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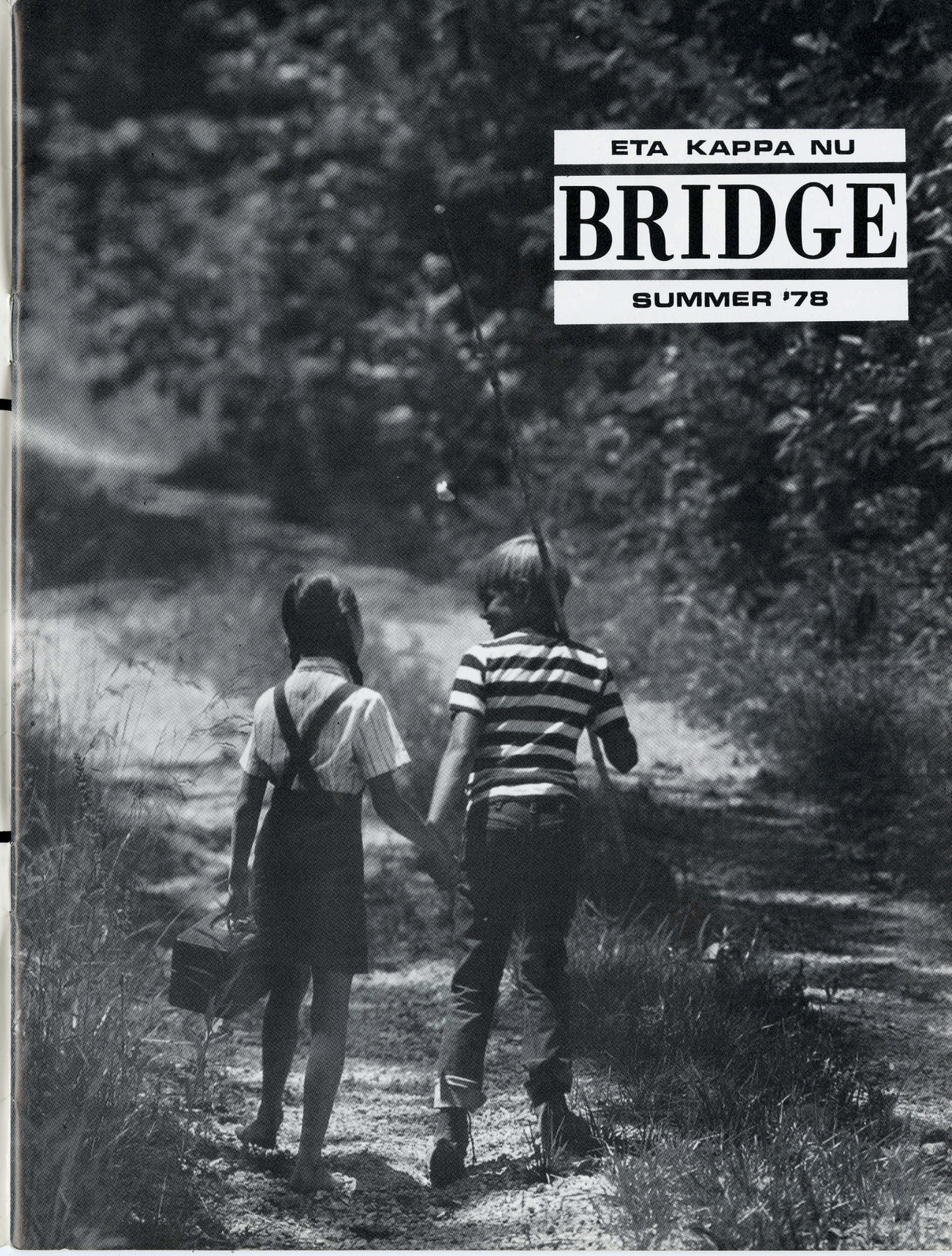

ETA KAPPA NU

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Electrical Engineering Honor Society
August, 1978, Vol. 74, No. 4

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The BRIDGE is published by the Eta Kappa Nu Association, an electrical engineering honor society. Eta Kappa Nu was founded at the University of Illinois, Urbana, October 28, 1904, that those in the profession of electrical engineering, who, by their attainments in college or in practice, have manifested a deep interest and marked ability in their chosen life work, may be brought into closer union so as to foster a spirit of liberal culture in the engineering colleges and to mark in an outstanding manner those who, as students in electrical engineering, have conferred honor on their Alma Maters by distinguished scholarship activities, leadership and exemplary character and to help these students progress by association with alumni who have attained prominence.

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Impact of Government Funding on Engineering Colleges

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Forms of government funding over the last twenty five years have had an adverse impact on engineering colleges in that they contributed substantially to the shift of engineering education and research away from the needs of the industry. To remedy this situation, it would be desirable to modify the current funding format of sponsored research by government agencies and to introduce the degree bachelor of engineering, a degree whose background would be more in concert with the expressed and actual needs of the industry than a degree whose background seems to emphasize preparation for graduate study.

Introduction

It is extremely difficult to prove unequivocally impacts of social nature, particularly those that seem to have beneficial effects in the short term. It took decades to recognize that many of the educational innovations have not had the best impact on the primary and secondary level in spite of some relatively early critics of those techniques (1,2,3). Whether the deterioration of educational standards was due solely to those changes, one cannot really tell, for there are many interrelated factors that contributed to changes not only in the educational system, but in the society as a whole. Belatedly, some school districts and states are beginning to require competency demonstration prior

to promotions from grade to grade, and prior to graduation from high schools. In view of the large percentage of high school graduates who enter colleges, it is somewhat surprising that such deficiencies have not been noticed earlier; but, on the other hand, college admission requirements have been satisfied inasmuch as generally the better students were those who continued with their education.

In the case of the impact of government funding, the situation may be somewhat similar in that it will take many more years before the adverse effects of such funding will be generally recognized in spite of the fact that there are already indications that such funding may not have been as beneficial in the case of engineering colleges and profession as it appeared: decreases in the rate of patent applications and issue in spite of tremendous growth of expenditures for research and development: relative decline in engineering enrollments; growth of schools of technology: and others.

It would be presumptuous in our contemporary society to ascribe its trends or characteristics to one factor alone. The main reason for this is the complexity of our society and the degree of interaction between the many social factors, accelerated and amplified because of ease of communication and of travel. Nor do many of the available data lend themselves to an unique interpretation. As a result, it is necessary to review some of the probable causes of a given effect and to try to present a reasonable, self-consistent hypothesis on the basis of available evidence. In such a review and formulation of a hypothesis, one cannot divest himself completely of the influence of one's background and experience; but what one must do — or at least try to — is to avoid conclusions based on vested interest or on wishful thinking. Thus, one must learn — and this can be acquired reasonably easily by familiarizing oneself with the history of various trends and their effects — to temper the assessment of long-range impacts with much more than the short-term evidence.

