ChE department

ChE AT THE EREVAN POLYTECHNIC INSTITUTE SOVIET ARMENIA

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I LEFT NEW YORK on February 7, 1982 for Moscow with a Fulbright teaching grant at the Erevan Polytechnic Institute, Erevan, Armenian SSR. Three of us, all Fulbright Scholars, spent a few days in Moscow as guests of the Ministry of Secondary and Higher Education, and on February 10, 1982 two of us left for Erevan. My colleague, who was assigned to educational psychology at the University of Erevan, travelled with his wife, three sons and his elderly father. I was alone and was assigned to chemical engineering at the Erevan Polytechnic Institute. Our third colleague left for the University of Keremova in Siberia to study anthropology and the migration of peoples (ancestors of the American Indians) from the Siberian land mass to North and South America.

BACKGROUND

Soviet Armenia is the smallest republic in the USSR. It is a landlocked, mountainous republic in the Caucasus mountains between the Black Sea and the Caspian Sea, and bordering on Turkey and Iran. It is rich in agriculture and has well developed industry. Its area is about 29,800 square kilometers, or about 0.13% of the territory of the USSR. Its population is 3.0-3.5 million, or about 1% or more of the total population of the USSR.

The average elevation is about 1800 meters above sea level, about twice the mean elevation of the Asian continent. The lowest points are 400 meters. The present republic is a small part of the Anatolian plateau, the traditional homeland of the Armenian people for over 3000 years. This area is about 300,000 square kilometers and covers large parts of present day eastern Turkey and northern Iran. The highest peak in the area (5156 meters) is Mount Ararat, the biblical mountain upon which Noah's Ark rested. The land is rich in ancient history and architecture. About 90% of the population of Soviet Armenia is ethnic Armenian.

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Mount Ararat rises to 5156 meters above sea level.

This visit was my eighth. I frequently visited my mother's older sister who lived there alone until she passed away in 1977 at age 92. Many of my colleagues in chemical engineering may remember my after-dinner slide presentation to the ChE Division at the ASEE meeting at the University of Tennessee in June of 1976.

Erevan, a large, culturally rich metropolis, is the capital city of the Armenian SSR. It is a hilly city shaped like an amphitheater which opens up into the plain of Ararat. The city is about 1200 meters in elevation, and Mount Ararat rises at one end, presenting a magnificent view. The population is about 1,200,000. It is a beautiful, well-planned modern city which has been essentially built since 1920. Last year a new Metro was opened which parallels the Moscow subway in beauty.

In 1923 Erevan was a small city of 30,000.

Deran Hanesian received his undergraduate and graduate degrees from Cornell University (BChE, 1952, PhD, 1961). He worked about nine years at duPont in Niagara Falls, New York and the Jackson Laboratory, Deepwater, N.J. He started teaching in 1963 at NJIT and since 1975 has been Chairman of the Department of Chemical Engineering and Chemistry. In 1977 he received the Robert Van Houten Award for Teaching Excellence. His sabbatical leave for 1981-82 was spent partly at the University of Edinburgh, Edinburgh, Scotland, and as a Fulbright Scholar at the Erevan Polytechnic Institute, Erevan, Armenian SSR.

Many of its people were survivors of the massacre of the Armenian people in 1915 by the Ottoman Turks. Many colleagues there shared a common history with me, the difference being that during and after the massacres their parents fled east to Czarist Russia and my parents fled to America. It was in 1933 that the Erevan Polytechnic Institute was founded, and in September 1983 they celebrated their 50th anniversary.

EREVAN POLYTECHNIC INSTITUTE

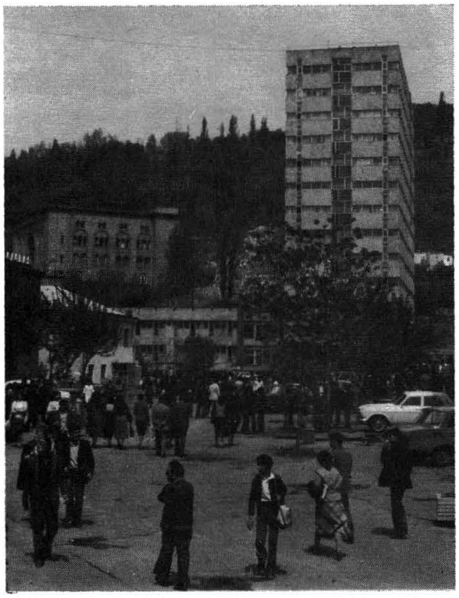
The Erevan Polytechnic Institute (EPI), is a large technological university with 23,000 students. Of these, 14,000 are day students in Erevan, 3000 are evening students, and 5000 are at the Institute's locations outside of Erevan. The remaining 1000 students are called "commuters." These students generally live in outside areas and are working students who study at home but periodically take leaves from work (lasting one month) to visit Erevan for concentrated lectures and to take examinations.

