THE PSYCHOLOGICAL AND PEDAGOGICAL BASIS OF GENERAL SCIENCE.¹

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Ever since the dawn of history there have been fads and styles in everything. Education has had its share. There have been certain types of education which have been only fads, perpetrated upon suffering humanity because they were longing for a solution to the educational problems. There have been certain types of education which have been stylish, and to this might be added tradition, which has been a great drawback to progress in education. The subject of general science came into existence a good many years ago, so far back that no definite record is known. It met with a certain amount of response in the form of natural philosophy a few generations ago, then slowly died out as college influences worked their way into the secondary educational institution. College professors dictated what these courses should be, regardless of the welfare of the community or of the pupil. The psychology of the secondary pupil was not then well known, and I mean by that, the psychology of interest, appreciation, and selectiveness, a thing which will be discussed a little later.

It has often been asked why there has been such a difference between the graded school and the high school. At no time in a pupil's life is there such a radical change as that which takes place from the graded school to the high school. One school dominated by trained teachers, equipped in every way with the theory of pedagogy and an understanding of the psychology of young people, and the other dominated by teachers who have worked under college professors, lacking in the theory of pedagogy and totally misunderstanding the psychology of the young pupil. In the graded school more individuality is shown, and better response on the part of the pupil is given, because the teacher has the interest of the child at heart and not the interest of any individual subject. This is the age of children. The child is studied and better understood today than at any time in the history of education.

Our textbooks are improving slowly. Have you ever written something which a child would enjoy reading? Have you ever published a textbook which a boy or girl would pick up and study

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for mere pleasure? And yet those are the problems which are confronting the school interests today. Not only are the majority of textbooks vitally inadequate and unsuitable to the student, but they are written in an abstract way and are studied only for the sake of passing certain examinations. The usual standard maintained is merely that of passing an examination. The vital subjects of interest, appreciation, and selectiveness are almost, if not totally, neglected in the average textbook of today. It is not the matter with which the child comes in contact that the text writer interests himself, it is merely a certain line of reasoning and a certain amount of information he thinks a child ought to know. You hardly ever attend a meeting but what you hear that trite, worn-out, threadbare statement, "What a child ought to know." It is not a question of what a child ought to know, but what a child can learn that will be useful to him, now, during the present day, this week, not what he ought to know for the future, but the things which are necessary for him to know to solve the problems he meets before he goes to sleep today, and that is exactly what you and I do when we do anything after we are grown up. The high school curriculum has been dominated and the teachers have been bullied into the idea that they must teach certain formulas and certain facts regardless of the interests of the school, the pupil, or the community, to satisfy a supreme dogmatic demand of the college professor. He has sent many of his pupils into the schools to teach, and they teach under his philosophy, and they will continue to do so until educational interests demand that the welfare of the school, the student, and the community be placed before the college entrance examination. Why is it one teacher is liked by the pupils? Why is it that certain pupils enjoy the subject taught by the one teacher in the school, while another may be teaching the same subject and all the pupils under him dislike, not only the subject, but the teacher? Is it the personality alone that is counting? I say "No." It is the presentation of the subject matter. One teacher is presenting it from a vital standpoint to the students, the other is teaching it merely for the subject and the subject matter, and there is a wide difference in such teachers. I would not have one of the latter in my school if I could help myself. In the grades the teacher has the interest and the training of the child at heart, in the high school the majority of teachers have the subject matter at heart.

The subject of general science again became foremost in the

attention of educators a few years ago. Some condemned it as a fad, others subjected it to the criticism of being stylish, while others believed it to be merely a subject for preparing students to take up the more serious study of science. As time went by and teachers became more acquainted with the field of general science, the more they were convinced that it was a subject necessary for vitalizing, socializing, and visualizing the everyday experiences of our boys' and girls' lives. The revival of general science is an outgrowth of a general rebellion against formular physics, chemistry, etc.

