A SCALE FOR MEASURING FREE-HAND LETTERING.

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I. PRINCIPLES AND METHOD OF ITS DESIGN.

In March, 1914, as a result of some two years' research, the writer submitted for the consideration of students of education and teachers of engineering lettering, a Scale for Measuring Free-hand Lettering. The aim of the entire study in this field has been (a) to design a scale for the measurement of free-hand lettering which can be efficiently used by teachers and students of engineering drawing, both in secondary and higher technical schools; (b) to so further the standardization of the teaching process in engineering lettering that practically all students might be enabled to develop all necessary skill through such incidental training in lettering as can ordinarily be given in the usual course in mechanical drawing. The opportunity is now presented of stating briefly the principles of design of such a scale, together with a preliminary critique of its use by teachers and students in the classroom.

The Function and Necessary Criteria of a Scale in Lettering.

1. The scale should be designed to be a definite classroom aid to both teachers and students of lettering in higher and secondary technical schools.

2. It should aid the instructor by enabling him (a) definitely to evaluate samples of student lettering and to assign them numerical grades; (b) to judge of the rapidity of a student's progress as compared with that of an average class using the Standard Method; (c) to solve more easily the daily difficulties encountered by his students; (d) to foresee the pitfalls in the development of skill in lettering by students of varying grades of ability and to devise methods of avoiding

them; (e) to know the effect of the "time" element on the development of skill of various types of students.

3. The scale should aid the student by enabling him numerically to grade his own lettering product; to compare his rate of progress with that of a normal class having the same previous training; more accurately to detect his errors in technique; to know the most efficient rate of speed to follow at various periods throughout the semester.

4. To accomplish these aims, any efficient scale must fulfill the following conditions: (a) It must be a numerical measure; (b) it should be based on an absolute system of marking alike for all samples used; (c) it should be made up of samples obtained under normal classroom conditions using the method suggested; (d) the samples should be arranged by equal intervals for the entire range of ability found in a normal class; (e) it should be easy to use and adaptable to any secondary or college class in mechanical drawing.

How This Scale Was Designed.

A. The Form or "Copy."

To obtain representative samples of student lettering a standard form or "copy" was required based on the principle that the frequency of letters in the form should be in proportion to (a) the relative difficulty of execution of the letters of the alphabet, (b) the frequency of their occurrence on representative engineering drawings. (For a complete description of the design of the form see the original descriptive pamphlet and Scale. These may be secured on request from the writer.) Since the data based on the principle of "letter difficulty" were not at hand, the design of the form was based on the principle of frequency of occurrence of letters on engineering drawings.

B. Securing the Samples for the Scale.

The form mentioned was designed and adopted for use in 1913 in all the sections of the Department of General Engineering Drawing, University of Illinois. Beginning with the second day of the first week's work in drawing, the writer conducted a daily lettering drill throughout the semester of 15 weeks. This class drill consisted of three lines of the Standard

Form, the elapsed time being announced by the instructor and recorded by the student. During the first four weeks the drill was preceded by discussions with each student of errors, best methods of procedure, etc. Faults (which are known from previous experimentation to appear at certain intervals) were pointed out and emphasized through brief blackboard talks to the class. After the first four weeks the personal talks with individual students were generally discontinued and brief general directions given to the class. Each student was always asked to do his best work regardless of the speed of his neighbor. In general this result was obtained and there has been evinced a very high degree of interest on the part of the student in a sort of technique which is generally considered to be tedious and devoid of interest to the student and teacher alike.

C. Scoring and Selection of Samples for the Scale.

Various methods of scoring have been studied and laboriously experimented with by the writer during the past year. The method finally adopted, with the underlying principles, may be analyzed thus:

1. The fundamental aim in lettering is to teach students "to make neat letters quickly."

2. Neatness in lettering may be taken as synonymous with "of good appearance."

3. Good appearance is believed to depend primarily upon "uniformity" in the construction of each individual letter and the combination of various letters into words.

