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THE STATUS OF PHYSICS TEACHING IN NORTH CAROLINA.

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AN ANALYSIS OF THE STATUS OF HIGH SCHOOL PHYSICS AND THE QUALIFICATIONS OF INSERVICE AND NEW PHYSICS TEACHERS IN NORTH CAROLINA IS PRESENTED. ALL SECONDARY SCHOOLS IN THE STATE WERE INCLUDED IN THE SURVEY. A RANDOM SAMPLE OF 88 TEACHERS WAS SELECTED FOR THE ANALYSIS OF THE QUALIFICATIONS OF PHYSICS TEACHERS. DATA WERE OBTAINED FROM THE BIENNIAL REPORTS OF THE PUBLIC SCHOOLS, TEACHER TRANSCRIPTS, AND TEACHER CERTIFICATION RECORDS. GRAPHS, TABLES, AND PERCENTAGES WERE USED TO INTERPRET FINDINGS. THE NUMBER OF SCHOOLS OFFERING PHYSICS AND THE NUMBER OF STUDENTS ENROLLED IN PHYSICS HAS SLOWLY INCREASED. MOST SCHOOLS WERE TEACHING ONE CLASS OF PHYSICS. THE MAJORITY OF THE TEACHERS WERE NOT ADEQUATELY PREPARED. FEW TEACHERS WERE BEING PREPARED OR CERTIFIED FOR SPECIALIZATION IN PHYSICS. THIS PAPER WAS PRESENTED AT THE ANNUAL CONFERENCE ON RECENT ADVANCEMENTS IN PHYSICS (4TH, CHAPEL HILL, DECEMBER 28, 1965). (AG)

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Our examination of the status of physics teaching in North Carolina was prompted by several questions put to us by superintendents, college officials, high school teachers, and others. Our most frequent question from schools is "where can we find a high school physics teacher?" Often the question comes without the adjectives "qualified," "certified" or "good." An allied question is "what institutions in the state are preparing physics teachers?" Several have asked if high school physics enrollments are increasing or decreasing. It only took a few questions about the feasibility of continuing to teach physics in the high schools to convince us of the importance of studying the present status of physics teaching in North Carolina.

The problem appeared to be in two parts. First, what is the situation in the state at the present time and in what direction do we appear to be moving? Second, what alternatives should we consider in planning for physics teaching during the decade ahead?

We attempted to deal with the problem of status and trends by asking ourselves four questions. Although we concentrated our attention on North Carolina, the national situation was also scrutinized in hopes of finding information that would be of help in answering these questions.

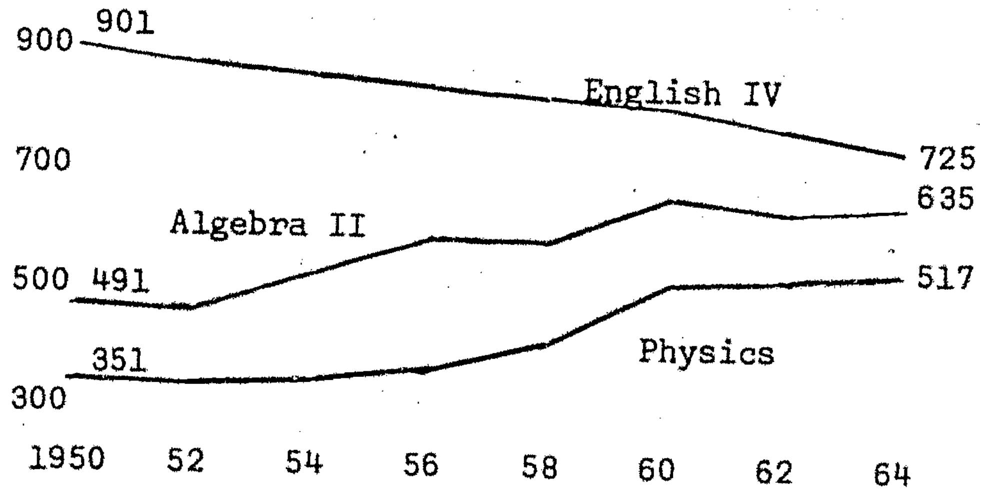
1. What is happening in North Carolina to the number of schools teaching physics and the number of pupils enrolled in physics?

