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Scope of Report: The information presented in this report was obtained from several types of literature. Textbooks, publications, reports, and other general mechanical drawing materials. An attempt was made to determin the present and future needs of a good practical mechanical drawing course that might be used for present day teaching. A questionnaire was mailed to mechanical drawing instructors in a wide area of Kansas. The main purpose was to determine what drawing subjects are being presented at the present time, and how they might be improved from an educational standpoint.

Conclusions: A questionnaire was mailed to 40 instructors in 37 high schools in Kansas. Replies from 27 instructors in 25 schools were received. This being over a 65% return which indicated good results for the desired questions. The results of the questionnaire indicate that several methods of teaching are being used with satisfactory results by many of the instructors. The new type textbooks are making mechanical drawing more popular because of the use of understandable techniques. The compiled results of the questionnaire identify by percentages the trends of teaching by the present day instructors. More variations of drafting are being offered and many schools furnish all drawing equipment. The results concerning this material fortified an idea and developed a better informed instructor. It is easy to visualize an interesting and improved curriculum. Industry is expanding in many directions and to keep pace with our changing world situation, industrial arts should also advance with the newest beneficial materials.

Advisor's Approval John B. Tate

# A SURVEY OF TEACHING MECHANICAL DRAWING

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By

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Bachelor of Science

Panhandle Agricultural and Mechanical College

Goodwell, Oklahoma

1954

Submitted to the Faculty of the Graduate School of

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MASTER OF SCIENCE

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# A SURVEY OF TEACHING MECHANICAL DRAWING

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MASTER OF SCIENCE

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F. J. H.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

# CHAPTER 1

## A UNIVERSAL LANGUAGE

Drafting or drawing is a means of expression, used by all nationalities, because a picture can be interpreted by all, therefore, the term universal language describes it very well. Early drawings were on cave walls, to describe stories that could not be told by a tribe or person to person, because of the language barrier.

The ancient buildings denote great skill developed in architectural drawing, building, and construction. Some seem almost modern from sound techniques used centuries ago.

As educational progress continues today, the drawing and art teachers are trying to do their job of continuing the knowledge of drawing plans for houses and objects, either for industry, construction, artistic value or beauty.

The Origin of the Study. In the last five years several publishing companies have entered their junior high school drawing textbooks on the market. Several new methods are described and presented. A graph squared paper method is used with tracing paper to develop orthographic drawings. Earl Harmon has a new introductory text published that is organized on a step system from one phase of development to the next in sequence. Each new step is printed in red ink and bold type so beginners can identify ideas presented. Charles Quinlan has a new drawing system that is very good for basic fundamentals. It is a printed sheet, eight and one-half inches by eleven inches, with twelve types of views included, either

isometric or orthographic. Beside a view, a small space, two inches by one and five-eights inch is divided into one-eighth inch squares. The required views simply have to be sketched in by pencil. No other tools are needed. These methods could be lacking in either fundamentals or quality. The tracing methods are the most appealing at the present time. The writer feels that a combination of several good drawing techniques could be developed into a desirable teaching tool. A different method is needed, at times, to present the same idea to two different classes or even to two students in the same class. If they cannot visualize the final construction, then a different technique is needed for their benefit. Many times in only a few months the industrial arts instructor is asked to explain the purpose of the mechanical drawing course. The average person is in a category with the student. They have not thought about drawing as a useful tool in later life or how it will develop their thinking in other fields of existence.

This report was developed to show the methods being used today in Kansas, for a better understanding of all drawing subjects, with mechanical drawing as the major item of interest. How and where it is taught, organized methods used by the instructors, school personnel attitude toward industrial arts program, and a personal indication toward a better method in each drawing field. They might be combined and developed into a satisfactory course of study.

The words, mechanical drawing, seem old fashioned, but as the name implies, drawing is the making of lines for a more desirable end result, self-expression or otherwise. Mechanical could mean the making of lines with tools, instruments or other machines that can be incorporated into our classrooms. Therefore, mechanical drawing in our present day high

schools should prepare the student for their adulthood from the standpoint of understanding and being able to read drawings, designs, or pictures.

Need for Mechanical Drawing. Reading a road map seems simple, but it takes understanding. The same type of understanding is needed to read a floor plan of a house that a student may some day own. If the high school student does not have an opportunity for drawing, and does not meet its equal some place in education, he or she has a handicap.

In most mechanical drawing courses there is a new discovery for most young people. The manipulation of drawing tools and instruments seems awkward and hard to handle at first. After a few beginning exercises under proper supervision, students improve rapidly, if inclined, and satisfactory results are visible from the drawings.

The instructor should insist on high quality standards. Teach drawing so it will be beneficial, not as a time consuming six or eight weeks with an O.K. on all sheets, disregarding the quality of drawing. Quantity in drawing will meet the need of speed, but the quality should be a much more important goal.

In drawing, a beginner should work on accuracy first. Lettering, lines, balance, method, and procedure must all be correct before speed can be stressed. Speed will tend to cause unacceptable work and mistakes if not properly handled. If the lettering cannot be read or if it is omitted the drawing will be worthless as a working drawing or working blueprint.

Different instructors could obtain the desired results from several different methods. In the last few years, several publishing companies have printed textbooks that are very easily understood by students. Guide sheets, tracing outlines, and graph paper systems are some of the

aids in helping a beginning student learn the fundamentals. Others will probably be developed as the need becomes known.

Today there are several different types of drawing techniques being used. A metal object or machine part is used for information toward industry or mechanics. The use of lines, arcs, and their combinations for geometric shapes for perfection with drawing tools and equipment. The age old pattern block is very popular for orthographic projections, a foundation for working drawings.

A combination of these three, or numerous others, could be interwoven into a desirable type of drawing course. It would be a background stepping stone for general knowledge, helpful in all civic or private life situations.

The development of a desirable drawing media will consist of a combination of drawing techniques, and outlined into a general mechanical drawing teaching situation by all means available.

The drawing student should first become acquainted with the drawing tools and equipment, where they originated, why, and preferred techniques of their use today. In the different types of engineering or industry, drawing is an important step. After becoming familiar with the drawing tools, the next step would be procedure for sheet layout. The layout should be functional, and fit the type of drawings assigned. Title strip or block should be designed to fit the sheet layout and contain all necessary information. No dimensions should be used that are not on the architect scale, or a multiple of those units present.

Method of Research. A great multiple of reference materials and literature is obtainable from public libraries and private collections

concerning this subject, but there is very little available of recently developed techniques, other than new textbooks and research reports.

The questionnaire, that was mailed to instructors of mechanical drawing in public schools of Kansas, was an attempt to identify and itemize the better quality materials for teaching more functional subject matter.

The questionnaire was a three-page mimeographed item, requiring only check marks and a short summary of that instructor's personal contributions. Some of the information obtained from each instructor was as follows: (1) grade level taught; (2) duration of subject; (3) areas covered; (4) materials furnished; (5) audio-visual materials used; (6) name of textbook, author, copyright date; (7) average number in classroom; (8) whether male, female, or both; (9) information concerning instructor, plus the instructor's personal opinion.

After this questionnaire was mailed, completed and returned. The results were tabulated and compiled. Consequently, the most desirable methods are combined and organized into a teaching outline to be used in the classroom for personal evaluation, and as an aid toward what should be taught to be most beneficial.

