

and the auxiliary wheel O. Sufficient weight is placed in U to balance the weight of the car and its load on the opposite side, thus eliminating all possibility of vibration. The motor is again started. The two circumferences L' L'' are shown to represent the paths that the car may be made to revolve in. Indicator M, which is also supported by the upright K, is marked L' and L'' and represents 15 cm. and 30 cm. respectively, when they coincide with J of the dynamometer D. In order that this may be so, as the centrifugal force increases, the dynamometer must be elevated, for which the crank C is provided. The centrifugal force is registered on the dynamometer when the radius mark (L', for instance) coincides with J.

Therefore this experiment shows that the formula for centrifugal force, $F = \frac{M(VV)}{GR}$, may be verified as follows:

The centrifugal force varies *directly* as the *mass*, when the *radius* and *velocity* are constant. Shown by readings 2 and 5:

2 $M=1.135$ kg. $V=282.75$ cm. $R=15$ cm. $F=6.27$ kg.

5 $M=.567$ kg. $V=282.75$ cm. $R=15$ cm. $F=3$ kg.

The centrifugal force varies as the *square* of the *velocity*, when the *mass* and *radius* are constant. Shown by readings 2 and 4:

2 $M=1.135$ kg. $V=282.75$ cm. $R=15$ cm. $F=6.27$ kg.

4 $M=1.135$ kg. $V=141.35$ cm. $R=15$ cm. $F=1.69$ kg.

The centrifugal force varies *inversely* as the *radius*, when the *mass* and *velocity* are constant. Shown by readings 2 and 3:

2 $M=1.135$ kg. $V=282.75$ cm. $R=15$ cm. $F=6.27$ kg.

3 $M=1.135$ kg. $V=282.75$ cm. $R=30$ cm. $F=2.85$ kg.

GENERAL SCIENCE.

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Science teachers of the high schools have been endeavoring for some time to plan a graded course in science. They have claimed quite naturally that the pupil should have the easier science first, to be followed by the more difficult sciences, just as the easier branches of mathematics come first. The earlier result of their attempts was to have physical geography the first year, botany or zoölogy the second year, chemistry the third, and physics the last year of high school. It was then apparent that

physical geography required a little of all the other high school sciences, as well as bringing into the course other sciences not usually taught in high schools.

The divisions into which science has fallen are natural and therefore helpful to the advanced student. The reasons which underlie the sequence of their occurrence in a high school curriculum, however, often are not so pedagogical as imitative. Physical geography certainly requires as much scientific imagination—the highest result of education—as does physics. Then, also, fully one half of each of the so-called physical geographies is devoted to astronomy, meteorology, physics, chemistry, botany and commercial geography, all of which are good, but should not be considered strictly physical geography.

After physical geography had been tried, general science was proposed as an introduction to all of the sciences, including physical geography. The question which arose at once was—What is general science? For two years, at least, science teachers have been trying to answer this question as well as giving courses no two of which are at all alike. No solution which satisfies the majority has been reached, but all are agreed on one point. General science must not be specialized in any particular science. The sub-questions are: Should the elements of science be taught? In what order should the different sciences come in the course? Should there be experiments in all of the sciences? Could such a course be given in one year? Should science or scientific method be taught? What is meant by an introduction to science? What is the true object of such a course? What ought to be the plan of such a course?

Science has earned for itself, or has had thrust upon it, in the high school, a very bad reputation, at least in the minds of the pupils. The chief aim of a course in general science should be to remove this impression, right or wrong, and to arouse the scientific curiosity of the pupil, stimulating his ambition to continue deeper and deeper into the study of science. If this object is not attained, the course has fallen short of its mark. It must be remembered that the teacher is dealing with the immature minds of the grammar school graduate, not the minds of the more developed high school graduate. Classifications, pigeon-holing corresponding acquisitions of specialized information according to psychological pedagogy, do not appeal to such a pupil as they may if he continues long in a highly specialized inhuman science. The pupil wants to know about what affects

himself. Tell him why he is hungry, why warm or cold, why he breathes; tell him what he sees, hears, feels, and make him want to appreciate more fully his own latent possibilities. In short, awaken him. Do not deaden him.

The youth of to-day has so much to learn about his own body, about his close surroundings, his fellows, in fact, about his highly organized life, that it is a pity to overlook these obvious calls for learning in order to develop properly the pedagogical sequence of scientific method. The final results are what show the success of a line of action. What can the orthodox scientists show in regard to the interest in, and eagerness for, high school science, as shown by the pupils? Yet science is the most interesting subject imaginable, has the greatest amount of possibilities of direct learning, applications and immediate results, and, in truth, is the only subject which can be vibrant with life, for it is—Nature. Why, then, is the study of science so detested in the high school? It is because the subject is divided into sections, many of which do not, and never will, touch the lives of the pupils.

The course which constantly has in view the teachings concerning the self, at first the smaller self, and later the larger self, will succeed in its object—it will make the pupils want to know. It makes no difference how this object is accomplished. One successful teacher will do it one way, another through a different method. The final results are the test. If after a year's course the pupils really wish to continue in science, then, and only then, do we know that the course in general science has been a success.

If we attempt to teach the elements of every science we shall fail on account of the impossibility of such a course. The order of the subject-matter should be such that it will fall naturally into ever-widening circles, leading farther and farther from the central self. If the course can be strengthened by experiments they should be performed, partly by the teacher and partly by the pupils. The experiments should be simple, with very simple apparatus. The scientific method, which should be encouraged, is a desire for more exact knowledge. What else could be required which would accomplish so much toward true education, scientific or non-scientific? General science has ahead of it a glorious success, full of wonderful possibilities. Scientific classifications and mathematics have characterized the other sciences. Let general science be general and free from mathematics, teaching about the "Larger Selfishness."