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SCIENCE BULLETIN

A Service Bulletin for Teachers of High School Science. Published Monthly by the Extension Division and Edited by the Departments of Natural and Physical Science.

IOWA STATE TEACHERS COLLEGE

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HIGHWAY SIGNS IN SCIENCE TEACHING

General Science

Let me assume that the General Science teachers of the state have been well prepared for their work and that at the present time they are more or less efficient teachers. Still there is the ever present task of keeping up with the curricular and learning studies that are going on in the field of General Science. New texts are appearing yearly, new studies on content and methods seem to be on the increase and it takes rather nimble stepping on the part of the teacher to keep pace.

After all, it is not an impossible undertaking for the General Science teacher to keep up-to-date and I am making a few suggestions here with the hope that you will adopt them as a whole or in part, as a start on the problem of keeping yourself generally informed in your field.

First. Keep yourself informed on recent books and articles in periodicals that deal with General Science. Write to the U. S. Department of the Interior for Bureau of Education Bulletin No. 13, (1925), price twenty cents. This is at present the most complete bibliography of all articles and materials relating to science teaching in our secondary schools. When you receive this you can select the articles for study which have a bearing on General Science and which appear in the periodicals your school subscribes for or that you yourself have. While you are waiting for this bulletin, borrow from your Superintendent the "Superintendents' Fifth Year Book", which has a thirty page report on "Junior High School Science". This report reviews 27 of the recent research studies in the field of General Science besides giving seven illustrative units of work in the Junior High School sciences from as many school systems. This Year Book may be purchased from The Department of Superintendence, 1201-16th N.W., Washington, D. C., for $2.00. Elliot Downing's book, "Teaching Science in the Schools", 1925, now published by Longmans, Green & Co., New York, price $2.00, offers an excellent discussion in chapter eight, of the various competing laboratory methods. J. O. Frank's book, "How to Teach General Science" ought to provoke some thought. Read "A Digest of Investigations of the Teaching of Science in the Elementary and Secondary Schools" by Francis D. Curtis, published by P. Blakiston's at Philadelphia.

Second. Study your own methods of teaching and try constantly to improve them. Ask yourself these questions: Am I keeping in mind the objectives set up for the course in General Science? Am I selecting subject matter that develops these objectives? Am I organizing the subject matter in such form that the method of study gives proper training in desirable attitudes, ideals, habits and skills? Does the subject matter selected give knowledge that has a positive value in the life of the pupil? What am I doing to improve my method of instruction? (Read Downing's "Teaching Science in the Schools", pages 113-142.) Do you attempt to formulate at the beginning of the teaching of each new unit the fundamental attainments you expect from the students? Do you use your tests as a basis for remedial work with pupils? What are you doing to improve your technique of instruction? Good references for building tests will be found in Ruch's "Improvement of the Written Examination", published by Scott, Foresman and Company, and Ruchs & Stoddard, "Tests and Measurements in High School Testing" published by The World Book Co.

Third. Join the Iowa State Teachers Association and attend the General Science sections of the state and sectional meetings. Let the leaders of these meetings know in advance what type of work you wish discussed, and contribute whenever possible to these meetings. Get acquainted with leaders of General Science in your section and talk over your problems.

Fourth. Visit classes in higher institutions as well as classes in secondary schools that offer work similar to yours. Study their methods, texts and courses of study. Then carry home with you and use any good ideas gleaned from your visit.

Fifth. Go back to college as often as possible. Keep your mind open to the changes in the field of General Science and come to accept them as a basis for adjustment and guidance.

Under the supervision of the State Department of Public Instruction a committee is now working on a Course of Study for General Science for the Secondary Schools. The formulation of such a course for the adolescent youth is a difficult task but it is the hope of the committee that the course will attain its aims, that the subject matter selected will appeal to the pupils, that the training and knowledge involved will be usable and worth while, that the content will be organized for teaching situations and that the suggested methods of presentation will conform to the best modern practices. When this course is placed in the hands of all of the teachers it should be valuable in unifying the work of General Science in the state.