The Institute has about 2500 faculty, 1700 of whom are in Erevan and 800 of whom are outside. Generally, a teacher-to-student ratio of 10.7 is aimed at.

The Institute is headed by a Rector and six Pro-Rectors working with him. Three Pro-Rectors take care of Academic Affairs: one for research and the others for business affairs and physical plant.

The three Pro-Rectors in Academic Affairs are directly involved with eleven Faculties. These Faculties (which are headed by a "Degan") are: Architecture, Civil, Chemical, Electrotechnic, Energetic, Mechanical, Automotive, Cybernetic, Computer Hardware, Radio, and Geology. In addition, there are many support departments such as the excellent Department of Foreign Languages.

Budgets are formula based and calculated from hours per year for all duties: teaching, research, service, etc. Professors (there are only a very few since the rank is difficult to obtain) are assigned 600 hours/year. The next rank (called "Dotszent") is assigned 750-800 hours/year. All contracts are for twelve months and are renewable every five years. Since everyone must work, there are no lay-offs, but there may be new assignments.



Campus scene showing a teaching and research building, Erevan Polytechnic Institute.

Sabbatical leaves are given to everyone for a semester every five years. Research work brings extra compensation (up to one-half of salary) and twice the salary in the summer. Rest leaves with pay are available.

Students enter the Institute following comprehensive three-week entrance examinations in August. These examinations are in physics (written), math (written), math (oral), and language (composition). Admission is by government plan and quotas. There are 4500 accepted as freshmen. Of those, 2800 are for the day division in Erevan, 500 are for the evening division, 200 are for the distant commuters, and 1000 are for

Undergraduate degrees require five years. To enter the graduate program, "aspirants" take examinations in language, field of endeavor, and humanities-philosophy. Those who are accepted work with a professor and d● not take formal courses.

the Institute locations outside of Erevan. Those who are not accepted can try again, or can work in factories and attend evenings. There is a good system for recycling marginal students. Students pay no tuition or fees and receive a monthly stipend of about 60 roubles, which is adequate for their personal needs and is about one-half the salary of a laborer.

The faculty members are organized into a powerful union called "Prof. Meeoutyiun." It represents faculty grievances against the administration. The union cannot be overruled by the Rector and differences are settled at the Ministry of Secondary and Higher Education or in the courts.

A few members of the Processes, Apparatus and Modelling group upon receipt of an Outstanding Department Award for 1981-82.

Undergraduate degrees require five years. To enter the graduate program, "aspirants" take examinations in language, field of endeavor, and humanities-philosophy. Those who are accepted work with a professor and do not take formal courses. They study and complete their thesis in three years, defend their study, and if successful become "candidates." A candidate must continue to work for many years, do original work, and defend this additional work before a committee of five academicians, or Professor Doctors. If successful, one is then entitled to the title "Doctor." The whole process of education is quite rigorous and is similar to the European system.

FACULTY OF CHEMICAL TECHNOLOGY

The Faculty of Chemical Technology most closely resembles a combined department of chemical engineering and chemistry, such as the one at New Jersey Institute of Technology (NJIT). At EPI this faculty has about 150-170 workers. About 70-80 are teachers and 80-90 are laboratory assistants. The faculty is under Degan Azad Gulzadian. There are six degree (diploma) programs governed by the faculty: Organic and Petroleum (Naptha) Synthesis, Inorganic, Silica, Electrochemical, Resins and Plastics, and Polymers. Each of the six groups is limited to twenty-five students per group for each of the five years in the degree program. About 90% of the students in chemical technology are women.

The program which most closely resembles our programs is Organic and Petroleum (Naphtha) Synthesis. I will compare it with our program at NJIT, which is an ABET approved program and therefore similar to others in the United States.

