JOURNAL OF THE TENNESSEE ACADEMY OF SCIENCE
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FOR THE HIGH SCHOOL SCIENCE TEACHER

JOHN T. JOHNSON
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Manuscripts or other items suitable for this section of the Journal should be addressed to the Editor of this section, Mr. J. T. Johnson, Young High School, Knoxville, Tennessee, or his home address, 608 Russell Avenue, Jefferson City, Tennessee.

Reprints of this section may be secured by writing to the Editor of the Journal, Dr. Helen L. Ward, Zoology Dept., University of Tennessee, Knoxville 16, Tennessee.

ACADEMIC PREPARATION OF TENNESSEE HIGH SCHOOL CHEMISTRY TEACHERS[1]

LONE L. SISK
Milligan College

Last year the chemical industry of the United States spent $1,600,000,000 for new plants and equipment. It spends $300,000,000 annually for research. The average industry-wide investment per employee is $25,000, with many as high as $100,000 per employee (1). Last year the need for chemical engineers was 33% greater than in 1952. Last year our colleges and universities graduated 21.5% fewer bachelors, 26.6% fewer masters and 12.5% fewer doctors of chemical engineering to meet the 33% greater demand (2). Industrial statistical studies show an acute shortage of chemists, engineers, physicists, physicians, research scientists, and technicians to fill the demand in industry, health and national defense.

The United States Office of Education statistical reports show a steady decline in percent of enrollment in high school chemistry, mathematics, and physics in the face of this increased demand. In 1952 the chemistry enrollment was 7.6% of the total enrollment. Observation indicates that those who do enroll in high school chemistry do not acquire sufficient interest to continue its study in college. Many acquire a positive dislike for chemistry. College chemistry enrollments are also declining. There must be a reason.

National Education Association statistics show that in 1950 the nation's colleges produced 1780 graduates who met the minimum legal requirement for certification as high school chemistry teachers (3). In June of 1954 the same colleges produced in the same category 608 (4), a 65% decline in production of chemistry teachers in four years. For the same period Tennessee colleges

[1]This paper was read at the meetings of the Tennessee Academy of Science in Nashville, November, 1954.

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dropped from 65 to 43 chemistry teachers graduated, a decline of 34%. There must be a reason.

The short supply of chemists, chemical engineers, the decline in chemistry enrollment, and the decreased number of students preparing to teach chemistry, present a situation little short of catastrophic.

Ours is a highly technical society. The humanities are, and must remain, its foundation; but the physical sciences are its superstructure. They contribute immeasurably to each area of human well-being: physical, mental, social, and spiritual. Hence it seems most strange that a lack of interest should obtain in chemistry. It is a matter of common experience, and perhaps as annoying as common, that Junior's third word is "why," progressing successively to "why does it do it," to "how does it do it," to "can I do it." Just why should this innate curiosity, this intuitive desire to learn, cease with respect to chemistry, a most fascinating and beneficial phase of human endeavor?

The purpose of this study was to determine the extent of teacher preparation in chemistry and with that information to ascertain whether there is any correlation between teacher preparation in chemistry (or the lack of it) and the decline in chemistry enrollment.

As used in this study the term chemistry teacher means any white person with an academic degree teaching chemistry in Tennessee high schools. An undergraduate chemistry major is a minimum of 36 quarter hours of collegiate chemistry; a minor is 27 quarter hours. A graduate major in chemistry is a minimum of 22 quarter hours of graduate chemistry; and a minor is a minimum of 12 quarter hours of graduate chemistry.

The names of those who taught chemistry in Tennessee high schools for the school year 1952-1953 were secured from the State High School Supervisor.[1] The Office of the Division of Certification[1] supplied the certification numbers of those teachers. These numbers provided the means of locating the teachers' records, including college transcripts, in the Division of Certification files.

There were 154 bachelors, 92 men and 62 women. Of that number, 101 records were complete and available for study. They came from thirty colleges in nine southern states and one midwestern state. Cosmopolitanism is more apparent than real. Eleven out-of-state colleges contributed only thirteen teachers. They had majored in eighteen subject matter fields, from agriculture to zoology. There were sixty-nine persons with master's

[1]The author wishes to thank Mr. R. R. Vance and Mr. A. B. Cooper of the Tennessee State Department of Education for permission to use these records.

degrees teaching chemistry, thirty-one of whom had complete undergraduate and graduate transcripts on file. They came from ten graduate schools, six within the state. The four out-of-state institutions contributed four teachers. All complete available records are included in the study.

