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Scope of Study: This report is a comparison comprised of two methods of determining the location of the decimal points in slide rule determined answers. These methods are the digit count method, which uses non-mathematical terms, and the logarithm characteristic method, which uses mathematical terms. In this report the operations and rules, for determining the answers and location of decimal points to problems solved on the slide rule, are given for multiplication, division, squaring a number, extracting square root, cubing a number, and extracting the cube root. It also gives some of the things to be taken into consideration when preparing to teach slide rule in the high school. This report does not include sample problems, examples, or illustrations of how to use the slide rule.

Findings and Conclusions: There is very little advantage to the use of either method over the other, if each is used under the proper conditions. The digit count method is excellent for the teaching of younger or weaker students. The logarithm characteristic method is more desirable when teaching more advanced students.

ADVISER'S APPROVAL James H. Zant

THE TEACHING OF THE SLIDE RULE
IN THE HIGH SCHOOL

By

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PREFACE

This report is intended to give a clear and concise set of rules for the location of decimal points in the answers of problems solved on the slide rule. The teaching of slide rule is considered by the author to be incomplete if the student can not locate the decimal point in his answer correctly. It is also a desire of the author to place before any teacher who wishes to teach slide rule in the high school an accurate set of procedures for the fundamental operations of the slide rule. It has been the pleasure of the author to see the increased interest in the instruction of the slide rule in the high schools of Texas in the last ten years. It was from a mathematics teacher in high school who did a fine job of teaching the slide rule that the author developed an interest in the teaching of the slide rule. The author is proud to say that in three years of teaching he has inspired several students to have an interest in the slide rule and to be able to use it with some skill.

In writing this report the author has found it necessary to become acquainted with several methods of locating the decimal point. Many of these methods involve an estimation of where the decimal should be located, or after the digits of the answer have been determined, the numbers then are rounded off and the operation done again mentally. These methods are time consuming and sometimes inaccurate. Of course, a person who has been using one of these methods for years achieves good results and will think that a set of rules just complicates the operation. However, the rules in this report are for the beginner, who is not an "old hand" at the slide rule.

The author wishes to acknowledge the assistance of Dr. James H. Zant, Director of the Academic Year Institute, and the National Science Foundation for its stipend which made this study possible.

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CHAPTER I

INTRODUCTION

The purpose of this report is to discuss the teaching of the slide rule in the high school. It does not attempt to give a definite method of teaching the slide rule, but rather it points out some of the problems and gives some possible solutions to these problems. A high school teacher who tries to teach slide rule soon will find the right combination of these solutions to meet his particular needs.

In preparing to teach slide rule in high school, there are a number of things which must be taken into consideration. Some of these are the following: the grade level of the students to be taught; when and how much time is to be spent on the subject; the type of slide rule to be used; processes to be covered; and the procedures to be used in these processes. It can be seen easily that there is some overlapping and that these factors must be considered as a group rather than individually. One quickly realizes that each school system and locality must make decisions on the various items listed to best fit the local situation. The situation involved in this report will be that of a high school which has about 350 pupils enrolled in the ninth through the twelfth grades. The slide rule is to be taught in a club, which meets once or twice a week, or possibly in a science or mathematics class, within a period of about two weeks.

When taking into consideration the grade level of the students to be taught, one must consider the mathematical background and the interests of the students. If the slide rule is taught in a mathematics or science class, the students will have had about the same background, and this will simplify this consideration. If it is to be taught to students of all grade levels where the backgrounds are varied, as would be the case in a club, one must use a method which will not kill the interest of the younger or weaker students and, at the same time, must not bore the more advanced students. If some form of competition can be started and maintained, the interest of the students may remain high. This is always desirable.

The time to be spent on the slide rule is often a limiting factor when being taught in a science or mathematics class where more basic concepts of the course are of equal importance. If by omitting some basic material the student may be placed at a disadvantage, the time may be considered by some as wasted. In a club the only limitation on time spent is the length of the meetings, which may be only thirty minutes once a week. Also, if more than one club meets the same day, the group of students may vary from one meeting to another. This can cause the failure of a club. It must be remembered that the club is optional in many schools and that a student may belong to two clubs or none.

