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INDIVIDUAL INSTRUCTION VERSUS GROUP INSTRUCTION IN THE NINTH GRADE.*

By C. B. Marquand

Columbus, Ohio

The story used in connection with the appreciation dinner given recently at Columbia, in honor of Dr. David Eugene Smith, fits this subject so admirably that I trust you will bear its repetition here.

Those of us who were born in the almost forgotten era of piety remember a story of the downfall of a giant at the hands of a stripling, wielding a sling. The youngster's name was David. We have been watching the assaults of a modern David upon a giant far bigger and tougher than Goliath.

The terror of the Bible story wore an armor, but it left a little opening just where a lucky shot would do the most good. Our hero has had no such advantage. The giant upon whom he has been operating has developed the toughest kind of shell from top to toe—a sort of concrete overcoat, made of a mixture of equal parts of tradition, prejudice, and smug self-satisfaction.

David the Wise has made no wild shots, but has used scientific methods. He realized that the monster could be a mighty useful member of society if he could be limbered up and headed in the right direction.

Now, to educate a giant is much like educating a child. First, you must understand him. So David began by looking into his heredity, sparing no effort to trace the family back to its ultimate source. Then he studied the giant's childhood, his playthings, his later development, and everything that would help him to learn how the fellow "got that way."

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*Read before the meeting of the National Council of Teachers of Mathematics at Dallas, Texas.

He discovered the main trouble—the creature never took a bath and never changed his clothes. On the rare occasions when he required a new garment, he just put it on outside the old layers. The burs and the barnacles which he happened to pick up stuck on just as hard as the things worth keeping.

It became evident that an operation was necessary. Economy called for a major operation—like Goliath's—but when you set out to cut up a giant with a shell like this fellow's,—well, don't try to finish the job in one afternoon!

So David began digging a bit here and cutting a bit there, and he kept it up. He has already removed several yards of vermiform appendix, which served no purpose except to cause pain. The giant is looking much better. He has a lot more life and energy. He is much more human—if you know what we mean. He seems more interested in real everyday life, instead of merely posing in a meuseum. School children are actually beginning to like him. Best of all, he has got a new look in his eye. He has stopped gazing backward over his shoulder and keeping his feet carefully in a deep rut. He seems to have an idea where he is going.

We may consider our present-day giant old-fashioned traditional class group instruction. The cutting that is to be done is a major operation, and the new material used to replace the old shell will be individual differences. We must examine briefly the life history and training of the upstart Individual Instruction who presumes to remove the old shell in performing this operation. It will be proper to state his purpose and meaning as used here. Further, it will be necessary to show how he developed to fit this particular case, the Ninth Year in Algebra.

Also, no major operation would be satisfactory without a bulletin or two on the patient's condition and how he underwent the treatment, so we have divided the topic into the following parts:

1. A brief history of Individual Instruction.
2. The reasons for Individual Instruction, and meaning as here outlined.

3. The means by which it was developed for the Ninth Year in Algebra.
4. Some results of the use of the method.

The first voice raised loudly in protest against the class lock-step method of teaching, and in earnest advocacy of complete individual progress, was that of Preston Search, as superintendent of schools, in Pueblo, Colorado. Apparently without any special technique, he simply determined that each child should progress at his own rate—and this was done during the Search incumbency, 1888–1894. Search went to Los Angeles for a brief and ill-fated superintendency. He tried in 1894 to carry out his ideas, but he was ahead of his time. From then on, his was "a voice crying aloud in the wilderness." But few persons did more than bask in his inspiration, then continue in their old ways. The traditional giant felt only a slight tremor of the spine.

It was Frederic Burk, with the help of Mary Ward, beginning in 1912 and 1913, who really started the present movement to individualize school work. In the elementary school of the San Francisco State Normal School (as it then was), he developed the first definite technique of individual instruction. His self-instruction bulletins spread all over the United States and to many foreign countries, until a ruling by the attorney-general of California stopped their publication. Burk's school was visited by educators from all parts of the world, and teachers trained under Burk carried his methods into rural, village, and city schools.

