1,200.00
Stephen Lee Cannon	12	-0-	1,200.00
Roy Russell Graham	13	1,100.00	-0-
David Vannoy Hayes, Jr.	14	1,000.00	1,300.00

(a) Approximately three-fourths time for 9 months. Also approximately one-fourth time on research at a salary of $4,750.00. Total salary for 9 months, $18,500.00.
(b) Also Dean of the School of Engineering. Teaching one-fourth time (1966-1967) and 28% time (1967-1968) for 12 months. On the budget for the Dean of Engineering (1967-1968).
(c) Approximately 88 percent time for 9 months. Also approximately 12 percent time on research at a salary of $1,440.00. Total salary for 9 months, $11,520.00
(d) Spring semester only.
(e) Approximately 13 percent time. Resigned January 17, 1967.

SCHOOL OF ENGINEERING

CHEMICAL ENGINEERING (Continued)	Item	1966-67	1967-68
Teaching Assistant (Continued)			
Richard Earl Lane	15	$ -0-	$ 1,200.00
_____	16	-0-	1,200.00
Technician III (488)			
Bennie Ray Gunn	17	8,100.00	8,940.00
Secretary II (116)			
Mrs. Lillian Juanita Lavender	18	(a)	4,080.00
Secretary I (115)			
Mrs. Diana Gale Frazier	19	3,360.00	-0-
Student Assistants and/or Part-time Help	20	1,400.00	1,500.00
Maintenance, Equipment and Travel	21	18,540.00(b)	20,000.00(b)
Total ----------	22	$102,678.32	$108,640.00

(a) In the Department of Electrical Engineering.
(b) Allocation for travel--$1,300.00 (1966-67) and $1,200.00 (1967-68).

DEPARTMENT OF

ELECTRICAL ENGINEERING

GOALS AND PLANS OF THE

DEPARTMENT OF ELECTRICAL ENGINEERING

I. HISTORICAL DEVELOPMENT

The Department of Electrical Engineering was created at the same time as the University in 1925. It was housed in the Textile Engineering Building with a faculty of one, Professor William J. Miller, who served both as head of the department and as Dean of Engineering. In the academic year 1927-1928, the department was moved to its present headquarters in what was then known as the West Engineering Building. At that time the faculty was expanded to three members and Associate Professor Young and Assistant Professor Fouaker joined the department. The academic year 1927-1928 was also marked by the fact that the first baccalaureate degree in electrical engineering was awarded to T. A. Rodgers, who is the owner of Lubbock Machine Shop.

The growth of the department in the pre-World War II days was slow due to the climate of the times: the depression years were at hand. However, under the leadership of Professor C. V. Bullen, who joined the faculty as Professor and Head of the department in 1932, the foundation of a fundamentally well-based undergraduate program in electrical engineering was established. During the war years, 1941-1945, the department was again a victim to the dictates of the times and was forced to concentrate its efforts in training naval personnel. Its contribution to the war effort

was significant.

The post-war years offered the Department of Electrical Engineering an opportunity to jump into the forefront of engineering education. The faculty in the years 1946-1955 was of the highest quality, as marked by their contemporary and subsequent achievements in education. Its brilliance was reflected in the quality of the undergraduate program which was developed at that time and through the creation of a graduate program, which was excellent for its time in 1948. The first recipient of the M.S. degree in this program was Wesley Joosten, in May, 1950.

The Korean Conflict and a legislature unsympathetic toward higher education took its toll of the faculty in the years 1956-1960. Although these years were marked by a tremendous increase in enrollment in the department, these were years in which the quality of the faculty and the quality of the program deteriorated. Although the first faculty member with a Doctor of Philosophy degree (Paul G. Griffith) joined the faculty of the Department of Electrical Engineering in 1959, 70% of the faculty of the department had as its highest degree, the B.S.(E.E.). Although the faculty worked hard, their accumulated knowledge was insufficient to meet the challenge of the times.

Upon the retirement of Professor Bullen in 1960, Dr. Harold A. Spuhler assumed the responsibility of guiding the department. It was during the years 1960-1963 that the undergraduate curriculum which had become outmoded was scrapped and new ideas of engineering education were adapted. Such innovations as the project laboratories and a

highly upgraded course content were introduced into the curriculum. It was through these innovations that the department gained some renown in the field of engineering education in the Southwest and throughout the nation. However, the department paid for this emphasis on quality of education over quantity of studies with a drop in enrollment, which reached a low of 471 students in 1964. This drop in student enrollment is dipicted in the table in Appendix I-A. There was another major reason for the drop in enrollment. The Air Force Institute of Technology (AFIT) program had been decreasing. Over 30 students of sophomore standing or better per year had been furnished this department since September 1961 by the AFIT program. Therefore, a decline from roughly 120 students in this program in 1962 to zero in 1965 was experienced. In 1963, the State Legislature approved a measure which gave this department the privilege of granting a Doctor of Philosophy degree. This represented a significant step forward for the department and it caused a significant upgrading in departmental goals and educational philosophies. In August 1965, another milestone in departmental development occurred: Reagan H. Beene and Eldred D. Merkl were the first recipients of the Ph.D. degrees from the School of Engineering and from the Department of Electrical Engineering.

The years 1964-1968 have been marked by an increase in student enrollment in both the undergraduate and graduate curriculum as noted in Appendix I-A and I-B. (It is difficult to assess this increase, although it is hoped that the department has acquired a reputation for excellence.) In 1965, the decision was made to concentrate on upgrading

the graduate program and complementing the program with a high quality research program. This decision was made in light of the fact that the undergraduate program as it stands can be enhanced by continuing minor modifications to the existing curriculum, and also due to the fact that the State government had committed itself to upgrading higher education in Texas. Since the State Legislature was and is funding programs and faculty salaries in a far better manner than in the years 1926-1962, the department was able to acquire young, highly capable faculty to implement the new graduate programs and to envision newer, better programs with which to better serve the state of Texas, and with which to assure the students attending this institution that they will receive the best education possible. The quality and quantity of services rendered by this department has increased considerably since 1965, as seen by the increase in grants and contracts through both State and National sources, from approximately $34,000 in 1965 to over $200,000 in 1968. There is every reason to believe that this record will be one of increase and growth, rather than one of decrease and deterioration.

II. PRESENT STATUS

The Department of Electrical Engineering at Texas Technological College is, in general, in good shape. If one were to list the strong points of the department, the list would include the following:

(1) A strong, dedicated faculty whose capabilities are directed

towards making the undergraduate and graduate curriculum excellent. The faculty, although young, has been very aggressive in the areas of basic and applied research.

(2) An excellent undergraduate curriculum which ranks philosophically with the best in the nation and is now being properly implemented.

(3) A good graduate program which has been upgraded considerably in the years 1966-1968. The program has promise of rivaling similar programs in the Southwest within the next five years. However, help will be needed to reach this goal.

(4) A potentially strong research program. The increase from $20,000 worth of research in 1966 to an estimated research volume of $300,000 in 1968-1969 certainly indicates the tremendous gains achieved in this important program.

(5) A 100% increase in graduate enrollment in the past four years and a steady increase in undergraduate enrollment.

The future for the department as a whole seems to be bright. However, there are weak spots in the department. Some of these weaknesses are listed below:

(1) Inadequate equipment support - The department has no complaint with its treatment in allocation of capital equipment funds with regard to other departments on the campus. However, the funds which have been allocated for equipment in this department are much less than that appropriated for comparable departments at other institutions in the State. This places the department of Electrical

Engineering in the unenviable position of having to curtail programs of promise or to not undertake needed programs while comparable departments at other schools are building these needed programs. Departmental activities in the area of research are severly restricted by limited funding. In the breakdown of the budget in the table of Appendix I-C, it is noted that capital outlay for the department has essentially remained the same for the past five years.

(2) The technical help is inadequate at best. The department has the equivalent of one, one-half time technician, to perform all technical functions such as repair and maintenance of graduate and undergraduate equipment. With the increase in equipment and activities, at least one more full-time technician is required.

(3) There is a very noticeable lack of space for research laboratories in the department including much needed air conditioned space for equipment and apparati which are succeptive to temperature changes. This lack of space certainly will retard a doctoral program in certain dey experimental areas such as integrated circuitry and controls and instrumentation. It is interesting to observe from the tabulation of space available for departmental laboratories that less space is available to the department for both undergraduate and graduate laboratories in 1968 than was available to the department in 1958. Common sense dictates that this is an untenable situation.

(4) More moneys and time will be needed to encourage young faculty members to develop their principal areas of interest and to encourage promising young graduate students to matriculate at this

institution.

The policy of developing the graduate program area by area with young, hard-working faculty has been successful to date and promises to exceed current expectations. The undergraduate curriculum is expanding hopefully to meet current needs in the field and, at the same time, the level of quality in existing areas is being maintained. It is anticipated that with proper administrative assistance, the Department of Electrical Engineering will be recognized nationally in the near future.

III. THE FUTURE

A. Prologue: Before the future objectives and goals of the Electrical Engineering Department are stated, it must be understood that the faculty of this department are attempting to develop a graduate research program at a time in history when the funds available from governmental and industrial agencies are in a questionable state, and at a time when the status of the graduate student is at its lowest ebb. Any predictions which are made are subject to changes, at a moment's notice, in governmental guidelines and in the international situation. It is recommended that any of the statistical data surveyed be analyzed, not on a growth basis, but on a basis of the domestic and foreign situations at the times each set of statistics were derived. Projections of new programs in these changing educational times, in these times of continually fluxuating social and political events, mean very little. The goals which have firm philosophical basis certainly

will be attained if the members of the faculty set their minds to achieving these goals, unless some catastrophe occurs.

B. Objectives:

1. Graduate Programs: It is the goal of this department to develop a graduate academic and research program of the highest quality in four major areas of endeavor encompassed within the Electrical Engineering disciplines. These areas are in the order of projected development:

(1). Physical Electronics

(2). Controls and Instrumentation

(3). Communications

(4). High Voltage Engineering.

The department is well on its way to developing the first area. The basic faculty has been recruited and a reasonable amount of equipment for experimental research has been purchased and is in operation. The basic deterrents to further progress in the area of Physical Electronics are the availability of space and the number of available graduate students. The program in Physical Electronics has been further enhanced by the addition of undergraduate and graduate courses under various area subheadings taught by people of high competance in their area of particular interest. It is anticipated that the Physical Electronics Laboratory will rank among the top ten in the nation within ten years.

Efforts are being made to develop one of the "bread-and-butter" areas of research, that of systems controls, at the present time.

It is anticipated that there will be a substantial increase in funding of the various research activities in this area over the next ten years due to an added number of competent young faculty interested in systems, theory and practice. It is anticipated that the research activities of the Control and Systems Laboratory will rank high within the nation if it is properly funded and if space is provided for this important research activity. This area of research will be wholly dependent upon rapport established between the personnel of the Computing Center and this department. It will be necessary to develop high quality hybrid computer simulation systems and to develop devices and systems with digital computers in the so-called feedback loop. The molding together of the hardware and software aspects of digital and analog systems is a necessity for quality performance in this laboratory. In time, the personnel in the area of controls and instrumentation must come to grips with such problems as traffic control, economic modelling, self-adaptive systems applied to the problems of the large cities, and medical electronics. In time, these interdisciplinary areas must rely upon the systems modelling and analysis techniques developed by the electrical engineer for their solution.