To answer the question we obtained our data from the Superintendent's Biennial Reports.[1] Let us first turn our attention to the number of schools offering physics. Since 1950 there has been a slow steady rise in the number of schools offering physics with the largest increase

*This paper was presented at the Fourth Annual Conference on Recent Advancements in Physics on December 28, 1965 in Chapel Hill. The data presented at the meeting on slides has been included as figures in this report.

Figure 1

SCHOOLS OFFERING PHYSICS, ENGLISH IV AND ALGEBRA II



occurring between 1958 and 1960. See Figure 1. This information does not support the rumors that schools are dropping physics from the curriculum. We were encouraged to find that the number of schools teaching physics has increased.

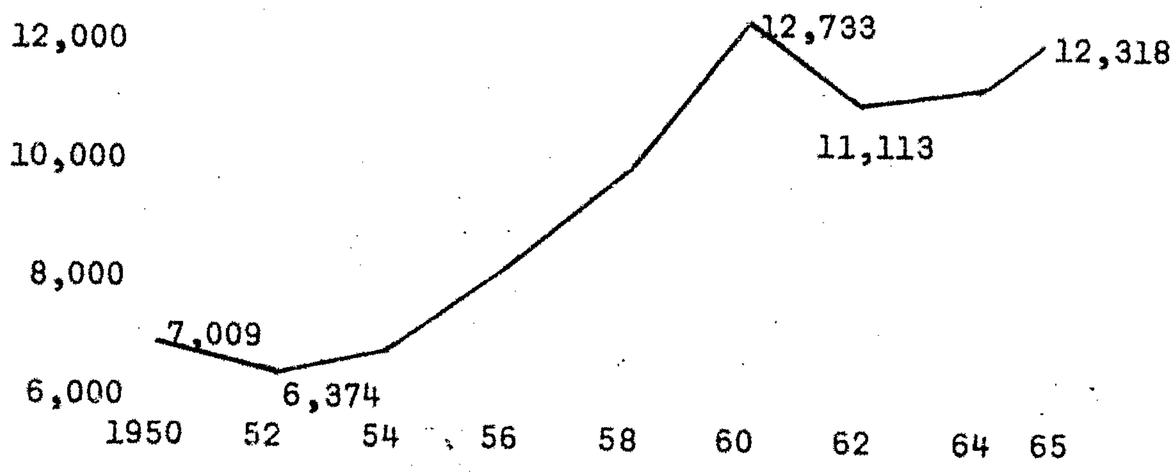
We again went to the Superintendent's Biennial Reports to obtain data on a course that is a senior requirement for graduation in North Carolina, English IV.[2] The curve in Figure 1 shows a steady decrease in schools offering this graduation requirement. The major reason for this decrease is the consolidation of many smaller schools. The comparison of the two curves shows that the number of schools teaching physics has increased during a period in which the total number of high schools in the state has decreased.

We also examined the data concerning another course, Algebra II, as shown in Figure 1. Algebra II is elected by college bound students with a science and mathematics orientation. This curve shows us that Algebra II is also showing an increase in the number of schools offering it. We see that physics is increasing at about the same rate as Algebra II, thus indicating it is holding its own with respect to mathematics.

Let us now turn our attention to the student enrollment in Physics, English IV and Algebra II. We see in Figure 2 that enrollment in physics has increased by a factor of two since 1952. We also note a disturbing dip in the curve showing the aftermath of the sputnik era. It is also obvious that the rate of increase of students has slackened

Figure 2

PHYSICS STUDENTS



during the past few years even if we ignore the peak sputnik years.

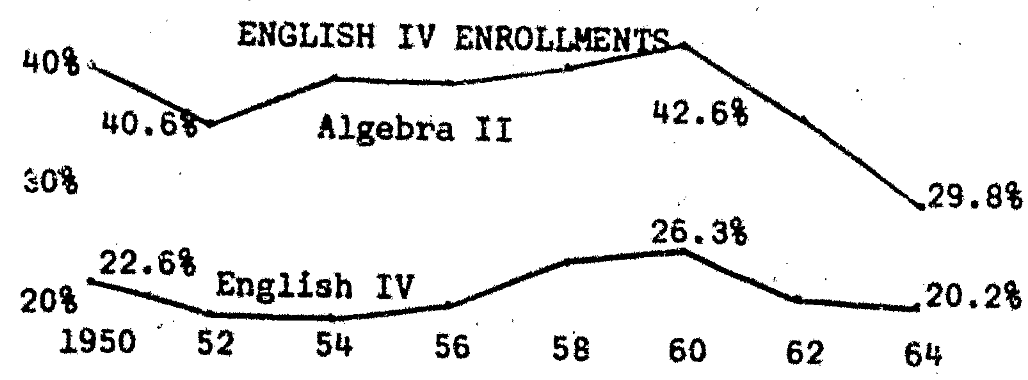
Because the enrollments in the other subjects were very large in comparison to the enrollment in physics we used a bit of mathematics to make the comparison more meaningful. Figure 3 shows the percentage of the state-wide enrollments in physics compared to the state-wide enrollments in English IV and Algebra II. We see that enrollment in physics is about one-fifth that of English IV, and less than one-third that of Algebra II.

