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HOUSEHOLD PHYSICS AND SOCIAL SERVICE

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FOREWORD

The purpose of this bulletin is to help teachers of physics to make a better adjustment of the elements of physical science to the needs of girls studying home economics. However it is believed that the criticisms and suggestions are equally applicable to boys.

Professor F. F. Good, of Columbia University, says: "There is a great demand at the present time for the teaching of real things in the high school. The whole education machine, in recent years has fallen under criticism from within and from without: and in almost every branch of the course we have witnessed a very commendable effort to readjust the the work of the public school to meet the needs of every day living. This humanizing movement, as it is related to the physics course is an attempt to make physics more practical, more real,—I dare say more popular with the average student and indeed more profitable. The high school physics of the future is to be a course for the many and not for the few. It is not to be a preparation for a specific kind of advanced physics but it is to be an educational unit, complete in itself."

HOUSEHOLD PHYSICS AND SOCIAL SERVICE

The Meaning of Household Physics. The subject Household Physics and Social Service may be interpreted to mean the adaptation of a course of physics to the needs of students who expect to lead a life of so-called social service as distinguished from those who are preparing for some scientific or technological vocation, or from those who may be merely making an attempt to pass some examination. Social service in its broad sense would include the work of every one who is helping not only to make a better living but to make living better. Any subject that deals directly with home life should and does command the respect and interest of thoughtful people. The term social service as here used refers not so much to the professional services of men and women, but to those who are destined to spend their lives in the home.

Physics Teaching Results are Unsatisfactory. Many teachers of physics are beginning to realize the fact that our courses in physics should undergo some radical changes both in content of subject matter and in the method of presentation. The results attained in teaching the very formal and highly organized courses in the elements of physics have been generally disappointing. The failure to get good results is perhaps due to a number of causes, some of which I shall mention and at the same time offer some suggestions for improvement. President Hall says: "The chief among many reasons all branches of science are so disappointing to their promoters in high school and college is, that the **exact logical, technical** way, they are taught violates the basal law of psychic growth, ignores the deep springs of natural interest, and attempts to force a precocity against which the instincts of the young, so much wiser truer and older than their consciousness, happily revolt."

The High School-College-Preparatory Physics. Regarding the physics teaching in many high schools, Dr. Woodhul, of Columbia University, has this to say: "We are told that the high school-college-preparatory course in physics, for instance, with its two hundred odd topics, is serious science, that it is highly specialized and that it is preparatory to still more serious science hereafter. My opinion is that it is a disjointed skeleton of falsely called 'fundamental principles'; that it is not science and does not prepare for science; that it is not specialized at all but is a hodgepodge of stuff never met with by intelligent people in real life." The details of these courses are dictated by colleges and university entrance requirements. These requirements often vary greatly from the inclinations and needs of students. The physics needed in social service is not the kind required for college entrance.

Physics Textbooks. Many of our textbooks in elementary physics have been composed by men who have had the idea of training the student for entrance to some college, and also from the viewpoint of the trained scientist rather than from that of the life interests of the student. The organization of many of these courses is made around these textbooks. There seems to be little connection between the work of the laboratory and the work of the world. The subject matter often deals with far-fetched topics, and the rigid logical arrangement and treatment is not the psychological order by which the normal mind learns physical science. It seems that the only successful physics teaching now being done is that which is built **on** and **in** the life experiences and interests of the student, but these textbooks often begin by presenting a lot of abstract principles, formulas and laws. At the end of the chapter or book the author places a few practical questions and applications. The student is expected to "tank up" on a mass of abstractions, and, when "thoroughly learned," are to be applied at some future date. Modern psychology teaches that all good thinking begins and ends in the concrete, and that for a thing to be concrete its useful purpose must be apparent. If this is sound doctrine, the useful appliances and practical questions should be placed at the beginning, not as they now occur, at the end. We sometimes hear it said that "one can not apply that which he does not know." The reverse of this statement is perhaps nearer the truth, namely: that which we **know** first made its appearance in the **application.** In nature, physical principles and appliances are not found separated. The separation occurs only in the textbook. I have tried teaching some of these books in various ways, and find that better results come when the books are used backwards, that is, by beginning at the end of the chapter where the concrete questions and appliances are located, making them the basis of study. As physical principles make their appearance to the mind in and through appliances, it seems that a direct study of these applications is a good method of procedure.

Information Massed and Left in a Heap. Professor Dewey says: "Adults have some occupation about which their thinking is organized; information is not massed and left in a heap. Inferences are made not from purely speculative motives, but because they bear on some of life's problems." Most of the useful elementary physics is learned out of school. Some schools have denatured the subject.