I once heard a prominent scientist say, "I well remember my own first experience in a laboratory. I had heard a good course of lectures on the subject, and was looking forward with eagerness to the laboratory work. When I entered the laboratory, the instructor handed me a pin and told me to determine whether the cross section of the pin was true or not. When I asked him what use there was in doing that, he explained that the scientist was much more interested in the minutest irregularities which he could by hook or crook discover, than he was in the operation of the machinist, whose function was solely to make machines that would go and do things. It took me about five minutes to satisfy myself that the pin was round, so round that its usefulness as a pin could not be discounted. The rest of this period was spent in trying to bend the pin with the help of the calipers into a shape that it would stand on the table point up. While the student nearest me was away, I surreptitiously placed it on the seat of the stool next to mine, and thus tested its efficiency as a pin, when the young fellow came back and sat on it. The boy is full of energy and curiosity which can only be utilized by appealing to his curiosity, which in turn reacts upon his motor activity, producing results which are not only comprehensive to the boy, but succeeds in holding his interest as well as awakening a spirit of work which it is a pleasure for the boy to accomplish. I do not, however, wish to imply that any course or study should appeal to any boy because it is soft and easy-going, nor should a course be made uninteresting and hard, to make the boy work. The only object is to get his interest and to hold it in order to obtain definite results, which will be either interesting or useful to him. That is exactly why the most of us do anything original or vital. We expect results. The usual expectation from the student of science is that he asks and receives a good mark, or gets his notebook O. K., or receives a blue check on an experiment.

As the world is full of vital, useful, and interesting things, all science may be made vital, useful, and interesting. Any one thing in science may out of necessity be all three. There are some things which are vital. There are some things which it is necessary to know, and there are some things which it is interesting to know. Now, in our life, in a day's time, we do things out of necessity. We do certain things because they are vital, and we enjoy some things because they are interesting, and we learn other things because they are useful. Upon these three great issues one directs most of his energy. With the world in which we live full of vital, useful, and interesting things, it is a surprising and sad thing that many of the people, and especially teachers, go through this world and die without seeing the beautiful and interesting things we find about us. It takes very little effort on the part of any teacher to open the eyes of his pupils to the things which will function throughout the pupil's entire life. How often have I heard an old person say, "When I was a boy we had a book, *Natural Philosophy*. This book was a storehouse of information. It was an introduction to the science of interesting, everyday things. As a result of the study or reading this book, many of us began to understand the world about us. In the years as I grew older, I always regarded that *Natural Philosophy* as most valuable." A distinguished physicist of an American university has said that such books did more to interest the people in the world about them than any subsequent books. A surprising fact, and one which is lamentable, is that too many of us as teachers of scientific subjects go through the world with a pair of scientific spectacles which have been stained the color of abstract facts, in order to filter out the rays of the beautiful, interesting, and vital science facts of the world that surrounds us.

Now with these two points in mind, that the student is interested in the subject of science, and that the world is full of interesting subjects, let us analyze them in a common sense way and see what they mean. First, I have said all boys and girls are willing to become interested in science, if they find something interesting and worth while. The world is full of interesting and worth-while things. Let us see if there is a way to bring them together.

Teachers are too likely to use a strictly scientific language, which is too scientific and too indefinite for the boy or girl to understand. Many an amusing incident happens which shows that

a student does not understand. In a test that I made recently before a class for my own satisfaction, I found a lack of ability to tell exactly what was meant when students tried to express themselves in some scientific terms. Three questions were asked: What is a molecule? What does it look like? Have you seen one? The class consisted of over two hundred pupils who were entering a normal school. They were all graduates of a high school and entered with physics and chemistry as a prerequisite. In most cases the answers were interesting. A number explained a molecule as a small round thing in things. Undoubtedly this answer would have surprised the teachers who taught those pupils the meaning of molecules. One young lady insisted that she had seen one. Several said that their teachers had seen them. Many teachers would be astounded or mortified at the answers if they were to ask their pupils practical questions on this subject.