4. All Reinhardt lettering may be analyzed into its four component elements, viz., heights of letters, spaces (both between letters and between words); stems (vertical, horizontal and slant), and ovals.

5. Uniformity of lettering is a composite of uniformity of heights of letters, spaces between letters and words, stems and ovals, and may be expressed algebraically as follows: $A = H \times k_1 + Sp \times k_2 + St \times k_3 + Ov \times k_4$, in which A equals the ability to letter as shown by a given sample, and H, Sp, St and Ov are percentages of heights, spaces, stems and ovals, respectively, found to be correct in the whole form, and where the k's are constants depending upon the weights to be given to the

various elements in lettering, k_1 for heights, k_2 for spaces, k_3 for stems, and k_4 for ovals.

6. The numerical value to be given the constants k were finally fixed in the following manner: Various words in the form were lettered by the writer, certain types of errors being purposely made. Comparison of results made it apparent that lack of uniformity in heights and spaces had a larger effect on the "good appearance" of the lettering than lack of uniformity in the construction of stems and ovals. Further to test this point, a preliminary grading was made of the samples obtained in the first week, assigning various values to the k 's for each of the four elements. Making all the values of k equal to .25 tends to undergrade the samples from the point of view of "good appearance." It was believed by the writer that making k_1 and k_2 .30 and k_3 and k_4 .20 underestimated the true effect of heights and spaces. The following values of k were finally empirically assigned: k_1 and k_2 = .33; k_3 and k_4 = .17, and were used throughout the computation. Thus the fundamental criterion upon which these samples have been graded is that weight should be given to those elements in which the greatest proficiency occurs. And careful examination of the tabulated scores throughout the semester shows that a much larger proficiency was obtained in the determination of heights and spaces than in the construction of stems and ovals. In critical examination of the values assigned to each of the k 's it should be remembered that the difference in numerical grade obtained from the samples by using k_1 and k_2 = .33 and k_3 and k_4 = .17 is on the average less than 2 per cent. higher than that obtained by using k_1 and k_2 = .30 and k_3 and k_4 = .20, and only 3 per cent. higher than that obtained by weighting all elements alike, *i. e.*, in making all the k 's = .25.

7. The determination of the method of scoring the samples and the final values of "A" was the result of laborious experimentation and computation in the grading of samples, carried out as follows: Two methods were used: 1. The method of "general impression" of uniformity. 2. The method of counting specifically the number of correct heights, spaces, stems and ovals in each of the samples, with the accompanying computation of the final grade of each sample by the use of the

above equation. By the first method the samples of the first week's work were arranged in order of general merit as determined by the "general impression" of good appearance. This ranking in order was carried through independently three times, the final ranking of each sample being determined by the closest approximation to the mean position of the ranking.

By the second method the total number of single operations in the three-line form was counted, these totals being, heights (letters), 176; spaces (both between letters and words), 167; stems, 173; ovals, 181. The percentage of correct number of heights, spaces, stems and ovals was next computed, tabulated and the resultant grade or ability "A" as shown in each sample was computed from the above equation. The order of the samples as ranked by this method was then compared with the order obtained by the method of "general impression." Nine of the first 10 samples occupied the same position in both orderings. The first 20 as scored by "impression" included 16 as scored by "counting"; the first 30 as scored by "impression" included 26 as scored by "counting." Careful examination of the two rankings showed that in general the arrangement of the samples by the two methods was very nearly identical.

Whereas the first method of grading gives only a qualitative ranking of samples and offers no indication of the quantitative interval between any two samples, and the second method, while ranking in the same general order, also gives a definite numerical grade to each sample, it was decided to score all samples throughout the semester by the "counting" method. The samples for the entire semester (1500 in all) were then scored by the writer by this detailed method. The number of single operations on each sample being separately counted and tabulated, the per cent. of correct strokes were computed and used in the efficiency equation by introducing the proper coefficients. Thus the scoring and selection of samples for this Lettering Scale has involved the counting and judging of the accuracy of something over 100,000 single strokes, with the necessary accompanying tabulation and computation.