All undesirable materials or items seldom used were tabulated and checked for percentages. All useable materials that could be valued on occasions were recorded and filed under that heading. All questions or unused materials, in ratio to the drawing instructor's experience at the present time are listed in the order of the most used to the least used.

Definition of Terms. The following terms are defined for a better understanding of mechanical drawing. The definitions were taken from the Dictionary of Technical Terms by F. S. Crispin.

Mechanical Drawing. Drawing accomplished with the use of instruments. Technically, the term includes orthographic projection, architectural and engineering drawing, various kinds of perspectives, and projections. (4, page 127)

Architectural Drawing. The art and science of drawing as related to buildings. (4, page 20)

Industrial System. A system of factory organization and management; factory production, employment of labor. (4, page 214)

Mechanic. A skilled workman who makes, repairs, and assembles machinery or mechanical parts. (4, page 256)

Orthographic Projection. A system of graphically presenting an object by means of several views, each view showing a face of the object, such as the front view, top view, right-side view, etc. (4, page 282)

Working Drawing. A drawing which contains all dimensions and instructions necessary for successfully carrying a job to completion. (4, page 436)

Engineering. The art and science relating to expert planning and construction in various fields of industry. (4, page 144)

Engineer. An expert in design, construction, and development in the fields of electricity, mining, mechanics, and building. (4, page 144)

Architect Scale. A piece of wood or other material graduated into divisions, used for measuring. The size of a drawing in relation to the size of the object presented. In architecture of buildings, drawings are usually made to the 1/8 or 1/4 inch equals one foot. (4, page 344)

Isometric. A form of perspective drawing accomplished without reference to vanishing points. Lines which are parallel on the object appear parallel on the drawing. (4, page 220)

Ink. A combination of pigments, varnish, and drier made in many forms, colors, and consistencies. (4, page 214)

Graphic Arts. A broad term which embraces every branch of pictorial representation. Embracing every form of printing represented by text and illustration. (4, page 185)

Study of Similar Reports. These studies and reports were very helpful in the guidance toward an idea for this report. After reading various reports in the industrial arts field, the writer feels that the

reports were lacking in the drawing area. A change is in progress at the present time, but it definately should be encouraged. If the people concerned will give time and talent, the mechanical drawing phase of industrial arts should definitely improve.

The Johnson Report. Mr. Ralph W. Johnson completed a report in partial fullfillment for the requirements for the Master of Science Degree at Oklahoma State University in 1956 entitled, Industrial Arts in the Junior High School of Sherman, Texas. This report itemized a list of seven mechanical drawing objectives, they in turn were to be acquired over a period of time from a well known textbook that had been copyrighted several years ago. A copy technique was employed.

The Loughridge Report. The Andrew Loughridge report was submitted for graduate work at Oklahoma State University in 1957. Entitled Industrial Arts in Newkirk, Oklahoma. The mechanical drawing materials were taken solely from French and Svenson Mechanical Drawing textbook, which is a very good text, but several years old.

The Francis Report. Mr. Charley O. Francis submitted this report for a Master of Science Degree at Oklahoma State University in 1958. Entitled Industrial Arts in the Public High Schools of Oregon. In this report a table that stated only 61 schools in Oregon offered mechanical drawing as a subject, out of a total of 159 schools reported, no type of teaching techniques were mentioned, or textbooks listed.

The Daniels Report. Marvin Daniels submitted this report for the Master of Science Degree at Oklahoma State University in 1958. Entitled A Survey of the Industrial Arts Program in the Separate Schools of Dallas. In this report a course of study for the mechanical drawing department was itemized. In the 44 items listed as necessary for students to know,

there is no mention of a progressive or modern type drawing technique being employed, but one must assume their curriculum is up to standard for the state requirements.

After having read several reports that contained brief outlines of personal drawing methods, the author believes that the needs of drafting should be listed, and each need developed in every beneficial category. To understand these needs, a knowledge of drawing, and drawing history, should be understood by those concerned.

## CHAPTER II

## HISTORY OF DRAWING

In our educational systems today, several subjects are being stressed, such as science and mathematics. The curriculum is usually organized around several required scientific or mathematical subjects with a number of branch or elective subjects for individual selection. Most subjects being taught today have originated, partially or entirely, centuries ago. This being true, a brief description or history is given on drawing instruments, and drawing methods of the past.

Egyptian. The origin of drawing instruments is lost in antiquity, for at the dawn of recorded history it was found that the Egyptians were drawing plans for their cities and buildings. Their circles were laid out on stone, wood, or papyrus with the aid of a piece of string. A bronze point, passed through a loop in the string, was manipulated with one hand to scribe the circle while the other hand, at a distance from the bronze point equal to the radius, held the string at the center. Circles too small to be readily drawn by this method were scribed free-hand with the metal point. After a circle had been laid out by one of these methods it was drawn over with the same pen used for writing. This was usually a slender piece of reed, or other fiberous woody material, some eight or ten inches in length, frayed out at one end and tapered to form a pointed brush. Lines were also scribed with a metal point and afterwards drawn over with a reed pen. (4, page 15)

Roman. Specimens of compasses and rulers used by Roman architects at about the time of Christ are to be found in some museums. Rulers were usually made of wood, but in some instances very fine ones were made of ivory pieces joined together with bronze. The compasses were made of bronze and were approximately six inches in length. The leg was usually of a more or less rectangular cross section, tapered to a round point at one end and broadened out at the other to provide for a hole. A simple bronze rivet held the two legs together sufficiently tight to provide friction to keep them at any particular setting. In general appearance they closely resemble some present day dividers. Three types of material were used for the drawing surfaces. Preliminary drawings were made upon tablets of wood coated with wax. Circles were simply scribed upon such a tablet with the points of the compass. Lines were ruled with a metal stylus. More permanent records were made upon papyrus imported from Egypt, or upon the skins of animals, usually sheep or goats. By the second century A. D. the preparation of skins had greatly advanced, the skins being split and processed to the thin, crisp, and smooth product now known as parchment or vellum. Circles were scratched or impressed upon these various materials with the sharp compass point and then drawn over free-hand with a pen. Lines were similarly laid out with the sharp point of a stylus and then drawn over with a pen. The Roman pen was usually made from a hollow reed, but instead of being frayed to a brush like the old Egyptian pen, it was cut to a flat point on one side of the reed and slit like the modern pen. (Fig. 1, page 12) Copper pens of similar design have been found in the ruins of Pompeii, but it appears that they were not in general use.