In what follows, an attempt will be made to justify the hypothesis that the long term effects of government funding of R & D on engineering colleges has not been good because it has contributed to unnecessary expansion of staffs and facilities, to reorientation of research and curricular emphasis which, in turn, contributed to a change of relations between the colleges and industry.

A Brief Historical Perspective

Until the post World War II period, engineering used to be associated more with doing than with reflecting, more with action than with scholarly pursuits. Engineers were people who built roads, bridges, railroads, power plants, transmission lines, etc. In the process, they relied more on handbook information, experience and rules-of-thumb than on direct application of fundamentals. In the process, they discovered improvements in methods, modifications of end products and sometimes even new products or devices, though the latter was more within the province of "inventors." if one may make such a separate classification.

Technological developments of the Second World War which came about as a result of application of fundamental principles of physics, e.g. the atomic bomb, and some of the post-war developments of similar nature, i.e. information theory and coding, the transistor, the computer, systems analysis, etc., modified the earlier engineering approach and education by incorporating both more basic sciences and at a more sophisticated level than before. Engineering research in colleges, most of it funded by various government agencies, began to have its goals predetermined and the process systematized, with concomitant growth both in size as well as in the number of research institutes or other establishments as a part of, or an adjunct to, respective colleges.

In the late sixties, another dimension was added to engineering: great concern for the environment, for technological impact, and for other societal factors. As a consequence, many of the concerns and activities of current engineers and engineering educators are now substantially different: on the one hand, they are in response to social pressures and changes within and without the profession, an expected, normal and desirable process. Changes caused by the funding patterns, on the other hand, have been accelerated and, among others, have been more concerned with preparation of students for graduate study than for practice in industry.

Some Statistics Related to Government Funding

There are at least two aspects of government funded research. One is the compliance with a number of regulations depending upon the particular funding agency. This, though expensive both in terms of money and man-hours (4) is not under consideration here.

The second, the dependence on the direction, process, and aims of the research on a particular funding agency, and on a particular project monitor, are of concern here and will be discussed in terms of some of the available data, personal observations and inferences.

Federal funds to universities and colleges for the performance of research and development and for basic research (sic!) increased nearly fourteenfold from nearly 170 million dollars in 1955 to nearly 2.3 billion dollars in 1975 in constant (1972) dollars; and to research centers nearly fivefold during the same interval from about 180 million dollars to nearly one billion dollars (5). Federal obligations to engineering R & D rose from 690 million dollars in 1960 to over two billion dollars in 1975 (6). In the same period (1955 to 1975), industrial expenditures for R & D rose about fivefold from over 4.5 billion dollars to over 24 billion.

At the same time, the number of engineering degrees conferred at the bachelor level rose from about 27,000 in 1955 to nearly 51,000 in 1974; at the master's level from about 4,500 to over 15,000; and at the doctor's level, from about 600 to over 3,500 (7). (It must be noted that the 1955 bachelor degrees represent a substantial drop from the nearly 53,000 such degrees conferred in 1950. This may be attributed in part to many veterans who enrolled following the cessation of WW II hostilities.) The recent numbers actually represent a relative, and also an absolute decline, as shown in Table I.

In 1974, there were 50,693 engineering degrees conferred at the bachelor level; 15,385 at the master level; and 3,312 at the PhD level.

The number of patent applications rose only from about 380,000 in the five year interval 1951-5 to slightly over 540,000 in 1971-5; whereas the number of patents issued, did not even double during the same period (8), as shown in Table II.

Clearly, depending upon a point of view, different statistical inferences can be made, statistics being defined as mendacious truth (9). For instance, in attempting to prove safety of the various transportation means, one uses passenger-miles to prove air travel safety; but the number of operations to prove automobile travel safety. It is instructive, however, to include numbers of patents in impact consideration of government R & D funding as one of possible measures of ingenuity, or creativity. Note that statistics are frequently used to support rather than illuminate (10).

In spite of the tremendous growth of expenditures and obligations for R & D, doubling of engineering BS degrees, quadrupling of MS degrees, and a nearly sixfold increase in PhD's, the total number of patents granted has not quite doubled in the period under consideration. At the same time, the number of US patents granted to foreign corporation increased eightfold; and those granted to foreign country residents, at least threefold. There could be a number of reasons for that, e.g. changes in patent laws and regulations here and abroad; changes in tariffs, quotas, and trade balances; currency adjustments, and many others. On the other hand, there

Table I
Degrees Conferred

	1955	1960	1965	1969	1970	1971	1972	1973
All degrees (in 1000)	354	479	668	990	1,073	1,148	1,124	1,280
Engineering: BS	22,445	37,679	36,485	41,248	44,479	50,046	51,164	51,265
MS	4,483	7,159	12,055	15,240	15,593	16,443	16,960	16,619
PhD	599	786	2,124	3,377	3,681	3,638	3,671	3,492

Table II
Patents Issued

	1951-5	1956-60	1961-5	1966-70	1971-5
Patents issued	208,964	251,872	275,443	342,889	396,668
Inventions	192,651	237,469	259,971	325,144	375,532
Corporations:					
U.S.	100,278	133,948	152,537	190,616	192,911
Foreign	10,537	21,043	30,992	52,771	86,005
U.S. Government	3,359	5,889	6,497	8,254	8,579
Individuals					
U.S.	78,459	76,589	69,945	73,503	88,037
Foreign Country Residents	Not Available	36,513	48,322	75,986	119,282

may also be other reasons, less profound but nevertheless no less valid: "We have grown so accustomed to looking for *deeper* causes of everything that we fail to consider even the possibility of *obvious* ones (11)."

As pointed out in the introduction, societal trends in contemporary society cannot legitimately be explained either uniquely, or in terms of one factor alone. There are instances, however, that there is enough evidence, pointing to one major factor. This is particularly true when the factor is of economic nature, and contributes to expansion and growth, used as synonyms for "good," according to the widely accepted myth. Data can support almost any particular point of view dealing with the impact of government funding of research; but an attempt at a reasonably objective assessment of it, if it at all has any semblance of reason and logic, should not be rejected out-of-hand.

In spite of the tremendous growth of professional publications and claims of galloping knowledge, Newton's laws and Maxwell's equations are as applicable now on an engineering scale as they ever were, even when one wants to nitpick and apply relativistic corrections to the former. We may have developed new techniques, but except for hand-held calculators, electronic watches, and copying machines, we have not had substantial engineering developments, e.g. less cumbersome emission controls, simpler automobile safety devices, effective internal combustion engines operating on different fuels, etc.