The public schools of Redondo Beach, California, among others, bodily took over Burk's methods and materials, as did some parochial schools. For the most part, however, people failed to see the applicability of Burk's basic principles to city school systems. They assumed that because Burk had adapted these principles to a normal school they could not be adapted to other types of schools. It was not until certain public school systems began to take hold of the movement, therefore, that it spread with any rapidity.

The first public school system definitely to undertake this work was that of Winnetka, Illinois. The thousands of visitors to Winnetka schools, the spread of the Winnetka mimeographed materials and the texts that are just beginning to be published, the lectures given in various parts of the country by Dr. Carleton Washburne and the Winnetka staff, the articles in such lay periodicals as the *Christian Science Monitor, Collier's* and the *New Republic* have done much to spread the idea that the lock-step can be broken in the public schools and that schools can be fitted to individual differences.

Public schools that have recently been experimenting with Individual Instruction are Mt. Vernon, Bronxville and Dunkirk, New York; Miami, Florida; Peru, Indiana; Racine, Wisconsin; and to a greater or less degree many other places. The movement seems to be just getting well under way and bids fair not to stop until all schools make provision for the wide differences that exist among individual children. Verily, the giant feels sickness and growing helplessness.

The most widely known form of individual instruction is the Dalton Plan introduced at Dalton, Massachusetts, a few months after the work at Winnetka was inaugurated. It remained almost unknown in this country until Rosa Bassett put it into the Girls' Secondary School in Streatham, London. This experiment caused an educational furore in England, the reverberation of which wakened America to the experiments that Helen Parkhurt had begun in Dalton.

In England, Miss Parkhurst tells us, there are now over 1,500 Dalton Plan schools. Miss Parkhurst is authority for the statement that the Dalton Plan has been adopted as the official method in Holland and in Moscow; that there are Dalton Plan schools in Norway, Germany, Poland, Austria, and Spain; and that 450 public or government schools in Japan are operated on this plan; 250 schools in China; and 50 in India. Her book has been translated into twelve languages. All this in about four years. The fact that the plan does not call for any changes in the curriculum or texts, and yet does much to free the child and individualize his work, probably accounts for its rapid spread.

We have now persuaded our mass instruction giant to believe that this operation will do him good, and that many school subjects will have convalescing patients to cheer him along. Thus we leave him for the present while we hold consultation with you as to the reasons for this procedure and the way in which we can inject some provision for individual differences.

We shall attempt to give a brief summary of some of the reasons for attempting to individualize instruction.

The widespread use of intelligence tests and achievement tests during the last few years have made every educator realize forcefully that children vary greatly as individuals, and that any one school grade contains children of an astonishingly wide variety of capacity and achievement. It has become absurd to expect to achieve uniform results from uniform assignments made to a class of widely-differing individuals. Scientific inquiry has shown that individual differences are due in some degree to inheritance and are magnified by experiences and the resulting mental organization. Superficially, children seem to be alike, but any attempt to determine how far they are alike results in a clear demonstration of the fact that they are not alike in the ability to perform any given task. Different amounts of time are required by the various pupils for the mastery of topics; different amounts of drill are needed for the development of abilities; different methods are needed for different pupils; and pupils vary in thir response to environmental conditions.

Experiments at the University of Iowa have shown the following results:

1. That there are wide differences in ability in each subject at the beginning of a year.
2. That there are great inequalities in rate of progress, not only among pupils of different ability but also those of the same initial ability.
3. That there are variations or spurts in the rate of progress of each individual.
4. That there are significant variations in the nature of differences which retard progress of various members of a class.

The present method of handling a mixed group on the same course of study and with the same method of recitation and presentation retards the bright and accelerates the dull, and the damage thus done to their minds, interests, habits, and attitudes is as yet unmeasurable. It can hardly satisfy any conscientious teacher to offer one single "patent medicine" curriculum to all pupils, whether advanced or retarded, with the exception that in some mysterious way the mere exposure to the curriculum is going to lead the child into habits of knowledge and power.