Not along ago I asked some pupils who had gone down in an elevator, what caused the funny feeling in their stomachs when the elevator dropped suddenly, and they looked at me with peculiar expressions in their eyes, because I had asked such a question, and one laughingly said, "I don't know." I then said, "Have you ever studied physics?" "Yes, last year." "Can you not apply some principle of physics to this thing?" He said, "I have not thought of it before." And truly he had not.

One day while walking on the sidewalk a girl stubbed her toe. She ran a few steps to recover her balance, turned around and smiled. She happened to be a pupil in the school where I was teaching. I asked her if she knew why she ran when she stubbed her toe. She laughed and said, "So I wouldn't fall down." I replied, "To be sure, but why would you have fallen down if you had not run a few steps?" She said, "I don't know." A few days later she came to my classroom and said, "I have an answer to your question." I had forgotten the incident, so she reminded me of it, and this was the way she explained it. "When I stubbed my toe, my feet stopped, my head kept on going, therefore, I had to run to catch up with my head." Exactly, so she had explained it in a common sense way.

Recently on a teacher's examination paper the question was asked, "How is coal made to leave a shovel when trying to throw it on a fire?" The young lady taking this examination had done very well on her abstract questions, which dealt with the physics,

but this is the way she answered the question regarding the coal. "After getting the coal on the shovel you hold it at the furnace door, the flames jump up and lick it in." I have given you these examples all from experience, and may I say that the pupils in all cases did know what inertia was, but it would have been hard work to have associated inertia with something that had actually happened in their everyday experiences.

Examine teachers who have had physics, chemistry, biology, or any other science in school, who are not teachers of these subjects, and ask them a few simple questions about simple phenomena and they will be unable to explain. They have had physics. "Oh, yes. When I was in college, or when I was in high school, but I have forgotten it all." You might say the same of Latin. We had that in college and high school, but that is a dead language. It no longer lives among us. Ninety-nine per cent of the problems of our lives are surrounded by science activities, and they are not abstract problems either. The trouble is that some of us as teachers are dead. We died long ago. We have been buried under six feet of abstract facts and formulas. We had a funeral service on notebook computations, etc. The flowers and the beauty of real living things were not present, and we have stayed dead, and nothing will resurrect us until we have thrown aside all of this material which is good-for-nothing, useless material to the average pupil, and reorganize it around the beautiful, the living, and the active world. And that notebook, the marvel of all wonders, with the objects, apparatus, and the observations; what you have seen; what you ought to have seen; what you did see; what your teacher wanted you to see; and usually a scene after school, the latter, if you are not a good mind reader and have not clearly read the mind of the teacher, and were not able to find out just what was expected of you. Some one will say, "You are not a science teacher." Then I thank God I am not, and I don't want to be, if science cannot consist of the real, live material and the problems which you have at hand to be solved from day to day. In other words, we must talk to pupils, we must teach pupils, and we must learn with pupils in the language they know, and in the environment they understand.

There is another valuable psychological reaction which has been talked about a great deal but has never been practiced, and that is to make pupils observe. Ninety-nine per cent of the science teachers do not teach pupils to see things, and it is only

one teacher out of a hundred we find acting upon the principles of psychology to produce observation.

It has long been a practice of mine in the classroom to spend ten minutes of the period in answering questions or discussing observations of the pupil. These ten minutes I presume have been most interesting. I have allowed each pupil to ask one question, or to give one observation. Throughout the year I kept account of the questions asked by pupils about things which they had seen. The number amounted to 1,056. In succeeding years I tried to keep account of the number of times the same question was asked by different pupils. Sometimes it was as many as ten, and other times it amounted to many more. This shows that pupils see the same interesting things, from day to day. The teacher should be willing to spend a little time in trying to open the eyes of his students to the art of observing things. Such an incident as this has been reported. One girl said, "Last night while washing dishes, one glass stuck tightly into the other, and I was unable to remove it, until I had placed the glasses in hot water. I asked my mother why this was so. She did not know. She had not thought of it."

Another incident by another pupil. "In our room we have a fireplace. Last night we put some wood on the fire, and a short time afterwards a piece of the wood had blown almost into the middle of the room. I tried to explain it, but I could not find any reason." This question was answered by one of the other members of the class. Such questions as these are coming up daily in the experience of everyone.