Discussion

As it is frequently the case, beginnings are usually good. With government funding, initially many of the facilities were rejuvenated, faculty and students imbued with new vigor. Proposals were of modest financial size, and even though there were only few schools that boasted substantial unrestricted institutional grants, other research was relatively broad and fairly flexible. In the normal course of events, the size of the research budget grew and presumably required greater control and accountability. It was then necessary to increase the personnel of the funding agencies with a concomitant growth of procedural details, whether related to proposals or reports. The inexorable positive feedback of social systems was initiated (12), and Parkinson's law, or Peter Principle (13) went into operation. Eventually, it became more convenient to administer few large grants than many small ones; but to occupy the funding personnel, more detailed procedures and forms were devised requiring in turn, an appropriate increase in supporting personnel to the research teams.

In the meantime, on campuses there emerged "the researcher," the individual who was successful in securing grants, the project director, the principal investigator. This created new autonomous units (14) with more or less substantial budgets, whether soft or hard monies, and consequently with substantial clout outside the usual academic channels. Research projects eventually led also to the proliferation of specialized courses to provide suitable backgrounds for graduate students who were to be employed in the projects.

While these changes were taking place on campus, with engineering education shifting its emphasis to graduate work and becoming more science oriented, the tendency to fund larger, but fewer projects shifted more of the research control to the funding agencies and their project monitors. At the same time, it also modified the peer review system by reducing the number of peers, not unlike the process leading to elections to the National Academies (15). As a consequence, it became relatively easy to control the direction of research whether unobtrusively via particular RFPs, or more blatantly via special programs such as Interdisciplinary Research Revelant to the Needs of the Society, Research Applied to National Needs, or the like. Furthermore, whether because of greater ease in administration, or some other reasons, it became easier to extend and/or renew projects than start new ones. And finally, reports, voluminous, verbose reports started taking place of substantial outputs, substantial and concrete results because, to paraphrase Burns (16), the means became elevated to the status of ends.

The situation became as follows: government directed reserch; additional automous units on campus, enlarged staffs and facilities; discretionary soft monies available to project directors and, through overhead costs, to university administration who, as a result, became interested in more projects. Also, as the project director became the important persons on the campus, the quality of educators and administrators seemed to be going down (17). Engineering curricula became preoccupied with preparation of students for graduate study, and graduate courses often became specialized for particular projects.

These changes in the background of neophyte engineers were not immediately discovered because in the 50's and early 60's the industry was developing new products, technology was changing with new materials, electronics, and in the presence of large demand. But as the demand started leveling off, as government research funds became less readily available, it was becoming more and more evident that engineering education had departed from the needs of the industry.

What evidence can one offer to substantiate the foregoing hypothesis? First, one can note the relative decrease of patent applications and issues (see Table II); second, increasing concern about the well being of science (18); and finally, the tremendous growth of schools of technology whose graduates fill the badly needed positions in industry that should possibly have been filled by engineers.

Conclusions and Recommendations

Engineers become engineers mostly because they would like to. Certainly a substantial number of engineering students could qualify for admission to medical or law schools. That they do not choose to do so suggests that their interest are, by and large, different from those who pursue other professions. Consequently, it seems to me futile to belabor the point that there are not enough engineers in legislatures, or that not enough engineers hold public offices. Apparently, most engineers are not interested in such positions, else they would have pursued them more vigorously. This seems rather obvious (11). Given this, it would be desirable to provide aspiring engineers with a background suitable to the needs of industry. One possibility would be to create a new degree called Bachelor of Engineering with an appropriate curriculum that would consist of less science and mathematics than the current Bachelor of Science in Engineering, but of more design, quality control, management, even accounting. Another possibility would be to return to less government-controlled research funding pattern, a suggestion that, unfortunately, has nil probability of realization because this would also suggest a reduction in staffs of the funding agencies. Difficulties that seem to be encountered by the domestic automobile industry in meeting emission control and efficiency levels; meeting design safety (e.g. Brown's Ferry plant fire); recall of numbers of products suggests that systems analysis is not the answer (19), and maybe, the obvious answer lies in a more engineering oriented engineering education, "to strike a proper balance between science and art." (20)

Quite obviously, the foregoing barely scratches the surface of the problem. I think, however, that there is enough evidence to suggest a careful rethinking of the place of government supported research in engineering colleges. Time and again we are beginning to find out that what may have seemed beneficial initially, either had undesirable long range consequences.

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CALIFORNIA AWARD DINNER

by Herbert Summers

Photos by Ada Dodson and Colleen Hamilton

About 80, of which 25 were students, attended the awards dinner on August 5, 1977 at the Disneyland Hotel in Anaheim, California. The event was sponsored by the Los Angeles Alumni Chapter whose president, Walter Williams, was chairman and Master of Ceremonies. Other distinguished guests were Marcus Dodson, National President; Albert Hauser, V.P.; Paul Hudson, Executive Secretary and Earl Eyman, immediate past president. These comprised the National Executive Council. The National Board of Directors, Robert Betten, William Johnson, Sidney Parker, Ronald Phillips, Willard Rusch and Alan Stoudinger were also present. In addition, Larry Hamilton, chairman of the award committee, Carl Koerner, Past President of H.K.N. and a number of other notables were there.

All six "honorable mention" students came from eastern universities to the meeting. These were: Peter Berntson, U. of N. Dakota; William Merwin, N. Carolina State; Neil Midkiff, U. of Missouri-Columbia; Maureen Quirk, Lehigh U.; Michael Reed, U. of Texas, Arlington and Linda Sims, Purdue. All are members of Eta Kappa Nu.

A social hour preceded an excellent dinner, after which came the award ceremonies, introductions and speeches. Principal speakers, other than the chairman were Larry Hamilton, Marc Dodson, David Welter, the award winner and Carl Koerner.

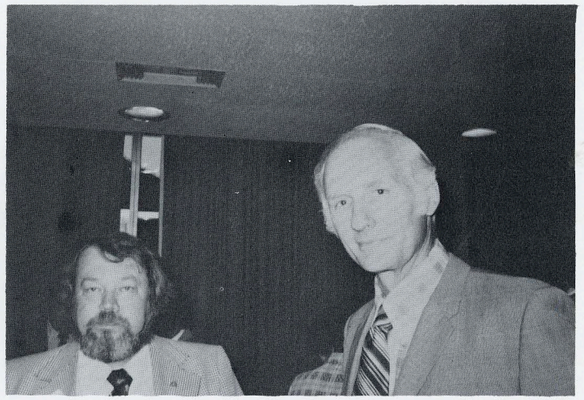
Mr. Welter, of the University of New Mexico, is a member of Eta Kappa Nu, Tau Beta Pi, Phi Eta Sigma, the American Nuclear Society and I.E.E.E. Has been president of the Delta Omicron Chapter of HKN at the U. of N.M. He was much involved in University activities and has worked with physically handicapped children. He has presented his research papers at IEEE meetings. As a member of the Naval ROTC program he served aboard a nuclear submarine. He received a UNM mathematics scholarship and a citation for academic excellence from the Society of American Military Engineers.