Medieval. The drafting methods of the Romans continued to be in general use for well over fifteen hundred years. However, during this period of time there were some changes in the materials used, the most important being the introduction of paper from Asia. The art of paper making was learned from the Chinese by the Arabs in the eighth century A. D. and was carried across North Africa through the lands conquered in the spread of Mohammedanism. The first paper making plant in Europe was established in Spain by the Moors about the middle of the twelfth century. In the year 1276 a plant was established in Italy and in the course of the next hundred years the art of paper making became well established throughout the greater part of Europe. While the greatest use of paper was for writing, and later for printing, it was also used for the drawings made by artists, architects, and engineers. Bradshaw in his book, The Magic Line, states:

> In the fourteenth century academical figure painting in miniature, which modern artists have never approached, reflects the influence of the approaching Renaissance. In many of these minature pictures more skill and knowledge must have been required than were needed for the painting of large mural decorations. (4, page 41)

Another change worthy of mention was the replacement of reed pens by pens made from quills of birds, preferably geese, during the seventh century. James Watrous agrees with this in his book, The Craft of Old Master Drawings:

> The goose quill seems to have been the pen commonly used and was the type depicted again and again in paintings representing artists drawing in their studios. The swan quill was considered an excellent substitute for the goose quill, but pens cut from the quills of ravens or crows were chosen when the finest and most delicate strokes were required. (12, page 47)

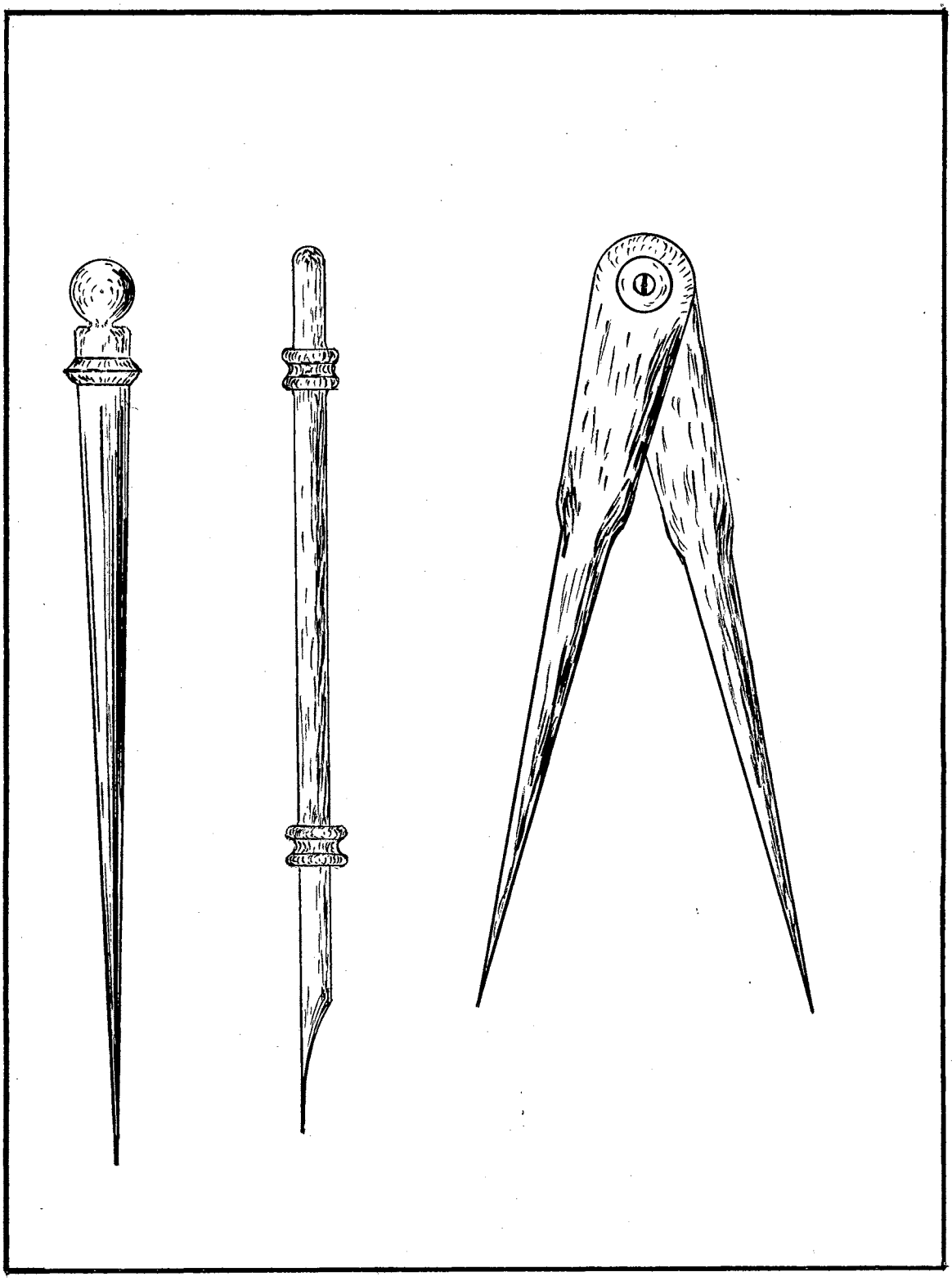

Figure 1

Roman Stylus, Pen, and Compass

Renaissance. Bradshaw's description of the setting of the Renaissance introduces it well:

> The Renaissance was at hand, Florence was its centre. At no point since the Athens of Pericles did so many men of genius make one city illustrious. Artists, architects, sculptors, historians, scholars, poets, statesmen, and scientists worked with inspired ardour, and shared their discoveries. (4, page 42)

With the general use of paper, the silver point method of marking upon it was developed. The paper was prepared by applying a wash, consisting of finely ground pumice suspended in a very dilute solution of glue or flour paste, and letting it dry. A silver point drawn across this paper would leave a line of finely divided metallic silver whose density could be varied by pressure from a pale gray to a good black. James Watrous tells of the silver point method being used in both art and commerce:

> Tested in both art and commerce, the metal points were widely used by artists of the late middle ages and the Renaissance. The unequivocal linearism and the limited but suggestive shading obtainable with the styluses satisfied many of the artistic requirements of master draughtsmen both in the north and in Italy. (12, page 4-5)

Circles were drawn by attaching a silver point to the leg of a compass. The silver point method was rather widely used by artists, and it found high favor with architects and engineers, for whom it afforded a great advance over previously known methods. Many of the beautiful mechanical drawings by Leonardo da Vinci (1452-1519) were first drawn in silver point and then gone over, free-hand, with quill pen and ink. (Fig. 2, page 14) Despite the numerous advantages of silver point, it never fully replaced the old Roman method of first marking with plain point and then drawing with pen and ink, because it required specially prepared paper.