The data suggest a couple of interesting questions. Is physics such a difficult subject that only one-third of those taking Algebra II should undertake a course in physics? Second, is it defensible to think of physics as a subject that could be of value to all high school seniors, regardless of ability or vocational aspiration?

Let us very briefly review the data on student enrollments. There were 517 high schools teaching physics last school year in which 520

Figure 3

PHYSICS ENROLLMENTS IN PERCENTAGE OF ALGEBRA II AND ENGLISH IV ENROLLMENTS



teachers taught a total of 538 classes. Clearly, the usual pattern is one physics teacher and one class in physics in almost every high school in the state. We feel that this finding is of paramount importance in considering ways to improve physics teaching in North Carolina.

2. How well qualified are our physics teachers?

To attack this question we obtained permission to use the preliminary principals reports for the 1964-65 school year. We examined each report and listed the name and certificate number of each physics teacher. We then selected a 16.9% random sample for further analysis. We examined the transcripts in the certification folders of the 88 teachers in our sample. We compiled the number of hours of undergraduate physics, the number of hours of physics after the bacculaurate degree, the date of the last physics course, whether calculus had been taken, the college of the bacculaurate degree, and areas of certification, and the sex of the teacher.

Let us consider our findings by first looking at the sample as a whole and then at a typical physics teacher. The percentages are to the nearest whole number. The undergraduate physics preparation ranged from no physics to 71 semester hours. The median and the mode were 8 semester hours. Five percent of the physics teachers have never had a college physics course! It is interesting to note that three-fourths of these teachers with no college physics have graduatedwithin the last five years.

Only 38% of the teachers have taken a calculus course. Most authorities would agree that calculus is a must if a true understanding of basic physics is to be developed.

According to certification records, only 30% of the teachers have taken a physics course since their undergraduate training. Because of the lack of an accepted definition we made no attempt to separate the courses after the bachelors' degree into graduate and undergraduate courses.

Sixty-five percent of our sample have had no physics course beyond the first year of beginning physics. This is far below the recommendations of the State Department of Public Instruction, the colleges of the state and, insofar as we know, every organization that has made recommendations concerning the qualification of teachers.

Let us graphically examine a portion of the above data.