8. The next and final step in the construction of the Scale was the selection of the specific samples which should go into its makeup, they being so selected that the interval between

any two consecutive steps should be constant, and the total range being taken as the numerical distance between the model copy and the lowest graded sample (98-29.8 per cent.) All samples whose grades fell between any of the intervals, 89.5-90.5; 79.5-80.5; 69.5-70.5; 59.5-60.5; 49.5-50.5; 39.5-40.5; 29.5-30.5; were next selected and arranged in separate groups, each group being arranged by "impression" in order of general merit. The most representative sample in each group was then selected to occupy a position on the Scale corresponding to the grade of that group. This results in a Scale of eight samples, ranging by intervals of approximately 10 per cent. each, from 100 per cent. to 30 per cent. It is believed that the samples selected are typical of their group, and that the intervals on the Scale as thus determined are for all practical purposes equal. The complete Scale reproduced herewith is a full-sized reproduction of these samples as originally mounted in the order of their excellence.

Outline of the Method of Using the Scale in Teaching Free-Hand Lettering.

The development of the ability in students to make "neat letters quickly" (our fundamental aim) involves a teaching process including at least the five following steps: 1. The exposition of the necessary facts and principles. 2. Creation of right attitudes on the part of the student. 3. The presentation of the necessary "mechanics of method." 4. Establishment of right habits of thought. 5. The building up of specific habits of finger and wrist technique. It is to the carrying out of the last of these steps that the administration of our Scale can contribute. An outline of the method of its use in the classroom follows:

A daily lettering drill (8 to 15 minutes in length) is held about the middle of the drawing period throughout the semester of 15 weeks, procedure being as follows:

1. After short general class directions as to specific elements of lettering to which various members of the class should be paying the most attention and caution as to the amount of time used, the entire class, beginning work at the same time,

letters a three-line block of the Standard Form. As each student completes his block the instructor states the elapsed time (in minutes and seconds), this result being lettered by the student in the proper place on the form.

2. The student then turns to his Scale (each student has one of his own), and compares his sample with those of the Scale, moving both up and down the sheet and grading twice, finally assigning the sample a numerical grade.

3. The instructor carefully checks the grading of each student's samples, suggesting revision of grade where necessary, with such thorough explanations as to enable the student to train his own judgment through future practice.

4. The student plots his grade and time on the proper ordinate of the Practice Curve cross-section (page 4 of the Scale), and compares critically the shape of his curve to date with that of the practice curve of the "average" class shown on page 3 of the Scale. It has been found to expedite matters to have all grading and plotting done once a week at the third exercise.

II. PRELIMINARY CRITIQUE OF THE LETTERING SCALE.

In September, 1914, the Department of General Engineering Drawing of the University of Illinois adopted for trial during the current year both the Lettering Scale and the complete method outlined for its use. It has been used daily by six instructors and 300 students, and is also being experimented with in six other institutions. After eight weeks of classroom use by both teacher and student we are now in a position to report briefly a preliminary critique of the efficiency and practicability of the Scale itself. To do so in the brief space allotted to this article, it will be possible to publish only the statistical summary of results. (All of the original data concerning the design of the Scale and its critical application in the classroom are on file at the University of Illinois and may be inspected by those interested.)