As soon as pupils begin to realize that they can see and understand some of the things about them, they begin to react. A short time ago one of my pupils coming across the meadows observed the fact that the fog stood about three feet above land. She wanted to know why. She had crossed the meadow hundreds of times before entering the science class, and never wondered at this phenomenon.

Another asked why ice steams on a hot day. I was rather amused with the answer given by one of the pupils who had had considerable science. He said, "Because the ice was evaporating and you could see it go."

Truly we can teach vital problems in a vital way. We can also teach the students to observe if we only get away from the habit of trying to drill a few definite laws into their minds to be remembered long enough to take an examination and to create

within them a natural dislike for the world's scientific facts. You should not be surprised to find the boy in a physical laboratory reading *Popular Science Monthly* instead of doing a useless experiment.

I once knew of a teacher who had given an experiment to a boy to do with a motor. He had careful instructions laid before him and he was supposed to follow them. About one-half of the period gone, the teacher stopped at his desk to see what he had done. He found the boy had not written anything about the motor, but was busily engaged, and the teacher rather sharply remarked, "Why have you not started your experiment?" The boy jumped because he had been absorbed in examining the motor, and said, "I have found out how the thing goes one way, but I cannot find out how it goes the other way." If the teacher had had a sense of humor and had understood the psychology of a boy, he would have said, "Keep at it until you do find out," but instead he dismissed the boy from the class and gave the remaining number of the class a lecture on following instructions. "Never mind what you want to know, just do as I tell you. You will learn something that way. If you want to find out anything else, do not find it out here." Rather poor psychology, and I doubt whether any pupil in that class will remember that teacher as being one which influenced his life.

Students can easily be taught to observe and become interested in anything if they are allowed to discuss things about them. How often have I heard a pupil say, "I have seen more things this year, going to and from school, than I have ever seen in my life before. I notice the clouds every morning, I have tried to predict the weather. I notice the people in the car. New things, new experiences happen to me, and I try to explain them." This is the spirit of observation. Not only have I had pupils come to me during class hours, but often have students come after school to ask a question which they could not answer about some phenomenon they had seen. Why? Because they are interested, and because science is a thing which produces the spirit of investigation, even on the dullest mind. Pupils have written letters after graduation asking for explanation of certain things which they have seen. They will never lose their interest in science.

The chief reason to my mind for the study of any general science in school is to give a consumer knowledge. We are all consumers, as well as producers, but as a consumer we must know something about food, its value in a human body, food

which is costly, as far as food values are concerned, and foods which are cheap, but useful. Every man should have some knowledge about his clothing; he should be able to be a judge and be a fair judge, not an expert, when he is buying a piece of clothing, to know whether he is getting the best value. He should have an intellectual viewpoint regarding his home, ventilation, the building material, the heating system, the water supply, etc. He need not be an expert, but a little knowledge will give him an opportunity to have an insight into economical values and give him a basis for forming good judgments. If he travels he should have some knowledge regarding the best methods in traveling, safety first, and general conditions which will keep him healthy and strong. His medicine is a vital problem when he is ill, or has sickness in his home. He should be well aware as to what are the ordinary advertisements which claim to effect many cures and produce none. He should have an intelligent viewpoint when a physician enters his home, and enough scientific knowledge to carry out and understand the reason for the directions which a doctor may give. All such material is included in the practical science of everyday life.

The subject matter of general science has been a field for investigation and thought. It has been exploited; the child has been exploited; and the teachers have been exploited. I have definitely made up my mind that in general science, physics should not be taught as physics, chemistry as chemistry, biology as biology, and astronomy as astronomy. Some of us have tried to make general science a sort of biology; others, elementary physics; a few have stuck to chemistry; others have emphasized astronomy; still others agriculture; but science must be divided into two classes, *pure* and *applied* science. In the pure science we have physics, chemistry, biology, and astronomy, etc. In applied science we have agriculture and physiology. These two subjects are taught in a practical and sensible way, and they do not need to be retaught in part in general science, but out of the pure science should be selected such material as can be applied to the everyday life. There are certain applications of physics, chemistry, biology, and astronomy which are interesting, helpful, and useful in everyday life. Some have tried to crowd in agriculture on top of this, and have made a botch of the whole thing without recognizing the fact that agriculture was a practical subject to start with, and always will be taught in our school as a practical subject. What students need to know is more of the

everyday environment of science which they would not get from the formal study of the pure science.

