year high school, (or the equivalent grade for a junior high school), to be followed by a year of required biology.

(2) That certification regulations for science teachers be altered and that certificates be no longer issued for high school science in general but for *each science* for which certain qualifications are met. For instance, the requirements for a general science teacher would be at least one year of each of the following college courses: biology, chemistry, physics, mathematics, and a half year of physiology and hygiene, and for a chemistry teacher, the requirements would be 2 (preferably 3) years of college chemistry, and one year of each of the following: physics, biology, and mathematics. Such regulations would represent a distinct advance over the present situation.

(3) That the number of adopted textbooks of general science be increased from two to five, and that the list of five books be revised every two years.

(4) That the State Board of Education be requested to revise its bulletin on Laboratory Equipment for Science Instruction (Vol. VII No. 1, July, 1924), including in the revision such valuable recent material as that contained in Monahan's *Laboratory Layouts for High School Sciences.*

(5) That the State Board of Education be requested to appoint a committee of science teachers to study the Natural Science courses at present offered in the elementary and high schools of the state, and to recommend such changes in the courses, laboratory equipment, preparation of teachers, etc., as will best meet the modern industrial, agricultural, and cultural needs of the state.

Fred C. Mabee and Others

Teacher: "What is 'average'?"
Small Pupil: "A thing to lay eggs on."
Teacher: "What makes you say that?"
Small Pupil: "Well, my mother says that our old hen lays six eggs a week on an average."

HINTS FOR THE HIGH SCHOOL TEACHER OF GEOMETRY

FOR MANY years the writer was a teacher in secondary schools and always the hardest task he had was the teaching of geometry. The task was somewhat lightened after he became familiar with some of the facts of modern geometry and projective geometry which came to him as part of a course leading to the Ph. D. degree in mathematics. But there was something yet lacking in his preparation for teaching high school geometry.

An illustration will show the difficulty perhaps better than any amount of explanation. Take the theorem given in practically all textbooks in geometry, "If two triangles have two sides of the one equal respectively to two sides of the other, but the included angle of the first greater than the included angle of the second, then the third side of the first is greater than the third side of the second." (If you are good at visualizing, try this in your head; if not, get a piece of paper and pencil and draw as you read.)

Draw two triangles ABC and DEF such that AB is equal to DE, and BC is equal to EF, but the angle ABC is greater than the angle DEF. Although it is not usually done in the textbooks, I suggest that you draw another triangle exactly equal to ABC as a basis for the figure upon which you are to base your proof. We now wish to prove AC is greater than DF.

Using the second triangle ABC lay the triangle DEF on it in such a way that D falls on A, and E on B then the line EF will fall inside the angle ABC and F will in general fall across AC from B. The proof usually given is: Bisect the angle FBC and produce the bisector to cut AC at H. Join H to F, then in the triangles BHF and BHC, BH is equal to BH ident-ical, FB is equal to BC. hyp. and angle FBH is equal to HBC const. Therefore, the two triangles are equal and HF is equal to HC (corresponding sides). But AH + HF > AF (straight line shortest distance between two points) hence substituting for HF its equal HC we have

$AH + HC > AF$ or

$AC > AF$

When the student sees this result "drop in his hat" perhaps his first reaction is "yes, I see it, but I would never have thought of doing it that way," or perhaps "I wonder how he knew he ought to bisect that angle FBC." And finally the student comes to the conclusion that if he is to be able to prove that proposition he will have to remember how the figure looks and that he must bisect the angle FBC, and he proceeds to memorize the proof.

But if he thinks at all, he wonders how the first fellow found that method of proof, or how he himself could have found it if no one had told him.

The writer wondered about this point for years, and about similar points in many other theorems where the book gave definite instructions as to what to do and when the instructions were followed out the answer appeared as if by magic. He wondered. He had had no training in either school or college which enabled him to find out how the other fellow knew how to proceed.

Teachers of geometry—have you had the same trouble? Can you find out how you can know that you must bisect the angle FBC, to solve this problem?

If you have never tried, lay down this article, take your paper and pencil and try it right now before reading any further.

It can be done. The writer got the cue to it from a very interesting book on geometry (so far as he knows the only one of its kind published in English) which appeared a few years ago. The cue is this: suppose the theorem is true, examine it and see what things must be true if the theorem is true, and then see whether these conclusions are true or not.

