A CRITICAL STUDY OF THE COURSE IN HIGH SCHOOL PHYSICS WITH REFERENCE TO CONTENT, TEACHING PRACTICE AND TEACHING PERSONNEL.

by

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Submitted to the Department of Education and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Arts.

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Date May 22, 1923.

ACKNOWLEDGEMENTS

The writer wishes to thank the many individuals who contributed to the development of this study. Special gratitude is herewith expressed:

To the parents who gave time and thought to the consideration of the "Parent Questionnaire";

To the teachers who consented to add to their many teaching burdens the additional task of answering the unusually long "Teacher Questionnaire", and also of distributing and collecting the "Parent Questionnaires";

To my wife and our son Warren for their most helpful assistance in tabulating the returns;

To Dean F. J. Kelly for the inspiration and encouragement to begin the study;

To Dean R. A. Kent and Dr. F. P. OBrien for their suggestions and valuable criticisms from time to time in carrying out, and writing this report of, the study.

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A CRITICAL STUDY OF THE COURSE IN HIGH SCHOOL PHYSICS WITH REFERENCE TO CONTENT, TEACHING PERSONNEL AND TEACHING PRACTICE.

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PART ONE
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EVALUATION, BY ADULT CITIZENS, OF THE DEVICES AND PRINCIPLES TAUGHT MORE OR LESS IN THE PRESENT PHYSICS COURSE.

Without unduly distorting the thought of Inglis[1], it may be said that every subject introduced into the high school curriculum, if it is to succeed at all, must pass through two critical stages of development before it can find its proper place. The first stage is that in which it is struggling for recognition as a part of the curriculum. The second stage is becoming standardized as to "content" of subject matter and "method" of instruction.

THE HIGH SCHOOL PHYSICS COURSE HAS BECOME STANDARDIZED.

These two crises have already been met and the decision made with respect to the high school physics course[2]. The basis, however, for making the decision was the traditional aim of secondary education, viz, "To prepare for College".

This aim for the physics course very naturally determined both its content and the method of presentation. With respect to the content there seemed to be little question. Since it was to prepare for college physics it meant, of course, that high school physics should be merely "elementary" college physics. College physics was divided into five divisions known as: Mechanics, Heat, Sound, Light and Electricity, consequently we find high school physics similarly divided.

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1. Editor's Introduction to "The Junior High School", T.H.Briggs Houghton Mifflin Co., New York, 1920

2. Mann, C. R. "The Teaching of Physics" The Macmillan Co., New York, 1912, Chapter 2.

The deductive method was usually used in the college course. This led to the organization of the high school course around "Principles". College physics made use of lecture and laboratory courses which were, and are, distinct one from the other. In like manner the same idea was adopted, early in the history of physics as a high school course. It has been almost a universal custom in high schools in the past to have three "Recitation" and two-double "Laboratory" periods each week. The college physics classes were required to prepare systematic written reports of their laboratory work. This too was adopted in the high school. The college physics was essentially mathematical, rather than descriptive or applied in its nature; hence we find the high school physics courses built along the same line.

NEW AIM IN SECONDARY EDUCATION DEMANDS REORGANIZATION.

Neither this organization nor the prevailing method of instruction regarding the high school physics course were called into question until the larger question was raised with respect to the true aim of secondary education. At the present time however we find the course in a somewhat similar position as at the beginning. It seems that it must pass yet a third stage before it is once more to become standardized. By a shifting of the aim of secondary education from the "College Preparatory" point of view to that of "Social Worth" we find ourselves face to face with three serious prlblems. First; is physics in the high school justifiable on the grounds of its social worth? Second; if it is, what should be its content and type of

organization? Third; what is the best means or method of enabling a student to secure this social worth while pursuing the course?

No one has presumed, thus far, to answer the first of the foregoing questions in the negative, There are two things however, which suggest that it is being considered less essential than hereto fore. One, is the fact that the proportion of high school students enrolled in the course is constantly decreasing.[3] The other, is the fact that for Kansas, at least, physics is no longer a state-wide required subject. In spite of the fact that the demand has been growing less and the course is no longer one of the state requirements, we find still a high degree of unanimity of opinion in the state that there is something worth while in the subject. This is shown by a study of reports sent by the various schools to the State Department in 1917-18.[4] It was found that 91% of all Class A, B, and C schools of Kansas were offering physics. Further evidence that the people of the state think physics is justifiable in the high school curriculum is found in the fact that of 112 replies received from a questionnaire in 1922, described later in this study, to the high schools within the state, all reported classes in physics.

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3. Barber, F. D. "The Reorganization of High School Science" School Science and Mathematics Journal, Vol. 18, pp. 247-262

4. An unpublished study by the writer.

NEED FOR A NEW CONTENT.

With respect to the question regarding what should be the content and type of organization when attempting to conform to the new aim in high school education, we have varied answers. Some of these answers, in the form of addresses, papers or scientific articles, if arranged chronologically, would be a very fine indication of the gradual change in point of view regarding the aim of high school physics.[5] Calls for reorganization always follow and do not precede a change in the objectives sought. Since 1908, and more insistently since 1910, we find teachers in increasing numbers voicing the need for a change in the content of high school physics so as to enable them to teach what is more significant in the every-day life of the student.[6] The result of this constant and increasing call is most strikingly reflected in the text-books which have appeared during the last decade. Just a glance at the titles of some of the leading ones shows clearly the attempt at a readjustment.

Texts by Millikan and Gale

Title used in 1913: "A First Course in Physics"
" " " 1920: "Practical Physics"

Texts by Carhart and Chute

Title used in 1912: "First Principles of Physics"
" " " 1918: "Physics with Applications"
" " " 1920: "Practical Physics"

Texts by Black and Davis

Title used in 1913: "Practical Physics"
" " " 1922: "Practical Physics" Revised.

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5. Woodhull, J.F. "The Teaching of Science" The Macmillan Company. N.Y. 1918. The Preface. The entire book is arranged chronologically.

It is particularly noteworthy that three different authors had adopted by 1920 a title which was apparently not thought of ten years previously. The fact that these texts have the same title is, of course, no indication that the authors agree either as to content or as to organization. It is significant, only, in that it shows that these men are aware of the new point of view as to the present aim in high school physics teaching.

NEW AIM OF SECONDARY EDUCATION.

This new point of view, which has been referred to as that of "Social Worth" has been described in various phrases. Many of them are as indefinite as the one just used. Inglis has probably given us the best working definition of this new aim. He says: "The key to any analysis of aims in education is to be found in an analysis of the activities of life in which people do or should engage. The aims of secondary education, therefore, as of any department of education, must be interpreted in terms of the activities in which the individuals may be expected normally to participate."[7]

Right here, however, we are confronted with a very important question. How shall we determine what these activities are? Shall the text-book writer closet himself with his organized body of scientific data and subjectively

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6. Eikenberry, W. L. "The Teaching of General Science" The University of Chicago Press. 1922 pp. 9-10

7. Inglis, Alex. "Principles of Secondary Education" Houghton Mifflin Co. N. Y. 1918. p. 367

decide what he thinks ought to constitute the activities of the average citizen, and upon this build a course in physics? Or, shall he attempt scientifically, to determine what society is doing; and, using this as a skeleton, add from his storehouse of scientific information such material, and only such, as will be significant in connection with these activities? If the former method is the correct one, we need go no farther in our investigation; for we have the above mentioned, as well as other, admirable texts based upon it. These texts are built on a frame work which is determined by pure science and go to every-day life merely for illustrative material. If we were to reverse the order and build the skeleton on the needs of society and then go to pure science for explanation and interpretation we would need not one, but many studies regarding the activities of people which come within the realm of physics.

THE MAIN PROBLEM.

Granted that the above statement of Inglis regarding the aim of secondary education as applied to the high school physics course is valid we face two vital questions:

First, What mechanical, electrical, acoustic, thermal, a nd lighting devices are used by the average person in every-day life?

Second, What facts and abilities are necessary before one can be proficient in utilizing and caring for these devices?

The writer's purpose in this study is to give in a specific way a particl answer to the first of the foregoing questions. No attempt is made in this study to answer the second question except in a suggestive and very tentative way. Further investigation must be carried on before scientific judgment can be made regarding it.

METHOD OF GATHERING DATA.

In order to get information regarding the devices which are used by the average citizen the first question which had to be decided was:

How to get a response from a representative group of citizens?

At first it was thought best to get lists of names taken at random from directories of Medical Associations, Lawyers, Implement and Hardware Dealers, Bankers, Farmers' Associations, Teachers, Labor Unions and the like. After some investigation, this plan was abandoned because of the excessive amount of clerical, postage and traveling expense that would be incurred by sending a communication to, or going to interview, the necessary number of individuals. It was decided, instead, to prepare a questionnaire to be sent to parents of the boys and girls enrolled in high school physics courses. This plan had five distinct advantages; three of which were due to the fact that the questionnaires were to be distributed and collected by the physics teachers. The advantages are:

1. The names of the parents were not required. This saved a great amount of clerical expense.

2. It made possible a very material saving in postage.

3. The teacher, being interested, made an appeal which tended to enlist the co-operation of the parents.

4. Since those receiving the questionnaire had children then enrolled in the subject, they naturally gave more serious consideration to it.

5. It gave automatically a random sampling of citizens. (As will be shown later)

Having decided upon the specific group to whom the questionnaire should be sent, the next task was to select the actual list of items to include in the questionnaire. For a time it was thought best to arrange the questionnaire so as to call for the evaluation of a large number of scientific facts: Such as: "Liquids expand when heated", "To every action there is an equal and opposite reaction", "In an electric circuit the current in amperes is equal to the volts divided by the ohms of resistance", "Hot air rises", Etc. This plan was thought to be too specific and technical.

THE PRELIMINARY QUESTIONNAIRE.

As a preliminary trial a list of 128 items, which are used more or less in every-day life, was arranged in the form of a questionnaire. The physics teachers of the Lawrence and Kansas City, Kansas, high schools kindly co-operated in handing these out to their students for the parents to answer. The method of answering this questionnaire was similar to that finally used. They were asked to check the items thus:

a) Check by the figure "1" those items you have found to be of real value to you to know and understand.

b) Check by the figure "2" those items whose actual value to yourself is doubtful yet which you think of value for your child to study.

c) Check by the figure "3" those items you have found of no value to you.

d) Leave blank any item whose meaning you do not sufficiently understand.

Of the 250 questionnaires sent out in this preliminary study, 40 replies were received. These were tabulated and the results carefully studied. In the light of this information the final questionnaire was prepared.

THE REVISED QUESTIONNAIRE.

In order to make the list of devices an impersonal one, three physics texts were examined.[8] Every device other than strictly laboratory devices, which was described or illustrated in any one of these texts was included in the list, save for a very few as, hydrostatic bellows, caisson. To this was added a few other items which one observes in the home, in business or travel, such as, cash register, typewriter, three way electric switch, etc. The following is a complete copy of the final questionnaire which was printed and sent to the parents.

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8. Black and Davis, "Practical Physics", 1913; Millikan and Gale, "Practical Physics", 1920; Tower, Smith, Turton and Cope, "Physics"; 1920.

THE UNIVERSITY OF KANSAS
SCHOOL OF EDUCATION

QUESTIONNAIRE TO PARENTS

Dear Fathers and Mothers:-

Do you believe, as I do, that the parents of our high school students as well as their teachers should have a part in deciding what things they should be taught? If you do, you will be glad to give the following your most earnest consideration.

As you may know, criticism has been made by many people that some of the material studied in the high school does not have a worth-while value to the students when they get out into life. In order, therefore, either to justify what we are now teaching or to find what changes ought to be made, I am coming to the parents of those now studying high school physics as the ones most interested in what the course should contain. The questionnaire has to do with materials of every day life which are associated with the principles taught in a high school physics course and can be answered just aa well, and with as much value, by the parent who has never gone to high school as by the college graduate.

Below you will find a list of machines, devices, and topics more or less common to the home, farm or shop, or met in ones reading or travel. As you read these items you will notice that they fall into four definite groups. One group would include all those items you are interested in and have found of value to you in life to know and understand. The second group would include those items which, because of the nature of your work, or for any other reason, you can not consistently say they have been of actual worth to you personally, yet whose study you are quite sure would be of value to your son or daughter. The third group would include those items which you are quite confident should not be included in the high school physics course. The fourth group would consist of those items concerning which your knowledge is so insufficient you would hesitate to make a judgment.

HOW TO ANSWER THE QUESTIONNAIRE:

Answering the questionnaire consists in checking each item according to the following rule: If you have found a knowledge of the principles involved in the item to be of REAL VALUE to you put the figure "1" before it. If

you are in doubt as to any personal value to you, yet THINK ITS STUDY HAS VALUE for your boy or girl, put the figure "2" before it. If you have found a knowledge concerning the item of PRACTICALLY NO VALUE to you, put the figure "3" before it. If you do not know the meaning of any item leave it blank.

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ITEMS TO BE CHECKED

First Check by "1" those items you have found worth-while to you to know and understand.

Second Check by "2" the additional items you think of value for your child to study.

Third Check by "3" those items you have found of practically no value to you to know about.

Fourth Leave blank any item whose meaning you do not sufficiently understand.

1. Thermometer
2. Spectacles
3. Ice cream freezer
4. Window shade roller
5. Automobile (or gas engine) Carburetor
6. Automatic Air Brakes on
7. Railway cars.
7. Telescope
8. Lightning rods
9. Cash register
10. Electroplating
11. Repairing a pump valve
12. Electric transformer
13. Dry farming
14. Fractional distillation
15. To regulate a clock
16. Ammeter
17. Inclined plane
18. Under sea telegraph
19. Piano
20. Automobile tires
21. Teeter board
22. Telegraphy
23. Iceless refrigerator
24. Steam heating system
25. Audion detector
26. Chicken automatic drinking
30. Fire Extinguishers
31. Fuse in electric light circ-
32. The kerosene lamp uit.
33. Ballons
34. Electric flat iron
35. Automobile radiator
36. Hot boxes on railway cars
37. Binoculars
38. Telephone transmitter
39. Automatic Stokers
40. Ignition on automobile or other gas engines
41. The windmill.
42. Ball and roller bearings
43. To stop a leaky valve
44. Vernier calipers
45. Thermos bottle
46. Ordinary kitchen range
47. Wireless telephone
48. Electric door bell
49. High tension electric lines.
50. Firing a gun (Ordinary rifle)
51. Barometer
52. Shades for lamps
53. Insurance code rules for wiring a house
54. Magneto
55. Water meter

fountain
27. Soldering a hole in a teakettle
28. Overshot water wheel
29. Ordinary mirror
56. Telephone receiver.
57. Centrifugal pump
58. Electric condenser
59. Derrick

(3rd page)

60. Synchronous motors
61. Hydraulic ram
62. Replace a gas mantle
63. Tubular steam boilers
64. Suspension bridge
65. Rotating lawn sprinkler
66. Sewing machine
67. Water trap under sink
68. Vacuum sweeper
69. Steam boat
70. Non freezing mixture for auto radiator
71. Moving picture machine
72. Kite
73. Three-way electric switch
74. Hydraulic press
75. Typewriter
76. Telephone central station
77. To make a freezing mixture
78. Cream separator
79. Corliss steam engine
80. Test the acid in a storage battery.
81. Block and tackle
82. Safety valve
83. The turbine water wheel
84. The spring balance
85. Force pump
86. Fever thermometer
87. Reading glass
88. Railway engine head light
89. Steam condenser
90. Burglar alarms in banks
91. Electric fan
92. Why an object is lighter under water than out.
93. To adjust the tension of a spring in a curtain roller.
99. The automobile muffler
100. Railway coach heating
101. Artificial ice manufacture
102. Three horse evener
103. Micrometer calipers
104. Super heaters
105. Wiring a house
106. Water reservoir on side of hot air furnace
107. Camera
108. Water faucet
109. Differential gears of automobiles
110. Banking rails at curves on railroad
111. Single wire telephone line
112. The windlass
113. Motors on electric street cars
114. Hot water heaters and reservoir
115. Wagon scales
116. Commutator of dynamo
117. Read a gas meter
118. The voltmeter
119. Force draft for steam boilers
120. Medical induction coil
121. Hot air house heating system
122. Pressure cooker
123. Automobile horn
124. The aeroplane
125. Electromagnet
126. The Pelton water wheel
127. The wedge
128. Traveling crane
129. Electric light meter
130. Arc Lamp
131. Fireless cooker
132. Clock pendulum

94. Telegraph code
95. The crowbar
96. Differential pulley
97. Floating dry dock
98. Electric incandescent lamp
133. Gasoline lamp
134. Hose nozzle
135. Automatic block signal on railway.