Students of the same chronological age vary in ability to acquire facts, knowledge, or skills. To complicate matters more, the same student varies considerably in ability to acquire facts, knowledge and skill in a school year. Individual methods are based upon the principle that both time and amount or quality of learning cannot be made constant factors. If time is made the constant, then the amount required must vary. The class method so generally in use makes time constant and necessarily varies amount and quality, thus giving occasion for charges of inefficiency.

The individual method allows the child to progress as an individual in securing facts, knowledge, and skills that he must acquire according to his own rate and ability. The individual method is not a wholesale tutoring method, because it does not segregate the individual from his regular social environment. Social environment progresses at the same time as the individual progresses. The essential feature of individual instruction is that there is an individual and personal check-up on the progress of each child.

Schools on the class group method seem to have acted on the assumption, heretofore, that with the pointing of the hands of the clock to time all members of the class would be interested in a definite study and every member of the class receive equal benefit from the recitation, and that the results would be identical. Further, when the hands pointed to 9:45 every child, including the teacher, would suddenly cease to be interested in that subject and give all-absorbing interest to the next, and so forth.

Of course, we did not believe these absurdities but we arranged our efforts as though they were the ultimate ends. We gave the same lessons to all and made the same explanations to bright and dull alike. The bright pupils were often bored and the dull pupils bewildered or muddled and discouraged by inability to keep pace.

Working in the Chicago schools, J. H. Henry has convinced the advocates of individual instruction that the following statements are true:

1. Children vary in mentality as well as in physique.
2. Every child should proceed at his own rate.
3. Everyone should have an opportunity to become more easily interested in some one subject than in others.

Having in mind, then, that there are individual differences and that they should be taken into account in any method of teaching, we adapted the method to our needs, making it just as flexible as we could in a school in which promotion by subject each semester is the common method. Our conditions, therefore, were not as ideal as they would be if the whole school, or a whole grade, were given over to the method and promotions occurred when a subject was completed. In other words, the old traditional methods of school administration were used, but adaptations were made in the subject of mathematics to account for individual differences.

Our procedure was to make the subject wholly individual after the first few days' explanation as to how the plan would work and how to attack the first set of exercises.

In the Nine B Grade, three or four days were used for building up a foundation for signed numbers before addition of signed numbers and checking was attempted. In the Nine A Grade, two or three days were used for reviewing graphical solutions of equations and recalling previous information for use in solving similar linear equations graphically. When this had been done, the pupils were told what exercises were to be handed in for credit. A great number of pupils were unwilling to wait until the assignment was given, but would inquire individually about the first exercise and would then proceed to work it. From the time when the exercise was given to the class, each pupil's work became individual as to checking work, explanation, and next assignment.

Pupils would appear after the first assignment with any number of problems worked, from part of one to a whole list of ten, twenty, or thirty problems, the extra large number often including a second exercise worked correctly from the explanation found in the book.

Our plan on the second day was to pass out tests for those having covered the first assignment, and to help immediately those with the fewest problems solved. Those ready for more advanced work were shown or directed to the explanation and assistance given as needed to make clear the process. Tests were made for small units of work, so that if failure were encountered in any unit, the repetition of it involved only a small amount of work. The grade for passing a test in a unit of work was set at 90 per cent. Failure to pass a test meant that the work must be repeated or another set of similar exercises given; and when handed in and checked and corrected, a new test was handed to the pupil. This process involved the making of numerous tests to prevent familiarity with problems and answers. For this purpose, assignments were given in most cases orally or written. When the assignments are long and somewhat difficult to make, mimeographed sheets are useful. On the other hand, extra work for *G's* and *E's* should not be presented too often to students. Such a policy would cause them to stay too long on one exercise.

Under this plan, each pupil progressed at his own rate—his progress was not hurried nor retarded by others. When he failed, the failure was his direct responsibility, and with the teacher's suggestions he was helped to master his difficulty. In a short time, he had learned to form the habit of success by correcting his mistakes instead of the continued habit of failure resulting from multiplied errors in carelessness.