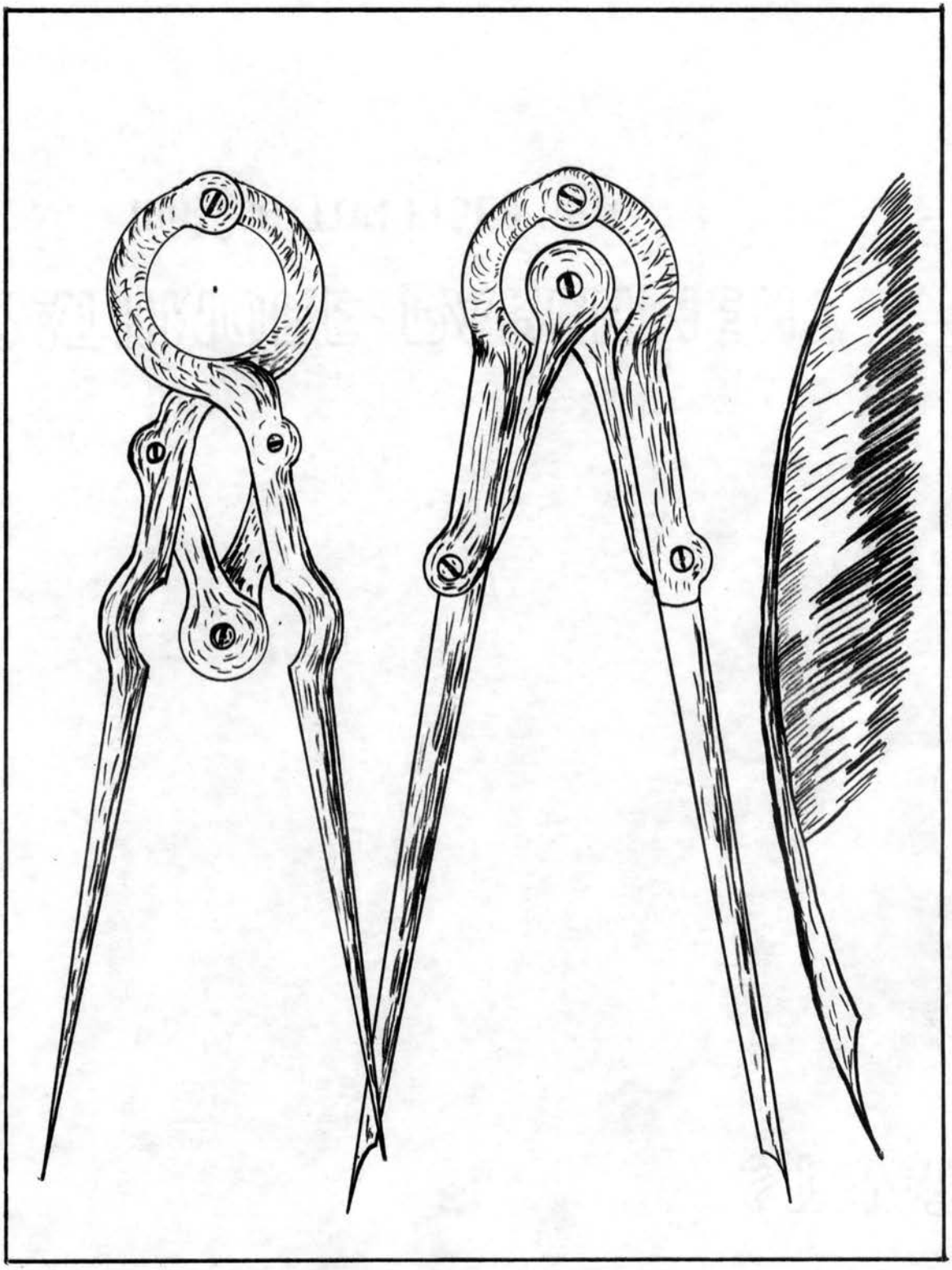

Figure 2

Drawing Instruments as drawn by Leonardo da Vinci

in about 1500 A. D.

Development of the Lead Pencil. The next great step in the development of drafting practices was the invention of the lead pencil. The inventor of the lead pencil is not known, but Conrad Gesner of Zurich wrote of its use in 1565 and stated that the core was of graphite from England where it had but recently been discovered at Borrowdale. The cores, or "leads," for the early pencils were cut from blocks of native graphite and then encased in the wooden holders. Pencils were gradually adopted by artists, architects, and engineers, but because of their softness they smudged the paper rather badly and offered some disadvantages. In 1760 the firm of Faber was established in Nuremberg, Germany, for the manufacture of lead pencils. Numerous experiments were made with mixtures, including various waxes and gums, in order to salvage the vast amount of scrap materials left over after cutting out strips of pure graphite, and also to control the hardness of the lead. The Encyclopedia Americana states:

> In 1795, the Frenchman, Conte, improved the process by grinding graphite and mixing it with clay in order to produce degrees of hardness and blackness. This method is the method used in manufacturing today. (13, page 137)

George Washington's Drawing Instruments. It is not known just when compasses were first adapted to receive pencil leads, nor when the first ruling pens of the two-bladed type were constructed, but they were in general use among engineers and architects in the early part of the eighteenth century. In the museum at Mount Vernon, Virginia, there is a set of drawing instruments of this period, bearing the date 1749, that was used by George Washington. This set comprises the following pieces: a divider made of brass; a compass similar to the divider,

but having the pointed lower portions of the legs made of steel permanently jointed to the brass; a compass similar to the divider, but slightly longer and having the steel segment of one leg held in a socket in the brass upper portion by means of a wing screw; a second compass similar to the first, but slightly longer; a brass leg segment interchangeable with the removable steel segment of the first compass and adapted to hold a pencil lead; a pen attachment interchangeable with the removable steel segment of the second compass; a ruling pen; two small porcelain dishes adapted for mixing ink. (Fig. 3, page 17)

The divider and compasses of this set are approximately five inches long and of rather heavy construction. The legs of each instrument are pivoted at a hinge without a handle. Although of simple construction, this hinge is well made and is provided with tightening means for increasing the friction as the parts wear and become loose. The pencil segment is almost identical to that used by many conventional compasses of the present day. The pencil lead holder is of the well-known split clamp and screw type, and a knuckle joint is provided for setting the pencil point perpendicular to the drawing surface. The pen attachment has a similar knuckle joint. The pen on this attachment is of the conventional two-blade construction, but is much broader than is now used with compasses; indeed, it closely resembles a modern Swedish type pen, being approximately three-eighths of an inch wide. The blade portion of the ruling pen is of approximately the same size and shape and is attached to a tapering brass handle of octagonal cross-section, the over-all length being approximately five inches.