The type of slide rule used is not of great importance, but all students should have about the same type to avoid confusion. If the cost is high, it might prevent some students from participating. "A 10-inch Mannheim slide rule is the most widely-used type of slide rule; it is simplest and easiest to master, . . ."[1] This slide rule has only the following scales: C, D, A, B, CI, and K on the front and may have S, L, and T on the back.

In general the processes to be taught are those which will be of everyday use such as multiplication, division, squaring, extracting square roots, cubing, and extracting cube roots. In advanced groups where a knowledge of trigonometry is known, the sine and tangent scales can be taught.

There are four major errors which occur while a student is using the slide rule, according to Dr. Carl N. Shuster. He makes the following statements:

> An analysis of the answers to more than 27,000 examples worked on the slide rule show that four classes of errors included a very large percentage of all common slide rule errors (about 93%). These common errors are: (a) errors in locating the decimal point in answers, (b) errors in estimating the third significant figure of the answers, (c) zero errors and (d) errors in reading the tertiary slide rule graduations. Ten other

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[1] Charles O. Harris, Slide Rule Simplified (Chicago, 1949), p. iv.

> miscellaneous errors account for the remaining 7% of the total errors.[2]

The last three of these errors may be said to be caused by the student's not being familiar with his slide rule. It is very important that the student become familiar with his slide rule. This will prevent many errors in estimating the third digit, zero errors or errors in locating the number, and errors in reading the slide rule in general. Practice is the only way a student can become familiar with the slide rule. It is not the purpose of this report to try to say how much practice is needed, because this will vary with the student. This leaves only the first class of errors, those in locating the decimal point in the answers. For this reason this report will discuss two practical solutions of this problem of locating the decimal point in the answer. These two solutions involve the use of the "digit count"[3] and the use of the logarithm characteristics. These solutions will be described in detail in the next two chapters. It is the purpose of this comparison to give a better understanding of the operations of the slide rule and the location of the decimal point in these operations.

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[2]Carl N. Shuster, A Study of the Problems in Teaching the Slide Rule (New York, 1940), p. 93.

[3]Harris, p. vi.

CHAPTER II

THE DIGIT COUNT IN THE LOCATION OF DECIMAL

When teaching slide rule to students at the ninth grade level, or to those who have taken very little mathematics, it is an advantage to use non-mathematical terms. Even though mathematics should not be difficult for them, they already may have a dislike for it. This will cause them not to try as hard as they might otherwise. By using terms not associated with the mathematics taught at a higher level, it is possible to encourage them at the very beginning. This may very well save some good slide rule student who would otherwise not make the effort or would stop trying to learn the use of the slide rule at any early stage in training. To save those students who lack the ability to learn mathematics quickly is the goal of all good mathematics teachers.

Since the slide rule is based on logarithms, it is a natural tendency to want to use logarithm characteristics. However, many students have heard someone complain about logarithms while taking the second year of algebra. What term can be used which could be defined similarly to the logarithm characteristic? When this term is coined, it will greatly help the teaching of slide rule to the weaker students. The term "digit count," as used by Dr. C. O.

Harris,[1] fills this need. The digit count is defined and explained by Dr. Harris as:

> The digit count for one or a number greater than one is the number of digits to the left of the decimal point in the number. . . . The digit count for any number less than 0.1 is a negative number, and is numerically equal to the number of zeros at the right of the decimal point and between the decimal point and the first digit of the number.[2]

This can be introduced without any reference to logarithms. Thus one of the stumbling blocks has been removed, and there is a satisfactory way of determining the location of the decimal point. It is true that this requires a different set of rules than those required when using logarithm characteristics, but they are no more difficult to learn and are just as accurate.