(4th page)

136. Automobile brakes
137. Armature of dynamo
138. Crystal detector for wireless
139. Adding machine
140. Water motor
141. To find the density of an irregular solid
142. Electric signal at railway crossing.
143. The Bourdon gauge
144. The automobile jack
145. The phonograph
146. Air mixer on gas stove
147. Hot water heating system
148. Sailing boat
149. Auto transmission gears
150. Suction pump
151. Door lock
152. Oil stove
153. Hydraulic elevator
154. Fountain pen
155. Series wound dynamo.
156. Grinding auto valves
157. Resistance coil on auto
158. Rheostat
159. Self computing scales
160. Electric rectifier
161. To repair an electric light socket
162. Microscope
163. Ordinary heating stove
164. Tire pressure tester
165. Automobile engine
166. Railway engine turntable
167. River dam
168. Field glass
169. Batteries (Electric)
170. Wireless antenna
171. Compound steam engine
172. Induction motors
173. Light house
174. Farm electric lighting system

What is the Occupation of the Father? .....
(As: Teacher, Farmer, Banker, Etc.)

(Please answer the next three questions for both the father and mother)
Have you ever studied High School Physics, Father?.....
Mother?.....
Are you a College Graduate, Father?.....Mother?.....
Are you a High School Graduate, Father?.....Mother?.....
Do you own a Tractor?.....
Do you own an automobile?.....
Is your house heated by Stove, Hot-Air, Hot-Water, or Steam?
State which.....
Is your child who is studying Physics a boy or a girl?
State which.....

Signed: Name.....
Address .....

When you have answered the questionnaire please see that your son or daughter returns it to the Physics teacher at school as soon as possible.

I thank you most kindly for your co-operation in trying to find a solution for this great problem in Education.

Chas. H. Watson,

University of Kansas.

THE "TEACHER QUESTIONNAIRE"

Before the questionnaires to parents were sent out, it was desirable to obtain certain data with respect to the present status of the teaching of physics in the high schools. Consequently, another questionnaire, called hereafter in this paper the "Teacher Questionnaire", was prepared for the physics teacher. This will be described in more detail in Part II. It should be stated here, however, that the teacher questionnaire, together with a letter to the physics teacher, were sent as an enclosure in letters sent by the University Extension Division to the various high school principals. The letter from the Extension office stated among other things that the writer

> "has prepared a questionnaire to the High School science teachers of the state in an effort to secure definite data on the method and equipment for the teaching of science.
>
> If you will be kind enough to hand this to your science teacher with instructions to fill it in carefully and return within ten days, we will greatly appreciate your co-operation".

It was hoped that by sending the letter through the Extension

Division and the principal's office the teacher would consider the appeal of greater significance than ordinarily.

REPLIES TO THE TEACHER QUESTIONNAIRE

The Teacher questionnaire was sent to all the high schools in the First and Second Class cities, and to all County and Rural High Schools, of the state, as listed in "The Kansas Teacher Directory" for the year 1921-22. There were 359 of these schools in all. They were distributed as follows: First Class Cities, 12; Second Class Cities, 75; County, 27; Rural 245.

TABLE NUMBER 1.

NUMBER OF SCHOOLS RECEIVING AND REPLYING TO THE TEACHER QUESTIONNAIRE

Type of School Dist.	First Class Cities	Second Class Cities	County	Rural	Total
Number of Schools to whom were sent Teacher Quest.	12	75	27	245	359
Number of Schools Replying	10	33	8	61	112
Per Cent Rep lying	83.3	44.0	29.6	24.9	31.2

Of the total number of schools to which this questionnaire was sent almost one-third replied. This might at first thought seem to be a poor response. But this should probably be accepted as a very fair return. There are several reasons why the total returns were so low. The most important of these is the fact that the Teacher Questionnaire required a considerable amount of time to be answered. It would be safe to say that at least two hours were consumed by each teacher in answering the questions

asked. Another reason for the low total response was the apparent reluctance of the teachers in the rural and county high schools to make reply. This may have been due to the usual heavy burden already carried by the teachers in these schools. It will be noticed that 83% of the teachers in the First Class, and 44% of the teachers in the Second Class city schools responded.

WILLINGNESS TO HAND OUT PARENT QUESTIONNAIRES

One of the questions asked in the Teacher Questionnaire was as follows:

> "Later in the year an attempt will be made to get the views of the patrons of our schools, especially the parents of the boys and girls now taking Physics, regarding what they think ought to be the topics emphasized in a high school physics course. Would you think such effort worth-while, and would you be willing to co-operate to the extent of handing out such a 'Questionnaire to Parents' to each student in your class to be taken home and, after being answered brought back to you? A supply of such questionnaires would be sent you and you would return same at our expense.

TABLE NUMBER 2

NUMBER OF TEACHERS WILLING TO CO-OPERATE IN DISTRIBUTING THE PARENT QUESTIONNAIRES

Type of School Dist	First Class	Second Class	County	Rural	Total
No. Teachers Replying	10	33	8	61	112
No. Teachers Willing	10	30	4	34	78
Per Cent Willing	100	91	50	55	70

We see by Table 2 that most of the teachers in the city high schools were willing to hand out the parent questionnaire; whereas little more than half of the teachers

in the county and rural schools so expressed themselves. This does not mean, however, that almost 50% of the teachers in the latter group were unfavorable to the idea of going to the parents with the question regarding what ought to be taught in the physics course. Of the 61 Rural schools which replied, 10 were not offering physics in 1921-22. Such replies left the question of co-operation blank. These, together with others who left the question blank, were non-commital regarding approving or disapproving the idea. Altogether we have 70% making definite statements of approval, 10% of disapproval and 20% not expressing themselves.

That so large a per cent of science teachers should indicate their approval of going to the parents for suggestions regarding the content of high school physics is most significant. There are but three possible reasons why a teacher would approve the idea. One is the possibility that a teacher would be reluctant to express himself counter to a point of view which came from the State University. This evidently had no influence in the present case because such a high per cent felt at liberty to ignore, not only this question, but the entire questionnaire. Another possible reason is that of mere curiosity. That such was not an influencing factor is shown by the statements which many made concerning the idea. The most probable reason why so

many physics teachers were glad to get suggestions from the parents is that they are not, at present, satisfied with the course. Not only are they dissatisfied with it but they are ready to break all precedents regarding making a science course of study and to appeal to those, admittedly not trained in science, for help. It means that the need of bringing the school nearer the practical concerns of every-day life, as expressed by President Lowell, of Harvard in 1909, is being felt by the science teachers of Kansas. President Lowell was speaking more particularly about the university but had reference to the high school as well. Such a school, he says, "to be of any great value, must grow out of the community in which it lives and must be in absolute touch with the community in which it lives, doing all the good it can and doing what the community needs. An institution which is not in absolutely close touch with the community about it is doomed to wither and die."[9]

INSTRUCTIONS TO TEACHERS:

The necessary number of Parent Questionnaires was sent to each teacher with the following letter of instructions:

---

9. Quoted from "New York Times" Dec. 20, 1909 By Woodhull. p. 154.

You will find one questionnaire marked "For Teacher". I desire that you also check the items included in the questionnaire, not from the view point of the parent, as the questionnaire states, but from your own view point as a science teacher. Such response from the teacher will have great value.

Again thanking you for your splendid co-operation and valuable assistance in this study, I remain,

Sincerely yours,

Chas. H. Watson, Supervisor of Physical Science Teaching.

DISTRIBUTION OF REPLIES TO PARENT QUESTIONNAIRE:

a) ACCORDING TO TYPE OF SCHOOL DISTRICT REPRESENTED

If any conclusion is valid which is based upon the response to the parent questionnaire, it is essential that such response represent the total population and not some particular group. A very important question, therefore, is, "To what extent do the replies to the parent questionnaire give a random sampling of the citizens of the state?" Table Number 3 gives the detailed account of the number of questionnaires received from parents in the various school districts.

TABLE NUMBER 3

NUMBER OF PARENT QUESTIONNAIRES SENT AND RETURNED, ACCORDING TO TYPE OF SCHOOL DISTRICT.

Type of Dist.	First Class Cities	Second Class Cities	County	Rural	Total
No. of Schools Receiving Parent Questionnaires	7	30	4	34	75
No. of Physics Students Enrolled in these Schools	357	1161	135	401	2054
No. of Schools Returning one or more questionnaires	7	22	3	19	51
Per Cent of Schools returning one or more questionnaires	100	73	75	56	68
No. of Physics Students enrolled in these Schools	357	905	106	200	1568
Number of Questionnaires Returned	148	382	55	84	669
Per Cent Returned	41.5	42.5	52.0	42.0	42.6

Although 75 teachers expressed their willingness to co-operate in the work, we see (third row, Table 3) that but 51 returned one or more of the questionnaires. Here again, the Rural schools made the poorest showing. This is due, in all probability, to the fact that, the physics classes being so small (Average enrollment of 12), the teachers hesitated to return the two or three questionnaires which may have been handed in. It is quite probable that, in some cases, the teacher deferred returning the few which had been filled out hoping that others would be handed in, until the time was so late it was an embarrassment to do so.

Table Number 3 also shows that responses were obtained from 669 adults. It does not tell who these people are nor what their specific interests are. We know, of course, that they are somewhat interested in education in general; not only because they are school patrons but also because the necessary time was taken to answer the questionnaire. The table does show, however, that the per cent returns from the parents in the various districts is relatively uniform. This is important if the conclu-

sions are to be tenable. For, if there should be a wide variation in the number of answers from any one type of district this would tend to be reflected in the total response; provided conditions in such type of district are different from those in other districts. It will be noticed that the per cent of returns in the table are figured on the basis of the number of questionnaires sent to those schools from which at least one reply came. If per cent of returns be figured on the basis of the total number of questionnaires sent out to the four types of schools we have 1st Class Cities, 41.5%; 2nd Class Cities, 33%; County, 41%; and Rural 21%; Average, 32.5%. This shows the largest deviation from the average in the case of the rural schools.

It is of particular interest to note that the major response in actual number of questionnaires was from 2nd Class City high schools. This is as it should be, because they represent the major portion of high school enrollment in the state. If the one County High School, which is in a city of the second class, be placed in that group and the other two county schools be placed with the Rural Schools, so as to compare the returns with distribution of population, we find a decided variation between the percents of the total high school enrollment in the state who are enrolled in the various types of schools and the respective per cents of the total population in the state who live in these school districts. This is particularly true of the second class city and rural school districts. This is clearly shown in Table 4. [10.]

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10. The data from the population were taken from the Second Volume of the "Fourteenth Federal Census Report". Those

TABLE NUMBER 4

COMPARISON OF THE DISTRIBUTION OF THE POPULATION IN KANSAS WITH THAT OF HIGH SCHOOL ENROLLMENT AND THE RETURNS FROM THE PARENT QUESTIONNAIRE.

Type of School District of City	First Class Cities	Second Class Cities	Rural & Others
Per Cent of Total State High School Enrollment	11.9	56.9	31.1
Per Cent of Total Population of Kansas 21 Years & above	21.5	16.2	62.2
Per Cent of Total Returns to Parent Questionnaire	21.4	59.7	18.7

There is a slight error in the figures for the high school enrollment of the city high schools due to the fact that in some cases the Junior High School enrollment was included with the report of the total enrollment of certain high schools.

A comparison of the first and third rows in the above table indicates rather definitely that the returns to the parent questionnaire can safely be said to give a representative distribution of those citizens who patronize the high schools. When, however, the second row is compared with the third we find the above mentioned variation in the relative number of adults living in cities of the second class and in rural school communities, as compared with the number of returns to the questionnaire from those respective school districts.

Although but 16.2% of the adult population live within the legal limits of second class cities in the state, 59.7% of all returned questionnaires were received from parents whose children attend high school in such cities. On the other hand, we find 62.2% of the adult population of the state living in cities of the third class or in rural communities, and but 18.7% of the returns to the questionnaire from

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for the high school enrollment were found in the "Kansas Educational Directory for 1921-1922"

parents whose children attend high school in such communities. This may seem to indicate that the returns to the parent questionnaire are in no degree representative of the state population as a whole. But such is believed not to be the case.

There are at least three reasons why we find 16.2% of the population supplying 56.9% of the high school enrollment. These are: First, In many instances parents, after many years of labor on the farm or in a small village, will move to town when their children are ready for high school. Second, It is quite probable that a larger proportion of parents who live in the cities appreciate the value of the high school. Consequently we find relatively more city children going to high school than rural children.

The third, and most important, reason for the apparent variation is the fact that the figures do not tell the real facts. In the case of population the percentages are based upon the number of people who actually live within the precincts of the city. On the other hand, the percentages for the school enrollment are based on the number of students enrolled regardless of where they live. Just the exact per cent of those attending school in a second class city who live in the country is not known, but we know that a great many country boys and girls attend high school in town.

DISTRIBUTION OF REPLIES TO PARENT QUESTIONNAIRE

b) ACCORDING TO OCCUPATION OF THE FATHER

Only in a general and very broad way would parents, whose children were attending a given type of school, be expected, therefore, to answer the questionnaire in a similar manner. A more fundamental factor, which would seem to have a pronounced effect upon the relative stress placed upon the various items in the questionnaire, is the occupation of those answering. Since the mothers' occupation was obvious, in most cases, it was only necessary to know the occupation of the fathers. One of the questions of the questionnaire was "what is the occupation of the father"? The answer to this question were arranged in groups according to the classification used in the Federal Census Reports. This report uses nine divisions as follows:

1. AGRICULTURE, including farmers, farm laborers and stock raisers.

2. EXTRACTION OF MINERALS, including coal miners and oil operators.

3. MANUFACTURE AND MECHANICAL, including bakers, carpenters, laborers, machinists, painters, managers and superintendents of plants, semi-skilled workmen.

4. TRANSPORTATION, including brakemen, conductors, firemen, draymen, expressmen, mail-carriers, telegraph operators, motormen.

5. TRADE, including bankers, clerks in stores, insurance and real estate agents, salesmen, retail and wholesale dealers.

6. PUBLIC SERVICE, including policemen, guards, soldiers.

7. PROFESSIONAL, including civil engineers, surveyors, clergymen, dentists, editors, reporters, lawyers, judges, photographers, doctors, teachers, veterinary surgeons.

8. DOMESTIC AND PERSONAL, including barbers, hotel keepers, janitors, restaurant workers and managers.

9. CLERICAL, including bookkeepers, cashiers, accountants, stenographers.

Fifty-eight of the returned questionnaires did not answer the question concerning the occupation of the father. In most cases this was because the father was not living. Of the 600 remaining replies, which were used, we find the distribution with respect to the fathers' occupation as given in the following table.

TABLE NUMBER 5

DISTRIBUTION OF FATHERS ENGAGED IN THE NINE OCCUPATIONAL DIVISIONS

Division	Number	Per Cent of Total
Agriculture	257	42.9
Extraction of Minerals	16	2.7
Manufacture & Mechan.	89	14.7
Transportation	47	7.8
Trade	103	17.2
Public Service	4	0.7
Professional Service	56	9.3
Domestic & Personal	13	2.1
Clerical	15	2.5
TOTAL	600	99.9

Since the Federal Census Report concerning the occupations of men in 1920 had not been published it was necessary to go to the Thirteenth Report for Data with which to compare the distribution found in this study. The Table below gives the per cent of the total adult male population both in the United States and in Kansas which was engaged in each of the nine occupational groups in 1910, together with the percent in each case as given in table number 5.

TABLE NUMBER 6

COMPARISON OF DISTRIBUTION OF OCCUPATION OF FATHERS IN THIS STUDY WITH THAT OF MEN IN THE U.S. AND IN KANSAS

OCCUPATION	PER CENT IN THIS STUDY	PER CENT IN KANSAS	PER CENT IN UNITED STATES
Agriculture	42.9	52.2	36.0
Ext. of Minerals	2.7	2.5	3.1
Manufacture & Mechan.	14.7	17.5	2 9.2
Transportation	7.8	8.9	8.3
Trade	17.2	9.9	10.4
Public Service	0.7	1.6	1.4
Professional Service	9.3	2.8	3.8
Domestic & Personal	2.1	2.3	4.1
Clerical	2.5	2.3	3.7
TOTAL	99.9	100.0	100.0

We find practically the same distribution represented in this study as is found in the entire state, with possibly three exceptions. These three require some analysis. Although 52% of the men of Kansas are engaged in agriculture work, but 42% of the returns were from men so engaged. This variation is not serious in view of the fact that this still constitutes, by far, the largest group.