We submit below: 1. Data showing the efficiency with which beginning students (never having seen the Scale and having had no training in engineering lettering) were able to arrange in order of merit the samples of the Scale. Table 1 presents

A SCALE FOR MEASURING FREE HAND LETTERING

FOR TECHNICAL COLLEGES AND SECONDARY SCHOOLS

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Efficiency in Lettering—Practice Daily Letters Most Frequently Used

Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
Required Name Number View	Drill Holes Mast Studs Cover	Bronze Pipes
Dimension All Detail Drawings	Taper Joint Lock Nuts Mixer	123456789C

Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
Required Name Number View	Drill Holes Mast Studs Cover	Bronze Pipes
Dimension All Detail Drawings	Taper Joint Lock Nuts Mixer	1234567890

Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
Required Name Number View	Drill Holes Mast Studs Cover	Bronze Pipes
Dimension All Detail Drawings	Taper Joint Lock Nuts Mixer	1234567890

Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
Required Name Number View	Drill Holes Mast Studs Cover	Bronze Pipes

Required Name Number View	Drill Holes Mast Studs Cover	1234567890
Dimension All Detail Drawings	Taper Joint Lock Nuts Mixer	

Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
Required Name Number View	Drill Holes Mast Studs Cover	Bronze Pipes
Dimension All Detail Drawings	Taper Joint Lock Nuts Mixer	1234567890

Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
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Material Finished Cast Steel	Section Gear Parts Keyways	Shaft Bearing
Required Name Number View	Drill Holes Mast Studs Cover	Bronze Pipes
Dimension All Detail Drawings	Taper Joint Lock Nuts Mixer	1234567890

the tabulated results as submitted by each of seventy-four students, typical tendencies being indicated by the summary. 2. Data showing relative efficiency of students and instructors in grading samples of student lettering, some without the Scale and some with the Scale. Table 2 presents the data, itemized as follows:

A. The average grade given by seven instructors and thirty-eight students, to twenty samples of lettering done by students in the writer's classes, samples so selected as to give approximately an equal distribution above and below 75 per cent. This average grade is regarded as the "true grade."

B. The mean variation from the True Grade of the grades assigned to each of the twenty samples by (1) the seven instructors of the department; (2) sixteen students in one of the writer's classes; (3) twenty-two students in one of Mr. F. M. Porter's classes. All students and instructors had used the Scale in the classroom during eight weeks.

C. The mean variation from the True Grade assigned to each of twenty samples by (1) the seven instructors of the department previous to having used the Scale in grading samples of student work, their basis of marking being that of the previous practice in the department as interpreted by the individual men; (2) twenty-two students of one of the writer's classes, trained in the use of the Scale (to the extent of not more than fifteen minutes' practice per week for eight weeks). In this case the grading of samples was without the use of the Scale, the students being asked to grade the sample in accordance with their memory of the quality of work represented by each of the samples on the Scale; (3) sixteen students in another of the writer's classes, all freshmen engineers, previously trained in drawing and lettering, but never having seen the Scale. This group was asked to grade according to their own best judgment, a brief explanation being written on the blackboard of the nature of the four essential elements of lettering and the way in which uniformity of sample was to be considered as fundamental in marking. All the grading above mentioned was done under the supervision of the writer.

3. Data giving (a) the practice curves (quality and time) of thirty-one students in the writer's classes during the first

semester, 1913-14, using the system of teaching at that time developed, but not having access to a Lettering Scale for measuring progress. (b) Similar practice curves (quality and time) of thirty-seven students in the writer's classes during the first seven weeks of the current semester, using the improved system and the Lettering Scale.

The results of several weeks' critical study of student work and our statistical data, coupled with the very helpful criticism of three members of the drawing department, enable us to comment as follows on results of using the Lettering Scale.