Multiplication

In the process of multiplication, the C and D scales are normally used, by setting one index of the C scale over the multiplicand on the D scale and the hairline of the runner over the multiplier on the C scale. Then the answer is read on the D scale under the hairline. Since there are two indices on the C scale, either one may have to be used in order to complete the process on the D scale. This means

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[1] Charles O. Harris, Slide Rule Simplified (Chicago, 1949), p. vi.

[2] Ibid., p. 50-51.

there will have to be a rule for determining the location of the decimal point for the product according to the index used. It is easily seen that, if the right index is used, the slide will extend out the left end of the stock of the slide rule. Also, the reverse is true. If the left index is used, the slide will extend to the right of the stock of the slide rule. With this in mind, the following rules for multiplication may be stated.

1. When the slide extends to the left, the sum of the digit count for the multiplicand and the digit count of the multiplier equals the digit count for the answer.

2. When the slide extends to the right, subtract one from the sum of the digit count for the multiplicand and the digit count for the multiplier to get the digit count for the answer.[3]

It will be shown in the following chapter that one is added to the characteristic, when the slide extends to the left instead of one being subtracted from the digit count, when the slide extends to the right. Since this is true, it will permit a student who knows nothing of logarithms to use the slide rule with accuracy and speed.

Division

Division is the inverse process of multiplication in common mathematics. It is also an inverse operation on the

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[3]Ibid., pp. 52-53.

slide rule. That is, the hairline of the runner is set over the dividend on the D scale, and the slide is moved so that the divisor on the C scale is also under the hairline of the runner. The answer is read from the D scale under the index of the C scale. Once again, it will be noticed that either index of the C scale may be the one indicating the answer, and the other will extend from the stock of the slide rule. There must again be two rules for the location of the decimal point which are:

1. When the slide extends to the right of the stock, the digit count for the answer is one more than the digit count for the dividend minus the digit count for the divisor.

2. When the slide extends to the left of stock, the digit count for the answer is equal to the digit count for the dividend minus the digit count for the divisor.[4]

There is one exception to this first rule; it is when the dividend is a multiple of ten. In the case of the dividend being a multiple of ten, the second rule will apply without regard to the direction the slide is extending from the stock. This also gives a method of teaching slide rule without reference to logarithms which has its advantages while teaching slide rule to a group of weak mathematics students.

[4]Ibid., pp. 70-71.

The Square of a Number

The operation of squaring a number involves the use of a new scale. This may be either the A or B scale. One of these scales and either the C or D scale will be used in the operation of squaring a number. On the ten-inch slide rule recommended for use of high school students, the D and A scales occur on the stock, and the C and B scales occur on the slide. Since the operation requires only the movement of the hairline of the runner, it is advisable to use both fixed scales on either the stock or the slide. This will prevent possible errors caused by not having the indices on stock and slide lined up properly.

The process of squaring a number is accomplished by setting the number to be squared on the D or C scales under the hairline of the runner and reading the answer under the hairline of the runner on the A or B scales, respectively. The A and B scales are single scales made up of two scales going from one to ten, on the left half of the scale, and from ten to a hundred on the right half of the scale. There is a rule for locating the decimal point for each half of the scale. These may be stated as follows:

1. When the square of the number is read in the left half of the A scale, multiply the digit count for the number by two and subtract one. The result is the digit count for the square of the number.

2. When the square of the number is read on the center index or in the right half of the A scale, multiply the digit count for the number

by two. The result is the digit count for the square of the number.[5]

These same rules will apply to the B scale for locating the decimal point.

Extracting the Square Roots

The operation of extracting the square root is the reverse operation of taking the square of a number. In extracting the square root of a number, it is very important that the correct half of the A or B scale be used. If the number has an odd digit count, it should be located on the left half of the A or B scales. But if the number has an even digit count, it should be located on the right half of the A or B scales. This is a normal line of reasoning if it is remembered that the left half of the scale is from one to ten and the right half of the scale is from ten to a hundred or some multiple of one hundred times these ranges.