WINIFRED GILBERT

A correspondent reminds us that some teachers of science leave the impression in the class that our present knowledge of science was given to the world ready made or grew out of the presses that printed the text. The moral is obvious: don't neglect the historical phases of your subject. In a future issue we will list "anniversaries in science" with references that can be found in the average high school library.

WHAT ARE WE TEACHING IN BIOLOGY?

Biology

This subject in order to be of real value must be an actual study of plants and animals. I have observed in my teaching that pupils, when given recognition characters of trees, may be able to pass a satisfactory examination on these characters, but fail to recognize the trees they describe when they see them in the field. They have simply memorized words that mean nothing to them. Children have a natural interest in the living world, but they often lose it before they finish high school. We begin by teaching from books early in the grades and continue this through the high school, so that by the time the pupils reach the college, they are saturated with textbook knowledge. The story is told of the learned men who had the perplexing question to answer, "How many teeth has a horse?" They debated the question at length. They consulted the writings of Plato, Aristotle, and other great scholars, but failed to find the answer. At last, they concluded that the question could not be answered. A young man who had been listening to the discussion timidly suggested that they might be able to answer the question if they would look in the mouth of a horse. I find that many college students try to answer all questions as did the learned men. They believe that all worth-while knowledge is contained within the covers of a book, yet round about them lies a world full of interest if they but knew how to study it. We fail to teach our boys and girls how to observe and how to draw conclusions from their observations.

One of the principal values of biology in high school is the opportunity it offers for the study of concrete materials. The only way to know birds is to study them in the field. The only way to become acquainted with trees is by observing trees. Textbooks are useful for reference, but the pupil should be led to draw his conclusions from observations of concrete material. He should be conscious that he is studying a plant or an animal rather than five pages of a textbook or the "fifth exercise". There is an abundance of material for the study of living things and no elaborate laboratory equipment is necessary. However, unless the teacher really knows his out-of-doors, his biology teaching must degenerate into mere textbook memory work.

I would prefer that the student who enters college should have some knowledge of the out-door world and the ability to draw conclusions from his observations than that he should be able to pass a superior examination on a biology textbook. This type of interest and knowledge is a most valuable training for life and is far superior to knowledge gained from a textbook. Are we teaching living plants and animals or are we teaching textbooks?

C. W. LANTZ

LABORATORY EQUIPMENT AND EXPERIMENTS FOR DETERMINATIONS OF DENSITY

Physics

Laboratory experiments in Density require the following apparatus: beam balances, meter sticks, graduates, calipers, tumblers, test tubes, and hydrometers. There should be as many of each as possible in order to reduce the amount of group work. The objects for study should include pieces of lead, zinc, marble, paraffin, beeswax, glass stoppers, shot, gasoline and solutions of salts such as blue vitriol. The solids listed above should not exceed one cubic inch in volume if tumblers are used for liquid immersion.

Before beginning the laboratory work, it is advisable to have the pupil perform a few preliminary exercises which can give him practice in the metric units of measurement. At this college, the first exercise is the measurement of the length and breadth of one of the laboratory tables, using the meter stick. The dimensions are first measured in centimeters and then in inches and ratios of the breadth to the length then computed in each case. The ratios obtained by the class should be approximately equal, depending upon the accuracy of the work. A second exercise calls for the volume of a tumbler, measured with a graduate and also by the method of weighing. This gives the pupil practice with the beam balance and the metric units of weight and volume.

Having done this preliminary work, the pupil is now ready to begin his study of density. Logically, the first problem should be a test of the validity of the buoyancy idea of Archimedes' Principle. For this we have always used short solid brass cylinders about three centimeters long and one centimeter in diameter, which can readily be cut from brass rods found in a plumber's shop. The dimensions of the cylinder are measured accurately by means of calipers and the volume calculated. After this is done the cylinder is weighed in air and again immersed in water. The difference between these weights completes the data for the problem.

Following the problem on Archimedes' Principle, it is customary to begin the actual work in density determinations by the use of some regular solid. Rectangular blocks of hard wood, as hard maple, with accurately mitred edges serve excellently. The length of the blocks should be about five centimeters, with breadth and thickness varying from two to three centimeters.