At first, nearly all the assignments were the same for all pupils, with advanced work at the end of a semester or during the semester for the more advanced pupils. This plan was, however, changed to a much more successful plan of having contracts on each exercise to represent *E*, *G*, and *F* work. This method served the purpose of spurring each individual to a greater capacity in accomplishment and overcame the tendency of some pupils to lag at times.

The work, by being individual, overcomes many remote difficulties that the teacher never even discovers by any other method. Individual instruction is often a true revelation of the previous training, experience, and habits of the pupil. A teacher finds out as in no other method that an explanation must be clear and forceful in order to carry across to the child. A teacher can tell often by the individual's reaction which explanations are successful and which are not. There is no necessity for waiting to see how many problems will be presented.

In order to proceed far with the work, the pupil must understand the previous work. There can be little or no haphazard learning, with Individual Instruction, if constant progress is to be maintained. Each individual does his own work for the reason that each is interested in his own progress, and no two are at the same place. Thus, there is no home work to copy and, besides, more of the work is done under the teacher's supervision in class and not at home with parents to aid and assist. If they do help occasionally, the pupil is still responsible for his test. Individual instruction provides a real place to do supervised study. The whole period is devoted to this method daily and excellent study habits are usually formed.

Pupils under the plan become self-helpful. They learn the study habit. They can take the book explanation and from it dig out the facts necessary to proceed with their work. They are often put on their own resources if at home or away from the teacher, or even in class if the teacher is busy and they get ready for the next assignment. They will often tackle it alone and pick out the necessary facts. I cannot make this point too emphatic, for if I had found nothing else in this method but this one point, I would still consider the method successful. Any method that can bring the present-day pupil up standing and make him rely on his own resources and find in himself the power to do instead of having it all explained away by the teacher certainly has a place for itself in the school category. If we still assume that a fundamental principle of education is self-activity, then it is time we had more pupil activity and less teacher activity.

This method changes very largely the attitude of many pupils from that of working for the teacher to that of working for the pupil's self. It is his record that the pupil sees and the one in which he is interested. The attitude now is, "How much can I do in this period?" instead of, "How much can I get out of doing?" There is an increased incentive to do maximum instead of minimum work. The pupil's attitude becomes that of one who says, "We want maximum pay, but for it we are willing to do maximum work."

Order and discipline are seldom, if ever, encountered in individual instruction, and attention to detail is unusual when any part of a process is being explained. The questions are surprisingly accurate and to the point, and many pupils have appeared before me with the statement, "I understand all of this explanation but this one point." Under the old plan, we have often left pupils to discover points in an explanation, but most often without successful results.

There is developed in individuals the attitude and spirit of "I can," a willingness to attempt and try,—another outstanding landmark against their former attitude of "I can't" and "There is no use trying." It removes the lock-step method of jumping the stream when all were not ready and of retarding the brighter and accelerating the slower pupils —a most brutalizing process. It brings home to the pupils that mastery is possible even in those who lack a keenness for mathematics. Mastery can be accomplished by any not feeble-minded if the time be extended to suit their needs. A pupil is brought to the realization that there is no real progress without mastery, and the sooner he has mastered a unit the faster he proceeds. A difference in the habit and outlook of the pupil is formed. Instead of an unsuccessful outlook in mathematics, he points to the fact that he has succeeded thus far and he expects to continue to his success. Under the old class method, failure is often felt by a pupil when the class jumps from one exercise to another when the pupil does not understand either.

The number of promotions was increased under this plan. Example: that of a 9A class with eight repeaters. Only two failures—and those due to absence and sickness. Two other classes—9B's: no failures. These pupils had previous experience in 8A mathematics, with individual instruction. Absence from school is no longer an excuse for failure, as individual work permitted many pupils to keep up in their class although out for several days or weeks.

Under the present plan of contract work, there has been much incentive to do *G* and *E* work instead of just "getting by." There was also a great amount of interest developed in the subject in a pupil who had heretofore hated the subject because of being forced to work problems.

