Historical Approach to the Problem of Training Geologists

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Of the scientific professions, geology has probably required the least in the way of academic preparation. For example, most oil companies, until recently, were willing to hire the majority of their geologists from the ranks of those who had earned bachelor's degrees. Today preference is being given to students who have completed a year of graduate study. While the number of candidates for the doctorate appears to be increasing, the higher graduate degree is generally regarded as necessary only for those intending to teach.

Because the formal education of geologists has come to be known as a process that requires no more than four or five years, students majoring in geology tend to look upon their undergraduate program of study as being professional in character. Some departments have done much to encourage this point of view by offering vocational courses. Indeed on some campuses geology has been transferred from the colleges of liberal arts to the schools of engineering, allowing for the extreme in concentration on technical studies. Other departments, however, have preferred to maintain their connections with the colleges, probably to some extent from inertia, though undoubtedly also out of the conviction that geologists should be educated.

Thus as matters stand there are two schools of thought on the subject of undergraduate training: the liberal and the vocational or technical. That both have their devoted following was demonstrated by the course of events following the second world war. At a time when the press of veteran enrollment threatened to destroy the better part of higher education, liberal and otherwise, the various geological societies met to take stock of the matter and to search for ways of improving education in the earth sciences. The discussion that took place in the course of six conferences, held between December of 1945 and December of 1947, revealed as much as anything else the differences of opinion that had grown up within the geological fraternity itself.

In the tradition of liberal education there was McKinstry's insistence on a broad cultural background for those who would be educated persons and not technologists merely,[1] Gilluly's provision for a third of the undergraduate program in the social sciences and humanities,[2] and Henbest's prescription of logic, philosophy and psychology as antidotes against scientific dogmatism.[3] Colbert emphasized the undergraduate's need for acquaintance with the great literature of the past, and regretted the neglect of Greek and Latin on the part of students specializing in paleontology.[4]

Others among the conferees were primarily concerned with the application of geology to problems of engineering, and these almost without exception favored a technical curriculum at the undergraduate level. For students primarily interested in the geological aspects of civil engineering, Burwell prefers an "undergraduate course patterned after that of ... mining engineering with an added dosage of geology ... substituted for the purely mining subjects."[5] Jacob maintained that a college should be able to train in the course of four years a man able to earn his living in one or two lines of work, "at the same time ... making him polished in a sense."[6] In what sense Mr. Jacob did not specify, but he went on to say that he could not "be led to believe that engineers are any less cultured than geologists. They generally become equally cultured after twenty years of practice and self effort." Offhand a period of twenty years seems overlong for cultural incubation. Yet it is only four years beyond the time required to complete the "ideal course" for mining geologists as put together by McKinstry on the basis of recommendations from his colleagues in this field.[7]

Speaking of time, Landsberg felt that too much of this is given to teaching high school subjects in college.

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[1]McKinstry, H. E. Desirable training for mining geology. Geol. Soc. America, Interim Proc. for 1946, pt. 2, pp. 12-19.

[2]Gilluly, James, The training of geologists. *Ibid*, pp. 3-8.

[3]Henbest, L. G. Remarks at conference on training in Geology. Geol. Soc. America, Interim Proc. for 1946, pt. 5, pp. 11-13.

[4]Colbert, E. H. A paleontologist's view of the geology curriculum. Geol. Soc. America, Interim Proc. for 1947, pt. 1, pp. 8-14.

[5]Burwell, Edward. Remarks at conference on training in Geology. Geol. Soc. America, Interim Proc. for 1946, pt. 5, pp. 5-8.

[6]Jacob, C. E. .., *Ibid.*, pp. 9-10.

[7]McKinstry, *Op. cit.* pp. 14-15.

It seems to me that "time" is one of our main problems in educating geological and geophysical engineers. The technical phases of this training start at too late a stage in the development of the student.

I am always surprised when people discuss the teaching of English in college, because I can't see the reason for teaching English there at all. I believe that an 18-year-old person ought to be able to write—I was almost tempted to say spell—and present what goes on in his thoughts so that we should not be confronted with that problem at the college level. Why couldn't a student when he enters college have a good background in such basic subjects as English, History, Social Science, so that we can just give him a technical education? I even think that a good deal of basic mathematics, physics, and chemistry should be pushed back from the college into high-school and elementary-school teaching.[8]

In some cases those who spoke in favor of the technical curriculum also went on the offensive against the liberal approach. Thus, Professor Graton was bold enough to say that what passes for liberal education these days consists of "going through gentle and pleasant motions in the thought of remaining scholarly and broad." He stressed the need for mental discipline, whether in the sciences or in the humanities, and emphasized the liberalizing effect of scientific subjects, properly understood.