The laboratory problems should cover density determinations of insoluble solids heavier than water, and lighter than water; also of common liquids, like gasoline and salt solutions, using the bottle and constant volume methods. Test tubes with fine shot can be used for the constant volume method. If time permits, the brighter students may be assigned a problem in the density of a solid soluble in water, such as crystal of blue vitriol, using gasoline for immersion. They may also make a rough determination of the density of the air in the room.

All problems mentioned above are described in current laboratory manuals for high school physics. All of the laboratory problems used in this college for student practice are outlined in a mimeographed pamphlet which is sold at twenty-five cents, the actual cost of printing. Readers can secure copies at this price through the Editor of the Science Bulletin. We prefer to use regular laboratory manuals for refernce only.

L. BEGEMAN

SCIENCE BULLETIN

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EDITORIALLY SPEAKING

We greatly appreciate the friendly comments on the first issue of the SCIENCE BULLETIN from our readers; and we have tried to answer your questions. In these first issues we are of necessity "feeling our way in the dark". You only, friendly reader, can give us light. This Bulletin can become increasingly efficient if you will write NOW and tell us: what kind of articles you need; what part of the contents you consider nonessential and what especially helpful; what ideas or methods of your own have proved valuable; what problems we can help you to solve; in short, wherein we are failing or succeeding in helping you personally. Address all correspondence to the editor.

Our staff is cooperating wonderfully. A wealth of material is being contributed. Your helpful letters reach us daily. We wish for you a well-filled stocking and a glorious Holiday vacation. Merry Christmas!

LABORATORY UPKEEP

Chemistry

Proper care of the laboratory is the phase of the high school chemistry teacher's task most apt to be neglected. This and later articles will point out some of the "little things that make perfection".

Bottles of sodium and ammonium hydroxide and of hydrochloric, sulfuric and nitric acids—the acids, both dilute and concentrated—should be placed on the desk shelves, at least one set for every two individual desks. Their labels should be in the glass. Bottles for other solutions and solids can be placed on wall shelves. Their labels should be uniform, with Denison No. 205 for small bottles and No. 201 for large bottles. Use No. 223 for number labels. Print labels neatly in India ink and protect them by painting with melted paraffin or colorless shellac, preferably the latter. To assist the pupil in learning formulas, the writer prefers to print formulas only on bottle labels and hang near the shelves a framed bottle directory, carrying in alphabetical order the entire name and shelf number. File solids and solutions separately. Use bottles uniform in shape and of two sizes, the smaller for the more expensive and the little used chemicals. The bottles should be wiped when they become clouded from fumes. Never place stock bottles in the laboratory because they spoil the uniform appearance of the shelves and their contents are liable to contamination. Do not allow pupils either to remove liquids by introducing a tube into a bottle or to return "left over" chemicals to bottles. Pollution is sure to result. Accustom pupils to holding stoppers between the fingers while using bottles. Rubber, not glass, stoppers are best for alkalies. If a glass stopper sticks, try first gently tapping upward on the projecting under edge. Failing in this, gently heat the neck on all sides with a small Bunsen flame and loosen the stopper before it also becomes heated and expands. A sealed stopper sometimes yields to the same treatment that sealed it, viz., inverting it (in a beaker, for safety) and allowing its contents to penetrate between the sealed surfaces.

R. W. GETCHELL.

HYDROSTATICS

Physics

The teacher may introduce this subject to the class by reference to the meaning of "pressure" as used in mechanics. Explain to them that the gauge pressure in a steam boiler or auto tire refers to the number of pounds pressure on each square inch of inner surface. Sometimes a problem will make it clear. Suppose that an automobile weighs 2400 pounds and that this weight is equally distributed to the four wheels. If the tires were inflated to sixty pounds, how much of the tire surface would continually be in contact with the road? Dividing six hundred pounds or one-fourth of the total weight by 60 gives 10 square inches as the answer.