Among some of the more useful of the results may be mentioned the fact that it developed a true responsibility for success or failure (placing it where it belongs)—on the pupil and not on the teacher. If failure were imminent, no pupil had to be warned of the fact. The pupils put forth extra effort in order to "come under the wire" for grades and promotion, without urging by the teacher. Many even asked for extra periods in order to complete work up to the median for the group. Pupils learn that true progress is related directly to effort. Class method does not bring the pupil face to face with progress in such a direct way as under the individual method. Even the dullest soon comes to understand that the next day's task will be held up by the unfinished task of today.

Useful results might be listed as follows:

1. The individual method puts plan and method into the work, but destroys methodical, monotonous routine teaching. Lesson and tests must be planned days and weeks ahead, thus doing away with haphazard plans. There is little or no monotony or routine in individual instruction. Every child has a different problem, a different situation, or the

same problem or situation from a different angle. As children differ so do their problems.

2. Transfer of pupils from class to class becomes easy in a subject where the teachers use the individual method. Each child proceeds from his present goal to the next in order. No time is lost and no repetition is made.

3. Substitute teachers find it extremely easy to proceed with such carefully planned work.

4. No longer is valuable time wasted in mass teaching where the teacher may do 80 per cent of the talk or work and the pupils 20 per cent.

5. Individual Instruction brings quicker and more lasting results.

Experiments at Winnetka with reading scales have shown that individual instruction produced better results and more progress. Experiments by C. N. Stokes on mathematics, in the New Trier Township High School, in Winnetka, Illinois, in the ninth grade, with a low *C* group as compared with a *B* group, have shown that a low *C* group (on Individual Instruction) rated higher in problem-solving abilities by a wide margin, and in the number and correctness of problems solved.

The results with the pupils have also justified the method. Pupils who have once tried the method are overwhelmingly enthusiastic about continuing it. This, too, in spite of the fact that they must work harder and more carefully and that this method gets the lazy ones singled out immediately.

Here, too, we can only account for the change in attitude of the pupil to accept greater responsibility in terms of heightened interest.

These results show further that, while the I.Q. is a factor to consider when teaching children, it is only one of many, and that to teach an individual requires that we break down this lock-step shell and take into account the individual ability, capacity, rate of learning, nature, sex, previous experience, training, former incorrect impressions, prejudices, inheritance, and will power, as well as other factors influencing the learning rate. (When we consider the individual as an individual and teach pupils as individuals and not as members of a group all to be molded alike, it appears that many of the old problems may fall before us.) Our giant does not suffer the slightest from the operation, and what immense good we do!

A SUGGESTED COURSE OF STUDY IN MATHEMATICS FOR HIGH SCHOOLS

J. R. Hitt.

Clinton, Mississippi

For a number of years we have been discussing the course in mathematics for high schools with two principal objectives in view: first, to bring about a better correlation among the different high school courses themselves, and second, to secure some more tangible point of contact between high school mathematics and college mathematics.

This question was first taken up by the college men who were seeking to find out what might be done from the high school end of the line in order to reduce the large percentage of failures in freshman college mathematics. The high school men, and educational leaders in general have taken a hand, but thus far there has been considerable divergence of opinion, and little has been accomplished. In fact, the question of the reorganization of the entire high school curriculum is now one of wide interest, but at the same time one far from final solution.

There are those who believe that "unified" or "correlated" courses in the high school mathematics, if generally adopted, would prove to be very helpful. However, the writer is not one of those who take enthusiastically to such courses. They will never solve the high school-college problem. We believe it is best to hold in the main to the courses as now given in our high schools, with such minor modifications and readjustment as might prove advantageous. Certainly, we are all agreed that better preparation of the teachers, both college and high school, would bring about much improvement in the present situation.

Below is submitted as a suggestion a high school course in mathematics. This is substantially the course given for a number of years by the writer when he taught mathematics in the high schools.