Communications and its impact upon civilization will certainly occupy a position of top priority in any Electrical Engineering Department. Due to lack of funding and competant faculty, this area of research has lagged. However, with the addition of highly competent personnel, it is anticipated that research in this area will accelerate

rapidly. Again, the personnel in this area will work with those in the area of applied mathematics to establish the area as one of high quality and repute. As research spreads into the unknown and the accuracy of measurement techniques is increased, the use of probabilistic and statistical methods of analysis and synthesis will assume greater importance. The transmission and retrieval of information whether through natural media, such as the atmosphere or artificial modes, such as computers, will take on added importance. The techniques developed may be used for the modelling of statistical systems. Hence, the need for cooperation between the Department of Mathematics and the Department of Electrical Engineering becomes increasingly necessary. The rate at which this vital area develops is dependent upon funding at the private and local level and the usual problem of space and faculty.

The fourth area of development is certainly in an embryonic stage of planning. However, it is the opinion of this faculty that the area of High Voltage Engineering holds a great promise for the future. In this area, so much of engineering research and application comes together. The area of materials research assumes a tremendously important role. The areas of research applications and design will be emphasized; and certainly the problem of transmission of energy will be studied in depth. All major engineering areas, as well as the areas of mathematics and physics, could and should be involved in this undertaking. The success of the plans for developing this creative area will depend largely upon the ability of the personnel of this institution to sell

the major power companies of the Southwest on the need for a High Voltage Institute and to demonstrate graphically to these people the capabilities of the faculty involved. It is planned to contact each major company with a concrete proposal to initiate such a program and, by well defined steps, to increase the participation in such a program. In this way, it is felt that this department and the university will render an exemplary service to one of the State's larger industries. Oddly enough, there are several faculty members of sufficient competancy available to initiate this program. However, the necessary funds and space needed are of such magnitude that it will require a joint venture between industry and the institution.

Only areas of primary importance to the Department of Electrical Engineering have been listed under research objectives. Certainly the classical areas of study such as circuit theory and electrical and electronic design will be emphasized. However, interdisciplinary activities must be the ultimate goal of the institution and this department.

2. Undergraduate Program: The philosophy encompassed within the present undergraduate program in Electrical Engineering is sound; therefore, radical changes in the curriculum are not anticipated within the next five years. Several goals are under study at this time. Some of these goals are:

(1) The establishment of an undergraduate research program for excellent senior students. The need to challenge our better students will be met in this way.

(2) Interdisciplinary programs in such areas as physical electronics (physics); statistical communications and information sciences (mathematics); systems modelling (computer sciences and geology); and materials sciences (chemistry and physics).

(3) Upgrading the undergraduate major and non-major laboratories.

Attaining quality of instruction and performance in each of the projected goals will require additional equipment, funds and space. It is estimated that an additional $125,000 in equipment funds over the next five years will allow the department to attain goals (1) and (2) listed in the preceding paragraph. This is reflected by the substantial increase in capital outlay for the next five years as depicted in Appendix II-C. The weaknesses of the department undergraduate curriculum is reflected in its inability to service the non-major laboratories adequately. It is necessary to implement these laboratories since electronics measurements techniques are becoming a necessary part of almost every scientific discipline.

C. Faculty and Enrollment

The number of faculty members in any department is directly dependent upon enrollment. The Department of Electrical Engineering is expecting an increase in undergraduate enrollment of approximately five to ten percent over the next five to ten years. As the Junior College System in the State of Texas increases, the largest enrollment increase in this department will occur in the junior and senior years.

The projections of enrollment in the next ten years by class rank are shown in the Appendix II-A. It is anticipated that at least one new faculty member per year will be required to handle this increased teaching load.

It is predicted that research funds in the Department of Electrical Engineering will increase at the rate of about $100,000 per year up to a level of about $1,000,000 in the next six years. This anticipated increase is reflected in the Table in Appendix II-F. After 1974 the funding may level off or will increase rapidly. As this research funding is acquired, the faculty required to man the graduate research program will be increased. This fact, coupled with the fact that an increase in the graduate enrollment is expected, results in the predicted needs of two new faculty positions per year to handle the overall graduate programs and, at the same time, to service the needs of the undergraduate program.

It will be noted that the faculty needs over the next five years will be fifteen new members. It is also realized that this goal may be either unrealizable or will be difficult to attain in the next five years. It can be noted for the record that at the time that the number of full-time faculty reaches 30, a levelling off of faculty requirements is anticipated. The table in Appendix II-E shows the number of faculty members in the department by specialty and depicts the increase in faculty members by specialty as needed year by year. Although this predicted increase in faculty seems to be somewhat high, it must be kept in mind that in the year 1968 the number of faculty members in

this department is one less than that of the same department in September 1959, and that this department is in the process of implementing a Ph.D. program that was not in existance at that time. In essence, the Department of Electrical Engineering has been undermanned over eight years.

Travel moneys are adequate for present needs but must increase if the department keeps its trust in obtaining adequate research funds from outside sources and by reporting research activities in the department at learned meetings. It is a notable fact that between 1959 and 1963 only two publications originated with the faculty of this department while over 24 papers and publications were accepted from this department during the academic year 1967-1968.

IV. CONCLUSIONS

The members of the faculty of this department believe that the future of the Department of Electrical Engineering is bright. The faculty,in general, also feel that there are circumstances beyond their control which will impede such progress; for example, cumbersome administrative procedures and not being well-informed by the administration. Money and space is, and probably will continue to be, a major impediment to departmental progress both at the graduate and undergraduate levels. However, by the acquisition of several high quality faculty members to complement the present excellent faculty, it is believed that the department will become one of the best in the nation within the next ten years.

APPENDIX I-A

UNDERGRADUATE ENROLLMENT
1958-1968

ENROLLMENT BY CLASSES

Academic Year	Total Enrollment	Freshman	Sophomore	Junior	Seniors
1958-1959	722	232	191	147	143
1959-1960	706	215	191	179	170
1960-1961	602	181	172	124	109
1961-1962	550	188	162	95	93
1962-1963	564	197	146	98	104
1963-1964	456	151	126	79	100
1964-1965	498	194	125	101	78
1965-1966	578	247	153	105	74
1966-1967	530	194	137	110	90
1967-1968	535	140	178	102	92

APPENDIX I-B

GRADUATE ENROLLMENT
DEPARTMENT OF ELECTRICAL ENGINEERING
1958-1968

Academic Year	Number of Graduate Students
1958-1959	9
1959-1960	11
1960-1961	16
1961-1962	12
1962-1963	19
1963-1964	13
1964-1965	24
1965-1966	21
1966-1967	34
1967-1968	30
1968-1969	40

APPENDIX I-C
DEPARTMENTAL BUDGETS
1958-1968

Academic Year	Total Budget	Faculty Salaries	MET	Technical Help	Student Assts.	Teaching Assts.
1957-1958	$ 76,265.	$ 63,000.	$ 2,500.	$ 8,000.	$ 3,225.	0
1958-1959	$ 99,798.	$ 85,700.	$ 3,073.	$ 8,000.	$ 3,225.	0
1959-1960	$108,733.	$ 88,138.	$ 5,353.	$ 11,040.	$ 2,600.	$ 1,600.
1960-1961	$ 83,840.	$ 61,880.	$ 4,960.	$ 7,440.	$ 2,600.	$ 7,000.
1961-1962	$ 90,300.	$ 62,830.	$ 11,975.	$ 15,800.	$ 2,800.	$ 6,900.
1962-1963	$105,760.	$ 73,480.	$ 8,025.	$ 16,260.	$ 3,000.	$ 8,000.
1963-1964	$131,130.	$ 85,830.	$ 19,110.	$ 16,900.	$ 3,300.	$ 6,000.
1964-1965	$156,978.	$106,308.	$ 22,500.	$ 17,870.	$ 3,300.	$ 7,000.
1965-1966	$184,315.	$133,405.	$ 22,500.	$ 18,410.	$ 4,000.	$ 6,000.
1966-1967	$209,998.	$138,448.	$ 22,500.	$ 21,300.	$ 3,500.	$ 14,200.
1967-1968	$228,670.	$152,160.	$ 23,000.	$ 32,710.	$ 4,500.	$ 16,300.
1968-1969	$263,120.	$197,220.	$ 23,690.	$ 23,510.	$ 4,500.	$ 14,200.

APPENDIX I-D

MEMBERS OF THE FACULTY AND FORMER MEMBERS
OF THE DEPARTMENT OF ELECTRICAL ENGINEERING

(In Order by Year and Rank)

Professors

1. William J. Miller
2. Charles Victor Bullen
3. Charles Ernest Houston
4. Paul Gene Griffith
5. Harold Aylesworth Spuhler
6. Russell Holland Seacat

Associate Professors

1. Fouraker
2. Young
3. William Helwig
4. Willard Grey
5. Byron J. Bennett
6. Tom Basil Stenis
7. Willie Edward Phillips
8. John Paul Craig
9. William Manos Portnoy
10. Magne Kristiansen

Assistant Professors

1. M. P. J. Minter
2. James Monroe Blackwell
3. Edward Price
4. Billy Howard Easter
5. James Monroe Hartsfield
6. Leonard Lee Grigby
7. Charles Lester Wright
8. Cecil Roberts Coale
9. Wilford Grey
10. Darrell Lee Vines
11. Larry Joe Langston
12. David Keane Ferry
13. Marion Otho Hagler

APPENDIX I-E

PUBLICATIONS OF THE FORMER

AND PRESENT ELECTRICAL ENGINEERING FACULTY

A. Alonzo F. Adkins

"The Analysis of Active Networks by Topological Methods," Proceedings IBM 1620 Users Conference, New York, September 1965 (with R. H. Seacat).

"Load Flow Analysis," SWIEEECO Conf. Record, April 1966 (with R. H. Seacat and A. A. Smith).

B. John P. Craig

"Experimental Optical-Maser Diagnostics of Dense Plasma," Bull. Am. Phys. Soc. II-9, 151 (1964), (with A. A. Dougal and R. F. Gribble).

"Time-Resolving Infrared Polarization Analyzer for the 2- to 4- Micron Range," Review of Scientific Instruments 35, 1501 (1964), (with R. F. Gribble and A. A. Dougal).

"Spatial Density Measurements in Fast Theta-Pinch Plasma by Laser Excitation of Coupled Infrared Resonators," Applied Physics Letters 5, 60 (1964), (with R. F. Gribble and A. A. Dougal).

"Time-Space Resolved Experimental Diagnostics of Theta-Pinch Plasma by Faraday Rotation of Infrared He-Ne Maser Radiation," Physical Review Letters 13, 156 (1964), (with A. A. Dougal and R. F. Gribble).

"Electron-Density Measurements in a Theta-Pinch by an Infrared Maser Technique," Bull. Am. Phys. Soc. II-10, 224 (1965), (with R. F. Gribble and A. A. Dougal).