A. Efficiency With Which Beginning Students Arranged the Samples of the Scale in Order of Excellence.

From a study of Table 1, giving the number of students arranging the samples in order with no mistakes, one mistake, two mistakes, etc., and the number of steps which the various samples were arranged out of place by various students, we can conclude as follows: 1. The upper and lower samples on the Scale are separated by such distinct intervals as to be correctly recognized by practically all untrained students. Samples 80, 70, 60 and 50 are separated by such intervals as to be correctly recognized by two-thirds of any group of such untrained students. In the case of these samples the proportion of the students misplacing each sample by one step is for the 80 per cent. sample, one-third; for the 70 per cent. sample, one-fifth; for the 60 per cent. sample, one-third; for the 50 per cent. sample, two-fifths. Questioning the students brings out the fact that in the case of practically all, the sample misplaced was always so placed after considerable debate over the question (1) of the relative emphasis to give to different elements in the sample; (2) of extraneous elements, neatness, heaviness of line, peculiar style of stroke, etc. This latter element was considered in detail by the writer in designing the Scale, and the attempt was made in selecting the specific samples for the Scale to take only those samples which not only "counted right," but which would also emphasize some distinctive quality as we proceed up the Scale. It is clear that this was successful to the extent of being recognized by all of the students at the upper

TABLE 1.

The order in which 74 beginning students arranged the 8 samples of the Lettering Scale.

No. of student.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Samples :																								
100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
90%	2	2	2	2	2	2	2	2	2	3	3	4	2	2	2	2	2	4	2	2	2	2	2	2
80%	3	3	3	3	3	3	3	3	3	2	2	3	4	3	3	4	4	3	3	3	3	3	3	3
70%	4	4	4	4	4	4	4	4	4	4	4	2	3	4	4	3	3	4	2	4	4	4	4	4
60%	5	5	5	5	5	5	5	5	5	6	6	5	6	6	5	5	5	6	5	5	5	5	5	5
50%	6	6	6	5	6	5	5	5	5	5	6	5	5	6	6	6	6	5	6	6	6	5	6	5
40%	7	7	7	7	7	7	8	7	7	7	7	8	7	7	7	7	7	7	7	7	7	7	8	7
30%	8	8	8	8	8	8	7	8	8	8	7	8	8	8	8	8	8	8	8	8	8	7	8	7
None interchanged.....	x	x	x	..	x	..	..	..	..	..	..	..	..	..	x	x	..	..	x	..	x	..	x	..
1 "	..	..	..	x	..	x	..	..	x	..	..	..	..	..	..	x	..	..	x	..	x	..	..	..
2 "	..	..	..	..	..	..	x	x	..	x	x	x	x	..	..	..	x	..	..	..	..	..	..	x

No. of student.....	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Samples :																									
100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
90%	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
80%	4	3	3	3	3	3	3	3	3	3	2	3	4	3	4	2	3	3	4	4	3	2	3	3	
70%	3	4	4	4	4	4	4	4	4	4	5	4	5	4	3	4	4	4	3	5	4	4	4	3	
60%	6	6	6	6	5	5	6	6	5	5	4	5	3	6	6	5	5	5	5	3	5	5	5	5	
50%	5	5	5	5	6	6	5	5	6	7	6	6	6	5	5	6	6	6	6	6	6	6	7	6	
40%	8	7	7	7	7	8	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	6	7	
30%	7	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
None interchanged..	..	..	..	..	x	..	..	..	x	..	..	x	..	..	..	..	x	x	..	..	x	..	x	..	
1 "	..	..	x	x	x	..	x	x	x	..	x	..	..	..	..	x	..	..	x	..	..	..	x	x	
2 "	..	..	..	..	..	..	..	..	..	..	x	..	..	..	x	..	..	..	..	x	..	..	..	..	
3 "	..	x	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	..	..	