The other two groups which show a variation in per cents are those engaged in "Trade" and in "Professional Service". In both cases a larger per cent appears in this study than is found in the entire state. This would be expected, since those engaged in such pursuits would be more likely to answer such a questionnaire than those in most of the other groups. Nor is this undesirable. This is an automatic means of giving slightly more weight to the activities required of these more highly trained groups than to those of less training, without unduly distorting the general tendency.

ARE THE REPLIES REPRESENTATIVE

From the foregoing it must be apparent that the replies used as the basis of this study are from a group of people whose interests and activities fairly well represent the entire adult population of the state. The replies are from all parts of the state. The various communities are satisfactorily represented and the fundamental occupational groups appear in a satisfactory proportion. The returns were gathered from apparently honest and ambitious parents who could have no motive for obscuring or misrepresenting facts. No one who examines the replies will doubt the sincerity with which they were made.

DETAI DETAILED RESPONSE TO THE PARENT QUESTIONNAIRE

For further comparative study of the replies according to the occupation of the father, the classification of the Federal Census Report was not followed. An effort was made to select such groups as would be most likely to show a variation in response to the list of items to be checked. After considerable study the following groups were used:

1. Farmers
2. Mechanics
3. Merchants
4. Professional
5. Clerical
6. Laborers
7. Blanks

Table Number 7 shows the readjustment which was made in the previous divisions in order to make possible this new grouping. It will be noticed that a considerable portion of those listed before under the head of "Transportation" and "Trade" are now included under the head of clerical workers. Individuals previously listed as workers in transportation; like postmen, mail clerks, depot agents, and conductors were in several cases believed to belong more properly, for purposes of this study, in the group of clerical workers. Also, insurance agents together with real estate men were classed with the clerical groups.

TABLE NUMBER 7

SHOWING THE REARRANGEMENT OF OCCUPATIONAL CLASSIFICATION

FORMER DIVISIONS	PRESENT DIVISIONS						
	FARMERS	MECHANICS	MERCHANTS	PROFESSIONAL	CLERICAL	LABORERS	TOTAL
AGRICULTURE	257						257
EXT. OF MINERALS		10				6	16
MANU. & MECHANICS		77	7		2	3	89
TRANSPORTATION		16	1		25	5	47
TRADE			53	9	25	16	103
PUBLIC SERVICE				4			4
PROFESSIONAL				56			56
DOM. & PERSONAL			6	1		6	13
CLERICAL					15		15
TOTAL	257	103	67	70	67	36	600

To the above 600 Classified replies should be added the 58 replies which did not answer the question regarding the occupation of the father, but which were otherwise answered satisfactorily. This makes a total of 658 replies which were tabulated and from which conclusions are made. It will be noted from the above table that there are 257 Farmers, 103 Mechanics, 67 Merchants, 70 Professional Men, 67 Clerical Workers and 36 Common Laborers.

It should be made clear that not in every case did the father answer the questionnaire. The only means we have of knowing whether the father or mother actually did the checking is the signature at the close of the questionnaire. It is probably safe to assume that in every case in which the mother's name was signed she was the one who did the checking. With less certainty, perhaps, we may likewise assume that in the majority of cases in which the father's name is signed, he was the one who did the checking. Of the foregoing classified returns 77.4% were signed by the father's name. The fact that such a high per cent of the answers were from men is the basis for assuming the response from the homes of those engaged in any given occupation as equal in the main to the response from such occupational group. It should be added that any influence upon the final evaluation of the devices, due to the answers by women, is not unwelcome; for it must be kept in mind that what the women have found of value is equally important, as the physics course is for girls as well as for boys.

The 58 replies which did not give the occupation of the father were answered very largely by the mothers (78.2%) This being the case, the total evaluation by this group is assumed to be equivalent to a large degree to that which would be obtained from a group of women alone.

EVALUATION OF EACH ITEM.

In order to compare the relative importance of each item as determined by the response from each occupational group Table 8 was first prepared. This shows the actual number of times each item was marked "1" by those in each occupational group. Table 9 was then prepared. This shows the percent of replies from each group which marked the item "1", signifying that they had found a knowledge of the instrument, device or process of real worth. These percentages are shown by items.

TABLE NUMBER 8

SHOWING THE NUMBER OF PERSONS FROM EACH OF THE OCCUPATIONAL GROUPS WHO MARKED THE ITEMS "I"

NO. OF ITEM	FARMERS	MECHANICS	PROFESSIONAL	MERCHANTS	CLERICAL	LABORERS	BLANK	TOTAL
1	226	85	66	54	58	34	52	575
2	185	69	60	37	48	23	41	463
3	218	80	60	46	52	31	48	535
4	203	75	57	44	49	26	46	500
5	179	71	51	43	35	26	24	429
6	46	34	18	12	24	6	6	146
7	84	38	41	19	26	10	16	234
8	155	46	27	26	24	15	28	321
9	85	44	32	47	34	13	25	280
10	23	18	17	8	6	5	7	84
11	190	68	45	35	30	17	19	404
12	45	38	28	14	10	5	7	145
13	143	47	36	23	23	11	15	298
14	21	14	13	2	3	5	4	62
15	193	79	50	47	47	28	43	487
16	49	32	18	14	15	10	4	132
17	95	48	39	17	18	21	13	231
18	26	22	16	10	7	2	6	89
19	130	59	47	30	28	14	36	344
20	182	75	51	46	37	26	26	443
21	123	47	35	24	27	23	28	307
22	55	33	24	19	22	8	10	171
23	78	38	30	20	15	8	12	201
24	100	64	42	29	49	17	23	324
25	6	8	7	2	2	4	0	29
26	179	61	33	25	33	18	31	380
27	179	74	46	34	43	22	33	431
28	43	24	20	13	11	4	2	117
29	146	65	40	35	37	23	39	385
30	133	69	46	41	42	18	32	381
31	88	75	48	38	41	20	35	345
32	202	73	52	45	46	26	43	487
33	55	23	23	12	11	6	9	139
34	125	74	56	50	56	27	47	435
35	166	68	45	37	36	25	19	396
36	43	29	17	17	22	6	8	142
37	24	21	24	9	15	3	3	99
38	127	59	37	28	31	18	29	329
39	17	27	6	5	11	6	1	73
40	131	62	45	30	26	19	17	330
41	202	62	39	35	34	23	27	422
42	178	75	46	38	38	25	29	429
43	151	67	46	29	35	15	26	369

TABLE NUMBER 8 (Continued)

NUMBER OF ITEM	FARM-ERS	MECHAN-ICS	PROFES-SIONAL	MERCH-ANTS	CLER-ICAL	LABOR-ERS	BLANK	TOTAL
44	21	29	16	8	5	5	3	87
45	126	71	50	39	44	28	36	394
46	201	85	59	48	51	30	47	521
47	50	24	26	15	10	7	11	143
48	92	63	49	41	40	24	35	344
49	31	27	19	7	11	13	7	105
50	227	76	51	39	45	24	22	484
51	104	49	40	20	30	18	28	289
52	154	61	46	33	39	21	36	390
53	49	35	27	14	18	10	10	163
54	127	60	38	21	25	17	13	301
55	83	69	37	27	37	21	23	297
56	154	62	47	34	38	23	40	398
57	75	41	23	18	19	14	8	198
58	22	27	16	11	6	9	6	97
59	147	56	34	27	30	17	14	325
60	3	13	9	4	5	4	2	40
61	46	34	19	12	14	10	6	141
62	105	58	40	28	33	15	31	310
63	36	44	14	12	16	12	6	140
64	52	32	18	12	13	4	8	139
65	96	55	34	26	27	14	20	272
66	191	80	58	48	52	25	51	505
67	143	76	48	44	43	21	33	408
68	152	73	49	46	45	24	44	433
69	40	27	21	14	8	7	5	122
70	120	62	47	32	28	19	15	323
71	43	29	23	10	9	8	10	132
72	116	51	36	31	31	16	18	299
73	48	48	38	20	23	11	16	204
74	42	41	19	14	13	11	10	150
75	94	58	55	41	40	13	23	324
76	84	41	26	19	21	12	16	219
77	91	47	32	14	17	10	21	232
78	217	58	39	33	32	19	27	475
79	32	34	9	10	13	7	3	108
80	93	50	29	26	21	12	9	240
81	203	73	46	42	38	24	24	450
82	145	74	44	27	29	21	17	357
83	36	29	18	9	8	6	5	111
84	136	65	37	22	29	19	25	333
85	173	74	42	28	35	19	23	394
86	193	74	56	42	50	27	45	487
87	112	40	36	27	30	15	32	292
88	48	38	17	16	21	88	8	156

TABLE NUMBER 8 (Continued)

NUMBER OF ITEM	FARM-ERS	MECHAN-ICS	PROFES-SIONAL	MERCH-ANTS	CLER-ICAL	LABOR-ERS	BLANK	TOTAL
89	51	38	19	14	14	6	7	149
90	46	27	23	14	13	7	8	138
91	124	71	51	48	47	22	34	397
92	77	35	41	18	20	12	16	219
93	135	72	48	32	41	21	36	385
94	26	19	19	10	17	6	5	102
95	191	80	48	39	40	26	27	451
96	108	50	25	25	24	16	15	263
97	17	16	12	10	5	4	5	69
98	65	53	40	23	25	15	22	243
99	143	62	42	36	30	19	18	350
100	51	37	24	13	15	6	9	155
101	67	39	29	18	21	12	15	201
102	172	47	35	26	27	20	14	341
103	20	26	21	8	5	9	4	93
104	19	29	17	9	11	6	2	93
105	61	56	33	21	24	12	14	221
106	80	48	39	23	24	13	14	241
107	126	62	40	29	31	17	28	333
108	176	83	52	33	46	27	39	456
109	151	57	39	30	30	19	12	338
110	56	42	30	17	18	12	6	181
111	125	39	32	18	20	15	18	267
112	142	58	40	31	30	20	17	388
113	35	24	17	11	10	8	5	110
114	107	63	41	30	31	18	21	311
115	189	66	36	37	30	22	23	403
116	36	32	18	10	9	14	6	125
117	66	65	48	33	35	12	20	279
118	41	35	26	12	14	14	7	148
119	37	40	19	12	14	10	4	136
120	10	28	12	5	5	7	2	69
121	111	63	48	32	31	18	21	324
122	97	44	32	19	21	12	22	247
123	147	69	40	37	30	23	22	368
124	48	32	23	10	9	8	8	138
125	47	39	36	11	14	13	8	168
126	12	13	6	6	6	3	1	47
127	163	66	41	31	37	25m	26	389
128	50	48	32	18	18	11	3	180
129	89	68	43	30	42	22	26	320
130	42	44	30	19	17	14	14	180
131	116	49	50	31	31	18	34	329
132	163	70	55	31	37	22	37	415

TABLE NUMBER 8 (Concluded)

NUMBER OF ITEM	FARMERS	MECHANICS	PROFESSIONAL	MERCHANTS	CLERICAL	LABORERS	BLANK	TOTAL
133	144	59	42	34	33	18	20	350
134	155	74	45	40	47	24	34	419
135	46	33	19	15	14	8	5	140
136	174	65	57	42	35	19	18	410
137	39	43	21	10	9	12	5	139
138	9	10	13	6	3	4	3	48
139	71	41	35	41	28	14	16	246
140	44	35	22	18	15	11	8	153
141	30	19	19	7	8	8	3	94
142	70	37	28	20	19	12	11	197
143	27	19	8	6	6	7	2	75
144	192	75	48	40	36	28	24	443
145	150	63	44	41	39	23	29	389
146	74	55	40	36	31	17	19	272
147	104	59	43	33	31	20	26	316
148	33	21	23	13	10	7	5	112
149	124	55	40	30	28	16	10	303
150	151	68	42	33	30	20	26	370
151	202	88	54	48	50	29	41	512
152	200	78	52	47	50	27	43	497
153	37	29	22	14	9	7	5	123
154	190	80	55	52	55	30	43	505
155	23	24	15	12	8	7	4	93
156	131	56	35	30	28	14	11	355
157	77	38	26	12	18	11	9	191
158	19	30	24	12	9	13	4	111
159	68	36	23	32	17	11	11	198
160	14	15	14	6	5	7	4	65
161	53	56	34	26	29	19	10	227
162	87	41	39	24	23	13	13	240
163	208	81	56	42	52	30	45	514
164	167	69	42	47	33	19	15	392
165	162	66	50	30	32	23	15	378
166	46	39	21	19	22	9	6	162
167	82	43	29	21	17	9	8	209
168	92	50	36	28	23	13	23	265
169	133	63	45	33	31	18	19	342
170	17	10	14	8	4	5	5	63
171	47	36	19	11	13	7	5	138
172	21	25	14	8	8	12	6	94
173	47	19	17	18	8	8	10	127
174	91	45	22	25	14	9	13	219

TABLE NUMBER 9

SHOWING THE PER CENT OF PARENTS IN EACH

OF THE OCCUPATIONAL GROUPS WHO MARKED EACH OF THE ITEMS "1"

NUMBER OF ITEM	PER CENT OF TOTAL IN EACH GROUP							PERCENT OF TOTAL
	FARMERS	MECHANICS	PROFESSIONAL	MERCHANTS	CLERICAL	LABORERS	BLANK	
1	80	80	90	80	80	90	80	80
2	70	60	80	50	70	60	70	70
3	80	70	80	60	70	80	80	80
4	70	70	80	60	70	70	70	70
5	60	60	70	60	50	70	40	60
6	10	30	20	10	30	10	10	20
7	30	30	50	20	30	20	20	30
8	60	40	30	30	30	40	40	40
9	30	40	40	70	50	30	40	40
10	00	10	20	10	00	10	10	10
11	70	60	60	50	40	40	30	60
12	10	30	40	20	10	10	10	20
13	50	40	50	30	30	30	20	40
14	00	10	10	00	00	10	00	00
15	70	70	70	70	70	70	70	70
16	10	30	20	20	20	20	00	20
17	30	40	50	20	20	50	20	30
18	10	20	20	10	10	00	10	10
19	50	50	60	40	40	30	60	50
20	70	70	70	60	50	70	40	60
21	00	40	50	30	40	60	40	40
22	20	30	20	20	30	20	10	20
23	30	30	40	20	20	20	20	30
24	30	60	60	40	70	40	40	40
25	00	00	10	00	00	10	00	00
26	60	50	40	30	40	40	50	50
27	60	70	60	50	60	60	50	60
28	10	20	20	10	10	10	00	10
29	50	60	50	50	50	60	60	50
30	50	60	60	60	60	40	50	50
31	30	70	60	50	60	50	60	50
32	70	70	70	60	60	70	70	70
33	20	20	30	10	10	10	10	20
34	40	70	80	70	80	70	80	60
35	60	60	60	50	50	60	30	60
36	10	20	20	20	30	10	10	20
37	00	20	30	10	20	00	00	10
38	40	50	50	40	40	40	50	50
39	00	20	00	00	10	10	00	10
40	50	60	60	40	30	50	20	50
41	70	60	50	50	50	60	40	60
42	60	70	60	50	50	60	50	60
43	50	60	60	40	50	40	40	50

TABLE NUMBER 9 (Cont'd.)