"Magnetic Field Measurements in a Theta-Pinch by Faraday Rotation of Infrared Maser Radiation," Bull. Am. Phys. Soc. II-10, 226 (1965), (with R. F. Gribble and A. A. Dougal).

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C. David K. Ferry

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"Microwave Emission from InSb and InAs," Bull. Am. Phys. Soc. II-11, 754 (1966), (with R. W. Young and A. A. Dougal).

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"Frequency Range of the Microwave Emission from InSb," Zeitschrift fur Naturforschung 22a, 576 (1967), (with R. W. Young and A. A. Dougal).

"Negative Resistance and Galvanomagnetic Effects of Hot Electrons in Inhomogeneous Bulk Semiconductors," Solid State Electronics 11, 561 (1968), (with H. Heinrich).

"Hot Carrier Current Oscillations in n-Type Germanium," Applied Physics Letters 11, 126 (1967), (with H. Heinrich).

"Avalanche Magnetoplasma Production and Instabilities in InSb," Bull. Am. Phys. Sec. II-13, 258 (1968),(with H. Heinrich).

"Effect of Magnetic Fields on Impact Ionization Rates and Instabilities in InSb," to be published in Physical Review, (with H. Heinrich).

"Recent Advances in Semiconductor Microwave Sources," SWIEEECO Conf. Record, April 1968.

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E. Marion O. Hagler

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G. Magne Kristiansen

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K. Robert D. Shelton

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APPENDIX I-F

ELECTRICAL ENGINEERING FACULTY
FACULTY BY AREAS OF INTEREST

1958-1968

Academic Year	Circuits & Systems	Controls & Instr.	Electronics	Physical Elect.	E. M. Fields & Appl.	General
1958-1959	2	2	3	0	0	7
1959-1960	3	2	4	0	0	7
1960-1961	1	3	2	0	0	1
1961-1962	1	2	3	0	0	2
1962-1963	1	2	3	0	0	2
1963-1964	1	4	3	0	1	1
1964-1965	2	4	3	0	1	0
1965-1966	2	4	3	1	1	0
1966-1967	2	3	3	2	1 1/2	0
1967-1968	1	2	3	4	1	0
1968-1969	3	3	3	4	1	0

APPENDIX I-G

LABORATORY SPACE AVAILABLE TO
DEPARTMENT OF ELECTRICAL ENGINEERING

1958-1968

Academic Year	Square Feet	Academic Year	Square Feet
1958-1959	16,200	1964-1965	147,000
1959-1960	13,560	1965-1966	12,400
1960-1961	13,560	1966-1967	12,400
1961-1962	12,450	1967-1968	12,400
1962-1963	14,000	1968-1969	(a) 12,900
1963-1964	14,800		

(a) This space is entirely inadequate for present programs.

APPENDIX I-H

RESEARCH SUPPORT FOR THE
DEPARTMENT OF ELECTRICAL ENGINEERING

1958-1968

RESEARCH CATEGORIES

Academic Year	State Organized	State	Federal	Private	Total
1958-1959	0	0	0	0	0
1959-1960	0	0	0	0	0
1960-1961	$ 15,593	0	$ 5,867	0	$ 21,460
1961-1962	$ 16,000	0	0	0	$ 16,000
1962-1963	$ 18,230	0	0	0	$ 18,230
1963-1964	$ 15,600	0	0	0	$ 15,600
1964-1965	$ 21,933	0	0	$ 10,000	$ 31,933
1965-1966	$ 17,600	0	0	$ 17,000	$ 34,000
1966-1967	$ 17,600	$ 35,000	$ 229	$ 3,500	$ 78,400
1967-1968	$ 36,600	0	$ 151,000	$ 13,350	$ 200,000
1968-1969	$ 26,000	0	$ 220,000*	$ 20,000*	$ 266,000

* Estimate

APPENDIX II-A

PREDICTED UNDERGRADUATE ENROLLMENT

1968-1975

Academic Year	Total	Freshman (a)	Sophomore (b)	Junior (c)	Senior (d)
1968-1969	535	195	140	102	92
1969-1970	574	214	150	112	98
1970-1971	626	235	162	124	105
1971-1972	681	258	174	136	115
1972-1973	747	270	182	149	130
1973-1974	783	280	191	164	145
1974-1975	830	290	200	180	160

(a) 10% increase 1968-1972, 5% increase 1972-1975, change due to enrollment in Freshman:Sophomore years being concentrated in Junior College.

(b) 10% increase in enrollment. However, it is predicted that there will be a levelling off of population by 1972.

APPENDIX II-B

PREDICTED GRADUATE ENROLLMENT
Department of Electrical Engineering

1968-1975

Academic Year	No. Graduate Students	Academic Year	No. Graduate Students
1968-1969	40	1972-1973	68
1969-1970	48	1973-1974	80
1970-1971	56	1974-1975	88
1971-1972	60		

APPENDIX II-C

PREDICTED DEPARTMENTAL BUDGETS REQUESTS

1968-1975

Academic Year	Total* Budget	Faculty Salaries(a)	MET(b)	Technical Help (c)	Student Assts.	Teaching Assts.(d)
1968-1969	$ 263,120.	$ 197,220.	$ 25,690.	$ 23,510.	$ 4,500.	$ 14,200.
1969-1970	$ 338,200.	$ 235,000.	$ 48,690.	$ 32,510.	$ 4,500.	$ 17,000.
1970-1971	$ 377,190.	$ 270,000.	$ 48,690.	$ 34,000.	$ 4,500.	$ 20,000.
1971-1972	$ 398,690.	$ 285,000.	$ 48,690.	$ 36,000.	$ 5,000.	$ 24,000.
1972-1973	$ 431,590.	$ 313,000.	$ 48,690.	$ 38,000.	$ 5,500.	$ 26,400.
1973-1974	$ 460,900.	$ 344,000.	$ 40,000.	$ 45,000.	$ 5,500.	$ 26,400.
1974-1975	$ 495,400.	$ 374,000.	$ 40,000.	$ 49,000.	$ 6,000.	$ 26,400.

(a) The faculty salaries include a minimum of one new faculty member and a five percent increase in cost of living per year.

(b) The increase represents capital equipment requests and an increase of thirty percent or better in departmental operating costs.

(c) Technical help includes the acquisition of one technician, one machinist, and one secretary in the period covered.

(d) Teaching assistant money has been minimized. It should be higher.

(*) Budget may be reduced year by year if the research activities are as successful as predicted in Appendix II-F.

APPENDIX II-D

ELECTRICAL ENGINEERING FACULTY
BY AREAS OF INTEREST REQUIREMENTS

1968-1974

Academic Year	Circuits & Systems	Controls Instr.	Electronics	Physical Elect.	E. M. Fields	Other
1968-1969	3	3	3	4	1	0
1969-1970	4	3	4	4	2	0
1970-1971	4	4	4	4	3	1****
1971-1972	4	4	4	4	4	2**
1972-1973	4	4	5*	5*	4	3*
1973-1974	4	4	5	6***	4*	4***

* Additions will depend upon how successful the areas have been in obtaining outside research funds through 1971-1972.

** Medical Electronics specialist.

*** Additions will be dependent upon success in obtaining outside research funds through 1972-1973.

**** Power specialist for Extra High Voltage Laboratory

APPENDIX II-E

ANTICIPATED SPACE REQUIREMENTS FOR THE
DEPARTMENT OF ELECTRICAL ENGINEERING

1968-1975

Academic Year	Square Feet	Academic Year	Square Feet
1968-1969	(a) 14,900	1971-1972	(d) 18,900
1969-1970	(b) 16,900	1972-1973	(e) 19,400
1970-1971	(c) 17,900	1973-1975	(f) 20,500

(a) Immediate needs are 2000 square feet for the Physical Electronics Laboratory; 1000 square feet for the Undergraduate Laboratories.

(b) 500 square feet for Integrated Circuits Laboratory; 500 square feet for Undergraduate Laboratories.

(c) 500 square feet for Controls and Instrumentation Laboratories.

(d) 600 square feet for the proposed Medical Electronics Area.

(e) 500 square feet for Information and Communications Laboratories.

(f) 500 square feet for Solid State Electronics Laboratory and 600 square feet for Undergraduate Laboratories.

APPENDIX II-F

PREDICTED RESEARCH SUPPORT
DEPARTMENT OF ELECTRICAL ENGINEERING

1968-1974

Academic Year	State Organized	State	Federal	Private	Total
1968-1969	$ 26,000	-	$ 220,000	$ 20,000	$ 266,000
1969-1970	$ 45,000	-	$ 350,000	$ 50,000	$ 445,000
1970-1971	$ 45,000	$ 150,000*	$ 400,000	$ 65,000	$ 660,000
1971-1972	$ 45,000	$ 150,000*	$ 450,000	$ 100,000	$ 745,000
1972-1973	$ 50,000	-	$ 600,000	$ 190,000**	$ 840,000
1973-1974	$ 55,000	-	$ 600,000	$ 250,000**	$ 905,000

* Predicted state support for Extra High Voltage Laboratory in 1970-1971

** Predicted support for Extra High Voltage Laboratory from Power Companies in 1972-1973.

ENGINEERING PHYSICS

(SEE DEPARTMENT OF PHYSICS

COLLEGE OF ARTS AND SCIENCES)

DEPARTMENT OF MECHANICAL ENGINEERING

THE DEPARTMENT OF MECHANICAL ENGINEERING

1968 REPORT ON MEDIUM AND LONG RANGE PLANS.

May 29, 1968

I. HISTORICAL SUMMARY

1. The Department of Mechanical Engineering was organized at the time of the opening of Texas Technological College in 1925. Since that time, the department has shown a steady, though not spectacular growth in enrollment, facilities, program and faculty. The details follow:

a. Listed below by year are the number of degrees granted to majors in the department.

Year	Undergraduate Degrees (B.S. in M.E.)	Year	Undergraduate Degrees (B.S. in M.E.)	Graduate Degrees (M.S. in M.E.)
1929	3	1949	64	
1930	2	1950	64	
1931	5	1951	46	
1932	7	1952	34	
1933	10	1953	24	
1934	4	1954	23	
1935	3	1955	21	
1936	10	1956	28	
1937	12	1957	39	
1938	7	1958	58	
1939	12	1959	50	
1940	14	1960	52	4
1941	16	1961	54	7
1942	13	1962	49	6
1943	16	1963	61	6
1944	5	1964	75	10
1945	3	1965	41	13
1946	3	1966	36	10
1947	28	1967	44	5
1948	32			

b. Instructional staff holding the rank of assistant professor and higher since the inception of the department are given below in chronological order:

Name	Highest Rank	First Appointed	Terminated
Tuve, George Lewis	Professor and Head	1925	1930
Hardgrave, John Coyne (deceased)	Professor	1926	1953
Farris, M. E.	Assistant Professor	1927	1930
Godeke, Harry Frederick (deceased)	Professor and Head	1930	1957
Doughtie, Venton Levy	Professor	1930	1938
Vail, Robert P. (deceased)	Assistant Professor	1937	1942
Kipp, Harold L.	Professor	1938	1947
Newell, Robert Lee	Professor	1941	
Mason, Robert Louis	Professor	1942	
Powers, Louis John, Jr.	Professor and Head	1942	
Williams, Floyd Lewis	Associate Professor	1942	1953
Helmers, Donald Jacob	Professor	1948	
Marshall, John Mark	Assistant Professor	1949	1950
Monasch, Alfred (deceased)	Assistant Professor	1949	1959
Martin, Robert Edward	Associate Professor	1954	
Davenport, Monty Earl	Associate Professor	1956	
Lawrence, James Harold, Jr.	Associate Professor	1956	
Reis, Levern Anthony	Associate Professor	1957	
Mann, William (deceased)	Professor	1959	1960
Fung, Sui-An	Associate Professor	1959	1962
Jordan, Duane Paul	Associate Professor	1964	
Reynolds, Elbert Brunner, Jr.	Associate Professor	1964	
Koh, Pun-Kien	Professor	1966	

c. Departmental enrollment of majors during the fall semesters for the period 1958 through 1968 is given below.