No. of student.....	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Samples :																									
100%	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
90%	2	2	3	2	2	2	2	2	2	2	3	2	2	2	2	2	2	4	2	2	2	2	2	2	
80%	3	3	2	4	4	3	3	3	3	3	2	3	3	4	6	3	3	2	3	4	3	4	3	4	
70%	4	4	4	6	3	4	4	4	4	4	6	4	4	3	3	4	4	6	4	3	4	3	4	3	
60%	5	6	6	3	5	5	5	6	5	5	4	5	5	6	4	5	5	3	6	5	5	6	5	5	
50%	6	5	5	5	6	6	5	6	5	6	5	6	6	5	5	6	6	5	5	6	6	5	6	6	
40%	7	7	7	7	8	7	7	7	7	8	7	8	7	8	8	8	7	8	7	7	7	7	7	7	
30%	8	8	8	8	7	8	8	8	7	8	7	7	8	7	7	7	8	7	8	8	8	8	8	8	
None interchanged..	x	..	..	..	..	x	x	..	..	x	..	..	x	..	..	..	x	..	..	..	x	..	x	..	
1 "	..	..	x	..	..	..	..	x	x	..	..	x	..	..	..	x	..	..	x	x	..	..	x	x	
2 "	..	..	..	x	..	x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
3 "	..	..	..	..	x	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..	..	..	
4 "	..	..	..	..	..	..	..	..	..	..	x	..	..	..	x	..	..	..	..	..	..	..	..	..	
5 "	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	x	..	..	..	..	..	..	..	

and lower range and by two-thirds of them in the middle range. The one place error of the remaining one-third of the students at least raises the question whether the attempt should not be made to obtain samples which will score correctly for each position of the middle range and have at the same time a quality so distinctive of their position on the Scale that all untrained students would arrange them in precisely the right order. In the Slant Lettering Scale, upon which the writer is now working, this characteristic of distinctive "style" is being taken care of by making up three scales, all of whose samples score correctly, but at the same time giving three distinct "characters" in lettering, with each individual scale emphasizing a constant weight of line peculiar to it alone.

*B. Results of Grading Twenty Samples of Student Lettering,
With and Without the Scale.*

Critical study of the above summary table and of the detailed data from which the main variations were obtained leads to the following conclusions:

1. The true grades on each of eight of the samples as expressed by average grades of forty-five judges lies above 75 per cent., and the true grades of twelve samples lies below 75 per cent.
2. The mean variations from true grade given to the samples by instructors and students when grading with the Scale run so closely together as to indicate that the limited training received, functioned to enable students to judge the quality of student lettering as efficiently as their instructors. Mean variations of all grading done by students is 5.92 per cent.; that of instructors, 5.31 per cent.
3. Samples of 50-60 per cent. quality can be judged as accurately with the aid of the Scale as those of a quality above 80-85 per cent.
4. When marking without the aid of the Scale and not having agreed upon a common standard, instructors show twice as much mean variation (10 per cent. to 5 per cent.) with samples grading below 75 per cent. as with those above 75 per cent. There is quite evident here the "high marking" personal equa-

TABLE 2.

Mean Variations (in Per Cent.) from the True Grade, of Grades Given by Instructors and Students

No. sample.....	8	7	2	10	18	12	Ave. of	3	19	Ave. of
True grade.....	89.3	88.9	87.0	85.6	84.4	83.2	M. V.	77.0	73.1	M. V.
7 instructors....	3.5	4.5	3.2	4.4	4.5	3.3	4.2	4.5	6.0	(5.3) with scale.
16 students.....	4.0	5.6	6.0	5.4	5.2	6.6	5.5	4.5	5.6	5.1 " "
22 students.....	5.6	4.5	3.9	3.5	4.6	3.8	4.3	6.6	6.6	6.6 " "
23 students.....	5.1	4.2	4.0	5.4	4.7	3.5	4.5	3.4	6.0	4.7 Trained on scale, but graded without.
13 students.....	3.7	4.2	6.1	2.8	4.8	7.0	4.8	7.6	5.8	6.7 Never had seen the scale.
7 instructors....	3.6	4.9	4.1	4.9	4.7	7.1	4.9	4.6	7.1	5.8 Without scale before having graded with it.