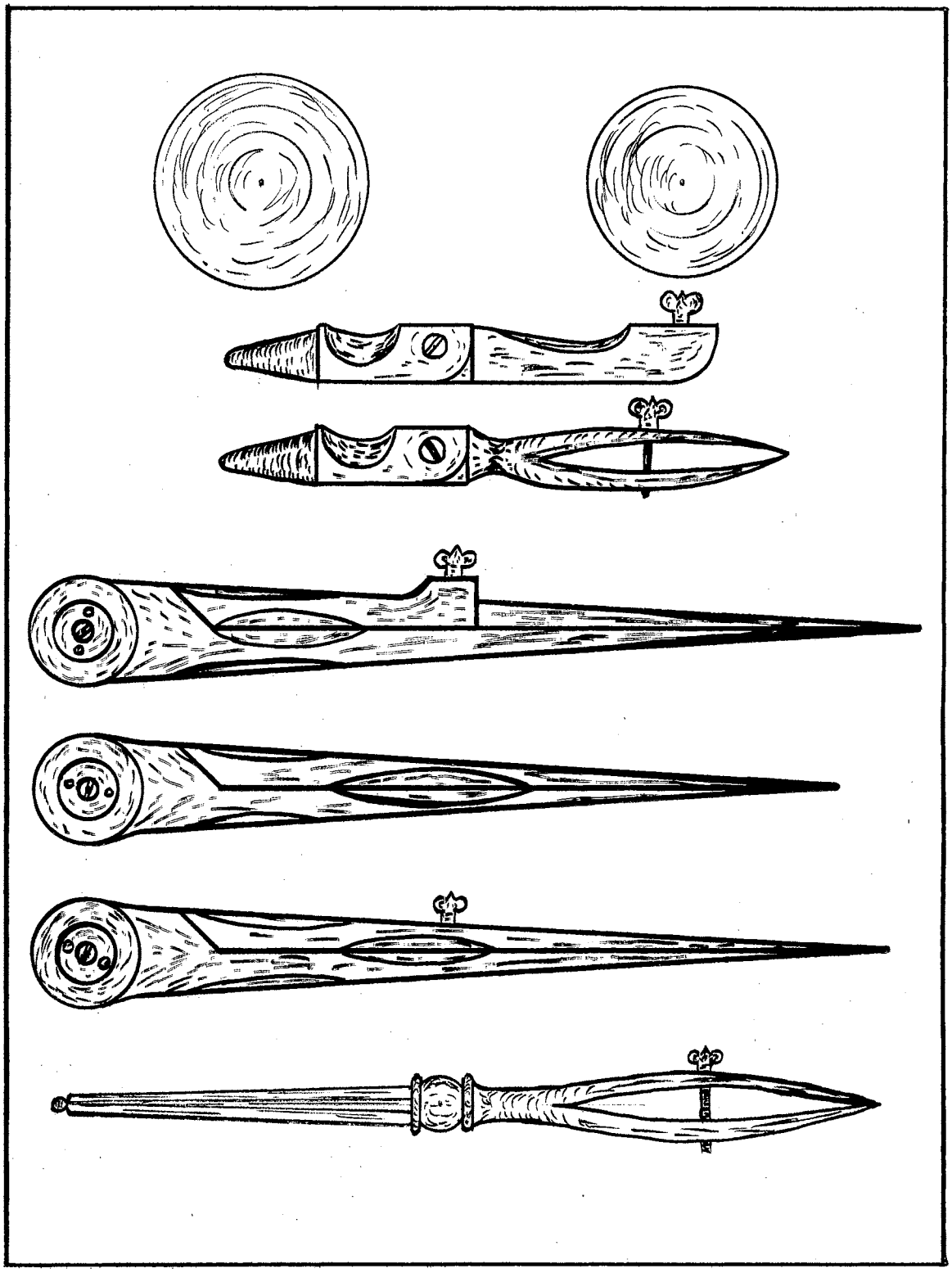

Figure 3

George Washington's Drawing Instruments

Developments in Method. Although Washington's set of drawing instruments represented great improvements since the time of Leonardo da Vinci, it is interesting to note that the general plan of operation which had been in use since the days of the early Egyptians was still followed; that is to say, circles and lines were first lightly drawn and then inked in. True, important improvements had been made in both steps. The preliminary drawing had advanced from simple scratching on stone, wood, or papyrus to drawing on especially prepared paper with a silver point, and finally drawing on almost any kind of paper with a graphite pencil. The process of inking had advanced from painting with a pointed brush to drawing freehand with a writing pen, and finally to the use of a pen which was mechanically guided, either by a compass, a straight edge, or some curved edge. Moreover, control of the strength of line was no longer entirely dependent upon the skill of the draftsman in maintaining proper pressures upon pens of reed or quill, but was mechanized in a blade type pen which could be set to maintain a line of any breadth.

The general procedure as outlined in the foregoing eventually developed into a highly specialized technique, including many refinements for obtaining better results. The draftsman learned to handle his instruments lightly, applying to his pencil, or pencil compass, just sufficient pressure to make a line that could easily be followed later with pen and ink, or could readily be erased for corrections. Pens were also handled lightly so as not to cut the paper and to insure uniformity in breadth of line, especially when drawing lines along a straight edge.

Period of the Industrial Revolution. During the period from 1750 to 1870 drawing instrument making showed considerable progress. Bow pens,

pencils, and dividers were brought out, also beam compasses and other less important instruments. Several improvements were made in the manner of pivoting together the legs of compasses and dividers, and handles were added at the hinges for convenience in manipulating the instruments. The technique described in the foregoing paragraph did much toward influencing the development of instruments. There was a definite trend toward light, even fragile, construction. As the art of making drawing instruments developed, greater complexity was introduced into their design, sometimes for practical reasons, but often for the display of craftsmanship. To facilitate the manufacture of the complex designs at reasonable cost, rather soft materials were generally used whenever feasible; the common was brass, while German silver (an alloy of nickel, zinc, and copper) was used for the better grades.

The Rise of German Supremacy. After the Franco-German War (1870-1871) the German march to empire went forward rapidly and within a few years a dominate position was attained. German banks and trade associations were found in principal cities of the world, including every coastal city of importancein the United States; German ships carried German goods to every port; German products practically eliminated competition in many fields including important chemicals, optical goods, surgical instruments, computing machines, and drawing instruments. German made equipment virtually dominated the drawing instrument business in the United States for seventy years. Both the use and design of drawing instruments followed conservative lines. The techniques of drafting remained unchanged until about 1925; that is to say, draftsmen continued to draw lightly in pencil and then follow with ink. The conservatism of this period is further

reflected in the slow acceptance of handle-erecting devices for compasses; that is, means for holding the handle of a compass so that it lies in a line with the bisector of the angle between the legs. First manufactured in quantity about 1890, these devices found considerable resistance and were not generally accepted for nearly twenty years. Some other improvements were developed, but in a general way the instruments followed along the old lines, being made of soft metals and of light construction. Lightly handled by experts, such instruments would last a lifetime and as long as the techniques remained unchanged and drafting was mostly in the hands of skilled men, there was no incentive toward rugged construction.

In the course of the general development through experimentation to meet special requirements, numerous combinations of instruments were made up into sets and finally the three-bow set became established as standard equipment for most draftsmen. A typical set of this type would include; one pen attachment for compasses; one compass, six inches, with detachable pencil holder; one extension bar for compasses; one hairspring divider, six inches; one bow divider, six inches; one bow pen, four inches; one bow pencil, four inches; one small ruling pen, four and one-half inches; one large pen, five and one-half inches, one metal box with extra leads and metal points. In addition to the foregoing, many draftsmen had a few special instruments to meet their particular needs, the more common being one or more of the following—drop bow compass, broad Swedish type detail pen, beam compass, contour pen and railroad pen.

Developments in Recent Drafting Practice. Although scarcely noticed until the change had neared completion, there began more than 60 years ago a slow development which was eventually to revolutionize drafting

practice. Surveyors ceased to ink in their plane-table sheets and simply traced them on tracing cloth, or paper, from which reproductions were made. Then mechanical draftsmen discontinued the practice of inking their original drawings before making tracings, the originals often being scrapped after completion of the tracings. In due course, this procedure spread to virtually all branches of drafting and became standard practice.

As early as 1910 some draftsmen, to save time in making drawings requiring few erasures, were laying out their work directly on tracing cloth, or paper. After the layout was made it was then inked. In time this practice became wide-spread, extending in some measure into most fields of drafting.