Year	Total Undergraduate Enrollment	Total Graduate Enrollment
1958-59	509	
1959-60	420	4
1960-61	360	7
1961-62	365	6
1962-63	377	18
1963-64	353	18
1964-65	370	27
1965-66	355	24
1966-67	365	15
1967-68	367	15

d. Publications by the faculty are compiled every few years by the Dean of the Graduate School. Because the list already exists in printed and bound form, it is omitted from this report.

2. Summary of Departmental Expenditures for the Period 1958 through 1968

	Salaries of Faculty, Staff, Students *		Maintenance, Equipment, Travel *	
Year	Teaching	Research	Teaching	Research
1958-59	$ 82,000.00	$ --	$ 4,000.00	$ --
1959-60	89,000.00	--	6,000.00	--
1960-61	90,000.00	2,000.00	4,000.00	8,000.00
1961-62	95,000.00	2,000.00	16,000.00	3,000.00
1962-63	94,000.00	--	14,000.00	--
1963-64	115,000.00	9,000.00	20,000.00	14,000.00
1964-65	135,000.00	18,000.00	20,000.00	20,000.00
1965-66	161,000.00	13,000.00	17,000.00	16,000.00
1966-67	187,000.00	10,000.00	17,000.00	20,000.00
1967-68	196,000.00	57,000.00	17,000.00	17,000.00

* Figures rounded to nearest one-thousand dollars

II. CURRENT (1967-68) DEPARTMENTAL STATUS

1. Enrollment by classes: (Mechanical Engineering Majors only)

	Freshmen	Sophomore	Junior	Senior	M.S.	Ph.D.	Total
Fall, 1967-68:	121	105	68	73	8	7	382
Spring, 1968:	119	101	92	80	8	7	407

2. The faculty teaching salaries are distributed as follows:

Rank	Number in Rank	Budgeted Teaching Salary (9 months)
Professor	5	$ 64,300.00
Associate Professor	6	$ 56,275.00
Assistant Professor	0	-
Instructor	2	$ 15,000.00

3. Departmental offices occupy approximately 2500 square feet of floor space entirely in the Civil and Mechanical Engineering Building. The laboratory activities are carried on principally in the Mechanical Engineering Laboratory Building of approximately 20,000 square feet. Carrels for graduate assistants, an analog computer laboratory, and a departmental library occupy approximately 1500 square feet of space in the Civil and Mechanical Engineering Building. A basement area of about 2500 square feet in this building, when renovated, will be used for a metallurgy laboratory by the department. All classrooms are shared with other departments.

4. Current research activities include:

   a. "Climatic Conditioning of the Existing Buildings in the Texas College and University System", Professors Jordan and Lawrence
   b. "Development of Analog Computer Slaving Mechanism", Professor Jordan
   c. "Non-Equilibrium Thermodynamic Processes-Gas Flows", Professor Davenport
   d. Research in fuel cell technology, doctoral student C. M. Epps
   e. Research in non-equilibrium thermodynamics, doctoral students G. S. Kirby, J. L. Chance, J. M. Koski
   f. Research in lake evaporation, masters' student J. W. Headrick
   g. Research in boundary layer heat transfer, masters' student R. Kliewer
   h. Research in thermal transients in buildings, masters' student C.M. Morris
   i. Research in titanium brittle fracture, Professor P. K. Koh

5. Three senior members of the departmental faculty have engaged in the continuing education program of the School of Engineering through graduate level instruction at off-campus locations in the Midland-Odessa and the Borger-Pampa areas. The department has no other regular extension or evening programs in operation.

6. The departmental annual operating budget* for the fiscal year 1967-68 is as follows:

	Teaching	Research
Salaries, faculty	$165,000.00	$ 26,000.00
Salaries, students	10,000.00	27,000.00
Salaries, Clerical	4,000.00	4,000.00
Salaries, technicians	18,000.00	-
Maintenance, Equipment and Travel	17,000.00	17,000.00
Total	$214,000.00	$ 74,000.00

*Figures rounded to nearest one-thousand dollars

III. OBJECTIVES AND GOALS OF THE DEPARTMENT

1. Departmental goals, both short range and long range will continue to be directed toward maintaining the highest level of instructional and learning standards compatible with our faculty and students at both the undergraduate and graduate levels.
2. Development of the undergraduate program will exhibit two new facets.

   a. Emphasis will be placed upon direct involvement of the engineering student in approaching some of the socio-economic problems of the local community. Because of our long experience in developing experimental techniques, in problem solving methodology, and in data interpretation we can develop for the engineering student a program to generate recognition, interest and investigation of such problems in a more meaningful way than have the liberal arts departments. A systems engineering approach in the socio-economic domain is now being prepared.

   b. Also planned is a block of related courses in basic engineering concepts and methodology for in-depth study directed to the liberal arts student. It appears that the vast majority of liberal arts- and business-trained people, predominantly our leaders in politics and business, have brought our civilization to the brink of disaster through their failure to understand and to properly utilize the technology at their disposal. Preparations are under way for a group of courses that will bring the liberal arts student to an understanding of the fundamental ideas and concepts and a working insight into the current technology of our society.

The undergraduate classroom and laboratory programs in the fields of Thermal Engineering, Materials Engineering, and Systems Engineering will continue to keep abreast of contemporary developments as they occur.

We will continue to depend heavily on agencies of the Federal government to provide funds for the few, but very costly items of equipment that will be needed for continued updating of our laboratories. Experience to date suggests that there is little reason to expect state appropriated funds to provide but little more than operating expenses.

Undergraduate enrollment will probably increase by no more than two or three percent each year for the next several years. Whatever factors have been operative for the past ten years to retard engineering enrollment will probably still be operative for the next ten years. Engineers of the future must therefore be more intensively educated, more strongly motivated, and more responsive to the socio-economic environment of the times than has been the case in the past. The above factors will lead to the gradual acceptance of the Master's Degree as the minimum requirement for entry into the engineering profession. The degree Bachelor of Science may then become a terminal degree only in the sense of denoting the completion of the purely technical phase of engineering education. Advanced work in engineering education will be directed toward preparing the student for his entry into policy making, managerial, and conceptual aspects of engineering.

3. In view of the tremendous growth of basic and applied research in industry, it is believed that the principal, though not sole, function

of research in the department will become that of teaching research methods as distinguished from the discovery of new knowledge. Engineering research is now of the nature of a team effort as distinguished from that of a single investigator. Clearly, then, must come the recognition of the validity of team research activities carried on and reported by small groups of investigators. Envisioned is the research activity in which the faculty member is an integral part of the team, not just the supervisor. The instructor's role will be that of the expert working closely with his students in a tutorial situation, directing their efforts, teaching and showing them at first hand the investigative and experimental techniques, assisting them in the interpretation of data, participating with them in the preparation of reports, and instructing them in the policy making, the managerial, and the conceptual aspects as well. To carry on such a graduate program will require no significant increase in our present graduate faculty or graduate enrollment. Past experience has served to emphasize that large financial support will not be forthcoming from agencies of the Federal government, from the State of Texas, from local industry, or from campus sources. Thus our graduate program must be carried on with budgets consisting almost solely of partial salary support and some travel expense.

4. To carry out this conceived undergraduate and graduate program will require three additional faculty. It is expected that these will be young men just beginning their careers in engineering education. For what we are planning, young men with visions are preferred to old men with dreams.

Because of the increasing sophistication of laboratory apparatus. two additional full-time technicians will be required within the next five years. One technician must have special competence in the repair, building, and maintenance of electronic equipment. The other technician will have special competence in metallurgy, particularly in X-ray diffraction and electron microscopy operation and maintenance. One additional full-time secretary will be required to assist with proposal writing, with added correspondence and reporting, with increased office records keeping, and because of added faculty and students. To give continuity and proper attention to the many and varied details of the burgeoning administrative work load of the department, a full-time administrative assistant to the department chairman is needed.

It is expected that the need of state-appropriated funds for departmental teaching salaries, maintenance, operation, and travel will continue to increase at the rate of about thirteen percent each year for the next ten years. The department will continue to request the large expense capital outlay items in its annual budget submissions, but will also continue to seek other sources as it has been doing.

Because departmental goals and objective must be developed within the framework of the objectives and goals of administrative levels above the department, it is hoped that such a framework will be early in forthcoming.

DEPARTMENT OF PETROLEUM ENGINEERING

Department

of

Petroleum Engineering

MEDIUM AND LONG-RANGE PLANS

for the

DEPARTMENT OF PETROLEUM ENGINEERING

TEXAS TECHNOLOGICAL COLLEGE
September 1, 1968

INTRODUCTION

A projective analysis of any operation must necessarily find its basis on an analysis of the total situation within which the operation functions. In the specific case of a college department teaching petroleum engineering technology, a projective study must consider trends in both engineering education and the petroleum industry.

The currently evolving patterns in engineering education are dominated by the exponential rate of growth of technical information. The force of this one factor along reduces to relative insignificance all other factors contributing to change. The recently published report of the American Society for Engineering Education under the title of "GOALS OF ENGINEERING EDUCATION" sets forth the majority thinking of those who guide engineering education. Their recommendations are motivated by this factor. What is not known now is, of the changes recommended therein, which ones will ultimately be implemented, or when they will be implemented. Difficult as it is to accomodate the present study to these uncertainties, it would be imprudent to assume for the purposes of this report that no changes in the basic pattern of engineering education are to be anticipated within the next ten years. On the other hand, if basic changes are to be assumed, a plurality of different possibilities must be considered. It would then become necessary to present an

individual study for each possibility; an obviously impractical procedure.

In addition to the difficulties of predicting the long range status of engineering education, there are changes taking place within the petroleum industry that can have, and certainly have had, a profound effect on the operation of petroleum engineering departments throughout the United States. It was an industry-wide economy panic in 1956 and 1957 which set forces into motion that augmented an already established decline in all engineering and forced petroleum engineering college enrollment in the United States down from approximately 3250 in 1958 to 995 in 1963, and at Texas Tech down from approximately 295 in 1958 to 36 in 1963.