David Welter gave a short speech of appreciation for the honor bestowed by HKN, also recounting academic and other experiences. The award was presented by Marcus Dodson, our National President.

IDENTIFICATION: Past President Carl Koerner, President Marc Dodson presenting award to David Welter of the University of New Mexico.

Opposite page: First column, Sally and Stu McCullough; Lawrence Hamilton; Reception. Second column, Norman and Ellen Nise; Bob Kennerknecht and Bill Rusch; Beverly and Dick Hermsen and Clay Stevens.

Following page: A good time was had by all.



MERRY MOMENTS WITH MARCIA

Customer: Look here, waiter, is this peach or apple pie?
Waiter: Can't you tell from the taste?
Customer: No, I can't.
Waiter: Well, then, what difference does it make?

A 80-year old man visited his doctor.
"I don't have any new complaints, doc," he said. "I just wanted to ask you something."
"Of course," the doctor invited. "What do you want to know?"
"Well," the old man begun, "you know that arthritis you told me I'd have to learn to live with, and my bad hearing, and my poor eyesight, and my high blood pressure?"
"Believe me, with your courage you'll be able to live with all of your impairments," the doctor assured him.
"Oh, I know that," the oldster said. "I was just wondering if you could add a 22-year old wife to that list."

A man stopped at the cafe and ordered a cup of coffee. When the waitress had delivered the coffee, he tried to make conversation.
"Looks like rain, doesn't it?" he ventured.
"I can't help what it looks like," said the waitress. "It's still coffee."

A lady was going 93 miles an hour on Route 93. A policeman stopped her and asked why she was going so fast. She said, "Well, the sign said 93".
"Ma'am!" exclaimed the policeman. "I'm glad I got you before you got on 234".

It is not always easy to say the right thing on the spur of the moment. We can sympathize with the chap who met an old friend after many years.
"How is your wife?"
"She is in heaven," replied the friend.
"Oh, I'm sorry," stammered the chap. Then he realized this was not the thing to say. "I mean," he stammered, "I'm glad." That seemed even worse so he blurted, "Well, what I really mean is I'm surprised."

The couple was shopping for wedding bands. "I don't want too wide or tight a band; it might cut off circulation," said he.
"It's going to do that anyway," said she.

Joe: "Does your friend ever talk to himself?"
Moe thought for a moment and then replied: "I can't say for sure. I've never been with him when he was alone."

Teacher: "Why are you late for school every day?"
Boy: "Everytime I come to the corner, a sign says 'School - Slow Down'."

Next year, let's name the first hurricane Zabrina and get the season over with in a hurry.

A successful man is one who makes more money than his wife can spend.
A successful woman is one who can find such a man.

The obituary editor of an Eastern newspaper was not one to readily admit his mistakes.
One day, he got a phone call from an irate subscriber who told him he had printed his name in the obituary column.
"Really," was the editor's calm reply. "Where are you calling from?"

by Marcia Peterman

Part Six

The Road to Ani

Armies marched through Ani for thousands of years; their history is writ in the stones of a dead city

by Charles E. Adelsen

Ani, the ghost capital of medieval Armenia, stands balanced on the cliffs over the Arpa Cay where the river marks the Turco-Soviet frontier. The land around it is as magnificently forbidding, and about as bare of the mechanized aspects of civilization, as it was when Persians, Romans, Byzantines, Arabs, Seljuk Turks, Georgians, Ottomans, and Russians first tramped across its rugged hills and cold upland plains on their way to conquest and settlement.

17

Three and a half miles of walls and towers surrounded what was once the fortress city of Ani. Little is left inside except churches.

Properly, the road to Ani begins at Erzurum, within living memory a westward-facing bastion of Russian empire-builders and now a primary center of the eastern land defenses of the Turkish Republic. Long an important link in the silk route, Erzurum has acquired that peculiar homogeneity of look that might be called "Turkish modern." From Erzurum the route leads to Kars, built as a model city by czarist Russia in the nineteenth century. It was at Kars that we had to stop to have our papers approved by the police and army before proceeding further into the military zone. From there to Ani, we were never out of sight of the army.

After having been checked and rechecked at recurrent sentinel posts during the hour's drive to Ani, we caught our first glimpse of dark battlements sprawling against the clouded horizon. The walls of Ani. There is an inescapable feeling of having come upon a living city. Especially from far off, the walls seem almost intact. The reaction is that of having come upon some Camelot set in a wasteland, and you wait for a challenge to come down from those high towers with their extraordinary black crosses set in an expanse of rose-colored volcanic stone. But Ani is dead, and has been since the fourteenth century when an ultimate terrible earthquake exiled its last citizens from their ancient town. Nature wrote *finis* to Ani's drama, something that conquest and occupation by Byzantines, Seljuks, Georgians, and Mongols had never really done.

Arches supported by coupled pillars lead the eye to where a dome once capped the cathedral. The style has a Gothic flavor, but the church was built 100 years before the Gothic style appeared in Europe.

The Jeep's motor was quiet at last, and the silence, accentuated by the twittering of a bird in the grass, was the silence of a wilderness. Yet we know that a hundred thousand souls lived here once and that Ani boasted — doubtless with Eastern hyperbole — that Mass was said in a thousand and one churches.

Where the relief figure of a lion vigorously strides across the middle gate, we entered Ani through what were once double walls, strongest defenses of a city also protected by the confluence of the ravines of the Arpa Cay ("Barley Stream") and the Alaca Cay ("Many-colored Stream"). These walls defended Ani's only really vulnerable feature, its frontage on the rolling plain of Kars, the logical area for attack by the land armies of medieval times.

A close look at what from a distance seemed to be wholly preserved walls reveals the sad truth. The decay of Ani has been accelerated in recent years not just by earthquakes, war, or the slow attrition of ice and frost — although the touch of all of these seems evident — but by the hand of man to whom Ani is only a gigantic stone heap for the building of his rude farmhouses and fences. The lower courses of superbly worked stone have been pried away and carted off, revealing the inner fill of conglomerate. Within the city, churches, mosques, even the castle all show the same despoilment.

A nineteenth-century visitor remarked how the facade of the so-called palace was even at that time being stripped of its stone mosaics, not by the ignorant, nor by the malicious, but by what he termed — no doubt with conscious irony — "patriotic Armenians." Photographs taken at the time, compared with our own pictures, show what seven or eight decades, a blinking of the eye in Ani's long history, have done to both Christian and Islamic structures.