In most texts on High School Physics, the discussion of the mechanics of liquids is largely limited to the

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STRESS PERTINENT FACTS IN HEALTH TEACHING

Hygiene

In the past, much of the health information which high school pupils acquired was handed down to them traditionally. They listened to what their elders had to say and seldom questioned the validity of it. Assertions to the effect that a buckeye carried in one's pocket would prevent rheumatism; that a piece of salt fat pork bound about the neck would counteract diphtheria; or that some malodorous substances would, if breathed, ward off certain communicable diseases were considered as truths and were passed on to the next generation. Since health is now taught in our high schools by teachers adequately prepared, such traditional material is fast giving way to facts.

The teacher of health topics must know what subject matter to stress and how to present it. She must choose topics for discussion which are pertinent to the health of the pupils if she wishes to arouse and hold their interest.

The relation of health to gas poisoning will serve as an example. Instead of teaching the supposedly terrible effects of carbon dioxide in the air we breathe, the up-to-date teacher should help the pupils to collect information concerning the danger of breathing air contaminated with carbon monoxide. Such a topic would be significant because carbon monoxide is impairing health and even taking a large number of lives each year. The Chicago Tribune (Nov. 4, 1928) stated that deaths from carbon monoxide had averaged one a week in Chicago during the year. Feeling that a warning should be given, the Iowa Health Commissioner devoted the issue of Nov. 21, 1928, of the Weekly Health Message of the Iowa State Department of Health to the consideration of "Carbon Monoxide Poisoning in the Home". A discussion of this topic with the class would now be timely since cold weather means closed doors and windows and poor circulation of air. Such conditions for the next three or four months are certain to increase the mortality and morbidity rates from carbon monoxide poisoning.

Science has found that carbon monoxide is a deadly gas, colorless, odorless, and tasteless,and hence one may be overcome by it before he is aware of its presence. It is the product of the incomplete burning of most fuels, due to insufficient oxygen. Among its common sources are the exhaust from automobiles; heaters, such as certain types used in autos and bathrooms; leaky stoves and furnaces; and gas stoves without flue connections. Danger from this gas can usually be prevented by being sure that burning fuel has enough oxygen for complete combustion and that there is sufficient circulation of air for diluting the gas in closed places where it might be present, as in inclosed cars, garages, and work rooms.

If one inhales air containing several per cent of carbon monoxide the result is acute poisoning and even death. It poisons by combining with the hemoglobin of the red blood cells in the lungs so that they cannot carry oxygen. The individual then suffers from oxygen starvation. Although acute prostration or unconsciousness sometimes appears without warning there are usually certain symptoms of poisoning such as an indefinite feeling of illness accompanied by throbbing of the blood vessels, a burning sensation in the face, a sudden severe headache with dizziness and nervousness, or a feeling of drowsiness. If such symptoms should develop under conditions where carbon monoxide could be a possible cause, the victim should seek fresh air at once. Sometimes the gas is inhaled in very small amounts but over a long period. The person then suffers from chronic poisoning and may have well-defined symptoms of ill health, such as nausea, headaches, palpitation of the heart, dizziness, lack of appetite, anemia, or general fatigue. Changes in the mental state may also occur, as loss of will power, lack of decision, restlessness, irritability, and insomnia. Any person having such disturbances as these should consult his physician. If some one is found apparently suffering from gas poisoning, he should be taken immediately into the open air and artificial respiration administered as for a case of suffocation, until medical help arrives. Do not delay in calling a physician.

The ingenious teacher should not merely lecture to her pupils on this subject. They will benefit more if they help to collect the information. She must not neglect the use of such devices as the following as an aid to interest: Assign the class recent magazine articles on carbon monoxide. Start a clipping file of articles pertaining to it from the local papers. Have oral or written reports on various phases of the subject. Debate the question: Resolved that all exhaust pipes on automobiles should extend to the top and rear of the car. Require the pupils to compile a list of safety-first rules for the prevention of accidents from this gas. Have a demonstration on the administration of first aid for carbon monoxide poisoning.

If high school pupils become really interested in such worth-while health topics as the one given here, they will realize their lack of authentic information on how to maintain or improve their health and should become ardent seekers of knowledge concerning such matters.

BELVA L. SWALWELL

SOMETHING FROM NOTHING

Physics

Matter made while you wait—hydrogen, helium, oxygen, iron or what will you have? No, it has not quite come to this! But the time-honored law of conservation which states that matter is neither destructible nor creatable is no longer accepted as unquestionably and universally true.