By 1925 a few draftsmen had taken the final step and were making many of their drawings with heavy pencil directly on tracing cloth or paper. The adoption of this practice proceeded rather slowly for several years, but in 1934 it was greatly accelerated and during the next two years there was a veritable revolution as draftsmen turned to carrying out the entire task of making drawings for reproduction on tracing cloth, or paper, in pencil. At first they were somewhat handicapped by the fact that their conventional drawing sets were not all suited to the task. To be entirely satisfactory, this kind of work should be done with a fairly hard pencil to eliminate smudging, and heavy pressures must be applied to get sharp, dense lines for making blueprints, or other reproductions. The instruments in use at that time would not stand up under this severe service, the large conventional friction compasses being altogether too fragile and subject to yielding in such a manner as to vary the radii of circles. A few large bow compasses were imported from Germany and these functioned somewhat better. However, in neither design nor materials were they suited to the

"heavy duty" service of the all-pencil technique. During World War II, the German supply of drawing tools was not available to western countries.

World War II. With the increasing demand to meet the needs of the war industries, it became apparent that there would soon be a serious shortage of drawing instruments of all kinds as most of this equipment had been made in Germany by old-school European craftsmen. In order to meet this emergency, many companies, which were then in the business of making drafting machines, undertook the manufacture of drawing instruments. The engineers of these companies studied the older types of instruments with the idea of not simply producing instruments of equivalent values, but with the intention of improving upon them. By designing instruments along new lines, they were able to meet the more exacting demands of strength and rigidity brought about by the revolutionary change from ink to pencil for final tracings. Moreover, they were able to produce lighter instruments and to use steel instead of softer materials, such as brass or German silver, that were commonly employed for the older instruments.

The new drawing instruments met with immediate success and were used in very large quantities throughout the war industries; for the production of all mechanized devices, large and small, begins on the drafting board. This includes the production of ships, airplanes, motor vehicles, arms, ammunition, clocks, watches, pens, pencils, etc. the production of a first class battleship requires three large freight-car loads (180,000 pounds) of drawings. Under the pressure for pushing large scale improvements in war equipment to combat an active enemy, drawings following the old practice would have been obsolete before they

could have been inked in. Speed and utility were the order of the day and pencil drawings established new standards for draftsmanship. The instruments had to meet most severe demands in service, not only due to the change from ink to pencil, but because of the fact that a large number of untrained people had to be put at drafting work and such people, not being familiar with the handling of precision instruments, were "heavy handed." These new types of instruments met with all precision requirements and at the same time could take the hard service that soon broke down so many of the older drafting instruments.

Not only has the new practice in drafting brought about changes in instruments, but also in the composition of drawing sets. Fewer instruments are required, but these must possess greater rigidity and durability. In a general way, a modern set must afford the utmost in convenience in the severe service of making finished drawings in pencil, and it should also provide for inking in case of need. A really good set would include one large bow compass, one small bow compass, one large friction divider, one pen attachment for compass, one ruling pen, and a box for extra leads and steel points. (Fig. 4, page 24) However, if the small bow compass or friction divider is eliminated, excellent work can still be carried out. If both of these instruments are eliminated, the set remaining can still be used effectively. A drop bow compass or beam compass may be added to take care of drawing very small or very large circles, respectively. It is of interest to note that, whereas the fragile instruments of conventional type required large cases with separation compartments well spaced, the new instruments are so strong that compact cases of soft leather, and with closely set compartments, afford ample protection, besides being more convenient to carry. (16, pages 10-15)

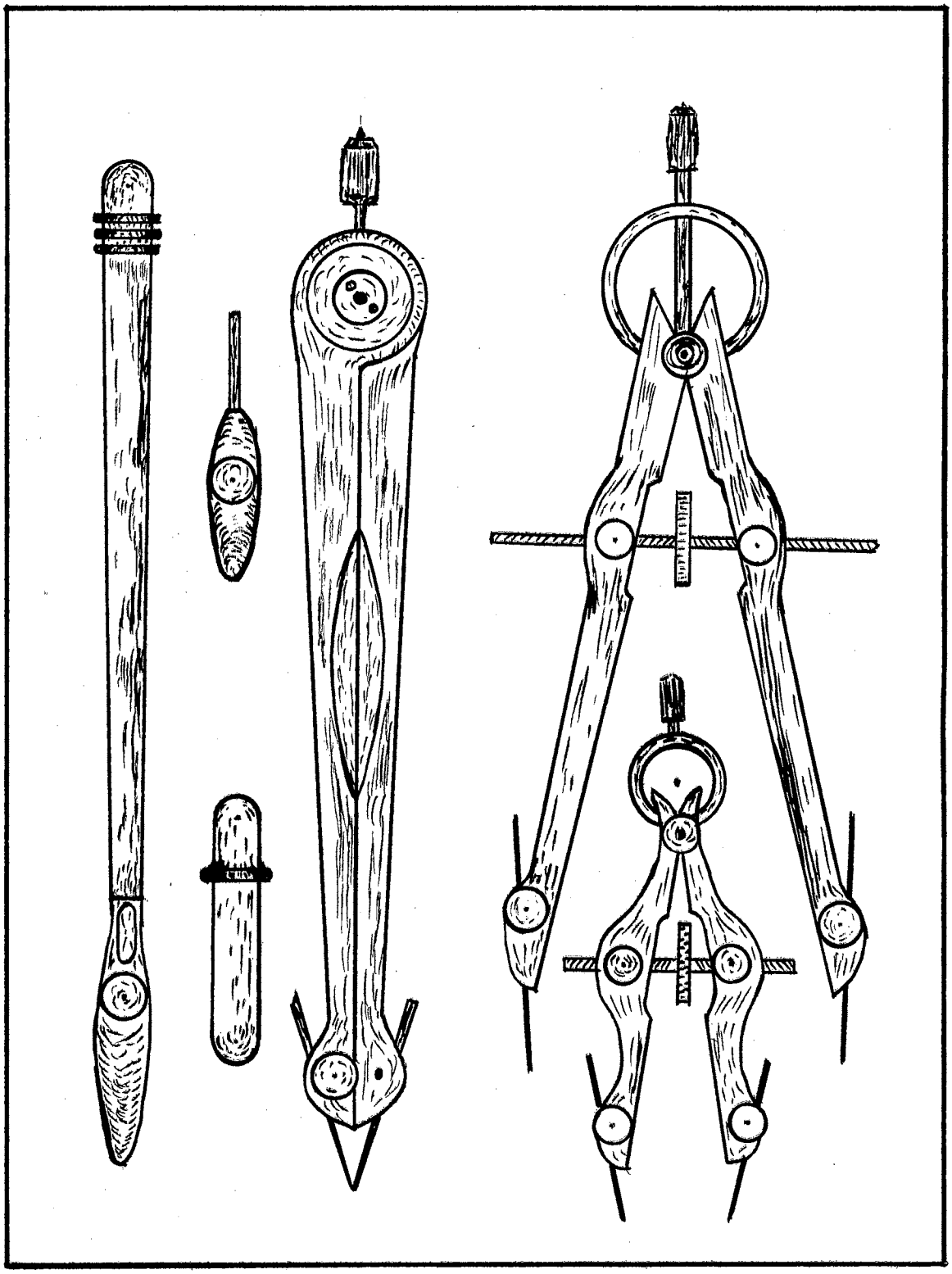

Figure 4

Modern Drafting Tools

Art, being a developed means of expression from pre-historic time, has constantly changed, but the changes progressed very slowly from the mechanical drawing standpoint. It seems that it takes a world war or industrial crisis to get a more progressive idea developed or utilized.