Today a gradual (although as yet only token) recovery of enrollment is being made (see Appendix I). Yet within industry the derth of petroleum graduates over the past several years has created an acute engineer shortage that is forcing oil companies into the most competitive recruitment practices. What future steps this situation will induce the industry to take to promote petroleum engineering college enrollment cannot be known. Nor can the normal long range effects of the overall engineer shortage be predicted.

It is within the framework of these unknowns that a projective study of the needs and operations of the Department of Petroleum Engineering must be made. To achieve a working

basis for the study, there seems to be no other possible alternative than to postulate that there will be no basic changes in the general pattern of engineering education, nor any fundamental changes in industry, that will affect the operations of the Department of Petroleum Engineering. It must be further understood, then, that such a postulate renders this report highly tentative--but no better procedure seems available. It will, therefore, be necessary from time to time to review the basic assumptions and, when necessary, revise the estimates of the report.

HISTORY OF THE DEPARTMENT OF PETROLEUM ENGINEERING

Petroleum Engineering at Texas Tech was established as a department in the School of Engineering in the fall of 1947. Prior to that time the petroleum engineering program had been administered as a sub-department within the Department of Geology in the School of Arts and Sciences. This change was made on the advice of the petroleum industry of West Texas, acting through the "Petroleum Industry Advisory Committee". This committee, (known as the Livermore Committee, for its chairman, George P. Livermore) was organized in the fall of 1946 to aid the college in developing a petroleum engineering program. Its membership consisted of executive-level personnel from most of the major oil and gas producing companies operating in the West Texas area. They selected the first faculty, advised them and the college on the content of the curricula, obtained funds to suppliment college salaries, to purchase laboratory equipment, and to otherwise aid the department in many various ways. In all, the Livermore Committee secured approximately $57,000.00 for the Department of Petroleum Engineering in its early growing days, and was active in its support until the death of Mr. Livermore in 1961.

The department was fully accredited by ECPD in December 1958, was last inspected in 1965 and approved for another six years.

The Department of Petroleum Engineering was originally housed in a barracks building. In the Spring of 1950 the department moved into its then recently completed permanent building, which consisted of the first floor, less the north wing, of the present building. Then in 1953 the second floor and north wing were added to the building, completing it in its present form.

FACULTY

Since the Department of Petroleum Engineering is young relative to most of the departments in engineering, it is possible, with brevity, to list the whole of the faculty, past and present:

	FROM	TO
William Lyon Ducker	1948	Present
Philip Johnson	1947	Present
Paul S. Johnston	1949	1951
Norman A. Lamont	1951	1954
Howard William Benischek	1954	1955
Harold A. Blum	1955	1957
James Carter (Instructor)	1957	1958
Duane A. Crawford	1958	Present
James Turner Rodgers	1958	1961

ENROLLMENT

The enrollment in the Department of Petroleum Engineering from 1949 to the present is shown in Appendix I. In general, Petroleum Engineering enrollment follows the trend of total

engineering enrollment at Tech. However, the decline that began in 1957 was, in the case of petroleum enrollment, seriously aggravated and accelerated by industry wide layoffs of technical personnel that began in 1957, continuing until 1962. These two factors forced petroleum enrollment, both at Tech and nationwide, to unprecedented low levels by 1964.

After the low of 1964, enrollment at Tech began again to rise. Today the demand for petroleum engineers is probably greater than it has ever been and starting salaries are leading most other branches of engineering. But enrollment is lagging demand so far that it will be years before the requirements of industry are met. Under these circumstances the departmental enrollment cannot do other than recover its proportional place among the several engineering disciplines.

DEGREES CONFERRED

The trend in degrees conferred follows, as would be expected, the trend of enrollment in the department (Appendix I). Since a graduate program in petroleum engineering is only now being established, the Bachelor of Science degree is the only one that has been conferred to date:

DEGREES CONFERRED
(Baccalaureate)

Prior to 1947	80		
1947	7	1958	53
1948	28	1959	57
1949	59	1960	47
1950	63	1961	30
1951	33	1962	17
1952	27	1963	10
1953	27	1964	9
1954	23	1965	1
1955	20	1966	6
1956	20	1967	2
1957	35	1968	4
		Total through 1968	658

PUBLICATIONS

The faculty of the Department of Petroleum Engineering has been productive of publications over the years. To date there have been 25 publications come from the faculty since 1949 (Appendix II). With a faculty of three people this represents an average of 1.25 publications per year for the department, or .42 publications per person per year. This listing does not include technical and editorial work of the staff on the Proceedings of the Southwestern Petroleum Short Course.

BUDGET

The budget for the Department of Petroleum Engineering for each year of the past decade is shown in detail in Appendix III. The totals of those yearly budgets are given below:

	TOTAL BUDGET
58-59	$33,550.00
59-60	33,625.00
60-61	35,175.00
61-62	32,050.00
62-63*	31,945.00
63-64	36,526.00
64-65	39,050.00
65-66	42,480.00
66-67	44,279.00
67-68	50,260.00
68-69**	52,670.00

*$4,440.00 paid from organized Research (3/5 time for Asst. Prof. salary)

**Requested

CURRENT DEPARTMENTAL STATUS

Today the Department of Petroleum Engineering is well on the way to recovery from the reverses of several years ago. Enrollment is increasing, and the test scores of entering freshmen are markedly superior to those of the entering freshmen of several years ago.

Although as yet, the department does not have a graduate program, the plan and structure of a master's program is accomplished and the actual administration of such a program could be initiated at any time with a minimum of difficulty.

ENROLLMENT

The enrollment of the department for the past academic year is given below:

	Fall-67	Spring-68
Freshmen	25	17
Sophomore	19	13
Junior	8	18
Senior	8	9
Totals	60	57
Graduate Students	None	None

FACULTY

At the beginning of the reduced enrollment period in 1961 the number of faculty was reduced to three by the resignation of one who chose to accept employment in industry.

Faculty members have assisted other departments during the periods of minimum enrollment by teaching general engineering courses. This has been instrumental in maintaining competent petroleum engineering faculty and in retaining ECPD accreditation. By maintaining the staff over this difficult period, the department is in a favorable position now that enrollment is increasing.

The present faculty and their nine-month compensations are as follows:

Ducker, William L.	Chairman & Professor	$17,000.00
Johnson, Philip	Associate Professor	13,400.00
Crawford, Duane A.	Assistant Professor	11,500.00

SPACE

The Department is housed in its own two-story brick and masonry structure. The building contains five offices, a reading room, three stockrooms, three laboratories, and two classrooms.

Classrooms are of adequate size and sufficiently equipped to handle the size sections usually scheduled in petroleum engineering courses. The size of the laboratories and classrooms are shown as follows:

Room	Rm No	SPACE Size	Area	Hd Rm	Student Capacity
Production Technology and Drilling Fluids Laboratory	110	28'0"x41'6"	1162 sq ft	12 ft	20
Natural Gas and Reservoir Fluids Laboratory	153	34'0"x34'0"	1156 sq ft	12 ft	12
Reservoir Mechanics Laboratory	205-B	28'0"x38'0"	1064 sq ft	12 ft	20
Classroom	201	33'0"x34'0"	1122 sq ft	12 ft	50
Classroom	205	16'5"x34'10"	572 sq ft	12 ft	35

About one-fourth of the building is air conditioned.

A portion of the gas laboratory is equipped with bookcases, tables and chairs to provide a petroleum engineering reading room for the students. Classrooms are suitably equipped with appropriate visual aids equipment.

A small machine shop is available for construction, repair and maintenance of much of the research and laboratory equipment.

Facilities for laboratory work include modern well-designed laboratory benches arrayed in adequate quarters containing equipment and laboratory apparatus sufficient for undergraduate studies in the various phases of petroleum production, drilling fluids technology, reservoir mechanics and natural gas engineering. In addition, work space is available for the conduct of research.

CURRENT BUDGET

The current appropriated budget (1967-68) for the Department of Petroleum Engineering is as follows:

PETROLEUM ENGINEERING BUDGET

Professor William Lyon Ducker, Chairman	$17,000.00
Associate Professor Philip Johnson	13,400.00
Assistant Professor Duane A. Crawford	11,500.00

Secretary I (115)	$ 3,360.00
Student Assistant and/or Part-time Help	600.00
Maintenance, Equipment and Travel	4,500.00(a)
Total	$50,260.00

(a) Allocation for travel--$750.00

SOUTHWESTERN PETROLEUM SHORT COURSE

The department's principal effort in adult, or continuing, education is the Southwestern Petroleum Short Course.

Late in 1953, upon the recommendation of the department's Petroleum Advisory Board, The West Texas Oil Lifting Short Course was instituted to fill a need for continuing education in petroleum engineering. The first course was held on April 22, 1954. With increased depth and scope, the course name was changed to the Southwestern Petroleum Short Course at the Eleventh Conference. The fifteenth consecutive conference was held in April, 1968.

The Short Course is a mutual effort of the petroleum industry of the Southwest and the Petroleum Engineering Department of Texas Tech, to provide instruction in and a permanent record of, technological advances in petroleum production. This is accomplished by the annual meetings on the campus, and publication of the proceedings of such conferences. The technical papers presented at the Short Course

are unique, important to the industry, and receive wide acceptance.

The technical information and engineering data accumulated in the Proceedings has been well received by conferees, industry and numerous libraries. Each year between 400 and 500 copies of the annual issue are distributed world-wide to individuals, book agencies, producing companies, service and supply companies, research libraries, public libraries, college and university libraries. In addition, each year numerous papers are reprinted for industrial distribution and for republishing by petroleum journals.

The Course is a self-supporting, non-profit organization, with no financial compensation made to any member of the Short Course for his services, nor is any budget assistance required from the College.

Its organization consists of a governing Board of Directors and Administrative Committee composed of members of the industry and the petroleum engineering faculty.

The extent to which this program has achieved its purpose is considered good and is evidenced in the year-to-year support of the petroleum industry of the greater Southwest. Cummulative individual attendance from 1954-to 1968 totaled 5,705 and during the same period 1,714 companies were represented. On the basis of this experience, the members of the Short Course expect to continue this effort indefinitely.

OBJECTIVES AND GOALS

ENROLLMENT

Shown in Appendix I is a projection of enrollment to ten years from this date. Because of the recent perturbations in departmental enrollment (discussed earlier) the recently past enrollment figures afford little or not basis for projection. Therefore the projected range of enrollment that predicts from 150 to 200 in 1977 is a combined subjective estimate of the petroleum faculty, based upon their individual appraisals of the totality of factors they believe to be in control. This projection includes undergraduate and graduate enrollment.

GRADUATE PROGRAM

Beginning in the Fall of 1968 the Department of Petroleum Engineering will be participating in the School of Engineering's Master of Engineering degree program, by offering graduate level course work in petroleum engineering.

Within a year or two after this program becomes established, and depending upon the demand, a strong effort should be made to secure the approval of the Coordinating Board for the establishment of a program leading to the degree of Master of Science in Petroleum Engineering.