Fig. 1 shows the calendar by weeks at EPI. It is fairly complex compared to the straightforward fifteen weeks of instruction and one week of examinations for each of two semesters at NJIT. At NJIT our students have twenty weeks of recess and take four years to obtain a degree. At the EPI, five years are required for a degree and recesses are much shorter (4-8 weeks). Table 1 shows a comparison of the number of weeks expended in various educational areas at EPI and NJIT. The regular four-year program for NJIT is shown. Students at EPI spend more time in

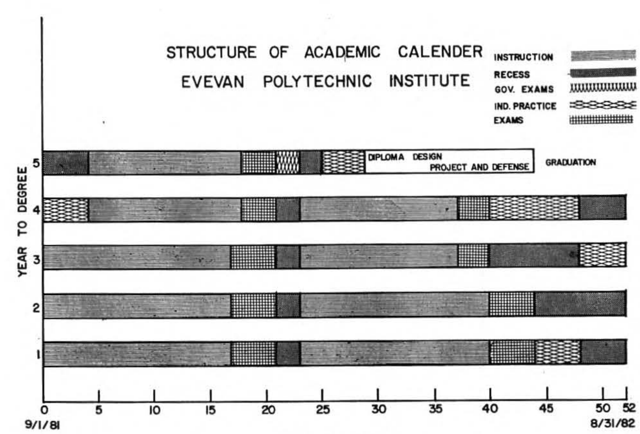


FIGURE 1

instruction, diploma design projects, and examinations, which are individual and oral at the end of the semester. The diploma design project must be defended to an external committee of six to eight industrial people. The committee chairman must be external to the Institute. In addition, much time is spent in practical experience in the chemical plants. Students at EPI have less recess time. Our students at NJIT spend some of their recess time, particularly between the third and fourth year, in chemical plants, when work is available. At NJIT co-op students spend two six-month work periods in industry during their third year. Table 1 also shows the class hours by week for each semester of study.

Tables 2 and 3 show a comparative breakdown of total class hours spent at EPI and NJIT. It is clear that students at Erevan study more subjects for longer class hours (4765 hours) than their colleagues at NJIT (2355 hours). In addition to attending school for two additional semesters, students in Erevan attend classes longer each week (by about 73%), and spend about twice as much total time in class until graduation. Also shown is a comparison of the percent of total class hours distributed in the subject areas. Students at NJIT spend a lower percentage of their class hours in formal computer courses, humanities-social science, and electrical technology. A larger fraction of class hours is spent at NJIT in chemical engineering, mathematics, and physics. Chemistry percentages are about equal. The program at EPI more nearly resembles in intensity the five-year program which I studied under "Dusty" Rhodes at Cornell in the early 1950's than the relatively condensed four-year programs of today.

PROCESSES, APPARATUS, AND MODELLING

Chemical engineering subjects are taught to all six groups by the "Processes, Apparatus, and Modelling Division" called an "Ambion." This group was involved in teaching chemical engineering as we know it in the unit operations areas of momentum, heat and mass transfer. The group was under the direction of a "Varich" who was the Rector Emeritus of the EPI. Professor Dr. A. M. Kasparian, an academician and excellent scientist and researcher, headed the Polytechnic as Rector for about fourteen years before retiring

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TABLE 1

Comparison of Calendars at EPI and NJIT, in weeks.

Class Hours per week of each semester are shown by ( )

YEAR	INSTR. AND THEO. STUDIES	EXAMS	INTRO. INDUST. PRACTICE	IND. PRAC. STUDIES	DIPLOMA DES. PROJ.	RECESS	TOTAL
EPI							
1	34 (33,34)	8	4	0	0	6	52
2	34 (34,	8	0	0	0	10	52
3	31 (34,36)	7	0	4	0	10	52
4	28 (34,36)	6	0	12	0	6	52
5	14 (30,Project)	5	0	4	15	6	44
	141 (33.8 Av.)	34	4	20	15	38	252
NJIT-Regular Program							
1	30 (23,21)	2	0	0	0	20	52
2	30 (17,20)	2	0	0	0	20	52
3	30 (19,19)	2	0	0	0	20	52
4	30 (19,19)	2	0	0	0	5	37
5	0	0	0	0	0	0	
	120 (19.6 Av.)	8	0	0	0	65	193
NJIT-CO OP Program							
1	30	2	0	0	0	20	52
2	30	2	0	0	0	20	52
3	15	1	0	26	0	10	52
4	15	1	0	26	0	10	52
5	30	2	0	0	0	5	37
	120	8	0	52	0	65	245