The process of extracting the square root of a number is to set the hairline of the runner over the number on the A or B scale and read the answer on the D or C scale under the hairline of the runner, respectively. There are two rules for locating the decimal point, as the number may be located on either half of the A or B scales. These rules for the location of the decimal point may be stated as follows:

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[5] Ibid., p. 110.

1. When the digit count for the original number is odd, add one to the digit count and divide by two. The result gives the digit count for the square root.

2. When the digit count for the original number is even, divide the digit count by two. The result gives the digit count for the square root.[6]

These rules will apply to both the A and B scales. The reason for having two scales from which the square root or square may be obtained is to increase the speed of operation if the problem requires a combination of operations. It will be remembered that speed in obtaining an answer is one of the main purposes of knowing how to use the slide rule.

The Cube of a Number

In cubing a number, the D scale will still be used but with the K scale. Both the D and K scales are on the stock of the slide rule. This means that only the hairline of the runner will be moved. The K scale is actually three scales in one. The ranges of these three scales are from one to ten on the left third of the K scale, ten to a hundred on the center third of the K scale, and from a hundred to a thousand on the right third of the K scale or some multiple of a thousand times these ranges.

The process of cubing a number is to set the hairline of the runner over the number to be cubed on the D scale and

[6]Ibid., p. 115.

read the answer off the K scale under the hairline of the runner. This means that the answer may occur on any third of the K scale. Therefore, there will be three rules for location of the decimal point when cubing a number instead of the two as in the case of the other operations discussed in this report. These three rules for locating the decimal point may be stated as follows:

1. If the cube of a number is located in the left part of the K scale, the digit count for the cube is equal to two less than three times the digit count for the number.

2. If the cube of a number is read in the center part of the K scale, the digit count for the cube is one less than three times the digit count for the number.

3. If the cube of a number is read in the right part of the K scale, the digit count for the cube is exactly three times the digit count for the number.[7]

Extracting the Cube Root

The operation of extracting the cube root of a number is the reverse operation of cubing a number. In extracting the cube root of a number, it is very important in which third of the K scale the number is located, because a number can only be correctly located in one of the thirds of the K scale. In determining which third of the K scale to locate the number, divide the digit count of the number by three,

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[7]Ibid., p. 144.

and the remainder will indicate the correct third of the K scale. If the remainder is a positive one or a negative two, the number is located in the left third of the K scale. If the remainder is a positive two or a negative one, the number is located in the center third of the K scale. If the remainder is zero, the number is located in the right third of the K scale. It will be remembered that the ranges for the three parts of the K scale are the left third from one to ten, center third from ten to one hundred, and the right third from one hundred to one thousand or a multiple of a thousand times these ranges.

The process of extracting the cube root of a number is to set the hairline of the runner over the number on the K scale and read the answer under the hairline of the runner on the D scale. Since the number may be set on any one of the three parts of the K scale, there must be three rules for the location of the decimal point in the process of extracting the cube root of a number. These three rules may be stated as follows:

1. If the original number is located in the left third of the K scale, the digit count of the cube root is equal to the digit count of the original number plus a positive two divided by three.
2. If the original number is located in the center third of the K scale, the digit count of the cube root is equal to the digit count of the original number plus a positive one divided by three.

3. If the original number is located in the right third of the K scale, the digit count of the cube root is equal to the digit count of the original number divided by three.

The operations, which have been described and explained in this chapter, are the only operations of the slide rule that may be taught without bringing in mathematics with which students of the ninth grade are not familiar. If this much can be taught, then students with sufficient practice can become very proficient with the slide rule.

The rules explained in this chapter are simple and easy to understand. The student who has a fear of mathematics may find an interest in slide rule even if he will not attempt other forms of mathematics. He might not even think of slide rule being related to the subject he is trying to avoid. In learning the use of the slide rule, he will have a useful tool which may help him the rest of his life. It is also true that through his work with the slide rule he may overcome his fear of mathematics. These simple rules may go a long way in the development of the student in his thinking toward mathematics.