Course:	Year	Units	Term
Elementary Algebra	9	1	
Plane Geometry	10	1	
Advanced Algebra I	11	1	
Solid Geometry	12	½	1st
Advanced Algebra II	12	½	2nd
Advanced Arithmetic	12	½	1st or 2nd
Trigonometry (op.)	12	½	2nd or 1st

This course, with the exception of plane trigonometry, was required of those preparing to major in college mathematics. The trigonometry was sometimes given to a group that showed exceptional aptitude for mathematics.

There will be objections offered to this scheme. Does it devote too much time to algebra? Most colleges would perhaps allow not more than two units of algebra on entrance credit, yet in view of the fact that algebra is the foundation for all college mathematics, and in view of the further fact that the great majority of freshmen failures in college are due to a lack of proper preparation in this one most essential branch, it does seem that the apparent undue stress put on the subject in the above program is justifiable. This leads us up to the point of saying something else that may not be in exact accord with modern ideas and tendencies.

For sometime we have had a growing conviction that there is a too marked tendency to sacrifice intensiveness for extensiveness in the high school curriculum. The high school student well prepared in English, Latin, and mathematics, especially algebra, will meet little difficulty in taking his college course. Besides that, supposing that he does not attend college, it is our conviction that he is better prepared for meeting the issues of life than is the student who has dipped only superficially into so many different things that he hardly knows what it is all about, having failed to develop the power of concentration and independent thought for himself that should be the end of every scheme of education.

Finally, it may be remarked that this arrangement of courses in algebra ought to be preferable to the present plan as found in most high school courses, in that it avoids the two-year period during which the student is given no work at all in algebra. Some would prefer to omit the course Advanced Algebra I, and give one or two terms of advanced algebra during the last year of the student's high school work. This arrangement is doubtless preferable to the older plan of giving all the algebra in the first two years, at least from the standpoint of the college teacher. But the two-year gap this would leave between the elementary course and the advanced course is very objectionable. With the above arrangement the teacher has ample opportunity in the last course not only to review briefly the student's previous work, but he may introduce topics that will enable the student to find a much better point of contact between his high school and his college mathematics.

THE HIGH SCHOOL CURRICULUM

BY C. D. RICE

The demands of thought and culture of a people should find an expression in educational aims and ideals. This should be true, especially, in secondary education. But on account of the great number of teachers and students involved secondary education follows rather than leads in the thought of the times. To often it lags far behind. This is true of all countries, but in a democratic country like ours the inertia of the masses is still more striking. Here we have a large body of teachers connected with a still larger number of students passing through a certain immature stage of development. In this phase of education, leadership in the main must come from those working in the higher institutions of learning or those whose inspiration is received from such institutions.

The methods of the average teacher depend to a large extent upon the way in which he has been taught. The great body of teachers that come under this class cling to the old methods, the old subjects and the old texts, and here again we find the inertia that pulls against progress. In general we may say that good teaching is the result of the experience and effort of many and is, so to speak, an inheritance. For this great body of teachers we should not change our curriculum too rapidly. Changes made too often are made at the expense of good teaching. We must advance but not more rapidly than our teachers. A new course of study cannot be set up by any one man. It must be a growth. A radical change may be a success in the hands of some one man, but a decided failure with the great majority.

There are still those who contend that at the high school age, mental discipline must be the principal aim. Such people rarely ever see mental discipline in a curriculum recent or modern. They wish to retain the old and oppose any change. This reactionary influence has done much to separate us from the problems of real life and the scientific spirit of the time. If it were a matter of mental discipline only, we would not worry about a change in curriculum. But there is a growing conviction that besides a mental discipline, the acquisition of a useful body of knowledge is also an important part of education. The Greeks long centuries ago had a perfect mental discipline in the study of geometry. But many of us believe today that a pupil may spend years in the discipline of the Greeks and not be able to attack a modern problem. This is not said in defense of a purely utilitarian theory of education, but with the belief that we should not turn a deaf ear to our civilization, its problems and its claims.