Within Ani's tremendous walls and the gorges of its protecting streams, we found ourselves in the precincts of a once teeming city where today the loneliness is utterly palpable. Man and nature, especially the latter, have swept away every feature of the humble dwellings of Ani's vanished population. Homes were undoubtedly built of the same fragile stuff — stone and mud — that the plainsman and highlander build with today. The effect has been to isolate the more durable public buildings, making their inspection all the easier.

There is no such thing as a simple recapitulation of Ani's history, just as a simple resume of the whole history of Armenia itself is impossible. Stability in the broad land existed, whenever it did, under the aegis of tyranny. Interregnum periods were typically chaotic. The Armenians had chosen, fatefully, to build their house in the middle of a busy highway. The consequences form the stuff of their Jeremiah-like chronicles.

Speaking an Indo-European language, the Armenians were thought by Herodotus and others to have migrated to Anatolia from Thrace with the Phrygians. These proto-Armenians supposedly settled in the ancient lands of Urartu sometime early in the seventh century B.C. The latter-day conflict of Turks and Armenians was only episodic in a centuries-long series of confrontations in which the Armenian native found himself, at best, the citizen of a buffer state wedged between superpowers. In worse times, he was athwart the line of march of resolute conquerors. Pertinently, the most eloquent outpourings of Armenian wrath were at first directed not at the Moslems, but at the heads of the "Greek" Byzantines, whom the Armenians accused on the one hand, of usurping their freedom and on the other, of ultimately emasculating them and leaving them to their fate.

In the tenth century A.D., Armenians were able to assert their sovereignty, at least nominally, as the whirlpool of Armenian history stilled itself for a while. Both the emperor at Constantinople and the caliph at Baghdad sent crowns, emblems of self-government, to Ashot II the Iron, called "king of kings," and the country entered a brief and precarious Golden Age. The great monuments of Ani belong to that time. The reigns of Ashot III the Merciful (951-977) and Sembat II (977-989) were the apex of that age.

Only part of the Chapel of the Redeemer still stands, with its finely worked inscriptions halfway up what is left of the building.

With the coronation of Ashot III, Ani stepped up from her position as a strategically placed fort, becoming the real capital of the Armenians. Her fortifications were strengthened, and the people's talent in architecture expressed itself in magnificent royal structures.

By the command of Sembat II the outer defenses were built and the foundations of the cathedral were laid. The great church was only completed, however, under Sembat's brother, Gagik I (989-1019), and then largely as a result of the efforts of Gagik's queen. Under Sembat, the Armenian patriarchs moved their seat to the city on the Arpa Cay.

With his death, Gagik's sons plunged the land into civil war. Unity suffered a blow from which it would never recover as the all-important feudatories of the no longer solid state showed themselves increasingly independent. At last, rule of Armenia was divided among four kings, including one at Ani. Faced by the irresistible mounted archers of the Seljuk Turks, Armenia compromised her independence, and in 1022 John Sembat, king at Ani, was persuaded by the Byzantines to will his country to the Emperor Basil II.

Fierce resistance by at least some of the Armenians to this Byzantinization followed the death of Basil, but at last a Greek-speaking governor sat at Ani in the name of a distant emperor. Even that symbol of strength was short-lived. Oppressed by their own difficulties, and with a wasted treasury, the Byzantines left Ani to its own wits, an act for which Armenians down the ages have labeled their fellow Christians perfidious.

In the short, flowery summer of the year 1064, Alp Arslan (Alp the Lion), a figure known to Turks for his chivalry and bravery, attacked Ani from the plain. After twenty-five days of siege, the city saw the horse-tailed tug of the Seljuk sultan brought ceremoniously into the capital. Ani's Golden Age was over. Ahead of the Seljuk Turks lay the road to Malazgirt, where in 1071 they defeated the Emperor Romanus IV Diogenes and a huge Christian army in one of the world's decisive battles.

In bewildering succession, Ani was ruled by a dynasty of Kurds — who acquired the city as a fief from the Seljuks — then by a Bagratid dynasty of Georgian kings; the Kurdish dynasty was restored; the Georgians came back; Moslems again ruled Ani; and at last the Mongols galloped through Ani's gates in 1239. The search for traces of all these peoples in these highlands may be left to the physical anthropologist. A fascinating, if endless, assignment! The architecture of Ani provides a more accessible record of so many successive rules by such disparate peoples as Armenians and Mongols.

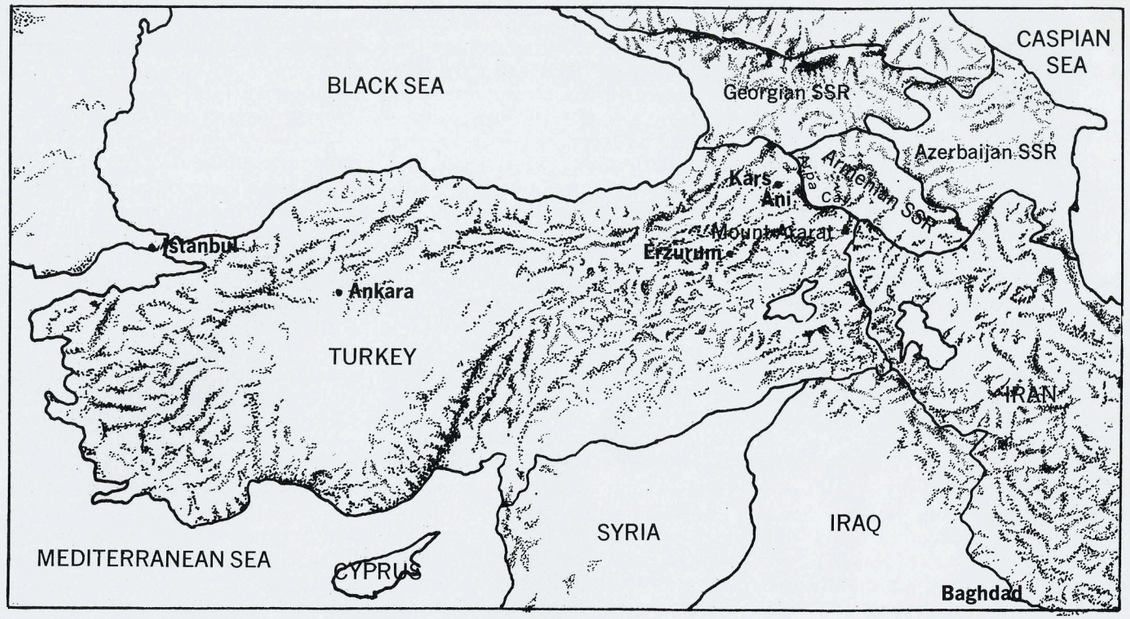
The importance of the cathedral, paramount surviving structure at Ani, lies as much in its identity as a milestone on the way toward the later development of the Gothic style in the West, as it does in its own near perfection of execution and form. When the first Mass was celebrated in Ani's cathedral in 1010, Gothic architecture had not evolved in the world. The Romanesque style reigned supreme in the West. Yet entering the cathedral today, anyone with even the slightest acquaintance with the great Gothic churches of Europe encounters something strangely familiar: the narrow aisles beneath the soaring roof lead one forward to the apse as the eye discovers the powerful columns with their coupled piers rising to the now-vanished dome. Similar piers rise at opposite ends of the church. Seeing the pointed arches overhead, the ribbed vaults, one automatically thinks "Gothic."