CHAPTER III

THE LOGARITHM CHARACTERISTIC IN THE LOCATION OF DECIMAL

The use of logarithm characteristics in the location of the decimal point in problems solved on the slide rule is a basic concept regardless of how it is disguised. The operations described in Chapter II will again be presented using the logarithm characteristic instead of the digit count.

What is a logarithm? What is a logarithm characteristic? These are questions which the student must ask and must understand the answers to before he can use logarithms in determining the location of the decimal point while using the slide rule. The slide rule as an outcome of logarithms is a very useful way of showing how a part of mathematics, thought by many students at the high school level to have no practical use, is of practical use. The student learns in second year algebra, or later in trigonometry, that a logarithm is defined as:

> The exponent of the power to which a given number called the base must be raised to equal a second number is called the logarithm of the second number.[1]

[1]William A. Granville, Plane Trigonometry (Boston, 1943), p. 105.

This means that any number may be expressed in terms of another if the correct exponent is used. The base of common logarithms is ten. Therefore, any number located on the slide rule will have the same location as any multiple of ten times the original number. This brings up the question of how the distinction is made between multiple of ten times a number. It is answered by the logarithm characteristic of the number. This characteristic may be defined or explained by the following statements:

> The characteristic for a number greater than unity is positive, and one less than the number of digits in the number to the left of the decimal point.
>
> The characteristic for a number less than unity is negative, and is one greater numerically than the number of zeros between the decimal point and the first significant figure of the number.[2]

These statements take care of all numbers except unity itself which has a characteristic of zero. By using this characteristic, which tells what multiple of ten the number located on the slide rule should be multiplied by, will give the location of the decimal point in the answer. When the student has a good understanding of logarithm characteristics, he is ready to learn the simple operations of the slide rule.

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[2]Ibid., p. 111.

Multiplication

The process of multiplication is the same regardless of the method of determining the location of the decimal point. The processes described in the previous chapter will be repeated for clarity while discussing the procedure in locating the decimal point. The operation of multiplication on the slide rule involves the use of the C and D scales. One index of the C scale is set over the multiplicand on the D scale and the hairline of the runner over the multiplier on the C scale. Then the answer is read on the D scale under the hairline. The location of the decimal point will be determined by the following rule:

> The characteristics of the product of two numbers is the sum of the characteristics of those numbers (the characteristic of the second factor being increased by unity if the slide extends to the left).[3]

This rule takes into consideration that the slide may extend either to the right or left just as the rules for the digit count method did. This rule may seem easier to remember because it is shorter, but it must be remembered that any set of rules may be stated in a more compact form if this is desired. In a comparison of the rules of the two methods of determining the location of the decimal point, there is very little advantage for either method.

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[3]E. L. Eagle, "Decimal Point and Slide Rule Answers," *Mathematics Teacher* (December, 1952), p. 573.

Division

The operation of division is to set the hairline of the runner over the dividend on the D scale and move the slide so that the divisor is also under the hairline of the runner on the C scale. The answer is read from the D scale under the index of the C scale. It will be noticed that either index of the C scale may be the one indicating the answer and the other will be extending from the stock of the slide rule. The rule for the location of the decimal point in the answer of a division problem may be stated as:

> The characteristic of the quotient of one number divided by another is found by subtracting the characteristic of the divisor from the characteristic of the dividend (the characteristic of the divisor being increased by unity when the slide extends to the left).[4]

There is also an exception to this rule, as there was to the digit count method rule in the foregoing chapter. This exception is when the dividend is a multiple of ten. When the dividend is a multiple of ten, the divisor always will be treated as if the slide extended to the left. The fact that this is the same exception as was found in the other method does not give either method an advantage over the other.

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[4]Ibid., p. 573.

The Square of a Number

The operation of squaring a number involves the use of a new scale. This may be either the A or B scale. One of these scales and either the C or D scale will be used in the operation of squaring a number. On the ten-inch slide rule which is recommended for the use of high school students, the A and D scales occur on the stock of the slide rule, and the B and C scales occur on the slide of the slide rule. Since the operation requires only the movement of the hairline of the runner, it is advisable to use the set of scales on either the stock or the slide. This will prevent possible errors caused by not having the indices of the stock and slide lined up properly.