Number of Item	PER CENT OF TOTAL IN EACH GROUP							Percent of Total
	Farmers	Mechanics	Professional	Merchants	Clerical	Laborers	Blank	
44	00	20	20	10	00	10	00	10
45	40	60	70	50	60	70	40	50
46	70	80	80	70	70	80	70	70
47	10	20	30	20	10	10	10	20
48	30	60	70	60	50	60	30	50
49	10	20	20	10	10	30	10	10
50	80	70	70	50	60	60	80	70
51	40	40	50	20	40	40	40	40
52	50	30	60	40	50	50	50	50
53	10	30	30	20	20	20	10	20
54	40	50	50	40	30	40	40	40
55	30	60	50	40	50	50	30	40
56	50	60	60	50	50	60	50	50
57	20	30	30	20	20	30	10	30
58	00	20	20	10	00	20	10	10
59	50	50	40	40	40	40	20	40
60	00	10	10	00	00	10	00	00
61	10	30	20	10	20	20	10	20
62	40	50	50	40	40	40	50	40
63	10	40	20	10	20	30	10	20
64	20	30	20	10	10	10	10	20
65	30	50	40	300	40	30	30	40
66	70	70	80	70	70	60	80	70
67	50	70	60	60	60	50	50	60
68	50	70	70	60	60	60	70	60
69	10	20	30	20	10	10	00	10
70	40	60	40	40	40	50	20	40
71	10	20	30	10	10	20	10	20
72	40	40	50	40	40	40	30	40
73	10	40	50	20	30	30	20	30
74	10	30	20	20	10	30	10	20
75	30	50	70	60	50	30	30	40
76	30	30	30	20	30	30	20	30
77	30	40	40	20	20	20	30	30
78	80	50	50	40	40	50	40	70
79	10	30	10	10	10	10	00	10
80	30	40	40	30	30	30	10	30
81	70	70	60	60	50	60	40	60
82	50	70	60	40	40	50	20	50
83	10	20	20	10	10	10	00	10
84	50	60	50	30	40	50	40	50
85	60	70	60	40	50	50	30	50
86	70	70	80	60	70	70	70	70

TABLE NUMBER 9 (Cont'd.)

NUMBER OF ITEM	PER CENT OF TOTAL IN EACH GROUP							PERCENT OF TOTAL
	FARM-ERS	MECHAN-ICS	PROFES-SIONAL	MERCH-ANTS	CLERK-ICAL	LABOR-ERS	BLANK	
87	40	30	50	40	40	40	50	40
88	10	30	20	20	30	20	10	20
89	10	30	20	20	20	10	10	20
90	10	20	30	20	10	10	10	20
91	40	60	70	70	70	60	50	60
92	20	30	50	20	20	30	20	30
93	50	60	60	40	60	50	60	50
94	10	10	20	10	20	10	00	10
95	70	70	60	50	50	70	40	60
96	40	40	30	30	30	40	20	30
97	00	10	10	10	00	10	00	10
98	20	50	50	30	30	40	30	30
99	50	60	60	50	40	50	30	50
100	10	30	30	10	20	10	10	20
101	20	30	40	20	30	30	20	30
102	60	40	50	30	40	50	20	50
103	00	20	30	10	00	20	00	10
104	00	20	20	10	10	10	00	10
105	20	50	40	30	30	30	20	30
106	30	40	50	30	30	30	20	30
107	40	60	50	40	40	40	40	50
108	60	80	70	40	60	70	60	60
109	50	50	50	40	40	50	20	50
110	20	40	40	20	20	30	10	20
111	40	30	40	20	20	40	30	40
112	50	50	50	40	40	50	20	50
113	10	20	20	10	10	20	00	10
114	40	60	50	40	40	40	30	40
115	70	60	50	50	40	60	30	60
116	10	30	20	10	10	30	10	10
117	20	60	60	40	50	30	30	40
118	10	30	30	10	20	30	10	20
119	10	30	20	10	20	20	00	20
120	00	20	10	00	00	10	00	10
121	40	60	60	40	40	40	30	40
122	30	40	40	20	30	30	30	30
123	50	60	50	50	40	60	30	50
124	10	30	30	10	10	20	10	20
125	10	30	50	10	20	30	10	20
126	00	10	00	000	00	00	00	00
127	60	60	50	40	50	60	40	50
128	10	40	40	20	20	30	00	20
129	30	60	60	40	60	60	40	40
130	10	40	40	20	20	30	20	20

TABLE NUMBER 9 (Cont'd.)

NUMBER OF ITEM	PER CENT OF TOTAL IN EACH GROUP							PERCENT OF TOTAL
	FARMERS	MERCHANTICS	PROFESSIONAL	MERCHANTS	CLERKICAL	LABORERS	BLANK	
131	40	40	70	40	40	40	50	50
132	60	60	70	40	50	60	60	60
133	50	50	60	50	40	40	30	50
134	60	70	60	50	70	60	50	60
135	10	30	20	20	20	20	00	20
136	60	60	80	60	50	50	30	60
137	10	40	30	10	10	30	00	20
138	00	00	10	00	00	10	00	00
139	20	30	50	60	40	30	20	30
140	10	30	30	20	20	30	10	20
141	10	10	20	10	10	20	00	10
142	20	30	40	20	20	30	10	20
143	10	10	10	00	00	10	00	10
144	70	70	60	50	50	70	40	60
145	50	60	60	60	50	60	50	50
146	20	50	50	50	40	40	30	40
147	40	50	60	40	40	50	40	40
148	10	20	30	10	10	10	00	10
149	40	50	50	40	40	40	10	40
150	50	60	60	40	40	50	40	50
151	70	80	70	70	70	80	70	70
152	70	70	70	70	70	70	70	70
153	10	20	30	20	10	10	00	10
154	70	70	70	70	80	80	70	70
155	00	20	20	10	10	10	00	10
156	50	50	50	40	40	30	10	50
157	20	30	30	10	20	30	10	20
158	00	20	30	10	10	30	00	10
159	20	30	30	40	20	30	10	30
160	00	10	20	00	00	10	00	00
161	20	50	40	30	40	51	10	30
162	30	30	50	30	30	30	20	30
163	80	70	80	60	70	80	70	70
164	60	60	60	70	40	50	20	50
165	60	60	70	40	40	60	20	50
166	10	30	30	200	30	20	10	20
167	30	40	40	30	20	20	10	30
168	30	40	50	40	30	30	30	40
169	50	60	60	40	40	40	30	50
170	00	00	20	10	00	10	00	00
171	10	30	20	10	10	10	00	20
172	00	20	20	10	10	30	10	10
173	10	10	20	20	10	20	10	10
174	30	40	30	30	20	20	20	30

A glance at table 9 shows that there was a wide variation in evaluating the importance of the various items. The item found of value by the largest number (87.3%) of the 658 people is the Thermometer (No. 1) The one found of value by the smallest number (3.7%) is the Audion Detector. (No. 25) The following table shows the distribution of all the items with respect to percentages of the total responses which marked them "1".

TABLE NUMBER 9 A

SHOWING THE DISTRIBUTION OF ITEMS WITH RESPECT TO THE PER CENT OF PARENTS FINDING THEM OF VALUE

PROPORTION OF TOTAL MARKED "1"	NUMBER OF ITEMS
0 - 9%	7
10% - 19%	26
20% - 29%	31
30% - 39%	21
40% - 49%	24
50% - 59%	31
60% - 69%	19
70% - 79%	13
80% - 89%	2
90% -100%	0
TOTAL	174

Median - - - 41 %

This table should be read thus: Seven items were marked "1" by less than 10% of all the parents. Twenty-six items were marked "1" by 10 to 19 per cent of all the parents. The median of 41% means that one-half of the 174 items were marked "1" by more than 41% of the parents and one-half were thus marked by less than 41%

If the list of items is a fair representation of what is now being taught in high school physics as far as devices are concerned, this median of 41% would indicate that on the whole our present day course functions to a

painfully small extent in daily life. Since, however, several items were included in the list which do not appear in most present day courses it will be of value to arrange the items in the order of their seeming value and determine how the traditional items rank in such list.

TABLE NUMBER 10

LIST OF THE ITEMS ARRANGED IN THE ORDER OF THE NUMBER OF TIMES EACH WAS CONSIDERED OF REAL VALUE IN EXPERIENCE

RANK	ITEM	NUMBER OF ITEM IN LIST
1	Thermometer	1
2	Ice Cream Freezer	3
3	Ordinary Kitchen Range	46
4	Ordinary Heating Stove	163
5	Door Lock	151
6	Sewing Machine	66
7	Fountain Pen	154
8	Window Shade Roller	4
9	Oil Stove	152
10	To Regulate a Clock	15
11	Kerosene Lamp	32
12	Fever Thermometer	86
13	Firing a Gun (ordinary rifle)	50
14	Cream Separator	78
15	Spectacles	2
16	Water Faucet	108
17	Crow Bar	95
18	Block and Tackle	81
19	Automobile Tires	20
20	Auto Jack	144
21	Electric Flatiron	34
22	Vacuum Sweep er	68
23	Soldering a hold in teakettle	27
24	Auto (or gas engine)Carburetor	5
25	Ball and Roller Bearings	42
26	Wind Mill	41
27	Hose Nozzle	134
28	Clock Pendulum	132
29	Auto Brake	136
30	Water Trap under Sink	67

TABLE NUMBER 10 Cont'd.

RANK	ITEM	NUMBER OF ITEM IN LIST
31	Repairing a pump valve	11
32	Wagon Scales	115
33	Telephone receivers	56
34	Electric Fan	91
35	Auto Radiator	35
36	Thermos Bottle	45
37	Force Pump	85
38	Tire Pressure Tester	154
39	Shades for Lamps	52
40	The Wedge	127
41	Phonograph	145
42	The Windlass	112
43	Ordinary Mirror	29
44	To adjust the spring in a roller	93
45	Fire Extinguisher	30
46	Chicken automatic drinking fountain	26
47	A uto Engine	165
48	Suction Pump	150
49	To Stop a leaky valve	43
50	Auto Horn	123
51	Safety Valve	82
52	Grinding Auto Valves	156
53	A uto Muffler	99
54	Gasoline Lamp	133
55	Fuse in Electric Light circuit	31
56	Piano	19
57	Electric Door Bell	48
58	Batteries (Electric)	169
59	Three-Horse Evener	102
60	Differential Gears of Auto	109
61	Spring Balance	84
62	Camera	107
63	Ignition on automobile or other gas engines	40
64	Telephone Transmitter	38
65	Fireless Cooker	131
66	Derrick	59
67	Steam Heating System	24
68	Typewriter	75
69	Hot Air House Heating System	121

TABLE NUMBER 10 Cont'd.

RANK	ITEM	NUMBER OF ITEM IN LIST
70	Non-Freezing mixture for auto radiator	70
71	Lightning Rod	8
72	Electric Light Meter	129
73	Hot-water Heating System	147
74	Hot-water Heater and Reservoir	114
75	To Replace a Gas Mantle	62
76	Teeter Board	21
77	Auto Transmission Gears	149
78	Magneto	54
79	Kite	72
80	Dry Farming	13
81	Water Meter	55
82	Reading Glass	87
83	Barometer	51
84	Cash Register	9
85	Read A Gas Meter	117
86	Rotating Lawn Sprinkler	65
87	Air Mixer on gas Stove	146
88	Single Wire Telephone line	111
89	Field Glass	168
90	Differential Pulley	36
91	Pressure Cooker	122
92	Adding Machine	139
93	Electric incandescent lamp	98
94	Water Reservoir on side of Hot Air Furnace	106
95	Test Acid in Storage Battery	80
96	Microscope	162
97	Telescope	7
98	To Make a Freezing Mixture	77
99	Inclined Plane	17
100	Repair Electric Light Socket	161
101	Wiring a House	105
102	Telephone Central Station	76
103	Why an Object is lighter in water than out	92
104	Farm electric lighting system	174
105	River Dam	167
106	Three-way Electric Switch	73
107	Iceless Refrigerator	23
108	Artificial Ice Manufacture	101
109	Centrifugal Pump	57

TABLE NUMBER 10 Cont'd.

RANK	ITEM	NUMBER OF ITEM IN LIST
110	Self Computing Scales	159
111	Electric Signals on Railway Crossings	142
112	Resistance Coil on Auto	157
113	Banking of Rails at Curves of railroads	110
114	Traveling Crane	128
115	Arc Lamp	130
116	Telegraph	22
117	Electro Magnet	125
118	Insurance Code Rules for Wiring a House	53
119	Railway Engine Turn Table	166
120	Railway Engine Heat-light	88
121	Railway Coach Heating	100
122	Water Motor	140
123	Hydraulic Press	74
124	Steam Condenser	89
125	Volt-Meter	118
126	Electric Transformer	12
127	Automatic Air Brakes on Railway cars	6
128	Wireless Telephone	47
129	Hot Boxes on Railway cars	36
130	Hydraulic Ram	61
131	Tubular Steam Boilers	63
132	Automatic Block Signal on Railway	135
133	Balloons	33
134	Suspension Bridge	64
135	Armature of Dynamo	137
136	Burglar Alarms in Banks	90
137	Aeroplane	124
138	Compound Steam Engine	171
139	Forced Draft for Steam boilers	119
140	Ammeter	16
141	Moving Picture Machine	71
142	Light House	173
143	Commutator of Dynamo	116
144	Hydraulic Elevator	153
145	Steam Boat	69
146	Over Shot Water Wheel	28
147	Sailing Boat	148
148	Turbine Water Wheel	83
149	Rheostat	158
150	Motors on Electric Street cars	113
151	Corliss Steam Engine	79
152	High Tension Electric Lines	49

TABLE NUMBER 10 Cont'd.

RANK	ITEM	NUMBER OF ITEM IN LIST
153	Telegraph Code	94
154	Binoculars	37
155	Electric Condensers	58
156	To Find the Density of an Irregular Solid	141
157	Induction Motors	172
158	Micrometer Calipers	103
159	Super Heaters	104
160	Series Wound Dynamos	155
161	Under Sea Telegraph Cable	18
162	Vernier Calipers	44
163	Electroplating	10
164	Bourdon Gauge	143
165	Automatic Stokers	39
166	Floating Dry Dock	97
167	Medical Induction Coil	120
168	Electric Rectifier	160
169	Wireless Antenna	170
170	Fractional Distillation	14
171	Crystal Detector for Wireless	138
172	The Pelton Water Wheel	126
173	Synchronous Motors	60
174	Audion Detector	25

CORRELATION OF THE REPLIES FROM THE VARIOUS OCCUPATIONAL GROUPS

At this point it will be well to examine the replies from the various groups as compared with the foregoing total response. It might be expected that the evaluation of many items by any given group would be considerably different from the evaluation of the same items by other groups or by the total. In order to make a comparison in this regard, the correlation was worked out between the responses of each of t the leading occupational groups and of the total of such responses. The coefficient of correlation was computed by the method usually used for correlating abilities of students

in two school subjects. In the first place it was necessary to condense the two distributions under consideration. This was done by computing the per cent of persons in each occupational group who assigned real value (1) to each of the several items. These were then grouped in intervals of 10 per cent in the manner shown in table 9. Correlation tables were then made which distributed the number of items according to these intervals for the occupational group and for the total. (See table 12) Having completed this, the coefficient of correlation was computed according to the formula:

$$r_1 = \frac{\frac{\Sigma x'y'}{N} - c_x c_y}{\sigma_x \sigma_y}$$

TABLE NUMBER 11

CORRELATION BETWEEN GROUP RESPONSES AND THE TOTAL RESPONSE, AND BETWEEN DIFFERENT GROUP RESPONSES.