Even now the department is prepared to offer minor work in the School of Engineering's interdisciplinary PhD degree program. To what extent the department's participation

in this program will develop within the period covered by this report is difficult to estimate at this time, but any departmental plans for degree programs beyond the Master's level would necessarily depend upon this factor.

Thus, at this time it can be estimated with a high degree of certainty that the Department of Petroleum Engineering will be involved in graduate work on the Master's level very soon. The precise form and extent of such involvement can less readily be estimated.

The department's involvement in doctoral level work is more nebulous and can now only be recognized as a future possibility that must await further developments before it can be considered on an firm basis.

FACULTY

It is estimated that the requirements of the increasing undergraduate enrollment and the developing graduate program will dictate a faculty development schedule as follows:

3	Present Faculty
4	1970-71
5	1974-75

At such time that graduate work and its accompanying research develops, the department will require a full time technician and storeroom manager. The position should be filled at the latest by the time the building expansion is completed (see next section).

SPACE

The present Petroleum Engineering Building was able, in 1956 and 1957, to accomodate, although with crowding, an undergraduate enrollment of close to 500. However, those were years of abnormally high freshman and sophomore enrollment and the number of upper classmen processed by the department was not proportionately high. Nevertheless, it would be unrealistic to aver that additional space would be required in the future for the undergraduate enrollment of 150 to 200 projected by this report.

On the other hand, at such time that graduate work develops, additional space will be required. Plans have already been developed for an 80 feet north wing extension to the building. This would provide additional class rooms, laboratories, stock rooms and a permanent student reading room. The plans were developed in 1957 and are still adequate to the foreseen needs even now.

RESEARCH

The department has consistently, over the years, conducted research on various problems related to petroleum and allied technologies. Only a minor proportion of this work has had formal support, but instead has been carried on with regular departmental supplies equipment.

The faculty is currently investigating methods of injecting raw surface waters into the Ogallala formation.

This work is supported by the state as research project 191-8609, entitled "Application of Water Stimulation and Treatment to Assist Water Recharge in the Ogallala Formation".

The project was initiated to determine feasibility and to develop a technique for hydraulically fracturing or otherwise stimulating water wells completed in shallow unconsolidated aquifers that suffer either natural low permeabilities or have experienced plugging from recharge attempts.

Linear-flow model studies have been conducted to determine the plugging mechanism and fracturability of unconsolidated formations. A research well is equipped to field test both gravity and pressure injection of turbid water. The research site (near Acuff, Texas) also has three observation wells to monitor localized ground water movement.

In November 1967 a research research report (covering the period 1962 through 1965) and a progress report (1966-1967) were published outlining the findings of this work.

The project is being continued to determine immediate and long range effects of injection and retention of recharge water near the injection well. In addition, laboratory studies are underway to determine the recharge flow mechanism, and cross flow effects in horizontal, interbedded, communicable sand layers possessing both air and water permeabilities.

BUDGET

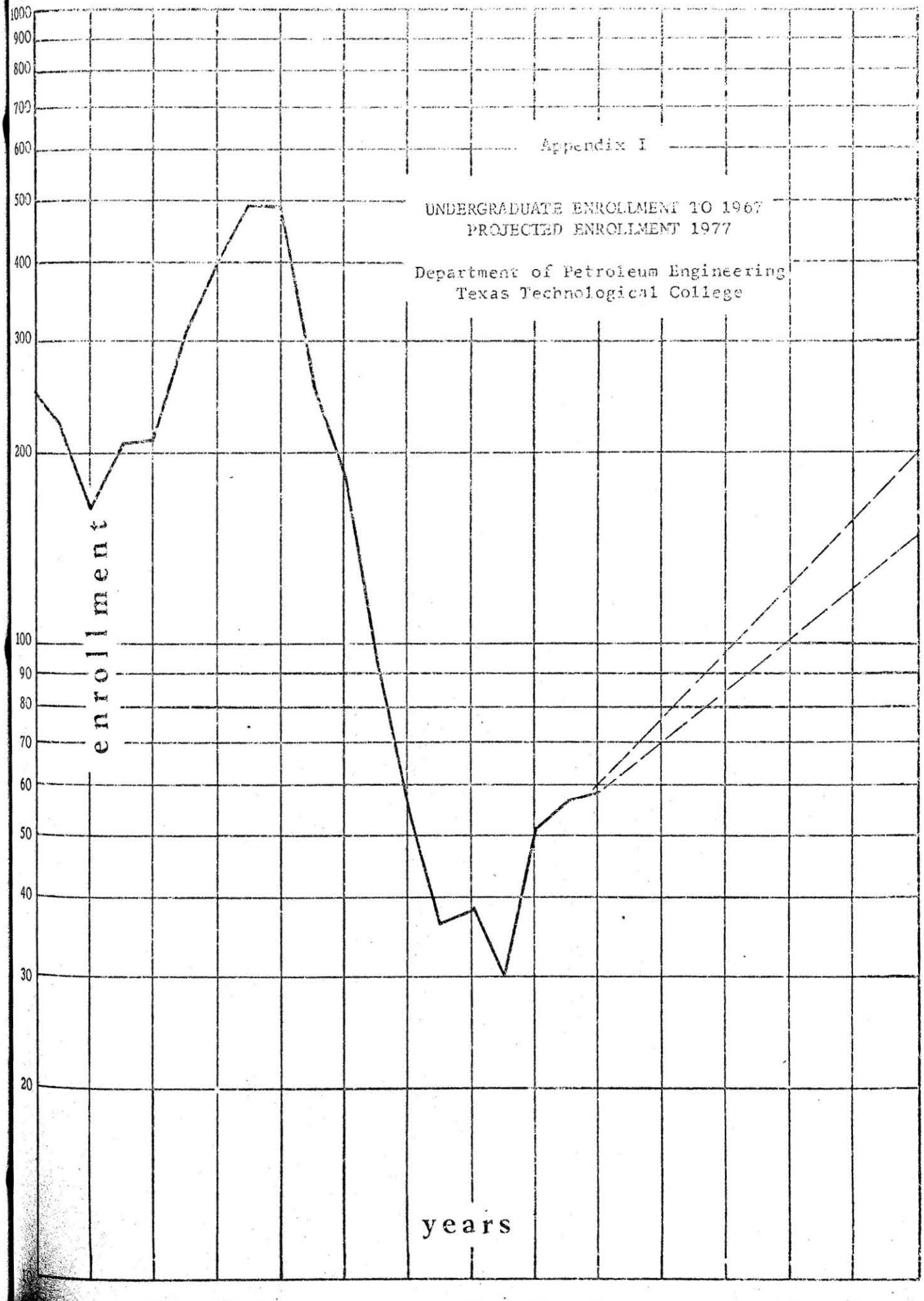
The anticipated budget requirements for future years exclusive of the cost of building expansion, is set forth in detail in Appendix IV. The yearly totals of that schedule are as follow:

1969-70	$55,850	1974-75	$111,910
70-71	74,510	75-76	104,610
71-72	76,810	76-77	108,300
72-73	79,466	77-78	111,200
73-74	81,766	78-79	115,088

The cost of building expansion has not been stated in this report. It is felt that any cost of building developed ten years ago would be completely unrealistic today, and it is further felt that the purposes of this report would not justify at this time the effort necessary to detail those costs on a present day basis. We would instead base such on estimate for 6400 square feet of space on a unit cost of $25.00 per square foot.

Building Addition $160,000.00.

Appendix I


UNDERGRADUATE ENROLLMENT TO 1967
PROJECTED ENROLLMENT 1977
Department of Petroleum Engineering
Texas Technological College
enrollment
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
years
51
53
55
57
59
61
63
65
67
69
71
73
75
77

Appendix II

PUBLICATIONS

BLUM, HAROLD

"Basic Principles and Value of Electric and Radioactivity Log Interpretation," Proceedings of the Fourth West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Texas, p. 38, April 11-12, 1957.

"Casing Program," Part of "Drilling Fundamentals" series, The Petroleum Engineer, p. B72-B94, April 1957.

"Importance and Application of Field Data," Proceedings of the Third West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Texas, p. 140, April 19-20, 1956.

CRAWFORD, DUANE A.

"An Investigation of the Effect of the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sand-face Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origins," Progress Report 1966-September 1967, Texas Technological College, Lubbock, Texas, co-author with Philip Johnson.

"An Investigation of the Effect of the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sand-face Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origins," 1962-65, Engineering Report, Texas Technological College, Lubbock, Texas, co-author with Philip Johnson.

"Economics of Stock Tank Vapor Recovery," Proceedings of the Ninth Annual West Texas Oil Lifting Short Course, Texas Technological College, p. 174-182, April 12-13, 1962.

"Evaluation of the Reliability of Fluid Flow Models for Areal Sweepout Studies," Producers Monthly, 26, p. 18-22, October 1962, co-author with R. L. Slobod.

"Economic Utilization of Stock Tank Vapor," Gulf Oil Corporation, 120 pp., July 1961.

"Reservoir Productivity Can be Improved by the Judicious Application of Sweep Efficiency Principles," Proceedings of the Seventh Annual West Texas Oil Lifting Short Course, Texas Technological College, p. 144, April 21-22, 1960.

"Sweep Efficiencies of Synthetically Consolidated Reservoir Models Using the X-Ray Shadowgraph Technique," The Pennsylvania State University, 1959.

"Sweep Efficiencies of Unsymmetrical Five-Spot Flood Patterns," a report to the Texas Tech Petroleum Advisory Committee on Sponsored Research during the Summer of 1958, pp. 16-41.

DUCKER, WILLIAM LYON

"The Crossroads of Engineering Education," The American Engineer, December 1953.

"The Validity of Knowledge in Science and Engineering," Journal of Petroleum Technology, 17, 521-524, May 1965.

Associate Editor, Section on Hydraulics, Petroleum Production, ed. Thomas C. Frick, The McGraw-Hill Book Company, New York, 1962.

"Natural Gas--The Nature of the Substance," Seminar on Natural Gas, Panhandle Petroleum Land Men's Association, Spring, 1960.

"Limited Equation of State for Gas Yields Simplified Pipelines-flow Formula," The Oil and Gas Journal, 58, p. 94-100, May 23, 1960.

Review of E. N. Kemler, "History of Mechanical Engineering in the Petroleum Industry", Mechanical Engineering, 78, 467-468, 1956.

"A Graphic Method for Solving Gas Pipe Lines Pressure Problems," The Petroleum Engineer, Vol. 22, September 1950.

"On Engineering and Professions, Part I," The Texas Professional Engineer, VIII, August 1949.

"On Engineering and Professions, Part II,"
The Texas Professional Engineer, VIII, September 1949.

JOHNSON, PHILIP

"An Investigation of the Effect of the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sand-face Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origins," Progress Report 1966-September 1967, Texas Technological College, Lubbock, Texas, co-author with Duane A. Crawford.

"An Investigation of the Effect of the Mechanism of Hydraulic Formation Fracturing in Water Injection of a Sand-face Filter Cake Deposited from Waters Carrying High Colloidal and Solid Suspensions of Organic and/or Inorganic Origins," Engineering Report, Texas Technological College, Lubbock, Texas, 1962-1965, co-author with Duane A. Crawford.