The process of squaring a number is accomplished by setting the number to be squared on the D or C scales under the hairline of the runner and reading the answer under the hairline of the runner on the A or B scales, respectively. The A and B scales are single scales made up of two scales, having the ranges from one to ten, on the left half of the scale and from ten to a hundred on the right half of the scale. The theorem of logarithms for raising a number to a power states that: "The logarithm of the pth power of a number is equal to p times the logarithm of the number."[5] There are two rules which may be derived from this theorem

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[5] Granville, p. 108.

for the location of the decimal point when squaring a number on the slide rule. These rules may be stated as follows:

1. If the answer is found in the left half of the A scale, the characteristic of the squared number is equal to the characteristic of the original number multiplied by two.
2. If the answer is found on the right half of the A scale, the characteristic of the squared number is equal to the characteristic of the original number multiplied by two and increased by one.

These rules will apply to the B scale as well as the A scale for locating the decimal point for a number which has been squared. The one which was added to the characteristic of the squared number found in the right half of the A is a one which had to be carried when the mantissa of the logarithm of the original number was doubled. The mantissa of the logarithm is the decimal part of the logarithm.[6]

Extracting the Square Root

The operation of extracting the square root is the reverse operation of taking the square of the number. In extracting the square root of a number, it is very important that the number be located in the correct half of the A or B scale. If the characteristic of a number is even, the

[6]Ibid., p. 111.

number should be located on the left half of the scale. If the characteristic of a number is odd, the number should be located on the right half of the scale. This is because the ranges for each half of the scale are from one to ten on the left half which would have an even characteristic and from ten to a hundred on the right half of the scale which would have an odd characteristic or some multiple of a hundred times these ranges.

The process of extracting the square root of a number is to set the hairline of the runner over the number on the A or B scale and read the answer on the D or C scale under the hairline of the runner, respectively. There are two rules, which may be derived from a theorem of logarithms for extracting the various roots of a number, for the location of the decimal point when extracting the square of a number on the slide rule. This theorem may be stated as follows: "The logarithm of the rth root of a number is equal to the logarithm of the number divided by r."[7] The two rules for the location of the decimal point when finding the square root of a number on the slide rule may be stated as follows:

1. If the original number is found on the left half of the A scale, then the characteristic of the square root of the number is equal to the characteristic of the original number divided by two.

[7] Ibid., p. 108.

2. If the original number is found on the right half of the A scale, then the characteristic of the square root of the number is equal to the characteristic of the original number decreased by one and divided by two.

These rules will apply to the B scale as well as the A scale. The decrease of one in the characteristic of numbers found on the right half of the scale is made up in the mantissa of the logarithm.

The Cube of a Number

In the cubing of a number, the D scale will still be used but with the K scale. Both the D and K scales are on the stock of the slide rule, so the only movement needed for finding the cube of a number is that of the hairline of the runner. The K scale is actually three scales in one. The ranges of these three scales are from one to ten on the left third of the K scale, ten to a hundred on the center third of the K scale, and from a hundred to a thousand on the right third of the K scale or some multiple of a thousand times these ranges.

The process of cubing a number is to set the hairline of the runner over the number to be cubed on the D scale and read the answer on the K scale under the hairline of the runner. The answer may occur on any one of the three parts of the K scale. For this reason there are three rules for locating the decimal point when cubing a number instead of the two, as has been the case in the other operations discussed in this chapter. These three rules may be derived from the theorem of logarithms for raising a number to a power which may be stated as: "The logarithm of the pth power of a number is equal to p times the logarithm of the number."[8] From this theorem the following rules for the location of the decimal point when cubing a number may be derived.