Armenian architects were well enough thought of in the West that one of them (in fact, Tiridates, who designed the cathedral of Ani) was summoned to Constantinople to repair major damage done to the dome of Hagia Sophia by an earthquake. Whatever influences must have flowed mutually between Byzantium and Armenia, one characteristic, so highly evident at Ani, hardly showed itself in the Byzantine art of building. The structures of Ani delight the modern eye with their sophistication of exterior design — a polished symmetry carried almost to the point of predictable, if exalted, stylization. The typical stone and brickwork of a Byzantine facade seldom achieves such an effect. Perhaps the difference in execution was philosophical: to the Byzantine, the shell of the structure was to the interior what the corruptible body was to the soul, a temporal housing for the mysteries of the spirit. Hagia Sophia at Istanbul astounds first with the marvel of its engineering, before one discovers the beauty of its art. Ani's cathedral, however, impresses with its loveliness, its symmetry within and without, before one wonders about the details of its construction.

Nearby stands the Church of St. Gregory, named for the "Illuminator" who converted the Armenian nation to Christianity more than a century before Theodosius I forbade pagan devotions in his realms. The church sits high on the eastward-facing bluffs of Ani, with the gloomy, turbid stream of the Arpa rolling far below.

From St. Gregory's, we saw peasants of the Soviet Republic of Armenia at work in the fields overlooking the Arpa's eastern banks. Their voices, and now and then a drift of song, were blown by the wind across the gorge. A soldier wearing a beret and carrying what looked like a Sten gun patrolled while the peasants worked amid the grain.

The tableau of the Turks and the Russians facing each other across the Arpa Cay is the essence of history in the making. Georgian script, along with elongated figures of El Greco-like saints decora-



ting St. Gregory's walls, recall an earlier dramatis personae of Ani's history, the period of Georgian rule. And the porch, a later addition to the church, shows its Islamic style even while the pillars suggest the yet-to-be-born Gothic.

The conic dome of the Church of St. Gregory has been lightened by the inclusion beneath its stone facing of hollow earthenware vessels. The origin of such domes — one sees them in Seljuk mausoleums as well as in Armenian and Georgian churches — has inspired much speculation. The modern traveler Lord Kinross saw their prototype in the cone-shaped stacks of dried animal dung, the *tezek*, standing in eastern Anatolian farmyards.

Another, more plausible theory holds that the great cylindrical felt tents of central Asia, those that could be moved about on wheels behind multiple teams of oxen, were the real prototype of the peculiar shape of both the mausoleums and churches. According to the same theory, the relief decoration on Seljuk tombs reproduces the felt-applique designs of the central Asian tents of Turks and Mongols.

One who has traveled today in eastern Turkey might conclude that both the round tent and the cone-shaped heaps of *tezek* represent a common response to an environment of wind and driven snow typical of the eastern Turkish highlands and central Asia. "Structures" composed of streamlined surfaces would be less vulnerable to such a climate than those made of resisting planes.

Another religious edifice named for the Illuminator is the Chapel of St. Gregory, built while Ani still had her own kings. At one time the twelve-sided chapel was the repository for the remains of the Pahlavuni family, one of whose members led an uprising to protest the ceding of Ani to the Byzantines. He survived that, but died in battle fighting the emir of Dvin. The inscriptions in the chapel, as on other buildings of Ani, are curiously free of the Eastern grandiloquence one might excuse in so persevering and proud a people. The inscriptions report family burials or record how the income from some business enterprises in the town should pay for Masses said for the dead. The style here, too, includes hints of the still unconceived Gothic.

What is left of the beautiful Chapel of the Redeemer, another relic of the rule of the Armenian kings, is so covered with inscriptions that one suspects that here were a people who utilized the decorative possibilities of their script in much the way that Moslems made a special art of their own calligraphy. The Armenian letters, devised at the start of the fifth century A.D., are always so neatly executed, they give the appearance of well-designed typeface. The letters add to the elegance of a structure, even if their meaning is hidden from those not familiar with the language. Here, they tell how a piece of the true cross was obtained at Constantinople in 1034 and enshrined in the chapel, where each night prayers were to be said until Christ came again. About half of the chapel has collapsed, the interior yawning hollowly in the direction of the Soviet Union.

On a slight rise are the ruins of what must have been a building

massive as a fortress — the synod house. As the center of church administration, carrying on the practical business, it would have seen convocations of black-cowled bishops presided over by the patriarch. Huge, lichen-covered, double-headed capitals must have surmounted truly enormous piers. The synod house, like so many Armenian structures, was apparently round, and we may imagine the princes of the church gathered in a circular seating arrangement.

What has been called "the palace" (simply a barracks building) is situated up against the northwest defenses of the city. It is the same rugged structure that was being robbed of its star-shaped mosaics by its admirers in the last century. Inspired by the palace folklore, local inhabitants tell travelers that it was, in fact, the *sultan-sarayi*, or "sultan's palace." A French *Souvenir d'Ani*, printed in 1904, identifies it simply as the *Palais des Bagratides*, with pictures of the edifice entitled *caserne* (followed by a question mark), indicating that this might have been the barracks of the supposed palace. There are no inscriptions at all, and it is a case of traditional belief — or wishful thinking — asserting itself.

Facing the ruin of a single-spanned bridge that once joined the banks of the Arpa Cay is the most prominent reminder of Moslem rule at Ani, a mosque upon whose minaret is encrusted, brick upon stone, the word *Bismillah*, "In God's Name."

If Ani is a veritable maelstrom of human interminglings in the floodtide of movement across Anatolia, its cosmopolitan character expresses itself most completely in the Church of the Apostles. Once a three-domed edifice, only the section covered by the easternmost dome remains. But it is an eloquent ruin. Church it is, with the peculiarly intricate Armenian cross carved elaborately upon its pink volcanic stone. Yet the stalactite motif seen in a remaining entrance, and even its whole plan, would proclaim it, were it not known otherwise, to be of purely Moslem inspiration. Since its earliest inscription dates from the time of the Armenian kings, it would seem that, in detail at least, it was altered under Moslem rule. Other inscriptions recall the government of the Georgians or the overlordship of the Mongol suzerain.