The procedure is as follows: Go back to the statement "The proof usually given, etc." At that point your figure is the triangle ABC with the line BF equal to BC, the point F below AC, the line AF drawn, and we have no other lines in the figure. We want to prove AC is greater than AF.

We suppose AC is greater than AF; if that is so I believe I could bend AC at some point H so that C would come exactly on F. That seems reasonable to me; I wonder if I can prove it. I'll try it. To do so I make a new drawing consisting of the two lines AC and AF just as in my first figure and no others. On A C choose a point H which appears to be about as far from F as it is from C. Then if I can bend AC at H until C falls on F, I would have HC equal HF. Then if that is so HCF will be an isosceles triangle with the vertex at H. What do I know about isoscles triangles? Thinking it over, I hit on the fact "the perpendicular bisector passes through the vertex." So if I join F to C, draw the perpendicular bisector of CF it will cut AC at some point H which will be equidistant from C and F, so I can find a point in AC at which if I bend AC, C will fall on F. Now go back to the original figure. I am sure now that if AC is greater than AF, I can find on it a point H equidistant from C and F. Suppose I have found it. Draw HF. Then I have HF=HC and BF=BC almost immediately I seem to see HB=BH. Therefore the two triangles are equal and the corresponding angles FBH=HBC, that is HB bisects the FBC. Hence I know that if AC is greater than AF, I can find a point H on it such that HF is equal to HC and that this point will lie on the bisector of the angle FBC. Hence if I bisect FBC and find the point H where this bisector cuts AC, I can prove that AC is greater than AF.

Until the writer became acquainted with this method of attack given in the geometry referred to above, he was unable to find out how the other fellow knew what to do.

It would seem a fine thing if every teacher of geometry in the high schools could become familiar with such methods; very few of them have had the chance.

For years the colleges have given plenty of courses which are helpful to a teacher of algebra or trigonometry but usually the high school graduate after he has gotten his A. B. or B. S. goes back to teach geometry in the high school and has not had a single course in college which would help him to teach geometry.

Within the last few years, however, a new book of geometry has appeared. This book opens a new field in geometry, in which the geometry of the triangle with a number of new and beautiful theorems is treated by the methods of Euclidian geometry, and with the appearance of this text, a number of the leading colleges in the country have put in courses in geometry based on it.

Try this once. In a circle of centre O inscribe a triangle ABC.

From A draw the altitude AD
From B draw the altitude BE
From C draw the altitude CF

These three altitudes meet at H. Take the middle point of HO and call it N. With N as centre and ND as radius draw a circle. This circle will pass through D, E, and F, the feet of the altitudes, it will pass through the middle points of the three sides of the triangle, and will pass through the mid points of the lines joining A, B, and C to H. This circle is called nine point circle of the triangle. Prove this by ordinary plain geometry.

N. B.—This article is not written to advertise a textbook, hence the title and author of the text referred to is not mentioned, but if any one who reads this will send a self-addressed stamped envelope, the writer will be glad to send the title, author and publisher.

H. A. CONVERSE

Bob: "Daddy, what is a Board of Education?"

Father: "Well, son, when I was going to school it was a pine shingle."

ELECTRICITY: A UNIT FOR GENERAL SCIENCE

IN JUNIOR high school general science the class is being introduced to the whole field of science for the first time, so the different topics cannot be taken up in detail. It is therefore necessary to choose for each unit certain fundamental principles which when thoroughly learned will be of use to the child throughout his whole career of science study. These principles should also be of value to the child who goes no further in science. The eight principles of this unit in electricity, chosen with these points in mind, follow:

1. Electricity is produced by rubbing or friction.
2. Electricity can be produced through chemical action.
3. Electricity can be produced through the use of magnets.
4. Electricity is of two kinds, positive and negative.
5. Electricity to be of value must have a complete circuit.
6. Some substances are conductors of electricity and some are non-conductors of electricity.
7. Resistance to electricity produces heat.
8. Many modern electrical devices are based on the above principles.

On the day that the topic is introduced to the class, a complete assignment, or worksheet, is placed in the hands of the class. Each principle on this worksheet is printed in capital letters, so that the child realizes its importance. Under each principle there are a number of jobs, each focusing directly upon the principle. The child does these jobs to learn the principle. The more difficult experiments are performed by the teacher, and a class discussion runs along to supplement the work. The child is required to master the required jobs in order to make a passing grade; he may further raise his grade through the mastery