BETWEEN	CORRELATION
FARMERS AND TOTAL	.951 ± .005
MECHANICS AND TOTAL	.92 ± .01
PROFESSIONAL AND TOTAL	.92 ± .01
MERCHANTS AND TOTAL	.915 ± .01
MECHANICS AND FARMERS	.869 ± .01
MECHANICS AND PROFESSIONAL	.892 ± .01
BLANKS (WOMEN) WITH TOTAL	.891 ± .01

TABLE NUMBER 12

CORRELATION BETWEEN RESPONSE OF FARMERS AND TOTAL RESPONSE

TOTAL Response	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	Totals
	20	40	16	20	18	23	15	17	5	174
81%-90%									2	2
71%-80%								10	3	13
61%-70%					2	2	8	7		19
51%-60%				2	4	19	6			31
41%-50%	1		2	7	11	2	1			24
31%-40%		1	8	11	1					21
21%-30%		25	6							31
11%-20%	12	14								26
0%-10%	7									7
	FARMERS									

(FARMERS) $c1 = -.735$ $s1 = 2.381$

(TOTAL) $c2 = -.43$ $s2 = 2.03$

$Sxy/N = 4.89$ $c1 \times c2 = .316$

$r = .951 \pm .0051$

TABLE NUMBER 13

CORRELATION BETWEEN RESPONSE OF MECHANICS AND TOTAL RESPONSE

TOTAL response.	3	10	23	34	23	20	34	23	4	Totals 174
	MECHANICS									
81%-90%								1	1	2
71%-80%						1	1	9	2	13
61%-70%							8	10	1	19
51%-60%					2	8	18	3		31
41%-50%				2	7	8	7			24
31%-40%				9	9	3				21
21%-30%			5	21	5					31
11%-20%		6	18	2						26
0%-10%	3	4								7
	0%--10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	

(MECHANICS) cl = .3 sl = 1.969

(TOTAL) See Table 12

Sxy/N = 3.568

r = .92 ± .01

TABLE NUMBER 14

CORRELATION BETWEEN RESPONSE OF THOSE IN PROFESSIONAL ACTIVITY AND THE TOTAL RESPONSE

TOTAL response	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	91%-100%	Total
	2	8	29	25	18	34	31	17	9	1	174
	PROFESSIONAL										
81%-90%									1	1	2
71%-80%						1		6	6		13
61%-70%						2	9	6	2		19
51%-60%					1	10	16	4			31
41%-50%				1	14	12	6	1			24
31%-40%				5	8	8					21
21%-30%			12	13	5	1					31
11%-20%	1	4	15	6							26
0%-10%	1	4	2								7

(PROFESSIONAL) cl = -.58 sl = 1.98

(TOTAL) See Table 12

Sxy/N = 3.959

r = .92 ± .01

TABLE NUMBER 15

CORRELATION BETWEEN THE RESPONSE OF THE MERCHANTS AND THE TOTAL RESPONSE

TOTAL Response	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	totals
	9	35	32	17	35	19	16	10	1	174
	MERCHANTS									
81%-90%							1		1	2
71%-80%					1	2	4	6		13
61%-70%					2	9	6	2		19
51%-60%				3	17	7	3	1		31
41%-50%			2	5	14	1	1	1		24
31%-40%			10	9	1		1			21
21%-30%		14	17							31
11%-20%	3	20	3							26
0%-10%	6	1								7

(MERCHANTS) $\bar{c}_1 = -.79$ $s_1 = 1.98$

(TOTAL) See Table 12

$S_{xy}/N = 4.00$

$r = .915 \pm .01$

TABLE NUMBER 16

CORRELATION BETWEEN RESPONSE OF FARMERS AND THE RESPONSE OF THE MECHANICS

MECHANICS	20	40	16	20	18	23	15	17	5	Totals
				FARMERS						174
81%-90%							1	4	1	4
71%-80%				1	1	3	4	11	3	23
61%-70%			1	4	6	12	7	4		34
51%-60%			4	2	5	7	1		1	20
41%-50%	1	5	1	9	4	1	2			23
31%-40%		19	9	4	2					34
21%-30%	10	12	1							23
11%-20%	6	4								10
0%-10%	3									3

0%-10% | 11%-20% | 21%-30% | 31%-40% | 41%-50% | 51%-60% | 61%-70% | 71%-80% | 81%-90%

(FARMERS) See Table 12

(MECHANICS) See Table 13

$S_{xy}/N = 3.856$

$r = .869 \pm .01$

TABLE NUMBER 17

CORRELATION BETWEEN RESPONSE OF THOSE IN PROFESSIONAL ACTIVITIES AND THE RESPONSE OF THE MECHANICS

MECHANICS % \ PROFESSIONAL	2	8	29	25	18	34	31	17	9	1	174
81%-90%								2	1	1	4
71%-80%							10	7	6		23
61%-70%						9	17	6	2		34
51%-60%					5	10	4	1			20
41%-50%			1	4	8	9		1			23
31%-40%		1	11	11	5	6					34
21%-30%	1	1	11	10							23
11%-20%	1	4	5								10
0%-10%		2	1								3
	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	91%-100%	

(PROFESSIONAL) See Table 14

(MECHANICS) See Table 13

Sxy/N = 3.63

r = .892 ± .01

TABLE NUMBER 18

CORRELATION BETWEEN THE RESPONSE OF THE "BLANKS" (WOMEN) AND THE TOTAL RESPONSE

TOTAL	BLANKS									
	32	38	25	23	19	12	10	10	5	Totals 174
81%-90%									2	2
71%-80%				1	1			9	2	13
61%-70%				4	6	5	2	1	1	19
51%-60%		1	7	5	5	5	8			31
41%-50%		1	4	10	7	2				24
31%-40%		5	13	3						21
21%-30%	6	24	1							31
11%-20%	19	7								26
0%-10%	7									7
	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	

(BLANKS) cl = -.34 sl = 2.25

(TOTAL) See Table 12

Sxy/N = 4.177

r = .891 ± .01

According to Rugg, a Correlation coefficient above .60 or .70 is high. If this be true we may state from the foregoing that there is a very high correlation between the percentages of the individuals in the several occupational groups that have found these particular instruments or devices of value in daily life. This is most enlightening, for heretofore we have believed the type of Physics for prospective farmers should be substantially different from that for prospective mechanics or professional men because they were naturally interested in different values or appreciations. There has also been almost universal agreement that the girls should receive a different content from the boys. The above table, however, shows that if the content of physics is to be determined by the usual activities of the citizens there will be little need for variation in the subject matter for a variety of contemplated activities. In other words, it shows that every one, regardless of his vocation, is in need of training pertaining to a definite list of every day devices.

LOW RATING OF SOME ITEMS USUALLY STRESSED IN PHYSICS

It is interesting to itemize some of the devices which are usually given considerable attention in high school physics, which were given a low rating by the parents.

TABLE NUMBER 19

PER CENT OF PARENTS SAYING KNOWLEDGE OF ITEM IS VALUABLE

ITEM	PER CENT
Telescope	30
Inclined Plane	30
Centrifugal Pump	30
Why Object is Lighter under Water	30
Differential Pulley	30
Microscope	30
Electric Transformer	20
A mmeter	20
Telegraphy	20
Hydraulic Press	20
Banking Rails at Curves	20
Voltmeter	20
Aeroplane	20
Electromagnet	20
Arc Lamp	20
Armature of Dynamo	20
Compound Steam Engine	20
Electroplating	10
OverShot Water Wheel	10
Binoculars	10
Vernier Calipers	10
High Tension Electric Lines	10
Electric Condenser	10
Turbine Water Wheel	10
Floating Dry Dock	10
Micrometer Calipers	10
Commutator of Dynamo	10
Find Density of Irregular Solid	10
Bourdon Gauge	10
Hydraulic Elevator	10
Series Wound Dynamo	10
Rheostat	10
The Pelton Water Wheel	00

HIGH RATING OF SOME ITEMS USUALLY NOT STRESSED IN PHYSICS

The foregoing table shows items which this study indicates should receive little, if any, serious attention in a high school physics course which is built on the aim of social worth. Below is another list of items which have not, as a rule, received attention in the past in the physics course but which should by all means be included.

TABLE NUMBER 20

PER CENT OF PARENTS SAYING KNOWLEDGE OF ITEM IS VALUABLE

ITEM	PER CENT
Ice Cream Freezer	80
Window Shade Roller	70
To Regulate A Clock	70
The Kerosene Lamp	70
Ordinary Kitchen Range	70
Sewing Machine	70
Cream Separator	70
Fever Thermometer	70
Door Lock	70
Fountain Pen	70
Oil Stove	70
Ordinary Heating Stove	70
Repairing a Pump Valve	60
Automobile Tires	60
Soldering a Hole in a Tea-Kettle	60
Automobile Radiator	60
Windmill	60
Ball and Roller Bearings	60
Water Trap Under Sink	60
Vacuum Sweeper	60
Clock Pendulum	60
Hose Nozzle	60
Automobile Brakes	60

SUMMARY OF PART I

1. The high school physics course, though once considered fully standardized with respect to both content and method of instruction, is now in urgent need of a complete reorganization and readjustment if it is to conform to the present day accepted aim of secondary education. This aim is agreed to be, in the words of Inglis, "To prepare the pupils for the activities in which they will be expected, normally, to participate when they leave school".

2. The content of a proper high school physics course can be determined by scientific answers to these two questions:

> First, What mechanical, electrical, acoustic, thermal, and lighting devices are used by the average person in every day life?
>
> Second, What facts, principles and abilities are necessary before one can be proficient in utilizing and caring for these devices?

3. In an effort to get a partial answer to the first of these questions a list of 174 devices, taken in the main from standard physics texts, was sent to parents of the boys and girls enrolled in physics in 75 high schools of Kansas. They were asked, among other things, to check those items which they had found to be of real importance to them in life by "1".

4. The distribution of the replies to this "Parent Questionnaire" was found to be representative, to a high de-

gree, of the entire population of Kansas. The percents of the fathers represented in the replies who are engaged in the various occupations is very close to corresponding percents shown in the federal reports for all the men of the state.

5. Replies were ~~used~~ from 257 Farmers, 103 Mechanics, 67 Merchants, 70 Professional men, 67 Clerical workers, 36 Common laborers and 58 which were blank with respect to the occupation of the father; giving a total of 658 replies.

6. The responses of these 658 people, regarding the value of a knowledge of the 174 items listed in the questionnaire, were such as to distribute the items fairly well over the entire range from very low value to very high value. The item judged to be of greatest value was the thermometer. This is probably due to the fact that it was first on the list. The next in value was the ice cream freezer (81.3%). The item to be judged of least value was the audion detector (3.7%).

7. A most important fact is observed when the items are ranked in relative importance according to the response of the entire group, and then according to the response of each occupational group separately. The coefficient of correlation between the response of any given group and the total response was in each case between .89 and .92.

The correlation between any two groups was found to be between .86 and .90. This is most significant for it seems to mean two very important things: first, that in further studies of this kind it may be unnecessary to get a response from so great a number of people, since the response of seventy persons is p ractically the same with reference to the percent assigning high value to any item as for 658. In the second place it means that it is not essential that the replies come from all the occupational groups to a representative degree. The response of a random sampling, or from people in the same activity would seem to be quite as reliable in this respect as from a random sampling of all groups.

8. Many of the items which were judged to be of value by less than 40% of the parents making reply are now being given considerable attention in the high school physics course. This, of course, does not prove they should be eliminated. It does show that, since they can not be retained because of apparent social worth, attention should be focused upon them to determine whether there is justification for their retention in the course of study.

9. Many items which were judged to be of real value to more than 60% of the people are given little or no consideration in the present day physics course. This does not mean that all such items should be immediately incorporated into the high school physics course. It does mean that, since these items are of social worth, they should no longer be excluded without a most definite and convincing reason.

PART II

PRESENT STATUS OF THE HIGH SCHOOL PHYSICS COURSE IN KANSAS

In order to get information regarding the present content and present practices in teaching high school physics, the writer made a survey of conditions as they existed in the high schools of Kansas during the school year 1921-22. By means of a questionnaire answers were obtained to the following questions:

1. What proportion of high school students are now pursuing the course?
2. What is the ratio of boys to girls enrolled in physics?
3. To what extent are girls in separate classes from boys?
4. Using the Teacher-Judgment as a basis, how do girls compare with boys with respect to:
   a) Interest in the course?
   b) Interest in laboratory work?
   c) Difficulty with problems?
   d) Interest in machines?
5. To what extent are women teachers of Physics?
6. What is the attitude of Physics teachers toward General Science as a prerequisite for Physics?

7. What other subjects are taught by Physics teachers?
8. What is the relative amount of time spent in the laboratory compared with time spent in recitation and in lecture?
9. What type of laboratory record is usually used?
10. How much value is placed on the laboratory record by the teacher in so far as grade is concerned?
11. What experiments are required in the average high school?
12. Which of these experiments, are performed by the teacher?
13. Do students, when working experiments, work in pairs or in larger groups?

In getting data upon the foregoing questions, 359 questionnaires were sent to as many physics teachers in Kansas. One hundred twelve replies were received. Some of the replies, especially from the Rural High Schools, were so incomplete they could not be used. In most cases 86 replies are considered throughout this study. The following table shows the distribution of the replies with respect to the type of school represented.

TABLE NUMBER 21

SHOWING THE DISTRIBUTION OF REPLIES WITH RESPECT TO TYPE OF SCHOOL REPRESENTED

TYPE OF SCHOOL	First CLASS CITIES	Second CLASS CITIES	COUNTY	RURAL	TOTAL
NUMBER OF SCHOOLS RECEIVING QUESTIONNAIRE	12	75	27	245	359
NUMBER OF SCHOOLS REPLYING	10	33	8	61	112
NUMBER OF REPLIES USED	9	31	6	40	86

For purposes of comparison these 86 schools were divided into eleven groups according to their enrollment. The first group includes those schools with an enrollment of less than 50. The groups from this on up are at intervals of 50, except for the last three intervals, which are greater. These intervals are shown in Table Number 15. The various questions stated above will be taken up seriatum and an attempt made to answer each in the light of the data received from the questionnaires.

Question 1. What proportion of the present high school enrollment is enrolled in the Physics Course?

Averages were computed for the total enrollment and also for enrollment in the physics classes for the schools in each interval of the distribution. From this the percent of those enrolled in physics is derived. Table Number 15 shows the number of schools falling in each group, average enrollment in physics, and the per cent in physics.

TABLE NUMBER 22

PROPORTION OF HIGH SCHOOL ENROLLMENT IN PHYSICS

Enrolment	Number of Schools	Average Enrolment in School	Average Enrol. In Phy.	Proportion in Physics.
0- 49	19	35.9	9.3	25.9%
50- 99	18	65.6	12.4	18.8%
100-149	5	119.4	26.6	22.6%
150-199	9	171.0	24.3	14.2%
200-249	6	221.3	31.7	14.3%
250-299	8	264.7	34.0	12.8%
300-349	3	331.7	45.7	13.5%
350-399	4	356.7	43.5	12.1%
400-599	7	528.0	55.4	10.5%
600-799	5	678.8	60.8	8.9%
800-1400	2	1350.0	131.0	9.7%
0-1400	86	228.6	25.8	12.6%

The Table shows at a glance that the larger the school, in general, the smaller is the per cent of its enrollment in Physics. This can probably be accounted for by two factors. First, Physics is not required by the state for high school graduation. This being the case it is optional with each school whether it requires the course. This would tend to reduce the percentage enrollment in Physics in the larger schools because of a larger range of electives. Second, since the range of subjects offered in the smaller schools is limited it follows that Physics is essentially

a required subject. This would tend to cause a high percentage enrollment in Physics in the smaller schools. For the fifty-one schools, with enrollments less than two-hundred, the proportion of students taking Physics is more than twice that of the fourteen schools, with enrollments more than four-hundred. For all the schools the average (Arithmetic mean) enrollment in Physics is 28.8, which is 12.6% of the average total enrollment. Since students remain in high school for four years and since Physics is open only to Juniors and Seniors, who constitute considerably less than 50% of the enrollment, this would seem to indicate that considerably more than half of the graduates from high school have had High School Physics.

Question 2. What is the ratio of Boys to Girls enrolled in Physics?

When the enrollment in Physics Course was tabulated, (Table No. 16) with respect to sex, it brought out a most interesting fact. It shows, that the number of girls pursuing the course exceeds the number of boys. This does not mean, that a greater proportion of girls elect the course. It indicates clearly, however, that our task is more than to adopt a boy's Physics course so as to meet the needs, as far as possible, of the girls. That is, if the girls predominate in numbers they should not receive secondary consideration.

Another item of interest is the fact that the per cent of boys is high in the very large and in the small schools. This would be expected in the larger schools because of the larger provision for differentiation of courses whereby more desirable courses are open to the girls. Just why relatively more boys take Physics in the small schools is not so evident. It may be due to more of an option in those schools between Physics and Home Economics, or possibly there is a higher proportion of boys enrolled in the Rural schools than in the larger schools.

TABLE NUMBER 23.

PROPORTION OF BOYS TO GIRLS IN PHYSICS

Enrolment	Number of Schools	Average Enrol. in Physics	Ave. No. of Boys	Per Cent of Boys
0- 49	19	9.3	4.5	48.3%
50- 99	18	12.4	6.4	51.5%
100-149	5	26.6	11.4	42.8%
150-199	9	24.3	10.7	43.8%
200-249	6	31.7	13.2	41.5%
250-299	8	34.0	15.6	45.9%
300-349	3	45.7	18.3	40.2%
350-399	4	43.5	19.2	44.2%
400-599	7	55.4	22.7	40.9%
600-799	5	60.8	32.2	52.9%
800-1400	2	131.0	79.0	60.3%
0-1400	86	28.8	13.5	47.1%

Question 3. To what extent are girls in classes separate from boys?

Within the last few years there has been considerable agitation in favor of separate classes for girls. The state text book Commission recommends a book on "Household Physics" for the use of girls' classes. As shown in Table Number 17 it seems that the size of the school has but little effect upon the tendency to separate the girls from the boys except that in the smaller schools the practice is a little below the average. It should be stated, also, that those schools that show the larger per cent of girls pursuing the course, show a greater tendency to provide for girl's classes. This is what we would expect.