Much of this school room physics succeeds better in developing the subject than in developing the student. The process of learning in and out of the school should not differ. The bare, and to the student, meaningless formulas and other abstractions that confront the beginner serve only to discourage and disgust the young mind. Much of this subject matter is organized around the teacher or a textbook instead of the life interests of the student. The beginning student is interested in **things** not abstractions. If a proper study of these things is made, the laws will take care of themselves. Dr. Dewey says: "If we do not master things, they will master us." The best grade of thinking as well as social service requires a working knowledge of the commonly used appliances.

The Method of the Masters of Physical Science. In reading the biographies of the great masters of physical science it is interesting to note that practically all of them devoted their time to the study of real problems and appliances. Very few of them, if any, received their early training in anything like our modern conventional physics course. Such men as Newton, Maxwell, Cavendish, Rumford, Faraday and many others learned the elements of physics by working on concrete problems and practical appliances. Pestallozzi's whole teaching was in direct opposition to the prevailing methods of physics teaching. He says: "When men rush into the labyrinth of words, formulas and opinions without having gained a progressive knowledge of the realities of life, their minds dwell on this one basis and can have no other source of strength." The usefulness of such a man as Thomas Edison might have been lost to the world if, when a child, he had been so unfortunate as to have been placed in some high school or college physics course. Some of these courses are powerful enough to smother the genius of even an Edison.

"Scholarship for the Sake of Scholarship." Too much of our school work partakes of the nature of trying to determine "how many angels can dance on the point of a needle." Thousands of boys and girls are spending much time in hairspliting and painfully accurate measurements of things far removed from their life interests in the vain belief that they are cultivating that something called "scientific spirit," and they are straining their minds trying to memorize a mass of laws and principles under the delusion that they are cultivating a profundity of knowledge which will increase their scholarship. Professor McMurry, in his book entitled "How to Study," says, "There is nothing less profitable than scholarship for the mere sake of scholarship, nor any thing more wearisome in the attainment. But the moment you have a definite aim, attention is quickened, the mother of memory, and all that you acquire groups and arranges itself in an order that is lucid, because everywhere and always it is an intelligent relation to a central object of constant and growing interest."

"Science for the Sake of Science." Again Professor McMurry says: "Should a student be a collector of facts at large, endeavoring to develop an interest in whatever is true, simply because it is true? Should he be unmindful of particular problems? Or should his study be under the guidance of a specific purpose? Much has been said in times past about art for art's sake, science for the sake of science and knowledge for the sake of knowledge, but these are vague expressions that will excite little interest so long as the worth of a man is determined by what comes out of him, by the service he renders, rather than by what enters in. If students regularly occupy a portion of their study time in thinking out live questions that they hope to have answered by their further study, and interesting uses that they intend to make of their knowledge, they are equipping themselves with active power both for study and the broader work of life. Indeed the reason why self-trained men so often surpass men who are trained by others in effectiveness and success of their reading, is that they know what they read and study, and have definite aims and wishes in all their dealings with books."

National Education Association Recommendations. A committee of the National Education Association formulated some fundamental principles as a basic guide for teachers of physics. They are as follows:

1. The fundamental purpose of all teaching of science in all grades of schools is to foster the development of the true scientific spirit.
2. Since all children are endowed by nature with the elements of the scientific spirit, the purpose of science teaching is accomplished most successfully when the science classes merely furnish the environment in which the scientific spirit can grow from the crude and instinctive childish form into a more finished and logical adult form.
3. The scientific spirit is characterized by three equally important elements; namely, (1) A desire to understand more fully the meaning and use of **things,** leading to the definition of problems concerning the meaning and uses of things. (2) A firm faith that the solution of these problems is worth while and possible. (3) A method of think-

ing that leads to the most expedient and useful conclusions. A science teaching that fails to recognize in practice all three of these elements is necessarily defective.

Household Physics Text Books. A number of colleges and universities are now teaching courses in household physics for girls. These courses are closely correlated with the work of domestic economy. I know of only three text books on household physics, one by Carlton John Lynde, Ph. D., Professor of Physics in Macdonald College, Canada, published by Macmillan company; one by Alfred M. Butler, published by Whitcomb & Barrows, Boston, Mass., and one by C. H. Brechner, published by Allyn and Bacon. Professor F. F. Good, of the Physics Department, Teachers College, Columbia University, has about completed the manuscript for a laboratory manual to be entitled Laboratory Projects in Physics, for use in high schools and normal schools. This manual includes laboratory directions for the topics listed below, and is to be published this spring (1920) by Macmillan Company.

A "Practical Physics Manual," by Ahrens, Harley and Burns, physics instructors in the Chicago High Schools, has recently been published. A paragraph in the preface, referring to a group of experiments called "Household Physics," reads as follows: "In the selection of the 'applications,' the authors have recognized the divergent interests of boys and girls. To the former, engineering problems have a fascination; to the latter, fundamental experiments are interesting, generally speaking, only so far as they serve to explain household applications. We feel no responsibility for presenting proof of the differences between boys and girls as regards their interest in topics from physics, our duty being rather to recognize these differences as already established and to provide experiments suited to these diverse needs. In the undertaking, we recognize the fact that we are pioneers, subject to the mistakes in judgment of pioneers in any new field. Of one thing we are certain, the field lies where we have traveled. Whether the path we have traveled will become well-worn remains to be seen; the route, however, has been carefully, and we believe, wisely chosen."