Of the popular dwellings of Ani, nothing, as has been remarked, remains. But the canyon of the Alaca and the lesser canyons leading to the gorge of the Arpa Cay have been extensively and anciently riddled by caves that were once human habitations. Since the hundred thousand citizens of Ani can scarcely have all resided within the walls, and since houses at least partly subterranean are still, out of fear of the winter and for scarcity of building materials, inhabited in parts of eastern Anatolia, it is possible that some of the Anians normally lived in such caves.

The dramatic history of Ani is given a final lugubrious touch by a traditional belief that the innumerable caves are visited by the unquiet souls — the voice of the murmuring river — of those who centuries ago were the flesh and blood of Ani.

Where the palace of Ani might have risen, on a mound affording a clear view of the Russian bank of the Arpa Cay, the flag of the Turkish Republic, small, as man himself appears small in so vast a landscape, flies in a strong east wind. As we left Ani, shafts of sunlight poured from a sky of dark or incandescently edged storm clouds, shade and light alternately sweeping across the city and giving it the apocalyptic look of a Dore engraving. Behind that Turkish flag marched the whole procession of kings of kings, emirs, sultans, and Mongol overlords who once held the scepter of Ani in their hands. At few other sites on earth is the impression of man on the land so multiform.

DIRECTORY

I Married One...

Engineers Are Special People

by Kim Wilson

On this weird wintry night following a surprise yesterday springtime, I cleaned wet, sticky masses of snow off my car in the driveway after dark. Intermittently, all the city's power went off and each time left me for a second or two in inky blackness.

Total absence of light produces an eerie sensation. Without candles or a well-functioning flashlight, you're absolutely sunk into oblivion.

There's something busily alive about electricity. It hums, it whirs small motors, it clicks thermostats. Turn off all switches, and you blank out sound as well as sight.

The buzzing and purring of harnessed electric current is a beautiful, vibrant thing. Out of control, this potent force can kill. Someone must know and understand this force's properties.

I never take for granted a cozy electric blanket on a snowy, subzero night such as this, for I know firsthand the countless study hours electrical engineers must endure. There's no such thing as inheriting this type of business from dad. Engineering is a profession where you have to do it yourself.

Being married to an engineer, whether you're the husband or the wife, adds zest and excitement to life. Although my husband died before he reached fifty, we packed decades of fun and work and travel into our 20 years together. Through George, I became personally acquainted with hundreds of you across the length and breadth of this land and overseas.

To me, engineers will always be special people. Sometimes you make a lot of money, and sometimes you don't. Sometimes your contributions to humanity are recognized, and sometimes they aren't.

Take the old joke about Cape Kennedy, for example. If all goes well, it's a scientific achievement. If anything goes wrong, it's an engineering failure.

Then, there's the story frequently shared by engineers' spouses at conventions. Yes, you have an Achilles' heal. Nothing riles you more than having people think you drive a train!

I remember the countless times I patiently explained to family members and friends what a Professional Engineer has to go through in order to get his seal. "Pass tests like doctors and lawyers? Surely PE exams don't take as much study and time," they said.

It does require a bit of patience to be an engineer's husband or wife. It's frustrating that so few understand, really understand, what your spouse does for a living. In retrospect, I see that patience is one of the virtues my husband taught me.

I used to have a maddening personal trait. My filing system consisted of tossing important documents into drawers. When George asked for a paper such as the car title, my predictable reply was, "Oh, I put it in the drawer.

With a sigh, he'd quietly ask, "Which drawer?" We only had about 50 of them. Well, the search would begin.

After an hour or so of agony, George would finally locate the target of his search in the back of the kitchen hutch cabinet or on the floor behind his desk. Darned if I knew how it got there.

Patiently, ever so patiently, my engineer husband taught me how to organize. You see, patience and organization go together.

On appropriate gift-giving days such as Christmas and Mother's Day, I received the most startling gifts in town. George provided (one by one) a metal box for cancelled checks, an accordian folder for paid bills, and a kitchen mailbox (which he nailed to the wall) for unpaid bills.

After all these receptacles started to overflow, I wondered what came next. Right. On Labor Day I was ceremoniously presented with a gigantic carton wrapped in red ribbon. What could it possibly be but a floor model filing cabinet!

Engineers give very practical gifts indeed. Until recently, those who worked for utility firms invariably bestowed the latest concept in electrical can openers, clocks, calendars and such to those lucky enough to be on their list.

That's why I have a frostfree refrigerator, which I just found out uses 5 kwh daily — all that for one person?

Maybe if people learn to count kwh, they'll come a little closer to appreciating the profession of electrical engineering. Think so?

Anyhow, today's spotlight is focused on energy, the energy which makes us mobile, keeps us warm and nourished and safe. If it ever narrows down to choosing which electrical helpers we want to use once a week, my vacuum cleaner will head the list. I'm very messy when I repot plants.

Well, I've mentioned the traits of patience, organizational ability, and practicality. Of course there are several more from which to choose — imagination, belated interest in the arts (we had fun with that one), ability to convert complex concepts to simple terms, humor, sociability, stability, compassion.

He or she who's lucky enough to marry an engineer can anticipate a most unusual life. Engineers are indeed special people.

CHAPTER NEWS

XI CHAPTER, Auburn University — A major accomplishment of the Xi Chapter at Auburn University has been the revision of the chapter's by-laws. These badly needed revisions were necessary to modernize the present proceedings at meetings and to help the officers perform their duties in a more efficient manner. Officer's duties have been revised and more explicitly defined. The new by-laws have been submitted to the national organization for acceptance.

One problem which occurred this quarter was the lack of bents for the new initiates. Because bents could not be obtained from the national organization, a mold was made from an old bent. The initiates then used this mold to cast their own bents using dental-grade plaster of paris. These were then painted and finished to give them a metallic lustre and worn by the initiates during their initiation period.

HKN also organized a faculty-student picnic in conjunction with Auburn's IEEE chapter. The festivities were not only recreational but also allowed the students to become more acquainted with the faculty. Everyone enjoyed this so much that tentative plans have been made to have such gatherings semi-annually instead of annually as they have been in the past.

At the end of fall quarter, the chapter also voted to give a Christmas gift to a needy family in the locality. This annual event has provided a great deal of help each year to those in need of it.

New officers have been elected for the Winter and Spring quarters. Their plans include an exhibit to be displayed in the student union on E-day, another spring picnic, and encouraging seniors to join the senior's club (an organization to help lower classmen in their coursework) among others. *by Al. C. Garber*

DELTA KAPPA CHAPTER, University of Maine — One of the chapter's most significant event of this semester was the winning of HKN's choice of $250 worth of books for the university library. Douglas Morton, secretary, submitted a letter to the Development Council in a contest between honor societies at the University of Maine at Orono. The contents of the letter described what HKN felt the goals and priorities of the university should be. These books will be well appreciated by the electrical engineering students.