The first type of blueprinting was a photographic type operation, by exposing a sensitive paper to light. Basically this process has not changed except by refinements of machinery and lighting. The Phoenicians made prints in Biblical times. But historians say Hershel, an Englishman, in 1837, developed positive and negative in connection with printing. The techniques have been gradually changing from blueprints by light and water. Van Dyke prints were made in the same fashion, except with different color lines. The ammonia gas or Ozalid print was a great advancement. These new printing machines were developed for mass production. Ozalid prints have either blue, black, or maroon lines on a white background, which are better adapted for notes or corrections.

The use of ink is becoming obsolete as newer techniques are being developed. The inking pens are not necessary to make a blueprint today. A pencil of good quality is sufficient to make a tracing and then a machine will automatically reproduce a print in a few seconds.

History of Drawing in American Schools. Before a person could write on the current history of drawing, the men who helped develop industrial arts and drawing should have due credit.

Before 1900 there were several educators that could see the need for industrial arts as a school subject. The following men were great leaders in their time.

John Locke (1632-1704) John Locke became the chief exponent of the idea that education should fit the boy for practical life. It was in 1697 that he organized a working school for young children where they could learn a trade, other than their father's. He recognized the value of drawing in that it is helpful in fixing the image of objects in the mind. (2, page 61)

Jean Jacques Rousseau (1712-1778) Another of these educators was a Frenchman, Jean Jacques Rousseau, who was a firm beliver that experience is the best teacher and he would have everyone possible taught by actions. Rousseau considered agriculture the most important of all arts and professions. Next to this was carpentry. Although Rousseau did not put his educational plan into action, it prepared the way for Pestalozzi and others who followed him. (2, pages 77-82)

Johann Heinrich Pestalozzi (1746-1827) Johann Heinrich Pestalozzi, who has been called the "Father of Manual Training," is the man who first organized handwork as a part of general school work. He wanted to use objects or concrete things to teach with instead of words and abstractions. (2, page 119)

Friedrich Wilhelm Froebel (1783-1852) Another great educator who followed in the footsteps of Pestalozzi was Friedrich Wilhelm Froebel. He was a firm believer in handwork and would place it in the center of his educational system. (2, page 161)

Early American Educational Practices. The first schools in America were clearly the results of the Protestant revolt in Europe. The family was responsible for the education of the children and a Massachusetts Law of 1642, which directed the officials in each town to find out if the parents were attending to their educational duties, was enacted. The first public school was organized in New York in 1805, and this was the real beginning of the public school development. (8, page 17)

Manual Labor Movement. It was in 1820 that the manual labor movement began in the United States. This was a plan of introducing manual arts instruction into the schools on the basis that pupils would work a half day and receive instruction the other half.

Morrill Acts of 1862. The Morrill Acts of 1862 provided the endowment of higher education in the agricultural and mechanical arts. This grant was to enable Land Grant Colleges to train more industrial arts people such as engineers, designers, draftsmen, and factory managers.

In America many schools had been established to teach industrial arts, and this in turn led the way for many men to become leaders in this very important field of education. A few of these men will be listed because of their contribution toward the development of drawing.

Calvin Milton Woodward (1837-1914). In 1872 Calvin Woodward, who is known as the "Father of Manual Training in the United States," began working toward a goal that included shop work in education. (10, page 13)

Charles A. Bennett (1864-1942). While serving at Columbia University, Mr. Bennett was instrumental in setting up for the first time in American

education a two year course for the preparation of teachers in the manual arts field. It was here in 1896 that the first graduate course in the teaching of manual training was given in an American college. Four of the books that he wrote were used for a foundation and guide for drawing. Problems in Mechanical Drawing, Beginning Problems in Mechanical Drawing, Grammar Grade Problems in Mechanical Drawing, and The Manual Arts. Probably his greatest books are History of Manual and Industrial Education up to 1870 and History of Manual and Industrial Education, 1870 to 1917. (17, page 310)

In the twentieth century there have been a multitude of leaders and educators in the industrial arts field. Two of the leaders in drawing who are working toward higher goals at the present time are Dr. DeWitt Hunt and Cary L. Hill.

DeWitt Hunt (1889- ). Dr. Hunt began his long and resourceful career as a teacher of manual training in 1908. He has been a recognized leader in the industrial arts field because of his many publications and articles. He is the author of A Manual for Hand Woodworking, A Manual for Machine Woodworking, Mechanical Drawing, and Problems in Sheet Metal Work. (6, page 532)

Cary L. Hill (1897- ). Mr. Hill began his teaching career in industrial arts in Joliet, Illinois in 1922. He worked at this profession until World War II, when he became an industrial engineer for three years. In 1946 he returned to teaching in the industrial arts field and at the present time is a very active leader in the drawing field. He is the co-author of the book, Introduction to Applied Drawing. (10, page 5)

# CHAPTER III

## CHANGING PHILOSOPHY

As early as 1700 great philosophers were advocating the teaching of the entire boy, not just the necessities of survival.

Rousseau, Pestalozzi, and Froebel were very instrumental in developing manual training subjects that could and were used as school subjects. Some of their ideas came from the Bible, but they expanded their personal thoughts to include the entire European continent.

Early Egyptians were very skilled at architecture, but they developed no means of teaching their skills except from father to son. The drawings were difficult to understand if not described by the draftsman. Life progressed in this slow fashon until the industrial revolution, which brought the people into settlements and changed their way of existance. The development of machines and their use in factories gave the people more free time and changed their educational systems. The boys could go to school and learn a trade, simply by taking part in the manual training that was advocated by Locke and Rousseau.

In New York in 1805 the first public school was organized. This put America in the lead concerning education for all of the people. Soon after this school was developed, the teaching of manual training, similar to the European system, was introduced into the curriculum.

The technique of drawing progressed very slowly through these many years. The development of mass production in the factories was one of the greatest things that ever happened to the drawing field, because with a drawing several interchangable parts could be made exactly alike.

Definition of Educational Terms. Several terms are listed below that are used in this chapter, their definitions were taken from a dictionary by Thorndike. The definitions should improve the meaning and educational value of each term.

Philosopher. A lover of wisdom, a person who has a system of true philosophy toward life.

Manual Training Subjects. Subjects that utilize the hands as well as the mind for learning.

Industrial Revolution. The development of factories, and the utilization of man power.

Free Time. Time that is not used toward an occupation.

Educational System. A system that teaches or educates the people.

Public School. A school supported by the public and for the public.

Curriculum. A number of subjects combined together to become an educational tool.

Technique of Drawing. A definite type of drawing operation.

National Thought. A generally accepted condition.

Democratic System. A system that is governed by the people or public.

Opportunities. A favorable time that better an individual.

The evolution of civilization has given the people of todays' world a constant strive for changes toward a desirable medium to develop better educated people. To determine the standard of progressive attitude toward drawing subjects taught in our public schools today, advanced ideas should be stressed to keep pace with the rapidly changing industrial and economical situation, even if the curriculum in our educational system must be changed to fit the current trends.

A questionnaire was mailed to several of the mechanical drawing instructors in the Kansas area, asking them to check the type of drawing they were teaching and their results, this questionnaire revealed trends or definite needs in the drawing classroom. It revealed the type of

drawing most common, how the subject is organized, and possibly how it could be improved.