Academic preparation in chemistry and related sciences, as shown on the transcripts, was tabulated by subject matter field in six quarter-hour groups: (0 hours), (1-6), (7-16), (17-26), (27-35), (36-up). The subject matter fields include chemistry, physics, mathematics, biology, astronomy, geology, meteorology, and health. For comparison purposes the number of quarter-hours of education and psychology combined was also tabulated. The tabulations for the bachelor degree teachers (see Table I) show on teacher with zero quarter-hours of collegiate chemistry preparation, 77 with fewer hours than a minor, six minors, and

TABLE I

PREPARATION IN CHEMISTRY AND RELATED FIELDS FOR 101 TENNESSEE HIGH SCHOOL BACHELOR DEGREE CHEMISTRY TEACHERS IN 1952-1953

	Number of Teachers With						
					Minor	Majors	Qr-hr
Quarter-hours	0	1-6	7-16	17-26	27-35	36-	Median
Chemistry	1	2	50	24	6	18	16
Physics	47	8	37	4	0	5	3
Mathematics	27	12	29	15	10	8	9
Biology	10	3	39	23	8	18	16
Geology	86	14	1	0	0	0	0
Astronomy	93	7	0	1	0	0	0
Meteorology	97	4	0	0	0	0	0
Health	68	24	8	1	0	0	0
Education, Psychology	0	0	0	1	68	32	31

SUMMARY

No undergraduate chemistry	1.0%
Some	99.0%
Less than minor	76.3%
Minors	5.9%
Majors	17.8%

eighteen chemistry majors. The remaining majors were in agriculture, home economics, biology, English, French, Spanish, education, health education, physical education, psychology, physics, mathematics, history, social studies, industrial arts, zoology, and "science." Eleven teachers reported "science" majors who had thirty-six or more hours in a specific science and these were tabulated as chemistry, physics or biology majors. Those who reported chemistry majors, and whose transcripts did not show thirty-six hours of chemistry were tabulated as "science" majors. This is the only bit of interpretive reporting of transcript records in this paper. The quarter-hour range of under-

graduate chemistry preparation is 0-108, the median is 16 hours, and the greatest quarter-hour frequency is 12 hours, the bare minimum to meet science graduation requirement. The professional education range for the same teachers is 22-76 quarter-hours and the median is 31 hours.

Turning to the master degree teachers, there were thirty-one whose records contained transcripts for both undergraduate and graduate work. This small number was due in part to the fact that a master's degree was only for salary increase purposes. Hence the graduate transcript was not required for filing. A statement from the degree granting institution was sufficient for the salary increase. The Division of Certification now requires the transcript to be filed. Of these thirty-one, six had chemistry majors and six had chemistry minors. The undergraduate chemistry range is 12-73 hours, the median is 23 hours, and the greatest frequency is 12 hours. Their professional education range is 3-93 hours and their median is 36 hours.

In graduate school three of these thirty-one majored in chemistry and four minored in chemistry. Two of the minors majored in education. Twenty-one had no chemistry and majored in education. The quarter-hour range of graduate chemistry preparation is 0-36 hours, the median is zero, the average is 5.6 hours per teacher. For graduate education the range is 0-55 and the median is thirty-two hours (Table II).

The combined undergraduate and graduate chemistry preparation range is 12-73 hours with a median of 25 hours. Note that this median is only two hours greater than the undergraduate median and that it is fewer hours than an undergraduate mior. The combined education range is 27-127 hours and the median is 63 hours.

Do these records indicate that those who teach chemistry in Tennessee high schools have sufficient mastery of chemistry to interpret it for high school students, to arouse their interest in and to motivate them for chemistry study? One must remember that by due process of law (5) a person who has "passed" a freshman chemistry course of twelve hours has met the requirement for certification as a high school chemistry teacher. The Division of Certification is merely complying with the provisions of the law in issuing the certificate. Do these records indicate that the teachers have not had sufficient professional education courses to be effective chemistry teachers? Do they indicate that these teachers have prepared themselves to teach in other fields than chemistry?