Other activities of the chapter included the running of a booth at this year's organizational fair. Demonstrations set up included a digital octave band analyzer, a computer controlled stepping motor, solar cell and integrated circuit displays, and a microcomputer that was programed to play "The Hustle". Many people discovered that day some of the more interesting things that electrical engineers do.

A project put on by both HKN and the student branch of IEEE was a coffee and doughnut stand for the students and faculty. This service was well accepted and half of the proceeds will go to the chapter's treasury. A portion of these funds are being used in support of a series of public displays in the EE building intended to publicize the profession of electrical engineering.

ZETA KAPPA, Tennessee State University — The first activity that we carried out in the academic services area was to arrange for a rap session where Physics, Math and Engineering majors were brought together and we present the Engineers to them as member of a three-part team of technical specialists. The specialist being the Engineers, Scientists and Technicians. Even though each of their spheres overlap they try to fit into specific roles appropriate to their areas of work. The above rap session was necessitated by the fact that most of the members of our chapter have overheard many Freshmen students ask themselves the question, "Do I really want to be an Engineer?" We thought it will be helpful for them to know just what the Engineer, Scientist and Technician does.

The Engineering Tutorial Centre which is run by students has two of our chapter members that tutor students having difficulty in Engineering, Math and related areas. Occasionally we arranged special problem solving sessions in EE courses for students who have difficulty in understanding some particular problems or material in EE courses.

During the celebration of National Engineers Week which our school observed, we organized a seminar where Dr. Mark Elder was guest speaker on the "Future of Microprocessors". Also, we jointly sponsored a trip with IEEE to visit Industries located around here so that some of our students could have a feeling for what is going in the field.

In the social area, the first activity we launched at the beginning of the year was to sponsor a picnic where attendance ranged from members, through prospective members to students and faculty members. At this picnic students had a chance to mingle with faculty members in an informal atmosphere and exchange ideas.

At this junction, a little bit of reflection on our last years goals indicate a lot of success. This success is exemplified by what took place on April 22, 1977, when we had our annual induction ceremony. This year we had nine student candidates to initiate into the Zeta Kappa Chapter. It is also remarkable that among the nine students were four girls. Records indicate that this was the first time a girl was being initiated into the Zeta Kappa Chapter and for the first time we had four of them! This time we had no students who declined our invitation to join Eta Kappa Nu. This indicates to some extent that the activities that we carried out impressed them a lot.

The Fifth Annual induction ceremony that was held at the Ayeni Room of the Student Union Building of Tennessee State University was attended by many faculty members, students and other officials from the University. They were also invited to our Dinner Party. The following students who had manifested distinguished scholastic abilities and met the required great point averages at their Junior or Senior year were inducted: Michelle Adams, Wilhemina Greene, James Humphrey, Jerry Ingram, Eddie Jackson, Ralph Peek, Sheila Rogers, Girard Simmons and Laverne Williams. We were honored to have as our guest speaker, the Dean of the School of Engineering, Dr. Edward I. Isibor who praised the E.E. Department for the good work. Enclosed are some of the pictures that were taken during the initiation ceremony.

May I seize this opportunity to express my gratitude and appreciation to the Zeta Kappa Chapter members for electing me in 1975 to serve as the secretary and in 1976 as the President. It has been so meaningful to me working with people like you full of ideas and even more, it has been my pleasure serving as an officer in a chapter of the only honor society that speaks for all Electrical Engineering scholars in the nation. *by Ngabuen J. Nshom*

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GAMMA EPSILON CHAPTER, Rutgers College of Engineering — The Gamma Epsilon Chapter had an active semester this year. Various projects, which had been started in the fall, were wrapped up or progressing nicely. The Graduate School Catalog Library which we had planned has become a reality. We have gathered together the catalogs of over 150 different schools of electrical engineering. The catalogs are stored in a cabinet in the lab wing of the Engineering School and are available for all engineering students use. In the same lab as the catalog library, we established a small reading room with various magazines related to electrical engineering.

The construction of a Smith Chart by the Chapter is about half completed. Our members are constructing several charts of different sizes. They are using an analog computer and plotter to design them. Special thanks must go to Professor Donald A. Molony for his assistance to the project.

Our Chapter By-Laws were revised for a second time this year. This was due to an effort by us to bring the By-Laws in line with the regulations of Rutgers University. As of this writing, they are still under consideration.

This semester, joint meetings of Eta Kappa Nu and the I.E.E.E. were held at Rutgers. They were extremely successful and I hope that this policy will continue in the future. Together, these two organizations can perform a great deal of good at Rutgers.

Elections for Chapter officers were held this spring. Those elected were as follows: President, Hugh Martin, Jr.; Vice President, Dominick Regina; Treasurer, Peter Tufano; Corresponding Secretary, Paul Ruthowski; Recording Secretary, Peter Thompson; Bridge Correspondent, Richard Traubin.

All of this past year's officers from the Gamma Epsilon Chapter have now embarked on new careers of one sort or another. It might be of interest to Chapter members, both past and present, to see what their fellow engineers are doing.

President, Mark Carey; Hughes Aircraft Company, Masters Program at U.S.C. Vice President, James Kraminski; Westinghouse. Treasurer, Michael Baum, Graduate School at Carnegie-Mellon. Corresponding Secretary, David Krozier; Singer Company, marriage (congratulations!). Recording Secretary, Mark Silvester; IBM. Bridge Correspondent Thomas Murakami; Graduate School at R.P.I., Troy, New York.

This spring, 7 new members were inducted into the Gamma Epsilon Chapter at Rutgers. One of the most deserving of those new members was George Goehrig. He is a member of the United States Army and is 37 years old. He returned under aegis of the Army to complete his education after a gap of some 15 years. In addition to school work, he had a family to support and a career in the Army. It was an honor to induct him into the membership of our Chapter.

After our induction ceremonies, there was a party at the home of Dr. John P. Newton, a former professor at Rutgers College of Engineering. Members and faculty both enjoyed themselves tremendously.

This year, for the first time, the Gamma Epsilon Chapter presented Outstanding Electrical Engineer Awards to the members of the Sophomore, Junior and Senior classes. The winners were: Sophomore Award, Edward Schultz; Junior Award, Hugh Martin, Jr.; Senior Award, Mark Carey and David Schear. The Chapter also nominated Mark Carey for the Outstanding Electrical Engineering Student award which is a National competition.

Finally, I would like to extend my personal appreciation and the Chapter's to three very important people, without whom the Gamma Epsilon Chapter could not have functioned as well as it did. The Department of Electrical Engineering secretaries, Connie and Dorothy, whose unstinting efforts made the paperwork for the Chapter vanish so quickly and Professor Louis A. Rosenthal, the Chapter Advisor. His assistance and counseling were invaluable. by Mark Carey.