Topics Suitable for Study. The following topics are suggested as being suitable for the class and laboratory work of girls who are educating themselves for social service. This is not offered as a perfected list, but it is intended to show something of the content of a course in Household Physics:

1. The Kitchen Hot Water Tank
2. Steam Heating Systems
3. How to Measure Heat of Condensation of Steam.
4. How to Measure Heat of Fusion of Ice
5. Conduction of Heat in Cooking Utensils
6. How to Charge, Keep, and use Fire Extinguishers
7. How to Measure the Heat of Combustion of Gas
8. How to Measure the Efficiency of a Saucepan
9. The Structure and Use of the Pressure Cooker
10. How to Measure the Efficiency of the Fireless Cooker, Refrigerator, and Thermos Bottle
11. Water Heater Efficiency
12. Water, Gas, and Electric Meters
13. Valve-action of Exhaust and Condensing Pumps
14. The Mechanism of a Clock

15. How to Measure Fluid Pressure
16. The Structure and Use of a Hydrometer
17. Efficiency of Pulleys and How to Use Them
18. Levers, and How to Use Them
19. Sewing Machines
20. The Automobile, How to Care for It and Use It
21. Illumination and Lighting
22. Formation of Images
23. The Pressure Tank Water System
24. Analysis of Sunlight
25. Color Combinations
26. The Structure and Use of the Microscope
27. The Projection Lantern and Motion Pictures
28. The Thermometer
29. The Vacuum Cleaner
30. Relative Cost of Electric and Gas Heat
31. How to Control an Electric Current
32. Electric Lighting System
33. How to Measure Electricity
34. Liquid, Dry and Storage Cells
35. Electro-Plating
36. Electric Stoves
37. Electric Immersion Heater
38. Electric Iron
39. Aluminum and Soapstone Griddles
40. Dynamo and Utility Motor
41. Electro-Magnetic Appliances
42. The Telephone
43. The Phonograph

Other useful laboratory exercises should be added to this list by consulting the wishes, purposes and life experiences of the students themselves. No attempt has been made to arrange the items of the above list in logical order. It is simply a suggestive list of topics. All students, even of the same class, should not be required to do the same experiments. Within certain limits and when practicable, each student should be allowed to choose her own experiments. She will then enter upon her work with a personal interest and a definite purpose, elements so essential to success in any field of endeavor.

Results to be Attained. A proper study of such things and appliances will funrnish a natural avenue through which the mind may acquire a knowledge of the laws and principles of physics, after which an orderly and logical arrangement of facts and relations may be made. It will bring about in the student (1) "motivation, (2) initiative and original thinking, (3) training in ability to recognize relative values, (4) organization of material." This method will not permit of so much "ground being covered," but as Professor Dewey says in his "Democracy of Education," "The chronological method which begins with the experience of the learner and develops from that the proper modes of scientific treatment is often called the psychological method in distinction from the logical method of the expert or specialist. The apparent loss of time involved is more than made up for by the superior understanding and vital interest secured. Moreover by following, in connection with problems selected from the material of ordinary acquaintance, **the methods by which scientific men have reached their perfected knowledge,** gains independent power to deal with material within his range, and avoids the mental confusion and intellectual distaste attendant upon studying matter whose meaning is only symbolic. Since the mass of pupils are never going to become scientific specialists, it is much more important that they should get some insight into what scientific method means than that they should copy at long range and second hand the results which scientific men have reached. Students will not go so far, perhaps, but they will be sure and intelligent as far as they do go. And it is safe to say that the few who do go on to be scientific experts will have a better preparation than if they had been swamped with a large mass of purely technical and symbolically stated information. In fact, those who do become successful men of science are those who by their own power manage to avoid the pitfalls of a **scholastic introduction into it.**"

Again Professor Dewey says: "Aside from the fact that active occupations represent things to do, not studies, their educational significance consists in the fact that they may typify social situations. Men's fundamental concerns center about food, shelter, clothing, household furnishings, and appliances connected with production, exchange, and consumption. Representing both the necessities of life and the adornments with which the necessities have been clothed, they tap instincts at a deep level; they are saturated with facts and principles having a social quality."

The charge that knowledge of practical things has merely a bread and butter value is false. The ancient idea that "cultural value" is to be found only in certain scholastic subjects has been exploded by a modern enlightenment.

The young woman who is gaining a useful knowledge of household appliances feels that her work is worth while. This definite and worthy purpose will impel her mind to a more thorough organization of facts and relations, and will enable her to make an intelligent interpretation of her daily environment, resulting in a better knowledge of physical principles and a better social service.

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