There are many who would say that what we propose is hard to teach. Just so. It does take time, thought, study, and an abundance of energy because you must be a real live wire. No semi-dead teacher has any chance in a classroom full of live, hungry, and willing learners.

What to teach becomes a problem. One thing is certain. Definitions and dry scientific facts are not to be taught first without any foundation. An example of this is found in a science class when an instructor attempts to teach inertia. The definition for inertia is, "Every body continues in its state of rest or of uniform motion in a straight line, unless compelled by some external force to change that state." The student is lost before he gets through the definition. It means little to him. He sees no relation between this and his own environment, and to tell the truth he has learned little. Suppose he had been asked why one must be careful to wait until the car stops before getting off? This is something he knows about. Why should one get off always facing the direction the car is going? Suppose the teacher arranged chairs in the classroom and had a demonstration of mounting and dismounting a car with books in one hand. What is the result? Everyone is ready to take part. Some one shows how one should get off the car. Another immediately says that is wrong. Why? If the car is moving and you get off with your back in the direction the car is going, what happens? Why? What happens when a car starts and you are standing in it? Why? We have got to call this something. What? Inertia. What does inertia make you do? What does it make everything do? What is inertia? What way does it make things go if they are moving? Tell all about inertia, etc. Hundreds of examples can be given, from the spilling of soup by pushing the plate, to why the world keeps on turning.

If I should ask any one of you to tell me how the water runs out of a washbowl, what would you say? Does it run from right to left, or left to right? Does it always run in the same direction? Why does it assume a turning motion as it runs out? Do you know? Why don't you know? The phenomenon happens every day of your life.

An organization of the subject matter for the general science I found to be a very difficult thing, and the more I studied the

proposition, the harder it became, as I was unable to definitely fix the field in which the student needs to apply himself for a thorough course in the subject. I had to recognize at the start that general science meant a practical application of all the sciences, and that any subject must be taught as a subject from the biological, physiological, chemical, astronomical, physical, and geological standpoints. Some subjects would have more of the divisions in science, others would have less. In an attempt to organize this thing around some vital center, I drew the house represented in the diagram on page 316, and about that home as the center of all activities, I drew lines to designate the subject matter which would come into the experiences of a boy or girl. I found that this would not cover the field. That there were outside interests, especially those interests which function in the lives of pupils going to and from school.

The diagram simply shows the subject matter which is important for him to know. The subject matter is not to be taught as pure scientific facts, but to be taught as science which is a part of his existence. There must be some starting point, and my method was to start with humidity, as the boy and girl are usually starting the subject of science at a time when moisture in the atmosphere is very vital. We have learned a great deal in the last few years about the amount of heat required in a home, and we have found that when the humidity is correct, a less amount of coal is required to maintain a comfortably heated home. In fact, experts have estimated it to be from one-eighth to one-quarter less coal during the season. Now, in order to make the work plain and systematic, I started with evaporation and the effects of evaporation. Each subject is to be taught from the standpoint of all science, and only that part of the science which is of vital use for the boy or girl to know, therefore the physics, chemistry, biology, metallurgy, astronomy, and physiology of any particular subject, no matter what it is, should be discussed for the subject in view at the time. The student easily sees the relation of the subject to all standpoints of life without studying the subject under different heads. In fact, the use of general science is to annihilate the divisions which have grown up between the different groups of sciences. I do not believe there has come into our system a more vital subject than the subject of general science, which can pick out vital facts of all the sciences and make them worth while to the student. Some have argued that general science should be taught simply

to prepare students to take up the serious study of other subjects in science, but general science is a serious study of itself. It may or may not prepare students for future study in a more scientific manner. It is bound, however, to assist the boy in any future subject of science, even though the ultimate aim is only to give him a better understanding of his environment, and that, after all is the ultimate aim of the teaching of general science. Natur-

NUMERALS REFER TO COST PER HOUR IN MILLS (TENTHS OF A CENT).