No. sample....	1	5	16	11	13	20	Ave. of	4	17	15	Ave. of	6	9	Ave. of
True grade... ..	68.5	68.4	65.2	65.2	60.5	60.0	M. V.	58.6	56.2	50.9	50.2	M. V.	48.9	44.6
7 instructors ...	6.7	5.0	11.3	6.7	6.2	6.7	7.1	5.8	6.3	5.0	4.2	5.3	3.3	5.8
16 students... ..	7.0	5.9	7.2	6.4	6.3	7.1	6.7	7.9	5.0	5.8	5.5	6.1	6.0	4.3
22 students.....	5.2	6.8	4.6	8.1	4.9	7.3	6.2	8.5	7.6	6.5	6.5	7.3	7.0	6.9
23 students.....	5.4	5.2	7.8	13.0	6.7	7.5	7.5	6.3	8.4	10.2	10.4	8.8	8.8	11.8
13 students.....	12.1	9.2	12.7	13.8	22.8	13.1	14.0	14.6	10.7	12.4	18.4	14.1	19.1	15.8
7 instructors. . .	7.7	8.6	8.6	12.6	9.1	8.6	9.2	8.3	11.1	9.7	12.6	10.4	6.7	9.0

tion of teachers and students and the distinct influence of the institutional passing grade (70 per cent. at Illinois) in restricting the range within which one "feels" he can grade a given product. Students, when marking without the aid of the Scale, show three times as much mean variation as when marking with it (15 per cent. to 5 per cent.)

5. In grading samples at the 85-100 per cent. end of the Scale both instructors and students show no larger mean variations in marking without the Scale than in marking with it. In grading samples between 60-70 per cent. without the Scale the students show twice as much mean variation as with it, and instructors show one-third again as large a mean variation as with it. In grading samples below 60 per cent. both show nearly twice as large mean variations without the Scale as with it.

6. Students who have been trained in drawing and lettering, but who have never used the Scale, show nearly twice as large a mean variation in grading samples below 70 per cent. without the Scale, and half again as large a mean variation with samples ranging from 70 to 80 per cent., as students trained in use of the Scale and grading with it.

7. Students who have had a few weeks' training in the use of the Scale, when grading samples above 75 per cent. without the aid of the Scale, show mean variations practically identical with those of students grading the same samples with the aid of the Scale. With samples below 60 per cent. the mean variations of the students grading without the Scale are larger. *Students trained in the use of the Scale when grading without it show a smaller variation at the high end of the Scale than those not trained in the use of it, and show a variation only half as large at the middle and low end of the Scale.*

C. Comparative Practice Curves of Classes in Lettering, 1913 and 1914.

All students in the 1913 and 1914 classes in lettering taught by the writer have been arranged in groups as determined by the efficiency of their initial lettering product (the average of their first week's work). This division gives us four groups of students as follows: Group 1, initial product above 70 per

cent.; group 2, initial product 60 to 70 per cent.; group 3, 50 to 60 per cent.; group 4, below 50 per cent. The practice curves obtained from the average grades given the samples of each of these four groups in the two years are plotted in Diagrams 1 and 2. Examination of these curves and the detailed data shows that all groups of the 1914 class, using the Scale and the improved method, maintain a higher efficiency during each of the first seven weeks than do the corresponding groups of the 1913 class. The shape of the time curves for the two classes will be better understood if it is stated that the time was consciously held at a uniform level during the seven weeks of the 1914 work, whereas with the same work in 1913 the class was allowed to run down the time curve as succeeding weeks went on. The increase in efficiency in 1914 over 1913 has come with almost no individual instruction from instructor to student. Constant comparison of samples with the Scale is developing in the student a greater precision in analyzing the faults in his own technique and functions as a spur to raise the quality of his own product. The detailed argument concerning this phase of the work will be found in a monograph on the "Practice Curve in Free Hand Lettering" shortly to be published.

DIAGRAM 1.

Progress of thirty-one students in an average college class. Curves show average grades for groups of varying initial ability during a semester of fifteen weeks.

Diagram 2.

Progress of 37 students in an average college class. Curves show average grades for four groups of varying initial ability during first 8 weeks of current semester.