Figure 4

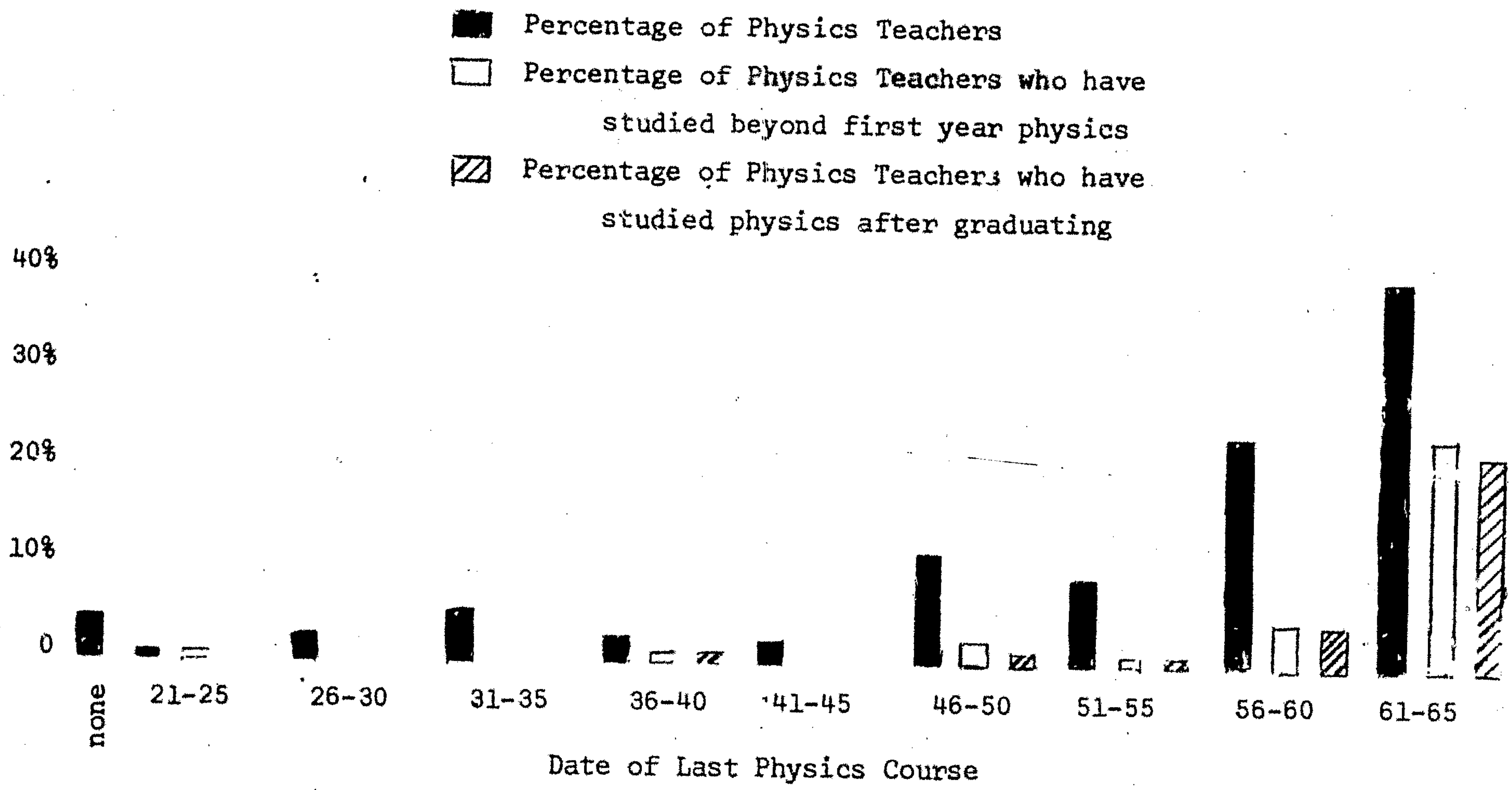


Figure 4 shows the percentage of physics teachers compared to the year of the last physics course. We can see that 13% of the teachers have not had a course since World War II, and 38% have not had a course within the last ten years. Let us now compare these teachers with those that studied physics beyond the first year of general physics. See Figure 4. There seems to be little or no relationship between the sets of data. Now let us examine the physics teachers who have studied physics since they received their bachelors' degree. See Figure 4. Again, we note little or no relationship with the previously mentioned groups.

Let us now examine the composite picture of the typical physics teacher, if there is such an animal. He graduated from a North Carolina college. (I am sure that all you gentlemen will be happy to know that with 23% of the teachers we would be forced to use the feminine gender.) The physics courses of our teacher were limited to the beginning year of physics taken without the advantage of calculus. He graduated seven years ago and has not taken any physics courses since.

3. <u>How many and what kind of teachers are being added to the pool of physics in North Carolina?</u>

Shannon and Anderson conducted a study of teacher education programs in North Carolina in which data was obtained about programs in 21 of the

35 institutions preparing science teachers. Included in the 21 were all the major institutions in the state. These 21 institutions reported a total of three physics teachers being prepared during the 1962-63 school year.

Dr. Jerry Hall of the State Department of Public Instruction studied the 2,374 teacher education graduates applying for certification in 1963.[3] These graduates represented all of the institutions of the state. Of the total of 2,374 certified, 1,654 were certified in secondary school and special subject areas.

Shown in Table 1 are the numbers certified in mathematics and the sciences and the average number of semester hours of physics taken by each group. Notice that there were no teachers certified with an area of specialization in physics in 1963. What happened to the three that were supposedly prepared in 1963? We can speak only of the single neophyte physics teacher at North Carolina State-- he took a job in Virginia!