"Evaluation of Wells for Re-Fracturing Treatments," Southwestern District, Division of Production. American Petroleum Institute, Paper No. 906-5-F, March 1960.

"Laboratory Manual for Petroleum Production Engineering," Lubbock, Texas, 1959.

RODGERS, JAMES TURNER

"The Fundamentals of Gas Volume and Flow Measurement," Proceedings of the Seventh Annual West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Texas, p. 139, April 21-22, 1960.

Appendix III

Budgeted Funds For Years Indicated
Petroleum Engineering Department

Year	Maint. & Equip.	Travel	Salaries	Student Asst.	Secty or Clerk Typist	Totals
58-59	2085	400	29,500	1565		33,550
59-60	2360	400	29,300	1565		33,625
60-61	2360	400	30,850	1565		35,175
61-62	4350	600	25,900	1200		32,050
62-63	2545	600	27,600 *	1200		31,945
63-64	4676	750	29,900	1200		36,526
64-65	4650	750	32,450	1200		39,050
65-66	3045	750	37,485	1200		42,480
66-67	3045	750	38,200	1200	1084	44,279
67-68	3650	750	41,900	600	3360	50,260
68-69 **	3630	750	43,750	1000	3540	52,670

* $4,440.00 paid from organized Research (3/5 time for Asst. Prof. salary)

Appendix IV

ESTIMATED BUDGET FOR YEARS INDICATED

Year	Maint & Equip	Travel	Salaries	Student Asst.	Secty	Technician StoreRm Mgr	TOTALS
1969-70	$ 4,500	$ 750	$45,900	$1,000	$3,700		$55,850
1970-71(1)	6,000	1,000	62,200	1,500	3,810		74,510
1971-72	7,000	1,000	63,400	1,500	3,910		76,810
1972-73	7,000	1,000	65,900	1,500	4,066		79,466
1973-74	8,000	1,000	67,100	1,500	4,166		81,766
1974-75(2)(3)(4)	18,000	1,200	81,780	1,800	4,330	$4,800	111,910
1975-76	9,000	1,200	83,280	1,800	4,430	4,900	104,610
1976-77	9,000	1,200	86,600	1,800	4,600	5,100	108,300
1977-78	10,000	1,200	88,100	2,000	4,700	5,200	111,200
1978-79	10,000	1,200	91,600	2,000	4,888	5,400	115,088

(1) Graduate Program with four staff members.
(2) $8,000 yearly Maint. and Equip., $10,000 additional office and laboratory equipment when addition to present building is completed.
(3) Graduate Program expansion.
(4) Full time technician and storeroom manager

SECTION II

SCHOOL OF LAW

SCHOOL OF LAW

LONG RANGE PLANS

MEMO *from the* School of Law

Texas Technological College
Lubbock, Texas

August 26, 1968

Dr. Grover E. Murray
President
Campus

Dear Dr. Murray:

Attached please find four copies of Dean Amandes' report on the Goals of the Law School called for in your memorandum of February 15, 1968.

If you have any questions concerning this statement, please feel free to call either Dean Amandes or myself.

Sincerely,

Justin C. Smith
Associate Dean and
Professor of Law

JCS/eg
Enclosures

SCHOOL OF LAW
Texas Technological College

I. Summary Through 1967

In 1963 the Board of Directors of Texas Tech provided for the addition of a School of Law. Subsequently this action was approved by the Texas Commission on Higher Education and by the Commission's successor, the Coordinating Board, Texas College and University System.

An appropriation of $187,300 for the 1965-67 biennium was forthcoming from the 1965 legislature. The first dean, Richard B. Amandes, was hired in February, 1966 and commenced his duties in residence in July of that year. Professor U. V. Jones was employed as law librarian also in February and assumed his residence in Lubbock on August 1, 1966 from which date the development of the law library commenced in earnest. Several valuable gifts of law books had been received on behalf of the law library prior to this date but these had been placed in storage awaiting the arrival of our law librarian.

On his arrival the culling, cataloging, and general processing of these books and additional gifts began. The book budget for fiscal 1967 was a meager one, but with this and these gifts the law library did open for the fall semester of 1967 with 19,956 well selected volumes.

Instruction commenced in the Fall of 1967.

Faculty

I

RICHARD BRUCE AMANDES, Dean of the School of Law and Professor of Law, appointed July, 1966.

A.B., University of California, 1950; J.D., University of California, Hastings College of the Law, 1953; LL.M., New York University, 1956. Admitted to practice in California, Texas, and Washington.

MARTIN ALAN FREY, Assistant Professor of Law, 1967.

B.S.M.E., Northwestern University, 1962; J.D., Washington University, 1965; LL.M., George Washington University, 1966. Admitted to practice in Missouri.

U. V. JONES, Associate Professor of Law and Law Librarian, 1966.

B.A., University of Oklahoma, 1939; LL.B., 1941; M.L.L., University of Washington, 1952. Admitted to practice in Oklahoma.

MAURICE BLAKE KIRK, Professor of Law, 1967.

A.B., Indiana University, 1943; J.D., 1952; LL.M., New York University, 1957; J.S.D., 1963. Admitted to practice in Iowa.

GLEN W. SHELLHAAS, Professor of Law, 1967.

A.B., Ohio State University, 1941; J.D., 1943. Admitted to practice in Ohio, Texas, and Wyoming.

JUSTIN C. SMITH, Associate Dean and Professor of Law, 1967, 1968.

B.S., Lawrence College, 1950; J.D., University of Wisconsin, 1954; LL.M., 1959. Admitted to practice in Ohio, Oklahoma, Texas and Wisconsin.

Budget

	1965-66	1966-67
Faculty & Administrative Salaries	$ 6,666.00	$64,442.00
Classified Personnel	700.00	13,099.00
Library Purchases	500.00	86,779.00
M.E. & T.	3,500.00	7,980.00
Search for Dean	3,634.00	--
	$15,000.00	$172,300.00

II. 1967-68

Instruction commenced in the Fall of 1967 with a first year class of 71 students. Sixty-eight of those 71 remained for the entire year, and a surprisingly high number, 62, successfully completed the first year. During 1968-69 and later years, supplemental courses will be added to complete the standard three year curriculum. Students in the first entering class will be eligible for graduation upon completion of the course of study in 1970. The program embraces only full-time instruction, and no evening division is contemplated. Ultimately three sections of 75 new entering students are planned each year, which will produce a student body of approximately 600 students.

The law library now has over 33,000 volumes. We hope to be able to continue to increase our collection at about 1,000 volumes per month so that we will have 45,000 volumes by the Fall of 1969. During 1969-70 we hope to continue to increase at a greater rate than 1,000 per month so that we will during this year meet our goal of at least 60,000 volumes. The proposed minimum standards of the Association of American Law Schools, which are almost certain to be adopted soon, require a law library of at least 60,000 well selected volumes.

The law library now has several thousand volumes in storage which are not presently included in our collection. These stored volumes are duplicates of those now on our shelves, which while not needed now, will be needed when our student body has increased and our new facilities give us sufficient space for them. These stored volumes, together with the appropriated money we have requested, should put us over this 60,000 volume goal. After we have attained this goal, we hope to continue to expand our holdings both in breadth and depth so that our law library will be recognized as a truly great research library.

Faculty

II

RICHARD BRUCE AMANDES, Dean of the School of Law and Professor of Law.

MARTIN ALAN FREY, Assistant Professor of Law.

U. V. JONES, Associate Professor of Law and Law Librarian.

MAURICE BLAKE KIRK, Professor of Law.

ELIZABETH MARTIN LEEMAN, Assistant Professor of Law and Assistant Law Librarian, appointed December, 1967.

A.B., Winthrop College, 1928; M.A., University of Texas, 1939; J.D., St. Mary's University, 1953; M.L.L., University of Washington, 1961. Admitted to practice in Texas.

GLEN W. SHELLHAAS, Professor of Law.

JUSTIN C. SMITH, Associate Dean and Professor of Law.

Professors	4	$86,000.00
Associate Professor	1	15,000.00
Assistant Professors	2	23,500.00
	Total compensation	$127,700.00*

* * * * *

ERWIN A. ELIAS, Professor of Law, 1968.

B.S., Marquette University, 1954; J.D., 1956; LL.M., University of Michigan, 1957. Admitted to practice in Texas and Wisconsin.

MURL ALTON LARKIN, Professor of Law, 1968.

LL.B., Southeastern University, 1939. Admitted to practice in the District of Columbia.

WALTER RAY PHILLIPS, Professor of Law, 1968.

A.B., University of North Carolina, 1954; LL.B., Emory University, 1957; LL.M., 1962. Admitted to practice in Florida and Georgia.

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*Includes teaching and administrative salaries.

WILLIAM REED QUILLIAM, Professor of Law, appointment effective January 27, 1969.

B.A., University of Texas, 1940; B.B.A., 1951; LL.B., 1953. Admitted to practice in Texas.

CORRIE THOMAS REESE, Assistant Professor of Law, 1968.

B.S., Sam Houston State College, 1956; LL.B., University of Houston, 1966. Admitted to practice in Texas.

Space

The School of Law is currently housed in several former barracks buildings purchased and moved from Sheppard Field, Texas. Three of these buildings (each 30' x 80') were joined together into one large building to serve as the law library. They were designed to provide ample space for eighteen months until our permanent quarters were completed. Because we shall remain in our current quarters for another fifteen months, they are now wholly inadequate.

Immediately adjacent is another building of the same size to serve as an administrative and faculty office building. It contains five faculty offices, an office for the dean, two secretarial offices and a faculty conference room. Classes will be held in another building of the same size, two buildings removed from the office building. The classroom is approximately 30' x 30'. Half of another similar building serves as the locker room and law school commons for the students.

Since we will be in our current quarters approximately two to two and one-half years after the commencement of instruction, we have requested additional space which is needed mostly for library purposes. The 1966 accreditation requirements for library holdings have been raised substantially, now totaling 60,000 volumes for

membership in the Association of American Law Schools. As a result we have had to add volumes to our collection at a substantially faster rate than originally contemplated and will have to continue to do so during the coming year. We recently made arrangements with Sylvan Dunn to fill the approximately 75 sq. ft. of floor space which was made available through alterations in his area. There remains in addition in the main library not more than 50 sq. ft. which Mr. Janeway indicates we may use for storage pending completion of our building. These spaces will not accommodate all the books currently on hand and in boxes in our law library so that all remaining books acquired must be stored in some area on campus or put on shelves. Our new order of stacks has just arrived and when assembled will displace a substantial part of our current law library reading area. It is substitute space for this displaced reading area which we will need and which has been requested for the academic year 1968-69.

Research Activities

Several members of the faculty have been engaged in research activities during the past year. Professor Smith has researched and published in the medical legal area; Professor Frey in the juvenile area as well as in connection with his service as an advisor to the Family Code Project for the State Bar of Texas. This summer Professor Elias has been undertaking research in connection with the preparation of a casebook dealing with Texas local government law and Professor Phillips is hard at work revising various parts of Professor Moore's multi-volume treatise on federal practice.