—Cost of gas used per hour in some common gas appliances

ally, as soon as we start any subject, there must be an organization or plan in which one factor fits into another, and that plan seems to start with the moisture getting into the atmosphere, effects of the moisture in the atmosphere, and the moisture coming out of the atmosphere, and under those three groups we would naturally have humidity, the effects of humidity, evaporation, and the effects of evaporation, and this takes us into discussion of the use of many things about the home. It takes us into physiology. It discusses the humidity of house sleeping rooms. It takes us into the pantry, where the butter is kept. It takes us to the shore, where we go in bathing. It takes us to

the sickroom. It tells about the iceless refrigerator, therefore the subject can only be taught from all the standpoints of science. When the discussion leads to moisture coming out of the atmosphere, we learn about weather, weather predictions, clouds, and other things related to the subject of weather. This leads us to the study of barometer, wind, air pressure, and finally to ventilation. Under the pressure of air many examples may be found as practical applications, non-skid tires being a very common example today.

Thus it is easy to see the lesson may have the physics, chemistry, physiology, etc., of the topic, combined in an understandable way as a whole, without the student realizing that many divisions of science have entered into the work.

Air pressure leads us to discuss boiling point. The subject of heat follows. How our homes are heated. Uses of heat, cooking utensils, saving of heat. Study of our heating systems. Lessons on fuel. Value of different fuels, types of burners, wasteful and saving forms of burners. Here is an illustration showing how the Bureau of Standards at Washington has worked out the relations between fuel and different burners for lighting purposes. This is really vital, and the student knows it without being told. He sees an immediate use for the lesson. I wanted a good lesson for students who were using gas pipes at home. While we were studying the subject of using gas, there was no better plan than to make a collection of the different gas tubes. Here you see the

results—a real lesson in hygiene and relative values. One gas pipe is made of paper and wire, covered with cloth. It is bound to leak, but it only cost three cents a foot. There were several grades as the illustrations show, varying in price and quality, until we reach the best, which is reliable. A good rubber connection, metal tubing inside which is well covered, not only to prevent gas from leaking, but for decorative purposes. This cost fifteen cents per foot, but was well worth the difference because of the hygienic value.

An object lesson on cheap penny candy. This doll was prepared by the students of the State Normal School, Newark, N. J., from cheap, unlabeled candy obtained at the penny candy-store near the school building. Buy candy which is labeled and is free from adulteration.

Results of burning. Ventilation, results of breathing, carbon dioxide, food, medicines. We have an exhibition of 240 useless patent medicines taken from homes of students. Study of med-

icines, candies, etc. I am showing you an interesting laboratory experiment performed by my students on penny candy. The material was collected and the experiments performed because the students saw something useful and worth while in this work. They were educating themselves to become better citizens, and incidentally preparing others to become better citizens, when they dyed the clothes of this doll with candy dyes.

The study of water follows that of food. Water supply dangerous and good. Indicently, the drinking fountain of the school building comes in for its share of criticism.

A danger always present in this type of drinking fountain is that of breaking the teeth of one child if another playfully pushes him when drinking. This type of drinking fountain may prove to be worse than the common drinking cup. Bacteria will remain in the little bowl and in the water standing in it. Even if the water is allowed to run continually, bacteria and disease germs have been found constantly moving up and down in the water.

This type of drinking fountain prevents the danger of having the teeth broken. A person drinking cannot get his mouth in contact with the metal. There is no bowl for the water to run back in, since the water meets in a spray at the center of the fountain and the excess water falls back into the drain.