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and returning to research and the classroom a few years ago. In Professor Kasparian's absence the group was headed by the "Varich," Prof. Raphael Y. Hagopian, another excellent teacher, researcher and leader. The group consisted of about fourteen full-time people and a number of part-time adjuncts who worked elsewhere during the day. This group was involved heavily in teaching and research, six days a week from 9-4:00 p.m. unless they had an evening class. The undergraduate laboratories were very basic but adequate.

There are no examinations during the semester and no formal homework assignments. I lectured

TABLE 2. Courses of Study at EPI *Percent of Total is shown by ( )*

SUBJECTS	Lec.-Rec.	Lab	Sem.	Projs.	Total
			TOTAL CLASS HOURS		
1. Chemistry (20.4)					
General Inorganic	136	85			221
Analytical	31	155			186
Organic	153	136			289
Physical	138	93			231
Colloid	20	22			42
	478	491			969
2. Mathematics (7.1)					
Higher Math	340				340
	340				340
3. Physics (10.3)					
Physics	187	85			272
Theo. Mech.	85				85
Appl. Mech.	102	17		17	136
	374	102		17	493
4. Computer Math (3.2)	68	17			85
Computer Use in Eng. & Econ.	34	34			68
	102	51			153
5. Eng. Graphics (1.8)	17	68			85
6. Eng. Standards (0.3)	14				14
7. Elec. Tech. (2.1)		68	34		102
8. ChE (21.7)					
Intro. Chem Tech	34				34
Proc. Appar.	169	62		14	245
Gen. Chem Tech	70	28			98
Model. Chem Pro.	56	14			70
Mechanism of Reactions	70				70
Chem. Tech. of Org. Synthesis	126	196		14	336
Proc.-Equip. Design	42	14			56
Elective-ChE				56	56
	623	328		84	1035
9. Environ. Prot. (0.3)	14				14
10. Safety at Work (0.9)	28	14			42
11. Other (31.9) History, Economics Philosophy, Management, Law, Foreign Language, Physical Education, etc.)	766	28	710	14	1518
	2824	1116	710	115	4765

for fifty minutes in Armenian, and answered questions for each group of twenty-five. At the end of the semester, all students are required to take a final examination. Each student studies and on the scheduled examination day comes before two faculty, individually, when prepared. The students then sit and, without texts, prepare to answer the questions which will be picked at random. When ready (usually after about one to two hours of meditation), the student comes before the two faculty, who then proceed to quiz the student on all related areas of concern.

Grades are from a low of 2 to a high of 5. Receipt of a 2 means failure. The student is then given two additional opportunities to pass, usually after a period of a few months of self-study and review. If a student doesn't successfully complete the examination in three attempts, he is discharged from the Institute. Following discharge, the student is given a job in a factory. After one year of serious work, the student's supervisors can recommend that the student work days at the factory and attend the Institute at night. This system of recycle impressed me very much. Upon graduation, all students obtain jobs in the chemical industry, if they desire. Otherwise they could go to other factories, but they have to work somewhere.

TABLE 3. Courses of Study at NJIT *Percent of Total is shown by ( )*

SUBJECTS	TOTAL CLASS HOURS (Excludes Finals) Lec.-Rec.	Lab	Sem.	Proj.	Total
1. Chemistry (21.0)					
General	105	60			165
Organic	105	45			150
Physical (Anal)	105	75			180
	315	180			495
2. Mathematics (10.2)					
Higher Math	240	0			240
	240	0			240
3. Physics (12.1)					
Physics	150	75			225
Mechanics	60	0			60
	210	75			285
4. Computer Use In Eng. & Graph. (1.9)	30	15			45
5. Eng. Graph. (1.9)	15	30			45
6. ChE (33.8)					
Chem. Proc. Prin.	90	0			90
Trans. Op. I (Fluid Flow)	45	0			45
Trans. Op. II (Heat Trans.)	45	0			45
Trans. Op. III (Mass Trans.)	60	0			60
ChE Thermo	90	0			90
Reac. Kin.	45	0			45
Proc. Dyn. & Cont.	60	30			90
Proc. & Plant Des.				60	60
ChE Lab.	42	138			180
ChE Elec.	45	0			45
Tech. Elec.	45	0			45
	567	168		60	795
7. Other (19.1) Humanities, Economics, Physical Education, etc.)	420	30			450
	1797	498		60	2355