Publications

RICHARD B. AMANDES, Dean and Professor of Law

THE USE, MISUSE AND REUSE OF THE JURY. Vol. 34, Insurance Counsel Journal, p.614, 1967.

LAW AND DORMITORY HOUSING, University Daily, May 10, 1968.

Examination Questions, State Bar of California, March, 1967.

TECH LAW SCHOOL, State's Eighth School of Law Opens in Lubbock. Vol. 30, No. 8, Texas Bar Journal, September 22, 1967.

Newsletters, Texas Tech Law School Foundation, March, June, 1968.

MARTIN A. FREY, Assistant Professor of Law

"The Effect of the Gault Decision on the Iowa Juvenile Justice System." 17 Drake L. Rev. 53 (1967).

In progress: "The Effect of a Delinquency Adjudication on Subsequent Criminal Prosecutions."

"The Juvenile Court's Failure to Separate Adjudication from Disposition: A Study of Commitment Without Proof of Guilt."

U. V. JONES, Associate Professor and Law Librarian

Contributor to supplement and assignments to accompany Pollack, Fundamentals of Legal Research. Third Edition. 1967.

GLEN W. SHELLHAAS, Professor of Law

Edited and prepared mimeograph material on Common Law Forms of Action for use in orientation.

In progress: "Texas and Federal Discovery Compared." (To be used in a speech to South Plains Trial Lawyers Association, October 3, 1968.)

JUSTIN C. SMITH, Associate Dean and Professor of Law

"Legal Vulnerabilities in Handling Student Records," American Personnel and Guidance Association, April, 1966.

"Conflict of Interest Between Investigator and Sponsor," National Association of College and University Attorneys, Proceedings of Sixth Annual Meeting, July, 1966.

"Project Research and the Universities" (with J. Munster) LAW AND THE SOCIAL ROLE OF SCIENCE, the Rockefeller University Press, 1967.

Article on Tech School of Law, Texas Bar Journal, Vol. 30, No. 10, Nov. 22, 1967.

"Man and His Land" (with Dan E. Feray), The Texas Techsan, February, 1968.

"Human Laboratory Animals: Martyrs for Medicine?" Fordham Law Review (with Marian Ratnoff), Fordham University Press, May, 1968.

Examination Questions, State Bar of California, March, 1968.

In Progress: "The Legal Problems Associated with the University Sponsorship of Exchange Programs," College and University Administration Handbook, McGraw-Hill.

Continuing Education Activities

Last October we held our first medical institute for lawyers and Professor Smith has been busy for several months in preparation for the second annual medical institute to be held on Saturday, September 28, 1968. He has also been engaged in preparations for a seminar on Law and the Coastal Margin to be held at Brownsville, Texas the following week and has also been assembling data for a seminar for Foundation executives planned for the coming year.

Budget

	1967-68
Faculty and Administrative Salaries	$ 127,700.00
Classified Personnel	36,360.00
Student Assistants and Part-time Help	7,448.00
Library Purchases	130,000.00
M. E. & T.	33,595.00
	335,103.00
Summer Teaching Salaries, 1968	10,471.00
	$ 345,573.00

III. Goals and Objectives

In order to assist those involved in the financial compilation of these reports, financial data has been projected for 1973 and 1978, five and ten years hence as requested. So far as this narrative is concerned, however, it seems more appropriate to make particular mention of 1975-76, and to a lesser degree 1970-71. With respect to 1975-76, the School of Law should be functioning at optimum size both in terms of utilization of our new law school structure and with a full complement of faculty. According to the current plans, 1970-71 will be the first full academic year during which our new building will be available to us.

Throughout the development of plans for the School of Law, the projections have been to add one year of course work or an additional section of the first year class per year from 1967 through 1975-76. More specifically, our first section of the first year commenced in the Fall of 1967; second year work is being added this year with third or senior year work added in 1969. Because the contract completion date on the new law school building is not until November 15, 1969, even were the demand to exist we would not feel in a position to accept a second section of the first year class along with our second and third year sections in the Fall of 1969. Progressing in accordance with the above schedule, by the end of 1972-73 we will have two sections of 75 students each through the three year law school curriculum and a student body of approximately 390 to 400 students. Developed along with the enlarging student body will be active programs in trial and appellate court work, law review, the Student Bar Association and activities in conjunction with the local bench and bar. If a law school is to remain viable in the society and

legal milieu into which it is supplying graduates, it must remain in touch with that society and the bar which serves it.

In general no dramatic change in the direction of the curriculum is contemplated in the forthcoming years. A curriculum committee has been at work since last month preparing a tentative draft of a course schedule to be offered during 1969-70 and future years. As the faculty is enlarged in the coming years, attention will be given to seeking individuals with interests in developing areas. For example, although we are offering no courses in either area during the coming year, we have on the faculty at the present time men interested in and capable of offering courses in international law and the place of computers in the law.

In the process of adding additional sections of the first year in 1970 and 1973, some switching of course offerings on the part of the faculty will be necessary. However, planning in this direction is continually in progress and no difficulties are foreseen. In the immediate future it is hard to predict with any degree of assurance (as a result of the military situation) the number of students who will be in the student body, but considering the increase in the number of applications this year over that in our first year of operation, in the absence of a major escalation of military activities no great disruption in student enrollment is foreseen. Further, transfer students, even this coming year, will help to assure a normal sized student body. None of our first year students have taken any steps to transfer to other law schools and we have three transferring to us, one who ranked first in his class, one who ranked second in hers and a third who had a B average in the school from which he comes to us.

As was the case this year we contemplate continuing to offer instruction in

the summer. Several law schools in Texas contemplate that many if not all of their students will pursue their legal education throughout the calendar year. Although we do not contemplate such a program, because we are competing for the same students as these other schools, we must make the opportunity available to our students to accelerate their graduation from June to January or December of their third academic year. As distinguished from our first summer program this past year, we contemplate in the future two five- to six-week sessions each summer, gradually increasing the number of courses available to those students who wish to attend summer school. Student enrollment in summer school is difficult to predict in even what might be called normal times. Until we have a few years of experience with our student body we will be unable to predict the number of courses which should be offered. Roughly one-fourth to one-half of the total student body probably will enroll for one or more classes during the summer. This summer 21 of our eligible 62 students completed at least one course in the summer session. Several others were forced to withdraw as a result of military commitments.

The projection of our enrollment through 1975-76 is listed on page 13.

Once our preliminary complement of faculty to teach all the necessary courses for a three year curriculum is completed with the 1969-70 academic year, the addition of three faculty members per year through 1975-76 is contemplated. Each of those years we will be adding the equivalent of at least 30 student contact hours necessitating at least two and one-half additional professors at the planned maximum teaching load of twelve semester hours per year. The additional time of the half professor will be devoted to broadening the elective curriculum offerings, offering specialized seminars, special projects such as voluntary defender and legal aid programs, additional administrative assistance, etc.

ENROLLMENT

	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
First Year	75	75	75	150	150	150	225	225	225
Second Year		60	60	60	120	120	120	180	180
Third Year			60	60	60	120	120	120	180
	75	135	195	270	330	390	465	525	585

1975-76. As mentioned above, the year 1975-76 was chosen for this narrative description for at that time the School should be operating at the planned optimum level in our permanent quarters. The first class which will have been composed of three sections of the first year will have completed its legal education and the student body should be in the range of 585-600 students. Assuming that the currently planned rate of faculty growth, three professors per year from 1970-71 through 1975-76, is followed, the School of Law will have a faculty of approximately 34 full time people with five of them devoting a significant portion of their time to administrative work in the dean's office or the library.

In order to assure a reasonable balance amongst senior and junior members of the faculty, it has been our contemplation that starting in 1970-71 we would add one professor, one associate professor and one assistant professor per year through 1975-76. Considering those currently on the faculty and probable promotions, that would produce a faculty in 1975-76 of twenty-one professors, nine associate professors and four assistant professors. Included in those figures are those intended to devote part of their time to administrative work either in the library or in the dean's office.

In line with the policy mentioned above of continuing contact with the bar and the society it serves, many research and consultive activities are contemplated beyond those of current members of the faculty. Areas in addition to those mentioned above include Professor Hemingway's research interest and activities in the oil and gas area; Professor Larkin's active interests and activities in connection with military evidence and military law; Professor Phillips' intimate association with Professor Moore in the development of federal bankruptcy law in addition to

his work with federal procedure generally; and Professor Stevens' active participation in the work of the accrediting agency of the American Bar Association as well as other bar activities. Further, as soon as Professor Guilliam joins the faculty, we contemplate an active program in legislation, an area which has been largely ignored by other law schools in Texas.

Professor Shellhaas has in the past been active in voluntary defender programs, but with only first year students to date, we have not been in a position to develop anything to take advantage of Professor Shellhaas' expertise in the area.

Inherent in these research activities are accompanying continuing legal education programs, ultimately probably something in the nature of four to six per year. Hopefully they will be in some of the same fields annually in order that Texas Tech may be known for its expertise in these particular areas, whatever they may be.

BUDGET

School of Law	1972-73	1977-78
Faculty		
Teaching	$ 444,344.00(a)	$ 747,741.00
Administration	50,725.00	62,180.00
Classified Personnel	72,780.00(b)	132,860.00
Student Assistants	6,900.00	9,600.00
Travel		
Faculty	10,284.00	19,749.00
Administration	5,158.00	6,705.00
Maintenance & Operation	24,500.00(c)	34,300.00
Capital Outlay	6,320.00	8,848.00
Library		
Professionals	39,560.00(a)	53,250.00
Classified Personnel	29,950.00(b)	42,300.00
Student Assistants	11,270.00	15,806.00
Books & Periodicals	78,652.00	105,254.00
Travel	3,300.00	4,100.00
Maintenance & Operation	6,350.00(c)	7,860.00
Capital Outlay	4,800.00	5,650.00
	$ 794,893.00	$1,256,203.00

(a) In computing faculty salary figures, 5% per year has been added to the total figure as a cost of living increase with no thought to whether that sum would go into take home pay or fringe benefits. Starting in 1970-71, an additional $50,000 per year has been budgeted for the three new faculty each year, in contemplation of starting salaries of $20,000, $16,500 and $13,500; commencing in 1973-74, the total beginning sum for the three new positions annually through 1975-76 was raised $2,500 to $52,500.

(b) In computing salaries of classified personnel and student assistants, 7% per year has been added pursuant to a discussion with Mr. Wendell Tucker that to remain competitive, Tech must increase these salaries at better than the 5% or one step per year rate. Additionally, extra positions are included to service the new faculty positions.

(c) M.E.&T. increases were also included at a 5% rate in addition to a few specific items which can be projected, i.e., additional copying equipment.

Conclusion

Because according to the planned projections discussed above, we will be at full capacity in 1975-76, it is not here contemplated that any additional professors or students would be added through 1978. If applications for the School of Law continued to increase for some years it would be possible to raise the entrance requirements slightly annually thereby improving the quality of the student body and its graduates. It may be, too, that a graduate program in certain phases of law should be undertaken starting in 1977, but until a fully operating logically developed basic three year program is fully underway, it would be inadvisable to consider graduate legal studies.

September 1, 1968