The first doubt was cast upon this law about thirty years ago, when it was found that the electrons which constitute the current in a Geissler or Plucker tube do not have a definite and invariable mass. Their mass was found to increase with increasing velocity, and since the velocity of these electrons depends upon the degree of evacuation of the tube and the voltage impressed upon it, this added mass is, within limits, under the control of the experimenter. He can create matter at will.

But it must not be supposed that by speeding up electrons one can create any kind of matter whatsoever or in any amount. Neither real estate nor pocket money can be obtained in this way. It is only the electronic mass that is increased and this to only a small degree. The speeds attainable in the tube are far too small to enable one to augment this mass by more than a few per cent. Electrons emitted spontaneously by radium and other radioactive materials are much swifter, in some cases attaining a speed almost as great as that of light. The swiftest of these electrons have their masses increased by several hundred per cent.

In the swift movement of electrons, then, there is an apparent creation of mass, due merely to the expenditure of energy in producing the motion. But it is not a mass that persists. According to the relativity theory, the increase in the mass of a moving electron is not a creation, but is due to the transformation of an equivalent amount of energy into inert matter, which in turn is reconverted into energy when the electron is stopped. It is now believed that this conversion of matter into energy is possible in other realms, that in fact it is going on continuously and at a stupendous rate in the sun and other stars. The various other hypotheses that have been advanced to account for the energy radiated by these bodies have been abandoned for the reason that the amounts available from the assigned causes are far too small.

If the sun is actually converting some of its own mass into radiant energy, the amount available per second or per day depends only on the rate at which the transformation takes place. According to the theory of relativity, in order to supply from this source alone the amount of energy the sun is known to emit, it would be necessary to convert 4,500,000 tons of its own mass each second into radiant energy. This energy is broadcast to the universe without possibility of the return of more than an infinitesimal fraction. Will not the sun soon be completely dispersed, like a drop of water on a hot stove? No doubt in future ages its mass will be far smaller than now and its temperature much lower. But even at this stupendous rate of loss, the sun will have lost only one per cent of its mass in the next 1,600,000, 000 years.

Notwithstanding the above mentioned transformations of energy into inert matter and the converse, it should be said that for everyday affairs we may still believe as firmly as ever in the validity of the laws of conservation of matter and of energy. The conversion of inert matter into energy or the converse is seen to occur only under conditions outside the experience of the majority of men. As long as we are dealing with objects having moderate masses and temperatures and speeds, we may still consider mass and energy as distinct entities, each indestructible and uncreatable, and we may deal with them in the customary manner.

W. H. KADESCH

FALL AND WINTER MATERIAL IN ANIMAL HUSBANDRY

Agriculture

Swine are now going to market in large numbers. This offers an excellent opportunity to study market types as represented in the herd and compare them with the sows from which they were produced. If brood sows for spring litters have not all been selected, the teacher has some valuable work for pupils in selecting the better prospects from the available groups.

The method of procedure will depend upon the quality of hogs that are available. If a herd can be found in which the farmer has marked the pigs so that litter mates can be recognized, no more valuable work can be found than that of separating the litters and comparing one with another. Usually in such cases a few outstanding litters will be found, as well as one or more that are inferior. This will suggest the desirability of keeping the dams of the best litters for further use in the herd, and will also show the value of marking pigs and keeping records so that we can apply the best of all tests to our breeding stock; ability to produce desirable offspring. This should be followed by a comparison of the dams of the better litters with the dams of the poorer ones, and a discussion of the value of conformation as compared with other factors in the profitable production of pork. Finally, a selection of a number of gilts from the best litters should be made, by a process of eliminating the poorer individuals. This method presents a practical working plan with a motive and is far superior to the mere formal judging of a few head of hogs. It should, of course, have been preceded by a thorough study of desirable types.

