

very nearly that of diamond makes it a still more dangerous imitator, but its hardness of 8 and its double refraction serve to distinguish it.

The other colorless gems in my list, phenacite, beryl, and rock crystal very closely resemble each other and all give brilliant stones when properly cut. The phenacite and beryl are but slightly softer than topaz and would wear well. The rock crystal is the softest in my list, and while it will hold its brilliancy for some time it would dull in the course of a few years or even months if subjected to hard wear as a ring stone.

Aside from the peculiar interest which attaches to these colorless stones from the fact that they may be and doubtless many times in the past have been substituted for diamond either ignorantly or with purpose to deceive, there is, I believe, a worthy interest in them for what they really are and for the real beauty which they undoubtedly possess.

When men shall have learned to practice honesty as the best policy, it is to be hoped that these gems, which do truly somewhat resemble the diamond, but which resemble each other more, may come into their own and be appreciated and valued for their own beautiful qualities.

AN EXPERIMENT IN THE TEACHING OF PHYSICS.

BY H. C. KRENERICK,

North Division High School, Milwaukee, Wis.

The general tone or expression of physics teachers' meetings throughout the country for the past few years has been such as would give to an outsider the impression that the teaching of physics in high school is a failure. Although not at all in sympathy with this wholesale criticism yet I am not so optimistic that there is no room for improvement.

The experiment of segregation has undoubtedly many arguments in its favor, but whether or not it is doing the greatest good for the greatest number is the question. From my experience with girls and boys I cannot feel that it is the best solution. About one third of my classes are girls. Last semester the average of the girl's standing was five points above that of the boys and it was not entirely the result of better effort and memory. The best fifty per cent of the girls are equal in every way to the best fifty per cent of the boys. Many girls are good in mathematics, they are interested in the quantitative and technical por-

tions of physics. Many boys are not. To deprive such girls of that phase of physics is an injustice.

The most marked and distinctive basis of classification of our physics pupils is not according to sex but according to mental aptitudes. The best high school pupils can be divided largely into two classes: those whose method of study involves logic, reason, understanding; and those who depend principally upon a retentive memory. The present method of adapting the subject-matter of physics to the so-called average student is an injustice to both of these classes.

To that class of students who are not scientifically or mathematically inclined, the returns from the technical and quantitative portions of the subject are not commensurate with the time and effort. They are nevertheless just as interested in and capable of comprehending the general information of the subject, but the lack of perfect understanding tends toward discouragement and dissatisfaction. With the other class the injustice is even greater. They are held back, their time to some degree wasted. The inability and constant drill of the others tends to encourage laziness rather than bring out their best efforts and possibilities.

If such an analysis of the situation is correct the solution of the difficulties can be obtained by dividing the subject-matter and presenting as two different courses which I shall call, for lack of better terms, elementary and advance. An experiment which I have wished to try for several years but was not able before to obtain permission. The first semester of next year we will offer the elementary course which will present in a qualitative way the more essential and practical principles of physics with special emphasis on applications. The laboratory exercises will be of the nature of diagrams and explanations of home, school, and city appliances rather than the verification of laws and principles. The second semester will be the advance course which will cover the more difficult, quantitative, and technical portions of the subject. Class room discussion to correlate with the laboratory work, which will cover about forty of the usual type largely quantitative experiments.

Credit toward graduation will be given for the elementary course whether or not the advance course is taken. (Students expecting to receive credit for physics in college or university will need to elect both courses.) Such a division of the subject-matter with the privilege of electing one or both courses will largely eliminate the injustices mentioned above. The elementary

course will be interesting, comprehensive, and instructive to all, while the advance course with the backward students eliminated, will be presented in a more strenuous and intensive manner with far greater results to pupils. Students are better able to comprehend the difficult parts after a survey of the elements of the subject. Some students will have had a semester more of mathematics thus better prepared for the quantitative parts of physics.

The nature of the laboratory work in connection with the elementary course is a decided change from the ordinary. The following is a list, with a word or two in explanation, of the experiments or exercises which are to be performed at home or outside of the regular class period:

BAROMETER.—Barometric curve. Relation of curve to the weather changes.

RELATIVE HUMIDITY.—Determined in school. In home, living room and kitchen. In open air.

SCHOOL VENTILATION.—Determine volume of fresh air per pupil per hour. Also space per pupil. Compare with state requirements.

HOME VENTILATION.—Determine volume of fresh air per person per hour in living room. (A gas or oil light equal to two persons.)

PUMPS.—Cross-section diagram with explanation of valve action.

HYDRAULIC RAM.—Diagram of model with explanation of action.