TABLE NUMBER 17

SEPARATE CLASSES FOR GIRLS

Enrollment	Number of Schools Replying	Number saying Yes	Per Cent of Total
0- 49	19	3	15.7
50- 99	15	2	13.3
100-149	5	1	20.0
150-199	8	3	37.5
200-249	6	2	33.3
250-299	8	1	12.5
300-349	3	1	33.3
350-399	4	1	25.0
400-599	7	1	14.3
600-799	5	1	20.0
800-1400	2	0	00.0
0-1400	82	16	19.5

Question 4. How do girls compare with Boys (according to teacher judgment) with respect to:

(a)Interest in the course?
(b) Interest in Laboratory work?
(c) Difficulty with problems?
(d) Interest in machines?

Ninety-two replies were used in answering this question. In the questionnaire an effort was made to get responses regarding this which would be comparable. The final wording of that part of the questionnaire, though still open to criticism, was, it is believed, of such a character as to reduce to a minimum any ambiguity. It read as follows:

"Cross out the words in the following sentences which do not apply in your Physics class or classes:

(1) Girls have greater, same, less interest in the course than boys.
(2) Girls have more, same, less difficulty with the problems than boys.
(3) Girls enjoy the laboratory work more, the same, less than boys.
(4) Girls take more, as much, less interest in practical machines (as, the auto, the telephone, pulley, etc.)"

TABLE NUMBER 18

ATTITUDE OF GIRLS COMPARED TO THAT OF BOYS

	More	Same	Less	Blank	Total
~~Interest~~ in Course	2	45	41	4	92
Interest in Laboratory Work	7	48	34	3	92
Difficulty with problems	47	38	4	3	92
Interest in Machines	0	21	69	2	92

Table 18 gives the response in tabular form. It should be read thus: 2 teachers out of 92 think girls, as a rule, show more interest in the course than boys do; 45 teachers can see no difference between the interest manifested by girls as compared with that of the boys; whereas 41 believe the girls take less interest. Four teachers failed to check this item.

The striking point about this teacher judgment is the unballanced appeal which in their judgment the present course is making to the boys and girls of the state. In Table No. 16 we found that more girls than boys were studying Physics; and now we find that the course is of such a nature that it is apparently much less interesting and more difficult for girls than it is for boys. A study of standard text books in Physics shows more than 30% of the total number of pages is devoted to a discussion of Mechanics.

The above table shows that 69 out of 92 teachers believe that girls take less interest than do boys in practical machines. This may have several interpretations. It may indicate that although girls naturally do not take to machinery, yet a study of Mechanics will be of real value to them. Or, it may mean that the various machines are studied in such a

way as to be more or less distasteful to the average girl. Or again, it may mean that even teachers can not get away from the traditional idea of associating machines with the masculine sex and conclude, therefore, "a priori", that girls do not take as much interest in machines as do boys.

If we may judge by the number and high scholarship of the girls in the arithmetic, algebra and geometry courses, we can safely conclude that any difficulty met by them in solving Physics problems beyond that met by the boys, is not caused by insufficient knowledge of the principles of Mathematics. Just why, then, do girls have greater difficulty with Physics problems is a question which should receive serious consideration.

In fact, as one analyzes this table the question keeps crowding into mind, "If it is true that the course is so much more difficult and so much less interesting to girls than boys, and more girls elect the course, what would be the proportion of girls if the course were as interesting and as easy for girls as for boys"?

Question 5. To what extent do women teach Physics?

In a course in which we find, consistently, more than 50 per cent of the enrollment made up of girls, it seems pertinent to ask to what extent women are engaged in teaching it? And now since we have a response from

the teachers which states that a majority of the girls have greater difficulty and take less joy in the work than boys, it is even more to the point to ask, "were their teachers men or women?"

TABLE NUMBER 19

DISTRIBUTION OF MEN AND WOMEN TEACHERS

School Enrollment	Number of Schools	Number of Men Teachers	Number of Women Teachers
0- 49	19	17	2
50- 99	18	17	1
100-149	5	4	1
150-199	9	9	0
200-249	6	5	1
250-299	7	7	0
300-349	3	3	0
350-399	4	4	0
400-599	5	5	0
600-799	5	4	1
800-1400	2	2	0
Not Classified	6	5	1
0-1400	92	82	7

Table No. 19 shows the number of men and women teachers in 89 schools, distributed according to the size of the school. The basis for determining sex was the name of the teacher. In the 89 replies used, it was very obvious whether the teacher was a man or woman. In three cases some doubt was raised, so these were not included, even though it seemed quite evident they were men. Of the 89 teachers, 82 were men and 7 were women. This means, according to this survey, that more than 92% of the Physics teachers are men.

The table further shows that there is relatively no more tendency for women to teach in the smaller schools than in the larger ones; nor vice verca.

Question 6. What is the attitude of Physics Teachers regarding General Science as a prerequisite for Physics?

The question as presented to the Physics teachers was stated thus: "Do you favor a General Science course as a prerequisite to the course in Physics?--Why, or why not?" The responses which this question brought cover a wide range of statements but a rather limited range of ideas. There were 59 out of 81 teachers who favored making General Science a prerequisite for Physics.

The writer has attempted to group the various reasons which were given for the affirmative answer, under five main heads:

First. It lays a foundation for Physics.
This reason was given in such words as:

1. "Physics is too abrupt if not preceded by General Science".
2. "Gives a basis for the study of Physics."
3. "Gives a foundation to build physical science knowledge on.
4. "I like for the student to have something leading up to it."

5. "Physics is not then absolutely foreign to them".
6. "Give a basis for the study of Physics".
7. "To get the rudiments".
8. "It better prepares student for Physics".
9. "Paves the way for Physics".
10. "Gives a better equipment for Physics study".
11. "It is a fundamental Course".
12. "Students are then familiar with nature of Physics".
13. "Gives general introduction to special science".

Second: It makes possible a better understanding of Physics.

This reason, which somewhat overlaps the first, was expressed in phrases such as:

1. "It prepares for a better understanding of the subject."
2. "Understand the work better".
3. "Handle the work better."
4. "Enables class to cover ground more thoroughly in Physics."
5. "It prepares the way for more effective work in Physics."
6. "Pupils do better work."
7. "Gives greater meaning to formal Physics."
8. "Better able to grasp general Physics."
9. "Students grasp most readily those ideas emphasized in General Science."
10. "My experience indicates pupils do better work."

Third: It starts pupils thinking scientifically.

1. "Gives general ideas of law of nature."
2. "Starts pupil thinking in Scientific lines before antering advanced work."
3. "Become more accustomed to the Scientific Method."
4. "Stimulates observation."
5. "Pupils learn to think scientifically."
6. "Gives student general idea of sciences."

Fourth: It makes Physics easier.

1. "Makes easier."
2. "Easy work to lead up to more difficult."
3. "Makes Physics more simple."
4. "Overcomes usual fear of Physics."
5. "Lessens novelty of new science."

Fifth: It awakens interest in Science, and gives a basis for choice between sciences.

1. "Gets pupil interested earlier."
2. "To interest student so he will continue."
3. "Develop curiosity for later sciences."
4. "Serves a diagnostic purpose."
5. "Give idea of relation of Physics to all other sciences."
6. "Enlarges the viewpoint."
7. "Gives insight into what is taught in Physics."
8. "More easily correlate the other sciences and Physics."

The reasons given by the 22 teachers who expressed themselves as unfavorable to making General Science a prerequisite to Physics are grouped under five heads. As in the other list of reasons we have overlapping here.

First: It is unnecessary.

1. "Get just as good results without it."
2. "I believe, however, it makes Physics easier."
3. "Good in itself but adds little outside of giving scientific viewpoint."
4. "Those having had General Science do not seem superior."
5. "Gives such a small background but it helps some."
6. "Does not help much."
7. "Student can easily pick it up during their study."
8. "Not essential."

Second: It destroys newness of subject matter.

1. "Saps interest from Physics."
2. "Apt to kill interest in Physics later on."
3. "Interest aroused and satisfied without teaching them anything."

Third: General Science is not taught properly.

1. "As now taught just a hodge-plodge of sciences."
2. "Too elementary and not exhaustive enough."
3. "Too much ground covered."
4. "Get smattering of ideas which hinders thoroughness."
5. "Isn't thorough, too much ground covered."
6. "So little laboratory work it is of little value as a preparation for Physics."
7. ""Not specific nor broad enough. (Have had no experience, only theory)."
8. "Too superficial."

Fourth: It is only a duplication:

1. "Duplication of effort".
2. "Too much duplication."
3. "Must cover subject matter again."

Fifth: Two teachers maintain that "ninth grade pupils have not sufficient grasping power to attain any valuable amount of the General Science Course."

This evidence shows in a convincing manner the need of scientific studies in science education. The above arguments of High School science teachers for or against General Science as a prerequisite to high school Physics show lack of agreement on fact and procedure. Here is a group of people who are quite agreed that one of their prime functions as teachers is to bring about a scientific attitude on the part of their students by both precept and example. They are usually very critical of so-called educational and social theorists who are thought to be too dogmatic for this age of science. They insist, as a rule, that no general statement should be made without sufficient and accurate data, obtained by scientific measurements, to substantiate such statements. It would be interesting, to say the least, to view the "scientifically obtained data" from which many of the foregoing judgments were deduced.

This is not an arraignment of the teachers who so kindly co-operated in answering the questionnaire. The question, we take it, was accepted as a bona fide method of finding the personal judgment of each teacher. That

is just what it was. Believing that every person has a right to whatever attitude he may hold, whether such attitude be arrived at by a logical deduction or not, the writer desired to know this attitude in each case and the reason for it as expressed by the individual. The arraignment, if it be such, is not concerned with those who answered the questionnaire, but with the attitude of the major portion of science teachers (granting that this response is representative), which seems to assume that observations made by a science teacher in the course of ordinary school procedure is sufficiently accurate to make valid a generalized statement concerning education.

It should be added, in connection with the above statements together with the discussion concerning the lack of appeal which the present Physics course makes to the girls, that the teachers, are not entirely responsible for the present status of the course. It is quite probable that the high school administrations have had as much to do by way of determining the points of view expressed by the teachers as the teachers themselves. This has been brought about by their control of the schedule, direction of enrollment, ultimate decision regarding laboratory equipment, responsibility for determining the curriculum and their tendency to influence the class-room and grading procedure in harmony with their personal points of view.

TABLE NUMBER 20

ATTITUDE TOWARD GENERAL SCIENCE AS A PREREQUISITE FOR HIGH SCHOOL PHYSICS

ENROLLMENT	NUMBER OF SCHOOLS REPORTING	NUMBER FAVORABLE	PER CENT FAVORABLE
0- 49	19	16	84.2
50- 99	17	13	76.4
100-149	5	4	80.0
150-199	8	7	87.5
200-249	6	2	33.3
250-299	8	6	75.0
300-349	2	1	50.0
350-399	3	1	33.3
400-599	7	5	71.1
600-799	4	2	50.0
800-1400	2	2	100.0
0-1400	81	59	72.8

If we take the reasons given for favoring or opposing general Science as a prerequisite for the Physics course at face value and examine the replies we find (Table No. 21) 72.8 per cent of the teachers are favorable. The size of the student body with which the teacher is associated seems to bear no relation to the point of view held by the teacher. The number of teachers in each group save the first two is so small, however, that any conclusion regarding this fact would be questionable.

Question 7. What other subjects are taught by Physics teachers?

Being interested in the preparation of College seniors for the specific task of teaching Physics in the high school, the writer was desirous of finding what other high school subjects, if any, teachers of Physics are called upon, most frequently, to teach. The following Table, Number 21, gives the list of other subjects taught, together with the number of Physics teachers, out of 86, who teach each subject.

TABLE NUMBER 21

DISTRIBUTION OF OTHER SUBJECTS TAUGHT BY EIGHTY-SIX PHYSICS TEACHERS

Other Subjects	Number Teaching	Percent of Teachers
Agriculture	33	38.3
General Science	20	23.2
Chemistry	19	22.1
Algebra	19	22.1
Geometry	18	20.9
Manual Training	12	13.9
History	6	6.9
Civics	6	6.9
Commercial Arithmetic	6	6.9
Normal Training	5.	5.8
Physiology	5	5.8
Athletics	4	4.6

Table Number 21 (Continued)

Other Subjects	Number Teaching	Percent of Teachers
English	4	4.6
Mechanical Drawing	3	3.5
Latin	2	2.3
Com. Law	2	2.3
Botany	2	2.3
Phy. Education	2	2.3
Biology	2	2.3
Economics	1	1.2
Typewriting	1	1.2
Phy. Geography	1	1.2
Com. Geography	1	1.2
Domestic Art	1	1.2
Psychology	1	1.2
Trigonometry	1	1.2
Sociology	1	1.2

Here are 27 distinct subjects which are being taught by one or more of 86 Physics teachers, in addition to the subject of Physics. Agriculture takes the lead with more than 38% of the Physics teachers. General Science, Chemistry, Algebra, and Geometry each demand time from approximately one-fifth of the Physics teachers.

TABLE NUMBER 22

RELATION BETWEEN SIZE OF SCHOOL AND NUMBER AND CHARACTER OF OTHER SUBJECTS TAUGHT BY PHYSICS TEACHER

Enrollment	Number of Teachers	Other Subjects Taught	Ave per Teacher	Most frequent Subject	Per Cent of Teachers	2nd Most Frequent Subject	Per Cent of Teachers
0- 49	19	57	3.00	Algebra	47	Geom.& Agri	36
50- 99	18	46	2.55	Algebra	50	Geom.& Agri	44
100-149	5	8	1.60	Agri.	60	Gen'l Sc.	40
150-199	9	16	1.77	Agri.	67	Chemistry	22
200-249	6	12	2.00	Agri. Phy.Edu	33 33		
250-299	8	17	2.12	Chemisy Agricul	50 50		
300-349	3	4	1.33	Chemisy Agricul	33 33		
350-399	4	5	1.25	Chemisy	75		
400-599	7	6	.86	Chemisy	57		
600-799	5	6	1.20	Chemisy	80		
800-1400	2	1	.50	Gen. Sci	50		
0-1400	86	178	2.07	Agri.	38.3	Gen'l Sci.	23.2

Table Number 22 was prepared to show the relation between the size of school and the number and character of other subjects taught by the Physics teachers. It should be read thus: In schools with a total enrollment less than 50, nineteen teachers reported. These 19 physics teachers are also teaching a total of 57 other subjects, or an average of 3 each. The one subject most frequently taught by these 19 is Algebra, which is being taught by 47 per cent of them. The subjects next to Algebra, which are most frequently taught by this group of teachers are Geometry and Agriculture, each of which is being taught by 36 per cent of the 19 teachers. As the size of the school increases the average number of other subjects which the Physics teacher is called upon to teach, materially decreases. The foregoing table also shows that Physics teachers in the smaller schools are usually called upon to teach three additional subjects. It should be kept in mind that the fourth column has to do with other distinct subjects taught and not with the number of classes taught. If a teacher, for instance, had one class in Physics, two in algebra, and two in Geometry, he was put down as teaching two other subjects.

The full significance of the variation in the amount and kind of other courses as taught by Physics teachers may be shown better by larger grouping of the schools according to enrollment.

TABLE NUMBER 23

NUMBER OF OTHER SUBJECTS TAUGHT BY PHYSICS TEACHERS IN RELATION TO SCHOOL ENROLLMENT (Larger ranges of enrollment)

Enrollment	Number of Teachers	Ave. No Other Subjects Taught	Most Frequent Subject	Per Cent of Teachers	2nd most Frequent Subject	Per Cent of Teachers	3rd most Frequent	Per Cent of Teachers
0- 99	37	2.8	Algebra	49	Geom.	40	Agri.	40
100-299	28	1.9	Agri.	50	Chem.	25	Gen'l	14
300-1400	21	1.0	Chem.	57	Gen'l	19	Agri.	14

This table should be read thus: In schools with a total enrollment less than 100, thirty-seven teachers reported. These physics teachers are also teaching on the average 2.8 other subjects each. The other subjects taught by the largest number of the 37 teachers is Algebra, which is being taught by 49 per cent of them. The subjects next to Algebra, which are taught by the largest proportion of this group of 37 are Geometry and Agriculture; each of which is being taught by 40 per cent of them.