In case marked pigs are not available—and this is often true—a different method of procedure must be used, but the same general results should be sought. It would be best to begin with the old sows if any are left on the farm. By so doing we can often find characteristics which have reappeared in their offspring so that when we study the younger pigs, we can select litter mates even though they are not marked. This will be especially true if the old sows present any very great variations in type, and will enable us not only to recognize litter mates, but to obtain a valuable lesson in heredity also.

In many cases we will find that the pigs have not been marked, records have not been kept and, as happens far too often, the old sows have been disposed of without any regard for their breeding value. Even here we can make an attempt to select litter mates, and get a valuable lesson in types while so doing.

Another valuable practice, when hogs nearly ready for market and also breeding stock are found, is to assign grades to the market hogs and then check these classes or grades against the breeding herd. It will be well to place considerable emphasis on market classes, on grades of swine and upon the ability to determine grades, because of the modern tendency to sell by grade. If the formation of county concentration points, using direct sales by grade to the packer, continues to develop, it will be of great value to the farmer to be able correctly to appraise the value if his swine.

After having selected the breeding herd and assigned grades to those which are to go to market, consider next the question of winter quarters for the breeding herd and the requirements involved. If the members of the class are taking work in manual training or farm shop work, valuable practice in both fields can be obtained either by building hog houses for farmers, or by repairing old houses and providing light and ventilation for them.

These studies of type in the breeding herd, of market classes and grades and of housing and equipment provide an excellent basis for the further study of management and feeding questions. This work will be the more valuable because we can apply it directly to the conditions studied in the field.

H. EARL RATH

HYDROSTATICS

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fundamental principles of hydrostatics, with hardly a reference to fluids in motion. Furthermore, the discussion of hydrostatics centers upon three principles, viz., Archimedes' and the two dealing with static pressure. The two latter are: (1) The pressure in a liquid at rest varies directly with the depth and density of the liquid, (2) Any external pressure applied to an enclosed liquid is transmitted undiminished in all directions. It is necessary that the teacher keep clearly in mind these three great concepts and their practical bearing on modern environment. This should lead him to coordinate his lessons in a well-knit project group.

Experience has taught the writer that the average beginning student cannot readily discriminate between the two principles of liquid pressure in their practical application. Accordingly he should be led to realize that the first principle of pressure is one that follows from the weight of the liquid itself. It is applicable to liquids in natural containers as a lake as well as to those enclosed in such vessels as the standpipe of a city water system. To state that the pressure of water in a lake at the depth of 100 feet is about forty-three pounds per square inch, means that the weight of a column of water of one square inch cross section and extending one hundred feet below the surface is forty-three pounds. At a depth of 200 feet this pressure would be 86 pounds, thus increasing in direct ratio with the depth.

The second principle of pressure commonly discussed in high school texts is known as Pascal's Principle. It refers particularly to external pressures applied to liquids wholly enclosed, such as cylinders of barber's chairs. The difference between the effects of applying external pressure to a solid and to a liquid should first be stressed. If ten pounds of force are applied to a solid in a downward direction it means a total of ten pounds of force in that one direction. If, however, ten pounds of downward force are applied by a movable piston to a liquid enclosed in a cylinder, it means the application of a force in an upward, lateral and downward direction. The magnitude of the force on any surface of the enclosing vessel would be equal to its area times 10 pounds.

Three corollaries grow out of the laws of Hydrostatics. One, the so-called Hydrostatic Paradox, states that "the pressure of a liquid in the bottom of the open vessel enclosing it is independent of its shape and dependent only on the depth and density of the liquid." This is usually illustrated experimentally with Pascal's vases. It is not a new principle and can easily be deduced from the idea of gravity pressure. A second corollary records that "liquids in a system of connecting tubes rise to the same level regardless of the size or shape of the tubes." Since the gravity pressure of any liquid at a given depth would be transmitted equally to all other surfaces at that depth it is evident that the heights of the connected liquid columns must be equal. The third corollary states that "the pressure at any given point in a liquid at rest is equal in all directions." Were this not true it is clear that the various portions of a liquid could never come to rest. The instructor must be careful to subordinate these corollaries to the fundamental principles. In fact, one test of good teaching rests in the ability to discriminate clearly between a major concept and its incidental outgrowth.

(To be continued)

L. BEGEMAN