Educators are blaming industry for the decline in good chemistry teachers. It is a fact that personnel representatives of industry are sitting on the door steps of every college in the land each June to interview chemistry majors,—and to employ them

TABLE II

MASTER DEGREE TEACHERS' CHEMISTRY PREPARATION

	Graduate In Quarter-hours						
Teacher	Chem.	Phys.	Biol.	Math.	Ed. & Psy.	Minor	Major
1	0	0	0	0	30	Soc	Ed
2	0	0	0	0	27	Ag	Ed
3	0	0	0	0	32	So. S	Ed
4	0	0	0	0	40	So. S	Ed
5	0	0	0	0	34	Econ	Ed
6	22	0	10	0	10	None	Chem
7	0	7	0	6	36	Sci	Ed
8	7	0	4	0	25	Eng	Ed
9	0	0	40	0	8	None	Biol
10	0	4	0	32	24	Ed	Math
11	21	0	0	0	28	Chem	Ed
12	17	0	0	0	32	Chem	Ed
13	0	0	0	0	42	None	Ed
14	24	0	16	0	0	Biol	Chem
15	0	0	0	18	39	Math	Ed
16	0	0	0	0	45	None	Ed
17	12	0	0	0	4	Chem	H.E.
18	0	0	32	0	10	None	Biol
19	0	0	0	0	55	None	Ed
20	0	0	0	0	32	Hist	Ed
21	0	0	0	0	36	Geog	Ed
22	0	0	12	0	33	Biol	Ed
23	36	13	0	0	0	Phys	Chem
24	9	11	0	28	0	Sci	Math
25	0	0	0	0	54	None	Ed
26	0	0	0	0	49	None	Ed
27	4	0	0	0	16	Ed	H.E.
28	0	0	33	0	12	Ed	Biol
29	12	0	0	25	4	Chem	Math
30	0	0	0	0	36	None	Ed
31	0	0	0	0	45	None	Ed
Median	0	0	0	0	32		

Summary	
No graduate chemistry	67.8%
Some	32.2%
Minors	12.9%
Majors	9.6%

at a salary far beyond what school administrators are willing to pay. "Industry is killing the goose which lays the golden eggs." But public school administrators are willing to pay also. Here is a bulletin from Superintendent John Q. Public, Blank County, Tennessee, that reads "Teachers Wanted," listing twenty-four desired teachers. And, "State salary schedule plus $35.00 per month." Note this quote, "Band, coaches, music, and principals additional supplements." Do administrators mean by these additional supplements to imply that those fields are more important to the school curricula than history, literature, chemistry, physics or mathematics for producing responsible citizen-

ship and social improvement? After seventeen centuries of Christian philosophy, which included such noble ideals as the brotherhood of man, the value of human dignity, the high moral worth of the individual, human slavery still was the rule—not the exception. The world's work was still done by men's backs. They worked like oxen, lived like pigs, died like flies. And few, if any, cared. Then the steam engine was invented. The steam engine was the greatest humanizing event in the nineteen centuries since the Man of Nazareth taught. It is the means by which those great cultural ideals were translated from abstract philosophical concepts into commonplace human realities; and at the same time converted those biped beasts of burden into men, creative men. Can school administrators afford to bid against industry for the services of prepared men who can transmute this field of knowledge into living monuments of responsible productive leadership, with the attendant high degree of cultural refinement, with an urgent sense of moral obligation for continuing individual improvement and national welfare? Is meager chemistry preparation denying America's children the opportunity for introduction to scientific study? Are America's schools—and the nation as well—being denied the services of scientifically trained personnel, because administrators prefer to pay higher salaries in other fields?

Editorial headlines say "Better salaries for teachers, Yes,—but better teachers too." Are those teachers with master's degrees in education, and an increase in salary, but with no increase in chemistry preparation better chemistry teachers? Do these records indicate that such meager preparation in chemistry by those who are now teaching chemistry could be a major factor in the decline of chemistry enrollment?

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