1. If the answer is found in the left third of the K scale, the characteristic of the number cubed is equal to the characteristic of the original number multiplied by three.
2. If the answer is found in the center third of the K scale, then the characteristic of the number cubed is equal to the characteristic of the original number multiplied by three and increased by one.
3. If the answer is found in the right third of the K scale, then the characteristic of the number cubed is equal to the characteristic of the original number multiplied by three and increased by two.

The increase in the characteristic is due to the product of three times the mantissa of the logarithm.

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[8] Ibid.

Extracting the Cube Root

The operation of extracting the cube root of a number is the reverse operation of cubing a number. In extracting the cube root it is very important in which third of the K scale the number is located, because a number can only be correctly located in one of these. In determining which third of the K scale to locate the number, divide the characteristic of the number by three and the remainder will indicate the correct third of the K scale. If the remainder is zero, the number should be located in the left third of the K scale. If the remainder is a positive one or a negative two, it should be located in the center third of the K scale. If the remainder is a positive two or a negative one, the number should be located in the right third of the K scale. It will be remembered that the ranges for these three parts of the K scale are from one to ten on the left third, from ten to a hundred on the center third, and from a hundred to a thousand on the right third of the K scale or a multiple of a thousand times these ranges.

The process of extracting the cube root of a number is to set the hairline of the runner over the number on the K scale and read the answer under the hairline of the runner on the D scale of the slide rule. Since the number may be set on any one of the three parts of the K scale, there must be three rules for locating the decimal point in the process of extracting the cube root of a number. These rules may be derived from the logarithm theorem which may be stated like this: "The logarithm of the rth root of a number is equal to the logarithm of the number divided by r."[9] The three rules derived from this theorem may be stated as follows:

1. If the original number is located in the left third of the K scale, then the characteristic of the cube root of the number is equal to the characteristic of the original number divided by three.
2. If the original number is located in the center third of the K scale, then the characteristic of the cube root of the number is equal to the characteristic of the original number decreased by one and divided by three.
3. If the original number is located on the right third of the K scale, then the characteristic of the cube root of the number is equal to the characteristic of the original number decreased by two and divided by three.

The operations which have been described and explained in this chapter included only those which were included in the previous chapter so that a comparison could be made without being influenced by including new operations. If additional operations, such as finding the sine or tangent of an angle, it would give the impression that the first

[9]Ibid.

system was incomplete or impractical for use in these other operations. This is not the case, as the first system has covered just those operations that would be desirable for the weaker mathematics student to know.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The problem in this discussion of teaching the slide rule in high school was a comparison of two methods of locating the decimal point in the answers of problems solved on the slide rule. This report briefly considered five things believed to be the most important considerations to be made when preparing to teach slide rule in high school. These considerations were: (1) the grade level of the students to be taught; (2) when and how much time is to be spent on the subject; (3) the type of slide rule to be used; (4) the processes to be covered; and (5) the procedures to be used in these processes. It was concluded that the main difficulty encountered by students is finding where to place the decimal point in the answer. To overcome this difficulty, two methods for determining the decimal point in the answer were described and explained for six operations which are profitable for most people to know. These six operations were multiplying, dividing, squaring a number, extracting the square root of a number, cubing a number, and extracting the cube root of a number. These two methods for determining the location of the decimal point in the answer were the digit count method and the logarithm characteristic method. The digit count method is a method for determining the decimal point in the answer without mentioned the basic principle of the slide rule, that is, logarithms. This method is desirable if the students who are to be taught are considered to be weak or at a low level of achievement in mathematics.

The logarithm characteristic method places the basic principles of the slide rule before the students. The rules for using this method are not of a difficult nature but require a working knowledge of logarithm characteristics. If the time will allow and the students' interest can be maintained, this method should be used. However, this method should not be used unless the students have a well developed understanding of logarithms. If it is used without this understanding, the student may acquire a dislike for mathematics and the little he learns about the slide rule's basic principles will not make up for the damage done to his mental attitude toward mathematics.

This report does not take into consideration the merits of teaching slide rule in the high school, because the slide rule is a very useful instrument in many types of business today.

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