HOME PLUMBING SYSTEM.—Diagram showing connection of all hot and cold water pipes in home.

GAS METER.—Diagram and reading each week for month. Cost of gas per week per person.

COOK STOVE.—Cross-section diagram. Purpose and manipulation of dampers.

HOME HEATING SYSTEM.—Diagram and explanation. Control and action of dampers. Proper manipulation of furnace.

HOT WATER TANK.—Diagram and explanation.

SCHOOL HEATING SYSTEM.—Diagrams and explanation of furnace, boiler, and radiators for one room for each floor.

SCHOOL VENTILATING SYSTEM.—Diagram with full explanation.

EFFICIENCY OF GAS STOVE.—Compare B. T. units obtained in kettle to the units in gas consumed. Compare kettles of different material. Compare different burners.

CITY WATER SYSTEM.—Suitable diagrams with explanation.

SCHOOL THERMOSTAT.—Diagrams and explanation for control of one room.

DOOR BELLS.—Diagram of wiring, front and rear door connections. Explanation of bell.

TELEGRAPH.—Diagram and explanation of system in laboratory.

EFFICIENCY OF ELECTRIC HEATER.—Compare B. T. units obtained in vessel with the units consumed. (1055 watts = 1 B. T. U. per second.) Compare in efficiency and economy with gas burner.

COST OF HOME LIGHTS.—From candle power and meter determine cost per candle power per hour. Repeat with gas light. Compare.

Several of the above exercises have been assigned and performed by the students during the present year. The unusual interest aroused not only in students but in parents as well in such investigations has been exceedingly gratifying. The ignorance displayed by some of the best students of the working principles of some of the most common home appliances is convincing that it is a much-needed phase of physics instruction. With such a course the assignments can be varied to suit the need and ability of the individual student; an adaptation highly desired but almost impossible in the large schools under present methods. One of the most serious defects in our present laboratory treatment of physics is our inability to have the laboratory exercise correlate with the class room discussion. Unless there is that perfect correlation the laboratory day is bound to be a break or diversion in the class room treatment of the subject-matter. The experiments or problems as planned above will cause no interruption in the elementary course. While in the advance, which is more of the nature of a laboratory course, the class room discussion will be adjusted to the experiments of the laboratory. Here the experiment will precede the recitation; an ideal order, which is impractical in many instances under present methods. With the general information gained in the elementary course the student is now able to proceed with more independence in his laboratory work.

One of the criticisms of such a division of the subject will be that the treatment will need to be too superficial if the entire subject is to be covered in one semester. By eliminating some

of the quantitative parts which receive an undue portion of time and drill and remembering that the laboratory work takes about one third of the time devoted to the subject we will find that there is ample time in one semester for the subject-matter remaining to receive just as intensive consideration as at present. Furthermore, high school physics is not a complete treatise of the subject and no two persons are agreed as to just what should be eliminated. If we were to take only that subject-matter which we find common to the recent high school text-books, one semester uninterrupted by laboratory days, would be sufficient time for its consideration.

About seventy-five per cent of all of our students graduating have had physics. This we believe is a good showing for a subject that is required in only one course. By the method of division we believe that this percentage will be increased. Many students who do not now elect physics because of its reputation of being mathematical and difficult will be attracted to this one semester popular treatment of the subject. Once interested more will elect the second course. No other science or subject of the high school offers subject-matter so closely related to everyday life and affairs, consequently the essentials, at least, of the subject should be presented in such a manner that the course could be unhesitatingly recommended and urged, if not required, of every boy and girl before graduating from high school.

PORTLAND CEMENT IN THE PHILIPPINES.

At the present time there is no Portland cement manufactured in the Philippines. Consequently concrete work is expensive. It is understood, however, that if the raw materials, fuel, etc., can be secured in locations favorable for transportation, that two or three mills will soon be erected.

BY-PRODUCTS OF COAL.

From one ton of ordinary gas coal may be produced 1,500 lbs. of coke, 20 gallons of ammonia water and 140 lbs. of coal tar. By distillation the coal tar will yield 69.6 lbs. of pitch, 17 lbs. of creosote, 14 lbs. of heavy oils, 9.5 lbs. of naphtha yellow, 6.3 lbs. of naphthaline, 4.75 lbs. naphthol, 2.25 lbs. alazarin, 2.4 lbs. solvent naphtha, 1.5 lbs. phenol, 1.2 lbs. aurine, 1.1 lbs. benzine, 1.1 lbs. aniline, 0.77 lb. toluidine, 0.46 lb. of anthracite and 0.9 lb. of toluene. From the latter is obtained the substance known as saccharine, which is 230 times as sweet as the best cane sugar.