Moreover, we must not hesitate to make clear that it is as worthy and scholarly to know works of Steno and Playfair, de Beaumont, Zirkel, and Gilbert as those of Homer, Dante and Kant; that to comprehend a phase diagram, an Alpine overthrust, or a Cordilleran pluton and what stands behind them is as constructive and broadening as appreciation of composition in painting or knowledge of Gothic architecture; and that to warm to the great controversial problems of our science as well exhibits dignity and culture as to delve in literary criticism, the Crusades, or determinism versus free-will.[9]

The same range of opinion that appears in the remarks of different individuals may be found in the recommendations of different committees. Representing the technical point of view, there is the report of a committee of the United States Geological Survey published in 1947,[10] and another by the Committee on Geological Education of The Geological Society of America published two years later.[11] Both would require approximately three-fourths of the undergraduate hours to be in mathematics and science. Both recognize the importance of foreign languages as part of the working equipment of scientists. The first makes no

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[8]LANDSBERG, H. Remarks at conference on training in Geology. Geol, Soc. America, Interim Proc. for 1946, pt. 5, p. 21.

[9]GRATON, L. C. Remarks at fifth conference on training in Geology. Geol. Soc. America, Interim Proc. for 1947, pt. 1, p. 82.

[10]BRADLEY, W. H. A suggested geological curriculum. Geol. Soc. America, Interim Proc. for 1947, pt. 2, pp. 8-13.

[11]HUBBERT, M. K., T. A. HENDRICKS, & G. A. THIEL, *Chairman*. Report of The Committee on Geologic Education of The Geological Society of America. Geol. Soc. America, Interim Proc. for 1949, pt. 2, pp. 17-21.

provision whatsoever for courses in literature, history or kindred subjects, although it does recommend one course each in economics, logic and composition. The second allows for one course-year in writing and speaking.

TABLE 1. — Comparison of four geological curricula. (I. Curriculum at Southern Methodist University, II. Recommended by James Gilluly, 1946, III. Recommended by Committee of Geologists of the U. S. Geological Survey, 1947, IV. Recommended by Committee of The Geological Society of America, 1949.)

	I		II		III		IV	
	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%
Geology	30	25.00	40	33.33	27	22.50	33	27.50
Mathematics and science other than Geology	42	35.00	32	26.66	46	38.33	59	49.17
Mathematics and science recommend in addition to above	none		none		17	14.16	none	
English composition and Literature	12	10.00	48	40.00	3	2.50	6	5.00
Foreign language	12	10.00			12	10.00	12	10.00
Social sciences	18	15.00			6	5.00	10	8.33
Electives	6	5.00			9	7.50		

In 1950, a committee representing The Geological Society of America, the Association of Geology Teachers, and the American Geological Institute, issued a report on the undergraduate curriculum with special reference to the liberal arts colleges.[12] It was pointed out that so long as general requirements call for studies in the humanities, languages, and social sciences, it will not ordinarily be possible for students to take all the courses in sciences and mathematics that had been recommended. The value of liberal studies was defended, but no effort was made to specify courses in fields outside of science and mathematics. Requirements in geology amount to approximately 35 semester hours, and in physics, chemistry, mathematics and surveying to some 37 hours; the total of 72 hours representing sixty per cent of the course work normally taken in four years of college.

There is nothing to suggest that those who debate the issue of liberal versus vocational education are likely to come to an agreement. Perhaps agreement is not necessary, nor desirable. At least this seems to be the point of view of the Committee on College Curricula of the American Association of Petroleum Geologists.

In surveying the large number of suggestions that have been presented to us, we find that the basic question seems to be, should a curriculum for preparing a student for petroleum geology be of a technical engineering character or should it be broader, with more emphasis on fundamentals and humanities and less emphasis on technical specialization. There are definitely two types of school, namely, the technical and liberal arts. It is our belief that there is room for both types of training, both leading toward the same goal, one to be

[12] COMMITTEE ON GEOLOGIC EDUCATION, The Geological Society of America, *et al.*, Geology curriculum in the liberal arts college. Geol. Soc. America, Interim Proc. for 1950, pt. 2, pp. 9-17.

offered in the technical schools, and the other in the liberal arts colleges[13] . . . .