For schools whose enrollment is less than one hundred we find more than half of the physics teachers giving one or two courses in Mathematics, with Algebra the most frequent. The proportion for the highest ranking subjects are: Algebra 49%; Geometry 40%; Agriculture 40%; General Science 32%; Manual Training 22%; History 14%; It is not uncommon to find a Physics teacher in one of these smaller high schools teaching four subjects besides Physics. In two schools each teacher reported that he gave instructions in five other subjects. This means that such individuals are not only teaching six classes but six different courses. In one of these cases there was the following combination: Physics, General Science, Agriculture, Physical Geography, Commercial Arithmetic and Commercial Geography; in the other: Physics, Algebra, Geometry, General Science, Mechanical Drawing and Athletics.

Since combinations found in schools with less than 100 are determined more by accidental factors than by real educational needs these combinations need not to be considered seriously. The combinations of subjects with Physics as found in schools with an enrollment of more than 100 are shown in the following list:

TABLE NUMBER 24

COMBINATIONS OF SUBJECTS TAUGHT BY PHYSICS TEACHERS IN SCHOOLS WITH AN ENROLLMENT EXCEEDING 100.

SUBJECTS	NO. TEACHERS
Physics only	7
Physics and Chemistry	9
Physics, Chemistry and Agriculture	4
Physics, Agriculture and General Science	3
Physics, Agriculture and Manual Training	2
Physics, and Agriculture	1
Physics, and General Science	1
Physics, and Physiology	1
Physics, General Science and Mathematics	1
Physics, General Science and Biology	1
Physics and Mathematics	1
Physics and Mechanical Drawing	1
Physics and English	1
Physics and Manual training	1
Physics, Agriculture and Mathematics	1
Physics, Agriculture and Normal Training	1
Physics, Chemistry and General Science	1
Physics, Chemistry and Ancient History	1
Physics, Chemistry and Mathematics	1
Physics, Chemistry and Physical Education	1
Physics, Agriculture, Manual Training and Civics	1
Physics, Agriculture, General Science and Biology	1
Physics, Agriculture, Athletics and Physical Edu.	1
Physics, Agriculture, Botany and Athletics	1
Physics, Chemistry, Biology and Mechanical Drawing	1
Physics, Agriculture, Biology and English	1
Physics, Mathematics and Psychology	1
Physics, Mathematics and Sociology	1

TABLE NUMBER 25

FREQUENCY OF OTHER SUBJECTS TAUGHT BY PHYSICS TEACHERS

LESS THAN 100 Enrollment			MORE THAN 100 Enrollment		
Subject	No. Teachers	Percent of Teachers	Subject	No. Teachers	Percent of Teachers
Algebra ----------	18	48.6	Chemistry -------	19	38.7
Geometry ---------	15	40.5	Agriculture -----	18	36.7
Agriculture -----	15	40.5	General Science -	8	16.3
General Science -	12	32.4	Manual Training -	4	8.1
Manual Training -	8	21.6	Geometry --------	3	6.1
History ----------	5	13.5	Physiology ------	3	611
Civics ----------	5	13.5	Mechanical Drawg-	2	4.1
Com.Arith.-------	5	13.5	Athletics -------	2	4.1
Normal Training -	4	10.8	English ---------	2	4.1
Athletics -------	2	5.4	Botany ----------	2	4.1
Latin ----------	2	5.4	Physical Educan -	2	4.1
Physiology ------	2	5.4	Biology ---------	2	4.1
English ---------	2	5.4	History ---------	1	2.0
Com. Law ---------	2	5.4	Algebra ---------	1	2.0
Mechanical Draw.-	1	2.7	Civics ----------	1	2.0
Economics -------	1	2.7	Psychology ------	1	2.0
Typewriting -----	1	2.7	Trigonometry ----	1	2.0
Domestic Art ----	1	2.7	Sociology -------	1	2.0
Physical Geog. --	1	2.7	Com. Arithmetic -	1	2.0
Com. Geog. ------	1	2.7			
Total No. Teachers	37		Total No. Teachers	49	

Question 8. What is the Relative time spent in the Laboratory compared with time spent in recitation and in lecture ?

In order that comparable data might be obtained regarding the actual time spent in the laboratory, the questions were asked in the following way:

"How many minutes, each week, is each Physics class actually under your supervision?_____

Of the above amount of time how many minutes each week are spent:

a) In Laboratory work? _____

b) In discussions (Recitation, lectures etc.)?_____

c) In Study (Supervised or otherwise)? _____ "

By referring to Table Number 26 it will be noticed that in schools with an enrollment of less than 50 and more than 300, relatively more time is spent in discussions than in laboratory work. With all the rest, it is practically the traditional four to three ratio. That is, there are two double periods for laboratory and three single periods for recitation each week.

TABLE NUMBER 26

TIME SPENT EACH WEEK IN THE LABORATORY, IN RECITATIONS AND IN CLASS ROOM STUDY.

ENROLMENT	NO. OF SCHOOLS	AVE. TOTAL TIME	AVE. RECITA TIME	AVE. LAB. TIME	AVE. STUDY TIME	RATIO LAB. TO REC. TIME	PER CENT OF SCHOOLS REPORTING STUD
0- 49	19	318.6	145.8	142.4	30.5	.97	36.8
50- 99	17	304.1	118.0	152.6	33.5	1.29	35.3
100-149	5	362.2	133.8	168.4	60.0	1.26	40.0
150-199	9	325.0	120.0	163.3	41.6	1.36	44.4
200-249	6	300.3	135.0	162.0	5.0	1.20	16.6
250-299	8	320.6	122.9	161.2	36.5	1.31	37.5
300-349	3	330.0	130.0	140.0	60.0	1.08	66.6
350-399	4	300.2	137.2	173.0	15.0	1.26	25.0
400-599	7	342.1	139.3	130.0	74.3	.93	85.7
600-799	5	330.0	150.0	137.0	43.0	.91	60.0
800-1400	2	300.00	135.0	135.0	30.0	1.00	50.0
0-1400	85	319.7	132.4	150.0	37.3	1.13	42.3

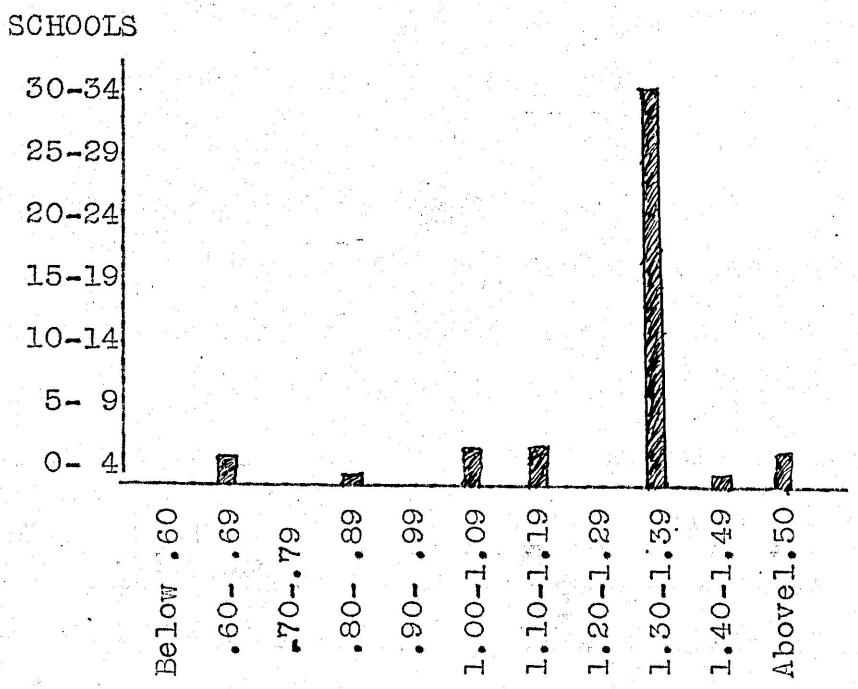
It is seen from the last column of the above table that less than one-half (42.3%) of all the schools provide for any kind of study during the class hour. Nor does the size of the school seem to have any vital connection with the amount of time thus provided. Of the 85 schools listed in the table but 36 reported any time for study under the teacher's supervision. In these schools the average time allowed for study under the direction of the teacher was 88.1 minutes per week.

The significant fact is not how much time was thus spent, but rather that 36 out of 85 schools (42.3%) were making provision for some kind of study, supervised or otherwise, for the students of the physics classes, under the direction of the physics teacher.

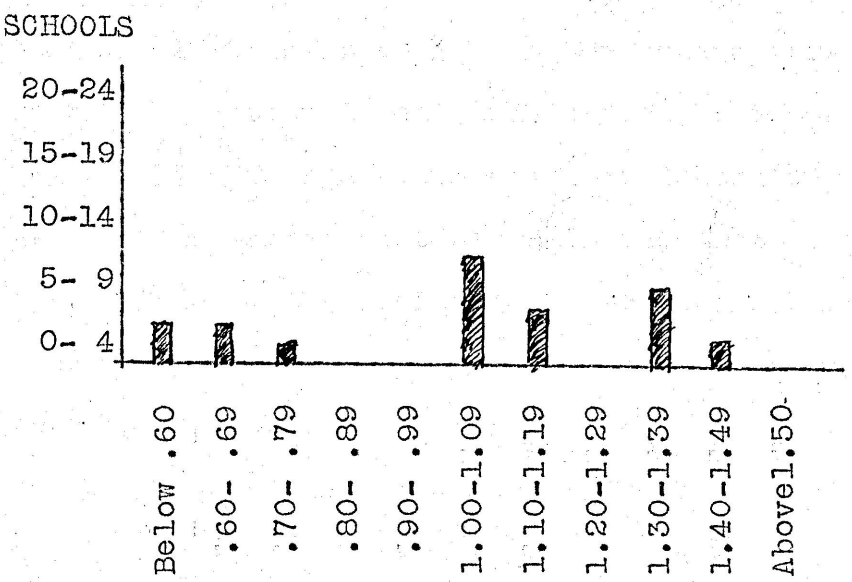
Another very significant trend is observed regarding the tendency to depart from the universal ratio of 4 to 3, which prevailed two decades ago, to the ratio of 1 to 1, with respect to laboratory time as compared with recitation time. This tendency is more pronounced in the schools with an enrollment above 300, as will be readily seen upon examining the following graphs.

GRAPHS NUMBERS 1 and 2

1. SHOWING FREQUENCY OF USE OF VARIOUS RATIOS OF LABORATORY TIME TO RECITATION TIME IN SCHOOLS WITH ENROLLMENT BETWEEN 50 and 300.



2. SHOWING FREQUENCY OF USE OF VARIOUS RATIOS OF LABORATORY TIME TO RECITATION TIME IN SCHOOLS WITH ENROLLMENT ABOVE 300.



The above ratios represent the per cent that the time spent in laboratory work is of the time spent in recitation. For instance, two schools reported that less than 60/100 as much time was spent in laboratory as is spent in recitation. In Graph 1 are represented 45 schools; in Graph 2 are represented 21 schools. Schools with an enrollment less than 50 are not shown because it is believed that the relative amount of time devoted by the physics class to laboratory work and to the recitation is determined very largely by incidental factors rather than any definite policy in education.

In examining these graphs one sees at a glance that, especially in the larger schools there is a real tendency toward the 1 to 1 ratio. This means that in such cases, as much time is devoted to the recitation and lectures as to the laboratory work. If this is to become the general practice in the future the question immediately arises, which should be changed? Should the usual time given to laboratory work be shortened so as to equal that given in the past to the recitation? Or, should the recitation time be increased so as to equal that given heretofore to the laboratory work? The only possible alternative to the foregoing is to say that the total amount of time now devoted to Physics is the correct amount; and that all that is needed is a redistribution of the time.

This alternative apparently is what is actually being chosen. For in schools whose enrollment is above 300 the average laboratory time is 137 minutes each week; the average recitation time is 140 minutes each week, making a total of 277 minutes a week. In schools whose enrollment is between 50 and 300, the average laboratory time is 159 minutes each week, and the average recitation time is 123 minutes each week, making a total of 282 minutes a week. This shows an increase in time devoted to recitation and a like decrease in time devoted to laboratory work, such that the total time is only 5 minutes a week less than when the 4 to 3 ratio is followed. At the same time it must be admitted that if the schools thus devoting 5 minutes less each week to the study of physics are getting just as good results as the others, they are saving considerable teaching time in the course of even one year.

Question Number 9. What type of Laboratory Record is usually required ?

For years, one of the requirements of a creditable course in physics was a written record of the laboratory experiments performed. That this view is still generally held is shown by the statements in the "State Course of Study"[11], and in the Federal Bulletin on "The Reorganization of the High School Science Curriculum"[12]. This being the case it is not surprising to find that all the high schools answering the questionnaire require a written report of the physics laboratory experiments.

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11. Kansas State "Course of Study for High Schools"Part V.1919 p.58
12. Federal Bulletin No. 26 1920 p. 54.

There is not, however, such full agreement regarding the nature and type of this report. About two-thirds of the teachers (See Table 27) say it must be written in ink. Slightly more than half require the use of a bound note book, and about the same proportion have the students take rough notes in the laboratory and complete the report outside the class session periods.

TABLE NUMBER 27

PRACTICE REGARDING CHARACTER AND TYPE OF LABORATORY REPORTS

ITEMS	No. of Teachers Saying Yes		No. of Teachers Saying No		No. of Teachers Saying it is optional		BLANK
Must be in Ink	63	73%	--	-	20	23%	3
All Notes written in Class	36	42%	47	55%	--	--	3
Bound Note Book	48	56%	31	36%	--	--	7

In 25 cases the teacher says that the reports are made on separate sheets which are kept by the teacher. In only 6 instances are printed forms used.

Question 10. How much value is placed on the Laboratory Record, as far as grade is concerned ?

Here, again, the type of question asked might determine to a large extent whether answers were comparable. The following is the form that was used:

> "In rating a student with respect to his laboratory work, every teacher probably takes into account at least two things; 1st, the laboratory notes, and 2nd, the student's performance in the laboratory as observed by the teacher from time to time. If 300 points were to be allowed for both of these items taken together, how many of the 300 points do you think proper to allow for the laboratory notes alone?_____"

Eighty responses were received on this question. The answers fall into definite groups as shown in Table Number 28.

TABLE NUMBER 28

NUMBER OF POINTS OUT OF 300 TO BE ALLOWED FOR THE WRITTEN NOTES ON THE LABORATORY GRADE.

NUMBER POINTS	PER CENT of 300 POINTS	NUMBER OF TEACHERS	PER CENT OF ALL THE TEACHERS
50	16.6	3	3.7
100	33.3	44	55.0
150	50.0	17	21.2
200	66.6	14	17.5
250	83.3	1	1.2
300	100.0	1	1.2
	TOTAL	80	99.8

This table shows a slight majority of the teachers favor counting the written report equal to 33% of the laboratory grade. There is not the degree of unanimity that should exist, seemingly, regarding the value of the written report.

The fact that more than a fifth of the teachers think that the note-book is equal in value to the student's performance, and that another fifth believe it is of twice the value of the work of the student in the laboratory, makes quite pertinent the question as to the real purpose of the laboratory notes. If the note book is of vital importance, that fact should be capable of such demonstration that the notebook practice would become more uniform than at present. Two questions should be answered in this connection: First, to what extent, if any, do students learn more and receive better training in solving a certain science problem by the "performance" of an experiment, than by "writing up" the results of such experiment? Second, is it not true, that such a great value is being placed upon written notes, not because teachers believe the notes are in themselves of such value, but because, as yet, we have no better means of determining quantitatively the relative value of the student's performance in the laboratory.

If these questions are answered in the affirmative, it behooves teachers of science to give immediate attention to working out a more economical measuring rod. For, if writing laboratory reports is primarily for the purpose of determining whether the student has been "thinking" and reasoning while working the experiment, the exhorbitant amount of time required in many schools for writing such reports is unjustifiable.

Question Number 11. What are the Experiments required in the Average High School ?

In the questionnaire to physics teachers, an itemized list was given of all the experiments suggested in the State Course of Study, together with additional ones regarding certain everyday devices; as, the Electric Iron, Wiring an Auto, Hot Water Heater, Refrigerator, testing a Storage Battery. The teachers were asked to check the ones which were required of their classes. They were also asked to add any experiments, not included in the list, which constituted a part of their course.