In Europe, where the different countries have a more or less centralized control of secondary education, it has been possible to bring about certain reforms and revisions in a more effective way than is possible in our country. And, yet, with this great advantage they still feel that there is much to be done. They have their reactionary spirits that believe in mental discipline only, and that such discipline is possible with the old and not with the new. Modern industrial conditions, however, have brought about many changes in curricula and the more recent subjects and methods are finding their way into the secondary schools. On account of having fewer secondary schools for a given population, it has been less difficult to supply the call for teachers and at the same time make a demand for a much more thorough preparation on the part of their teachers than we have been able to make in this country where the spread of the secondary school has been so rapid.

The advance in modern mathematics has made possible the great industrial advance of the present century. Each forward step in scientific and engineering fields has been made side by side with the mathematical expression of the principles involved. With this advance we should expect some change in the viewpoint of the secondary teacher and the methods used. There must of necessity be a change in content and arrangement of curricula. Certain subjects that formerly appeared important become irrelevant. New and more direct routes from lower to higher will be mapped out. With this growing demand for change we know that we must face the conservatism so characteristic of this phase of education. While it may be better to follow in the wake than to run too far ahead, shall it be said that the high school curriculum is the only "unchangeable thing in the world." The activity that we now find in many of our best city systems is an answer to this challenge.

SOLID GEOMETRY

C. E. Rowe

Associate Professor of Drawing, University of Texas

The entrance requirements for engineering and architecture in the University of Texas are somewhat different from those of the College of Arts and Sciences. Practically every American school of engineering or architecture requires solid geometry for entrance. This has been a requirement in the University of Texas for several years, but the information has probably not reached all of our high schools. About 50 per cent of those entering the freshman class in the School of Engineering in the University of Texas come without any knowledge of solid geometry. Some of them state that they were advised by their high school authorities that they would have no need for solid geometry in the University of Texas. Such advice has been harmful in many cases. In order to meet the unfortunate situation half-way, the University has accepted such students conditionally and requires them to take solid geometry in the freshman year. This work is done without gaining any degree credit and too often it requires much of the student's time that should be given to his regular work. This practice of giving solid geometry in the University of Texas to engineering students is a temporary arrangement only and is far from satisfactory to either the faculty or to the students, and will be abandoned as soon as possible. Any high school graduate who decides to enter the School of Engineering should review his solid geometry and in case his high school diploma was given without solid geometry he should study the subject during the summer before coming to the University.

Training in solid geomety is needed for three of the subjects studied in the first year of engineering, namely: drawing, descriptive geometry and mathematics. It is true that the deficiency in solid geometry may not be felt in mathematics until the sophomore year, but it is felt seriously in the very beginning of the freshman year in engineering drawing and again the lack of a knowledge of solid geometry is felt in the second half of the freshman year in descriptive geometry. This last named subject is probably the most difficult work of the first year in engineering and the student should not come to the University with this serious handicap in his preparation. Teachers interested in the success of their pupils who are to come to the University are begged to advise them on this point. The time necessary for the study of solid geometry in the University is a serious loss to the first-year student who is working for a good record in his studies. The University has no desire to teach the subject and believes it belongs properly in the high school.

Solid geometry offers fine training in the visualization of space relations of points, lines and planes. It is probably the first subject studied which trains the student to "think in space." The ability to visualize clearly is the first qualification of the engineer and architect. Those who expect to study for these professions should begin to develop this faculty in the high school.

It is also important for an engineering student to be familiar with solids and their dimensions. It would be ridiculous for a student of engineering to have no knowledge of the rules of computation of the familiar solids, surfaces, with which an engineer has to deal. Many of those who come to the University to study engineering not only have no such knowledge, but they do not even know the names of the solids. They do not know the difference between a prism and a pyramid. They do not know how to distinguish between a right and an oblique cylinder. Such terms as "lateral edge," "lateral surface," etc., are totally unknown.

We, therefore request teachers in our high schools to determine those of their pupils who expect to study engineering and to give them the proper advice regarding this matter.