I hold in my hand two types of drinking fountains, one dangerous and unhealthy. It is so constructed as to allow disease bacteria of all kinds to collect. Children break their teeth on such fountains by pushing each other. It is a bubbling fountain and may easily spread disease. Here is another type made to prevent children touching the metal and breaking their teeth. It is clean, sanitary, and wholesome.

Of course, under this subject come water pressure, and the physical and chemical lesson, as well as the lesson in hygiene. Bacteria and disease naturally follow a subject of water. Light should get its share of attention next, since light is the greatest germicide known. The vital subjects of the pupil's environment must be taught, and no general science should miss the opportunity to teach safety first.

In no part of school work is more practical psychology required than in the teaching of science. One of the chief faults of a teacher is to dominate a class, to talk too much. The ideal

place for a teacher is in an out-of-the-way place in a classroom trying to keep still. The teacher may ask, "What am I paid for?" A teacher is paid to use his brains and keep his mouth shut as much as possible. This is the hardest job a teacher can have. It was a hard lesson for me to learn, but I can conscientiously say I did pretty well after fifteen years of trying.

Enthusiasm is needed in every recitation. Pupils should fairly climb over each other to get into the science room. One day the history teacher came into my room just after the class had started, expecting to see something unusual. She said, "Will you kindly ask the class to go more quietly from my room to your room? They fairly walked on each other, and they have been doing the same thing for several days." What had happened? Why, I had tried another experiment to get enthusiasm into the work. I had decided that one member of the class should conduct the class each day, and that each one who wished should report on any observation he might have seen. In the first place I had a barometer, thermometer, and stormograph to be read and adjusted each day, weather flags to be placed on a pole, and weather charts to be read. Those who got into the room first reported on conditions.

Observations came next for ten minutes. These produced enthusiasm and many discussions. Here is where the teacher comes in. Do you know there seems to be an old feeling about teaching that we must ask a lot of questions? Is it not funny when we think of it? We are forever asking questions of others who may or may not know the answer, when we know the answer. Why ask questions when we know the answers? When we want to know things in real life we don't know, we ask questions of those who do know. What an ideal method to use in class work. Let the student ask questions of the teacher instead of the teacher asking questions. Many a time one pupil knows a whole lot about some subject. How interesting and helpful to the whole class to have that student get out in front and let the class ask questions of the student. He is always glad to tell what he knows. Here is where the case system may be used. The case system has been found valuable in teaching law and medicine. It is excellent for teaching general science. There was a time when the project method was in vogue. But no one today knows what a project is. We thought we knew once, but since that time every known idea and method under the sun has been called a project.

A boy or girl has something special to contribute. Let him do it, and let the rest of the class, together with the teacher, join in asking questions about the matter presented. The students get a sense of importance which communicates itself to other pupils, causing them to want to find something to contribute in like manner.

Why should a teacher do any of the experiments in science? Any one of his pupils will stay after school and prepare the experiment, study it, and gladly explain it to the class the next day.

The recitation usually opens by a student's voluntary recitation as to the most important part in today's lesson and why second in importance and why, etc. No one is called on. All recite because they want to. Each student rises and is recognized by the leader. Do they enjoy this recitation? They certainly do. They are not sitting in their seats waiting for the teacher to call on them. Their mind is on "What can I contribute?" Interest is often stimulated by dividing the class into two groups, and keeping account of each side. The students will see that every student contributes, and if the teacher is wise he will see that the class is held to contribute essential things. The class is a good judge of this if you allow it to use its judgment as a whole.

To sum up in a word, general science is essential to the school as a medium of teaching a student more about the environment he lives in. It is also a medium for teaching students how to express ideas, to rely upon themselves for explanations when strange phenomena appear, to see more of the world about them, and to ask questions about things. The grade pupil asks more questions about his environment than the average high school pupil of science, but you give the high school pupil the same opportunity and he will become a real live question mark.

The future of general science will be for the student and not the subject matter.

The world has advanced by finding real problems and solving them. To study means to solve vital problems. The average person does not have time to spend on anything but the real problems of his environment. General science must be, and will be, the source through which vital contact with the real things in nature are made.