Table Number 29 gives the experiments in the order of the number of schools requiring them. Column one gives the per cent of schools requiring each. But one experiment is required by every school, viz, "Finding the Specific Gravity of a Solid".

TABLE NUMBER 29

SHOWING THE PER CENT OF THE SCHOOLS REQUIRING THE VARIOUS EXPERIMENTS, WHETHER WORKED: BY STUDENTS ALONE OR IN PAIRS "a" BY STUDENTS IN GROUPS OF MORE THAN TWO "g", OR BY THE TEACHER"t"

TITLE OF EXPERIMENT	Per Cent of Schools Requiring	Number of SCHOOLS "a"	"g"	"t"
Specific Gravity of Solid	100	35	51	1
Density of Solid	98.9	47	37	2
Straight lever	98.9	43	41	2
Inclined Plane	98.9	34	50	2
Measurements	97.6	58	25	2
Archimedes Principle	97.6	35	48	2
Specific Gravity of Liquid	97.6	32	51	2
Specific Heat of Metal	95.6	26	54	3
Weight of Lever and Center of gravity	94.3	37	41	4
Efficiency of Block and Tackle	93.1	31	46	4
Resolution of Forces	93.1	34	45	2

TABLE NUMBER 29 (Continued)

	Percent of Schools Requiring	Number of Schools "a"	"g"	"t"
Heat of Fusion	92.	27	51	2
Heat of Vapory	92.	27	51	2
Voltaic Cell	92.	28	45	7
Induced Currents	90.8	25	46	8
Plain Mirror	90.8	40	36	3
Ma gnetism	89.8	33	33	12
Boyle's Law	88.6	22	40	15
Frequency of a Tuning Fork	88.6	26	45	6
Sliding Friction	87.5	30	42	4
Fixed points on a Thermometer	87.5	30	43	3
Rate of Expansion of Solid	86.3	24	43	8
Wheatstone Bridge	86.3	20	45	10
* Density of Solid lighter than water	85.1	32	42	0
Measurement of Heat	83.9	28	43	2
Wave-Length of Sound	83.9	23	46	4
Focal Length of Convex Lens	83.9	25	41	7
Magnetic Properties of Coils	80.5	22	35	13
Weight of Air	79.4	14	32	22
Static of Electricity	78.2	20	27	21
Electromotive Force	78.2	20	39	9
Ohm's Law	75.9	15	36	12
Magnifying Power of Lens	75.9	27	35	4
* Conductivity	75.9	18	30	18
Hooke's Law	72.5	28	15	3
* Reading an Electric Meter	72.5	26	21	16
* Telephone	72.5	16	34	13
Breaking Strength of a Wire	71.3	23	34	5
* Storage Battery	69.	11	29	20
* Telegraph	67.9	9	34	16
Other Static Electrical Effects	63.4	10	21	24
Internal Resistance of Battery	63.4	14	35	6
* Resistance by Voltmeter Ammeter method	63.4	13	34	8
Rate of Expansion of Air	62.1	15	30	9
* Testing Acid of Battery	56.4	17	16	16
* Electric Iron	46.	15	21	4
* Wiring of Auto	40.2	11	17	7
* Hot Water Heater	35.6	—	—	
* Refrigerator	23.0	6	6	8
Gas Pressure	19.6	6	6	5
Cooling Curve	8.1			
* Pendulum	5.7			
* Gas Engine	5.7			
* Heating and Ventilating Systems	5.7			
* Electric Bells	4.6			
* Accelerated Motion	4.6			
* Light Plant	4.6			
* Dynamo & Motor	4.6			
* Electroplating	3.5			
* Photometer	3.5			

TABLE NUMBER 29 (Concluded)

	PER CENT OF SCHOOLS REQUIRING
*Dispersion of Light	3.5
*Telescope and Microscope	2.3
*Human Eye	2.3
*Parallel Forces	2.3
*Index of Reference	3.5
*Barometer	2.3
*Composition of Forces	2.3
*Mechanically equivalent of Heat	2.3
*Water Systems	2.3
*Calipers	2.3
*Determination of Dew Point	2.3
*Water Meter	1
*Faucet	1
*Pumps	1
*Phonographs	1
*Range	1
*Oil Stove	1
*Vacuum Cleaner	1
*Sewing Machine	1
*Human Horse Power	1
*Convection	1
*Boiling point of Liquids	1
*Measure Va	1
*Gas System	1
*Action & Reaction	1
*Diffusion of gas	1
*Pressure Coefficient of Air	1
*Temperature of Water at greatest density	1
*Steam Engine	1
*Vibration Strings	1
*Manometric Flame	1
*Temperature of Flame	1
*Pressure in all directions beneath the surface of a liquid unequal	1
*Heat effect of current	1
*Physical and Chemical changes	1
*Bent Lever	1
*Graduating Hydrometer	1
*Bourdon Gauge	1
*Ice Plant	1
*Bridges	1

* The star indicates those experiments not listed in the Kansas State Course of Study.

One of the most interesting facts regarding the present practice in laboratory work is that, save for a very few schools which add a small number of other experiments, the experiments worked in the high school physics laboratories of to-day are to a large extent the same as those worked thirty years ago.[13] This would indicate that, in the main, the agitation for the "Project-Problem Method" of the last few years has not carried over into school-room practice of this subject. It shows also the tremendous influence of a state course of study. In Table Number 29 the experiments which are not included in the "Kansas State Course of Study" are starred. It will be noticed that the per cent of schools requiring the starred experiments is decidedly lower than the others. The one high star is accounted for by the fact that in earlier editions of the Course of Study that experiment was included. We thus see that but few experiments not included in the state course, are required to as great an extent as those suggested by it. It seems to be the unusual thing for schools to depart from the regular course, even though this is quite permissible.

It is therefore justifiable to ask why the experiment "Weight of a Lever and Its Center of Gravity" should be given attention by 94% of the schools in their laboratories, whereas the experiment "Testing the Acid in a Storage Battery" receives laboratory attention from but 56%? Do not Do more people work

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13. Mann- pp. 51,56,& 64.

with a weighted lever whose center of gravity should be known, than have to do with keeping a storage battery charged? Also, why is such a great disproportion between "Inclined Plane" and "Electric Iron"?

Question 12. Which Experiments are performed by the Teacher principally, and which by the students?

In checking the experiments which were required, each teacher was asked to mark with a "t" those experiments which were worked by the teacher in the presence of the class. The third column of Table Number 29 shows the actual number of teachers who make a demonstration experiment of the experiments which are listed. The following table shows the experiments most frequently worked by the teacher. The percentages were worked out using 87 schools as a base. This was done so as not to distort the sequence by introducing the results pertaining to an experiment in which but few schools responded. For instance, if the exact number of schools working any given experiment was taken as standard for that particular experiment, we might have, as with the "Water Heater", 49% of the teachers giving it as a demonstration. This is true for those schools using it; but it should be kept in mind that but 35.6% of the schools use it.

TABLE NUMBER 30

SHOWING THE EXPERIMENTS WHICH ARE USED AS DEMONSTRATION EXPERIMENTS AND ARE WORKED BY THE TEACHER; (Including only those 50 used by at least 10% of the schools)

TITLE OF EXPERIMENT	PER CENT OF ALL SCHOOLS IN WHICH TEACHER PERFORMS IT
Other Static Effects	27
Weight of Air	25
Static Electricity	24
Storage Battery	23
Conductivity (Of Heat)	21
Reading an Electric Meter	18
Testing Acid in a Storage Battery	18
The Telegraph	18
Boyle's Law	17
Hot Water Heater	17
The Telephone	15
Magnetic Properties of Coils	15
Magnetism	14
Ohm's Law	14
The Wheatstone Bridge	12
Electromotive Force	10
Rate of Expansion of Air	10

It is commonly agreed that the teacher-demonstration experiments constitute one of the most important phases of the teaching of physics. The reports from the questionnaires probably do not tell the whole truth. For, in many cases, physics teachers give demonstrations without dignifying them with the dignifying name of experiment. The significance of the above data lies in the fact that the response had to do with the so-called "laboratory course"

If the 50 experiments required by the largest proportion of the schools (Table 29) be divided into groups according to the division of Physics in which each occurs we find that the per cent of "Experiments in Electricity" which are worked by the teacher is about three times that for any of the other divisions. Possibly this is the way it should be. On the other hand, it would seem that some real questions are here involved. Does any lack of apparatus account entirely for the difference? Are the electrical experiments more complex and intricate? Is the electrical apparatus too delicate, compared with that in mechanics, to risk it in the hands of the students?

Are the results, from the teacher-experiments, superior to those obtained when the students perform the experiments? If not superior, is there economy of time in having the teacher perform them? If either, or both, of the last two questions is answered in the affirmative would our whole teaching method be improved by having the teacher work more of the regular experiments. Recent studies indicate that in several ways the demonstration experiment by the teacher gives better results than individual experiments.[14]

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14. Cooprider, J. L. "Oral Versus Written Instruction and Demonstration Versus Individual Work in High School". Sch. Sci. and Math. Dec. 1922, pp. 838-44.

Cunningham, H. A. "Lecture Demonstration Versus Individual Work in Science". An unpublished thesis at the University of Chicago.

Phillips, T. D. "A Study of Notebook and Laboratory Work as an Eddective Aid in Science Teaching". School Review, Vol. 28 June 1920 pp. 451-53.

Question 13. Do students, when in the laboratory, work in pairs or in larger groups?

The Kansas "Science Course of Study" in connection with the enumeration of the various experiments which it suggests makes this statement: "Working singly or in pairs, the students of the class should during the year perform thirty to forty experiments". In order to find to what extent this advice was being fulfilled the teachers were asked to check the experiments, which were performed by the students, in this manner:

> "If the experiment will be performed by students working ALONE OR IN PAIRS place the letter "a " before it.
>
> If the experiment is to be worked by students in GROUPS OF THREE OR MORE place the letter "g" before it."

Table Number 29, columns two and three, give respectively the number of teachers checking each experiment by "a" or "g". When the actual number of times the experiments have been checked "a" have been added together we have 1210 times, compared with 1771 times that they have been checked "g". This indicates that 59.3% of the laboratory work of the students is carried on in groups of three or more. Table 32 gives the data and the per cents for the various divisions of physics.

It will be noticed (Table 31) that a larger percent of the experiments in all the divisions is worked by the students in groups than is worked by them alone or in pairs. In fact,

we find the experiments thus worked are almost half again as many as the others. The disproportion is not so great for experiments in Mechanics and Light (54% each); but for Heat (63%), Sound (65%) and Electricity (64%) it is decidedly pronounced.

TABLE NUMBER 31

SHOWING THE NUMBER OF TIMES THE EXPERIMENTS FROM THE VARIOUS DIVISIONS OF PHYSICS WERE CHECKED "a" OR "g"

DIVISION	NUMBER MARKED "a"	PER CENT "a"	NUMBER MARKED "g"	PER CENT "g"
Mechanics	551	45.6	656	54.3
Heat	207	36.4	361	63.5
Sound	49	35.0	91	64.9
Light	92	45.1	112	54.7
Electricity	311	36.0	552	63.9
TOTAL	1210	40.6	1771	59.3

SUMMARY OF PART II

1. Of 86 schools representing a total enrollment of 19,659 students, the per cent enrolled in the physics course is 12.6. The larger the school, in general, the smaller the proportion enrolled in the course. This is probably due to the fact that physics is more frequently an elective in the larger schools.

2. Of those now pursuing the course 53 out of every 100 are girls. This is without doubt due to the fact that a

confronting the physics teacher is to teach a course which is vitally concerned with the education of the girl, rather than to attempt to adapt a boy's course so as to appeal somewhat to the girls.

3. Nineteen-and-one-half per cent of the schools are now making provision for separate classes for girls. There seems to be a slight though quite definite relation between large numbers of girls in the course and the tendency to have separate classes.

4. It seems that either girls have a poorer background, by way of native capacity or acquired ability, or that the type of physics course now taught makes less of an appeal to them than to the boys. Forty-one out of 88 teachers say girls manifest less interest in the course than boys. Thirty-four of 89 teachers say girls take less interest in laboratory work. Sixty-nine of 90 teachers say girls show less interest in machines. Forty-seven of 89 teachers say the problems are more difficult for girls than for the boys. The writer's conclusions are: First, the foregoing data may represent in many cases only opinions based upon "a priori" reasoning and therefore do not state actual facts. In the second place, the present course of high school physics, as presented in the text-book or as presented by the teacher, is altogether too fre-

quently confined to those devices and activities which concern men only, that it engenders a dislike on the part of the girls.

5. Eighty-two, of eighty-nine teachers reporting, were men. There is apparently no greater tendency for women to teach in the small schools than in the large ones. Physics seems to be a course which the women are, to a very large degree, willing to concede to the men. This should not be, for with more girls studying the subject and at the same time manifesting a dislike for it, it would seem advisable for more women to enter this field and attempt to vitilize the course for the girls.

6. General Science, as a Prerequisite for Physics, is favored by 72.8% of the Physics teachers. The reasons given for thus favoring it may be grouped under five heads:

a) It lays a foundation for Physics.
b) It makes possible a better understanding of Physics.
c) It starts pupils thinking scientifically.
d) It makes Physics easier.
e) It awakens interest in science, and gives a basis for choice between sciences.

The reasons for not favoring it fall into five groups also:

a) It is unnecessary.
b) It destroys the newness of the subject-matter.
c) It is not taught properly.
d) It constitutes a duplication.
e) Ninth grade pupils have not sufficient grasping power to learn it.

7. It is the usual practice for the person teaching physics to teach at least one other subject. Only ...

in the very large schools is it otherwise. In the smaller schools, however, more frequently two, three, or even four other subjects are taught. More than one out of every three physics teachers is also teaching Agriculture. General Science is next most frequently taught (23.2%) with Chemistry (22.1%), Algebra (22.1%) and Geometry (20.9%) following closely. Mathematics is taught by the physics teachers only in the smaller schools. Agriculture is seldom taught by the physics teacher in schools whose enrollment is above 300, whereas Chemistry is taught by 57% of the physics teachers in these schools. Training schools for secondary school teachers might well insist that those who expect to teach physics should also make preparation to teach chemistry.

8. The average number of minutes each physics class is under the direct supervision of the teacher, per week, is 319.7. This is divided, on the average, as follows: 132.4 minutes in class work, 150.0 minutes in the laboratory, and 37.3 minutes in study. In the schools with less than 300 enrolled, 1.3 times as much time is devoted to laboratory work as to the recitation. In the larger schools, however, there seems to be a tendency to divide the total time equally between the laboratory and the class period time.

9. All the schools require a written report of the work done in the laboratory. Not all agree as to the form.

for writing such reports. Seventy-three per cent require them to be written in ink. Forty-two per cent insist that all the reports shall be written in the class or laboratory room, whereas 55% permit the formal write-up to be written outside of school. Fifty-six per cent require a bound note book in which the reports must be written. In but 6 cases are printed forms used.

10. With respect to the grade-value of the written report of the laboratory work the majority opinion is to allow or count the note book as one-third of the laboratory grade. Although 55% would thus grant one-third, 21.2% think the record should count half of the laboratory grade and 17.5% would give it a weight of two-thirds. It is questionable whether the actual value to the pupils of writing such notes is proportionto to the time required to write them. If the most important value of such notes is a grade measuring-rod, some other more economical device should be devised.

11. The experiments which are being worked by the average school follows closely the list of experiments given in the State Course of Study. Proportionally more experiments from the division of Mechanics are required than from any other division. Fewer are required in the Electrical field because, probably, the laboratory equipment of the schools is less plentiful in this line and also because the average preparation of the teachers in electricity is possibly

lower than in the field of mechanics. Some of the schools are introducing a few "practical" experiments not included in the State Course of Study.

12. In a majority of the cases (88.5%), the experiments are performed by the student. Only about 6.5% of the experiments in Mechanics, Sound and Light are performed by the teacher. In the experiments in Heat he works 11%, and in those in Electricity 18.9%. Just why the teacher performs nearly one-fifth of the experiments in electricity one can not be sure. It possibly is brought about by the fact that electrical apparatus may be more fragile or complex than any other. The relative efficiency as an educational device, of the Demonstration Experiment is a question which should receive the study of teachers of physics.

13. Of the experiments which are worked by the students we find in a majority of them (59.3%) that the students must work in groups of three or more. To what extent this invalidates the accepted claim placed upon the value of individual laboratory work is not known. Here, again, is need for real scientific studies as to the efficiency of our present practice in this regard.

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