To say the least this is a clear analysis of a confused situation. It is common knowledge that students with the most diverse academic backgrounds manage to find places in the geological profession. On the other hand, it is hard to believe that liberal and technical (or vocational) approaches can literally be "leading toward the same goal." For different types of geologic work it would seem that one or the other preparation should be the more effective. In fact it should be possible to determine the relative strengths and weaknesses of the two educational formulas by analyzing the professional records of graduates from the liberal arts colleges and comparing these with similar records for graduates from the technical schools. To be sure it would be necessary to have a large sampling of both classes, and the labor involved in gathering and analyzing the data would be considerable. Yet how else can we hope to get to the heart of the issue?

What is involved in gathering information for such a project as this, we recently learned in the course of a survey of graduates in geology from Southern Methodist University. The purpose of this was to prepare a directory in honor of Dr. Ellis W. Shuler, who founded the department in 1915 and who was retiring in 1952. Working with lists of names supplied by the Registrar, and using addresses in alumni records and professional directories, it was possible to locate 228 out of the total of 240 persons involved. Questionnaires asking for the kind of information given in biographical directories such as *American Men of Science* were mailed, and 222 replies were received. Owing to the migratory nature of geologists and to the difficulty of getting mail delivered to some of the out-of-the-way places they frequent, it was a year before all the information could be assembled. Because this department in certain respects may be typical of small departments in liberal arts colleges, some of the results of the survey are given in tables and figures.

Table I compares the undergraduate curriculum at Southern Methodist University with three others, of which one would be classed as liberal and the other two technical.

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[13]LAHEE, F. H., *et al.*, Report of committee on college curricula. Am. Assoc. Petroleum Geologists, Bull., Vol. 26, 1942, p. 943.

Figure 1 shows the distribution of graduates by years. Each of the students had essentially the same sequence of undergraduate courses in geology: general physical and historical geology, mineralogy, petrology, structural geology, geomorphology, invertebrate paleontology, stratigraphy, and field geology. Although the degree requirements relating to work in other sciences have changed somewhat over the years, most graduates have taken a year each of physics, chemistry, biology and mathematics, and in addition a second or third year in one of these fields.

Figure 2 shows that, so far as the 228 persons accounted-for are concerned, two out of five have taken or are taking graduate work. One out of four has earned a graduate degree. The large diagram in the figure shows the present classification of the entire group of two hundred and forty. Three-fourths are professionally engaged in geological, geographical, geophysical or engineering work. Graduate students and students on tours of military duty may raise this figure to around 83% within the next few years. Included in occupations not related to geology are six housewives who were engaged in geological work prior to marriage.

Nearly all those classified as geologists are working in the field of petroleum geology. Although no courses in this subject are taught, many of the oil companies in Dallas provide students with part-time and summer jobs, and both the Dallas Geological Society and the Dallas Geophysical Society generously bring their lectures to the campus in order that the students may attend. In the following table the 126 petroleum geologists for whom biographical data are at hand are divided into three classes according to time elapsed since graduation. The majority of those who have

Year of Graduation	1917-1932		1933-1942		1943-1952	
	No. of Graduates	Per cent of total	No. of Graduates	Per cent of total	No. of Graduates	Per cent of total
Independent and Consulting Geologists	6	37.50	7	31.82	8	9.09
Administrative geologists, rank of Assistant Chief Geologist and higher	4	25.00	3	13.63	4	4.54
Administrative geologists below rank of Assistant Chief Geologist	5	31.25	10	45.45	10	11.37
Geologists	1	6.25	2	9.09	53	60.23
Junior Geologists	0	0.00	0	0.00	13	14.77
Total	16		22		88	

been out of school for less than ten years are ranked by their companies as geologists. The majority of those who have been graduated more than ten years are in the admin-

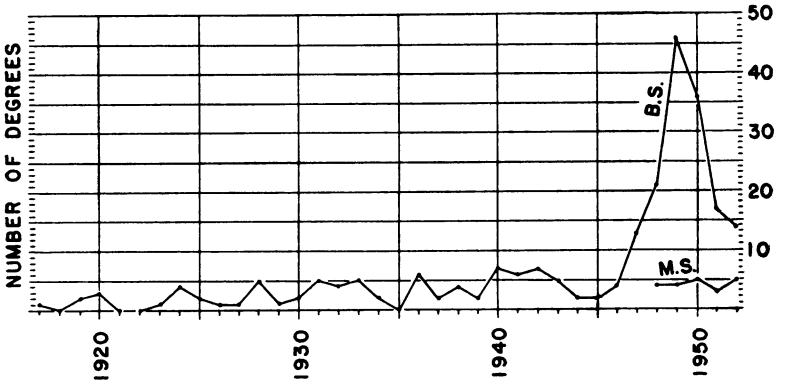

FIG. 1. Degrees in geology awarded at Southern Methodist University, by years.