I found the students at EPI to be very much like the students at NJIT. They had the same likes and dislikes as our students, and their behavior in and out of class was about the same. They were very interested in student life in America. One prime difference was that when I entered class, everyone rose to their feet and remained standing until I told them to sit. I enjoyed the students; they were intelligent, well-mannered, well dressed, clean, polite, pretty, and a lot of fun.

Our group ("Ambion") was heavily engaged in research. Research at the Ambion was done collectively by all personnel under the leadership of Prof. A. M. Kasparian and Prof. Raphael Y. Hagopian. We worked together on a number of projects which included an air pollution problem from a cement plant that involved experimental studies and a theoretical computer simulation. Extensive work was being done with the mineral "Berlite," a mixture of sodium, aluminum, and silicon oxides used in making crystal glass. There were various studies in solid-fluid reactors and their optimization. A computer simulation of the reactors was developed, and hydro-dynamic studies were made with various particle sizes of Berlite. We worked on a computer simulation of a scheme of series-parallel reactions which attempted to optimize the yield of useful products needed as corrosion inhibitors in pipelines. In addition, we worked on transport of solids in pipelines using a minimum of transport fluid to minimize attrition and pollution, and we also studied various optimal heat transfer problems simulated on a computer.

The faculty were very capable. We had one prime disadvantage compared to America. We couldn't pick up a catalog and order whatever equipment we needed (budgets permitting) as is the case at NJIT. However, this problem was eased because we could pick up a phone at EPI, call our friends and former students in the plants and ask them to send us the needed equipment. We managed to get a great deal of work done in a short time. Each year, one week in the fall is devoted to student research seminars. In the spring, one week is devoted to faculty seminars. The extensive program is Institute-wide. I was an invited speaker and delivered a seminar in Armenian to the Faculty of Chemical Technology.

In conclusion, chemical engineering at EPI more nearly resembles our co-op program and the intensive five-year program at Cornell in the early 1950's than the relatively condensed four-year programs of today. Chemical engineering students at EPI (about 90% female) spend more class hours in instruction, more time in examinations, more time in diploma design project, a considerable amount of time in industrial practice, and less time in recess. The number of class hours per week is about 73% greater at EPI than at NJIT, and the total class hours required for graduation is about double. Students at EPI spend a greater percentage of their class hours in computers, humanities-social sciences, and electrical technology, and fewer in the areas of chemical engineering, mathematics, and physics. Chemistry percentages are about equal. I was very impressed by the quality of the faculty in research and teaching ability and of the students with whom I worked. The system of recycle established for marginal students is excellent and enables unsuccessful students to reenter the educational process if they so desire.

ACKNOWLEDGMENTS

I am grateful to have been granted a sabbatical leave from NJIT, to have received a Fulbright grant to visit the Erevan Polytechnic Institute, and to have been accepted there as a Fulbright Scholar. I must first thank Dr. Angelo Perna, my colleague at NJIT, who in my absence assumed the role of Acting Chairman. I thank both Prof. Dr. A. M. Kasparian and Prof. Raphael Y. Hagopian who treated me as if I were a member of their families. They spent many hours with me in open, honest discussions about the details of chemical engineering education at both EPI and NJIT. I also thank them and my other colleagues at EPI for their help in enabling me to lecture in Armenian and for getting me totally involved in their research program. They made me feel like a permanent member of the department rather than a guest from America, and completely accepted me into their "collective." I also thank William James and Margaret Henry (Council for the International Exchange of Scholars) and Ms. Alla Dombrowsky (United States International Communications Agency) for their help. I thank Boris Fonarev (Ministry of Secondary and High Education, Moscow) and Mark Dillen and Leland Cross (Cultural Affairs Section, U.S. Embassy, Moscow) for their kind attention the few times I needed questions answered. Finally, I thank our departmental secretary "Chip" Lardier for everything she did for me during the past year. It would be impossible to itemize the details of all the support she gave to me from the conception of the idea until my return to NJIT. □