

SECTION E, SCIENCE EDUCATION

The Chemistry Backgrounds of Science Teachers Other Than Those Teaching Chemistry

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The recommendations of the Cooperative Committee (Science, 1960) represent best the scientists' considered judgment on the ideal preparation for the teachers of each particular secondary school science. The presentation of these recommendations in conjunction with the National Association of State Departments for Teacher Education and Certification (NASDTEC) indicates that serious consideration will be given to attaining these goals when and as the individual states modify their certification requirements. Accordingly, these outlines of targets should be kept in view by all parties interested. Certainly, the professional scientists, from whom so many criticisms have come, should take a strong interest in the further development of teacher programs.

The Cooperative Committee's recommendations apportion one-half of the teacher-trainee's time for study in the proposed teaching field (including related subjects as well as the single discipline), one-third in "general education" courses chosen to round out the education of the individual, and the remaining sixth in the study of professional education courses to gain insights into philosophies and methods of teaching.

This distribution of course credit brings back into consideration emphasis on subject matter that had disappeared from teacher-preparation programs under conflicting philosophies. The conflict continues but the logic of stronger subject-matter preparations has been gaining broader acceptance among the individuals most concerned.

These provisions of the Cooperative Committee's recommendations also should be considered. A revival of the specialized science teacher, as distinguished from the general science teacher, is implied. Whether separate certification of biology, chemistry and physics will eventuate is a moot question but the recommended programs lay the basis for such action. The Committee believes strongly that the combination of courses should give both an introduction to each of the related sciences and a sufficient under-graduate concentration in one subject to prepare the prospective teacher for real graduate study courses in the specialty. The assumption is made that each program will require one year of study beyond the bachelor's degree.

This paper compares the preparation of a number of teachers of biology and physics against these recommendations on the details of chemistry backgrounds.

THE SAMPLE

Records of teachers of biology and physics have been sorted from some 1400 applications to three different institutes specializing in remedial mathematics, remedial chemistry and multi-discipline studies at an intermediate course level. There were 93 teaching biology and 85 teaching physics (but no chemistry), one or more classes in the school year 1960-61 (Table I). The sample is extensive rather than representative.

Maximum useful data available on these applications were transcribed

TABLE I. CHEMISTRY BACKGROUNDS OF TEACHERS OF BIOLOGY AND OF PHYSICS

Subject:	Biology		Physics			
	Cooperative Committee Recommendations					
	10	8	6	6		
General Chemistry	Organic, Biochemistry		Organic, Physical			
Other Chemistry	1 or 2	3 to 5	1 to 5	1 or 2	3 to 5	1 to 5
Preferences	81	12	93	58	7	65
Classes taught	6	0	5	8	28	11
No. in sub-sample	33	16	31	24	14	23
% with no chemistry	46	83	63	67	58	66
% not meeting Genl. Chem. requirement	% of those meeting General Chemistry recommendations <i>a. u.</i> :					
% meeting General Chem. recommendation	39	70	42	13	100	30
% of those meeting General Chemistry recommendations <i>a. u.</i> :	16	50	17	not specified	not specified	7
4+ hrs. Organic	not specified	40	42	3	100	30
4+ hrs. Biochemistry	45	40	42	18	100	30
4+ hrs. Physical						
(4+ hrs. Analytical)						

and coded for a group of studies. The factors treated here are limited to the comparison with the Cooperative Committee criteria and the more pertinent characteristics of the sub-sample teachers.

These data (Table I) show:

1. A minority teach more than two classes of each subject per day, making the majority incidental or casual teachers of the subject.
2. A very limited number have no chemistry credit.
3. Approximately two out of three meet the criteria of a year of general chemistry.
4. A very definite minority have preparation in either of the second year courses specified for their subject.
5. A rather substantial percentage (30-40%) have had analytical chemistry, a subject not mentioned for either program but one that can be regarded as the "whipping boy," sacrificial-candidate in curricula revisions.
6. Overall, the teachers are not sufficiently developed in the supporting knowledge of chemistry to handle their own subjects.

CHARACTERISTICS OF THESE TEACHERS

The teachers in these sub-samples are predominantly male, married, and relatively young (52% under 35 and 10% over 50). Their teaching experience in the particular science is relatively short, with 43-45% having only one to three years of such experience. While not assigned to teaching chemistry in 1960-61, a very substantial number have one to three years of teaching experience in chemistry (43% for the biology sub-sample and 36% for the physics group). Two-thirds of the physics teachers and one-third of the biology teachers had the same length experience in teaching mathematics. One-quarter of the biology teachers had no physics teaching experience while one-half of the physics teachers had taught no biology. Altogether, these teachers showed the characteristics of most science teachers in small schools where the number of teaching assignments each year runs three or four, certainly not a condition that favors the depth presentation of a single subject.

More teachers teach in separately organized senior high schools than in combination junior-senior schools. The numbers teaching in small schools of enrolments under 250 are 67% for the biology and 57% for the physics sub-samples. Most of the teachers with three to five classes of the subject teach in schools having over 500 enrolments.

The turnover rates of the several sub-samples are similar. Approximately one-third were in the same school in 1956-57, approximately one-half in 1958-59, and slightly under four-fifths in 1959-60. The teachers having more classes of the same subject tended to stay longer in their particular schools.

Geographically, two-fifths of the biology teachers but only one-fifth of the physics teachers are located in Oklahoma.

IMPLICATIONS

If the Cooperative Committee's recommendations are to be taken seriously as the target for upgrading teachers, then biology and physics teachers have considerable study of chemistry ahead of them in the next several years. The greatest area of deficiency is physical chemistry which

underlies the aggressive curricular changes from descriptive chemistry to fundamental principles.

Teachers of chemistry and of general science probably also lack adequate preparation in chemistry. Conjecturally, although lying outside the scope of this paper, there could be other areas of subject matter weakness besides chemistry.

The retention of small high schools encourages retention of the teacher of all subjects having only smatterings of personal studies. Considering the political dedication to the very small schools in Oklahoma, changes along the line of teacher upgrading will proceed very slowly. The rate of change will not be helped by the continued apathy of professional scientists toward the problems of teacher qualifications.

LITERATURE CITED

- (1) SCIENCE, *131*, 1024-8, April 8, 1960
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