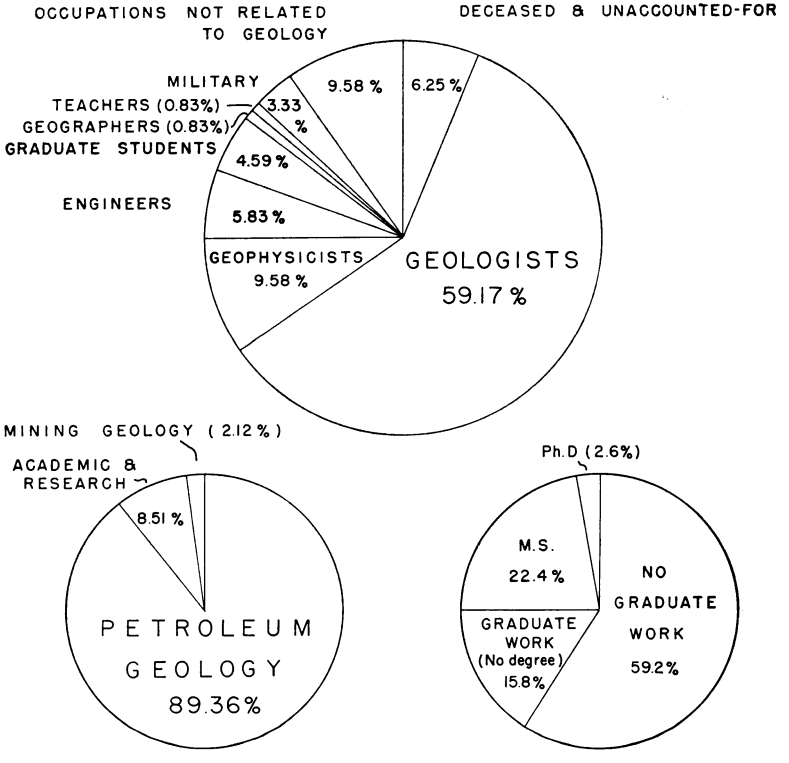

FIG. 2. Upper diagram shows classification of graduates in geology from Southern Methodist University, as of October 1952. Diagram at lower right shows status of 228 graduates with respect to graduate studies. Diagram at lower left shows professional fields of 142 graduates who are classified as geologists.

istrative grades, or else have become independent petroleum geologists or consultants. The same pattern of advancement with age appears in the case of the 23 geophysicists. Of the six who have been graduated more than ten years, all are administrators and two are presidents of their companies. Of the eighteen that have been out of school for less than ten years, none has advanced beyond the rank of party chief and only four have attained that rank.

For anyone concerned with geological education, this case history will hold a certain amount of interest. Comparisons of many such analyses for departments ranging from the most liberal to the most technical and scattered over the different provinces of the country might settle some issues that are now being argued largely on the basis of sentiment and prejudice.

Note

A Fossil Pleistocene Snake from Denton County, Texas.——In May, 1952, on an elementary geology field trip, an anonymous student discovered an articulated skeleton of what appeared to be a small fossil snake. The discovery site was a borrow pit just north of Garza-Little Elm Dam now under construction across the Elm Fork of the Trinity River, in Denton County. Associated fossils which purportedly had been collected previously by Dr. T. E. White, paleontologist with the River Basin Surveys, were a fairly complete *Equus*, and fragments of a glyptodont, bison and one of the mastodons.

The snake was sent to the Smithsonian Institution. In the letter of acknowledgment, Dr. W. F. Foshag tentatively classified it in the family Colubridae and recognized a marked similarity to the genus *Drymarchon*. The most outstanding factor in this addition is the articulated condition of the skull, jaws and vertebrae. The preservation seems to be associated with the caliche deposits which have acted as cementing agents. The present climate in this region is too moist for the formation of caliche by the precipitation of dissolved salts consequent to the surface evaporation of ground water. The implication is that in this region during a portion of Pleistocene time, the climate was such that conditions for preservation of delicate fossils may have been optimum. Therefore, the importance of the find is that truly outstanding data of the evolution of modern living forms may be available in this area.——*John W. Harrington.*