Table 1
Teachers Certified in Mathematics and Science (1963)

Areas of Certification	Number Certified	Average Number of Semester Hours of Physics
Mathematics	99	6.8
Science	78	8.2
Biology	52	1.2
Chemistry	2	8.0
General Science	8	6.8

Some might suggest that physics teachers be recruited from other states. A research report released recently by the National Education Association reveals that 499 physics teachers were prepared in the United States in 1964 and 584 in 1965.[4] Considering that there are about 12,000 teachers in the United States teaching one or more classes of physics, and assuming a modest rate of turnover of ten percent per year, we can see that we are preparing only about one-half the needed number of new physics teachers each year.

4. What is the relationship between a student's work in high school physics and his success in college physics?

This question was prompted by the not all together infrequent suggestion that high school physics be dropped from the curriculum. A review of the literature revealed little substantial evidence to support the claim that students who take high school physics do better in college physics than those who do not take high school physics.

For example, Dr. John Renner and associates at the University of Oklahoma asked college professors of physics to comment on the value of high school physics. Their results were reported in the August, 1965 issue of the American Journal of Physics in an article titled "Is High School Physics A 'Waste' for College Preparation?".[5] The article contains many conflicting comments about the value of high school physics. Perhaps college professors of physics attending this meeting will wish to share opinions about the value of the high school physics course.

An investigation conducted by Finger and others of 179 students taking the first course in physics at Brown University was reported in Issue I of the 1965 Volume of the Journal of Research in Science Teaching.[6] Of the 179 taking physics, 105 had conventional high school physics, 49 had PSSC, and 25 had no physics. There was no significant difference in the achievement in college physics of these groups except, and I quote, "probably the conclusion is justified that girls who have studied no physics in secondary schools do less well in physics than do others at Brown University."

Summary

At this point we would like to summarize what we have said thus far. The situation with respect to physics teaching is as follows:

1. Although there has been a rather slow increase in the number of schools offering physics and the number of students enrolling in physics, we feel that an even larger number of students could profitably enroll in physics. It is important to remember that the most common situation in North Carolina is one class in physics per school.

2. An analysis of the certification records of a sample of North Carolina physics teachers revealed that a large

majority of these teachers could be classified by almost any standard as being inadequately prepared.

3. Particularly no teachers with a specialization in physics are being prepared or certified in North Carolina. Only about one-half of the estimated number of physics teachers needed nationally are being prepared.

4. There is little evidence to show that college physics students who took high school physics do significantly better than those who did not take physics in high school.

The obvious question at this point is where do we go from here. We believe that the alternatives can be grouped in three categories. It is our hope that the remainder of this presentation can be an informal discussion of these alternatives and others you would care to suggest.

ALTERNATIVES PRESENTED

I. Maintain Status Quo

Continue to teach physics in 500+ high schools with the teachers available.

II. Drop Physics

Except in those schools when a qualified physics teacher is available - i.e., a minimum of 18 semester hours of physics, calculus, and at least one physics course during the past five years.

III. New Approaches

A. Within Present Framework

1. ETV
2. Filmed Courses
3. Programmed Materials

B. New Organizational Patterns

1. Traveling Physics Teachers
2. County-wide or regional summer schools

REFERENCES AND NOTES

1. North Carolina Public Schools, Biennial Report, Part I, 1962-64, Publication No. 384. Raleigh: North Carolina State Department of Public Instruction, 1965. Earlier Biennial Reports dating back to 1950 also were used.

2. The number of students enrolled in English IV is approximately the number of students in the twelfth grade in North Carolina high schools. Algebra II was chosen as an indication of the number of students who have at least average ability. One would expect that these students, with proper motivation, would experience success in physics.

3. Division of Professional Services, State Department of Public Instruction, Curricula for the Preparation of Teachers. Raleigh: North Carolina State Department of Public Instruction, n.d.

4. "The Selective Shortage of Teachers," NEA Research Bulletin, Volume 43, Number 3 (October, 1965), pp. 72-76.

5. Renner, John W., Robert J. Whitaker, and Leticia B. Bantista. "Is High School Physics a 'Waste' for College Preparation?", American Journal of Physics, Volume 33 (August, 1965), pp. 618-624.

6. Finger, John A., Jr., John A. Dillon, Jr., and Frederic Corbin. "Performance in Inductory College Physics and Previous Instruction in Physics," Journal of Research in Science Teaching, Volume 3 (Issue 1, 1965), pp. 61-65.