The results seem to be a well developed drawing course guide. Possibly a sheet could be developed from a number of the better ideas presented. All answers or ideas that correspond to the national thought and in line with our democratic type educational systems should be itemized. All radical information should be listed according to its classification and subject matter possibilities. The total percentages of the findings presented by the questionnaire could be listed on a graph for case identification.

All information on the guide sheet should be presented in an understandable manner, and have a retention quality for interested parties. It would have to be economical for the student and the school. Short class periods in a crowded classroom would limit the curriculum and subject matter presented. Mechanical drawing has been used for centuries so it is not new, but new techniques or improved methods have been developed because of a past war crisis or personal desire.

Recently there has been a remarkable change in methods of drawing and also in the development of blueprints. One must understand the past to appreciate the present or expect a future. The numerous fields of drawing are becoming more demanding as our world situation continues to look disagreeable, all types of industry seems to be splitting at the seams trying to expand in step with our opposition or to meet everyday needs.

The petroleum industry in particular has a standing bid for draftsmen with experience, because of the expansion the petroleum industry needs personnel to fill vacancies and grow with the industry.

Every year there are more applications available for the seniors in our high schools. This is especially true if the student has been exposed to a good drawing system and is interested in a drafting position with this type industry.

After World War II there has been a tremendous movement of population from the urban to sub-urban or rural areas and also away from the coastal areas. This movement has developed from many different situations such as, crowded conditions, racial disturbance, cold war influence, industrial changes, and a number of personal reasons brought about by the changing philosophy of the average American during the past 20 years. The United States government stated that in 1960, most of the larger cities had lost thousands of residents since 1950. The average individual has a desire to acquire physical and mental security for himself and family. One of these desired items is a dwelling that could be called home. This desire has become a blessing for the draftsman, plans and elevations are constantly being changed to meet the personal desires as newer materials are being developed and utilized. New homes and buildings are being constructed everywhere. The higher economical standards will develop numerous opportunities for several decades. These obvious opportunities must be challenged by our present and up-coming generations. Our educational curriculum is being changed to balance our needs with a system that is economically sound. The questionnaire concerning present day needs of drafting might be obsolete in a short time, assuming that progress in the future advances like it has in the past generation.

The following chapter was developed for a personal desire, to evaluate one drawing method against another or against several others.

This questionnaire has developed a new theory that certainly seems better than the one being used at the present time. It seems that if only one idea or better method is developed from many hours work in the teaching field, the time consumed is well spent educationally.

# CHAPTER IV

## CONCLUSIONS AND RECOMMENDATIONS

This research study includes the early beginning and development of drawing education and the development of the drawing methods from the earliest developments up to the present time. This information is based upon facts that were gathered from textbooks and magazines which were the principal sources of information, other than the questionnaire.

Summary. This study includes the progress of mechanical drawing from the time of its beginning in prehistoric days to the present time, therefore, the Egyptian, European, and American developments have been discussed. This development has been responsible for the high standards of drawing in America.

After pursuing this study through the reading of books and reports related to drawing, it is believed that mechanical drawing is a phase of general education, and that the content of the drawing subjects are definately an aid toward industry. Courses offered in the drawing department should be representative of the community needs. However, there are many kinds of drawing subjects that can be offered under a well developed drawing program. There is more transfer of learning in drawing than in many industrial arts subjects.

The purpose of this study was to offer a better organized drawing outline, and to evaluate the drawing procedures serving Kansas at the present time. A check to determine if the drawing objective is average or above average in quality and quantity.

Replies that were received from 27 instructors in 25 high schools concerning the questionnaire was the basis for these findings and results. The high return percentages indicate a good average coverage. The instructors listed 91 courses being presented at the present time with an average of 20 students enrolled in each course. Approximately 80% of the drawings are taken from textbooks, while the remaining 20% are from models, castings, blocks, audio-visual material, and instructor developed material.

Approximately 84% of the returns indicated architectural drawing was being presented as a subject, but on the other hand only 8 schools were offering other advanced drawing subjects. Only 7 schools use drawing paper other than 11 x 15 or 11 x 17 inches, and they utilize both sides of the paper. Altamont has the largest enrollment at 154, and Dodge City the smallest at 24 students. An interesting situation was revealed, 67% of the schools reporting, furnish mechanical drawing sets for all students, and a fee to cover loss or destruction of equipment. Approximately 50% of the schools furnish drawing paper, but only 20% furnish drawing pencils. The schools that do not furnish equipment for the drawing students do not charge a fee or dues, but require each student to purchase and maintain a personal set of drawing supplies. A large per cent of the schools permit girls to enroll in industrial arts subjects, but only a few have an opportunity to do so. The majority of the instructors do not rely on only one textbook, but utilize several sources of information. The percentages of material obtained from a textbook varies from 10% to 100%, depending on the type of drawing course.

After reviewing the questionnaire information obtained, reports tabulated and organized, the results consist of a conclusion listed on the next several pages which include Tables I, II, III, IV, and Conclusions.

Conclusion. The information itemized on Table I, II, III, and IV should have a brief explanation for each item and its utilization toward a better drawing outline.

The replies received from the drawing instructors indicate a desire to improve or extend the drawing curriculum. The instructors have an average of 6 years experience as teachers, and an average of 3.5 years experience as drawing instructors. All of the instructors have a Bachelor of Science degree and 3 % have a Master of Science degree. Approximately 5% of these instructors teach only drawing subjects in the classroom, while 95% teach other subjects during the day. The majority of these extra subjects are industrial arts subjects, the major one being woodwork, either hand or machine woodwork. General shop and driver education were also listed by several of the instructors as additional subjects being taught.

Seven of the instructors teach drawing three hours and then woodwork for three hours to complete their day. Nine of the instructors teach drawing only two hours per day. The class enrollments average about 20 students per hour. The largest class average being 51 at Altamont and the smallest class average at Dodge City and Russell with 12 each.

Table I has a section pertaining to drawings not taken from a textbook. The majority of the instructors answered this question by listing the materials used for a drawing project. This material was of several categories, such as wooden models, metal castings, items at random, shop projects, audio-visual materials, and problem blocks.

Approximately 84% of the schools listed, offer architectural drawing as a full year subject. Only 7 schools offer more difficult drawing subjects. The three schools that do not offer architectural drawing have only a few students enrolled or they have mechanical drawing offered each

TABLE I

SCOPE OF DRAWING COURSES

| SCHOOL | % drawing from text | Drawing not from text | Offering Arch. | Offering Other |
|---|---|---|---|---|
| Altamont | 50 | castings-others | yes | no |
| Anthony | 75 | models-others | 6 wk. | yes |
| Augusta | 75 | castings-others | yes | yes |
| Bonner Springs | 75 | castings-others | yes | no |
| Chanute | 75 | castings-others | yes | yes |
| Derby | 75-100 | castings-others | yes | yes |
| Dodge City | 50 | models-others | no | yes |
| Emporia | 75 | models-others | yes | yes |
| Junction City | 75 | all areas | yes | no |
| Kansas City | | | | |
| School A | 25 | student interest | yes | no |
| School B | 75 | others | yes | no |
| Liberal | 95 | all areas | yes | no |
| Marysville | 75 | models-others | yes | no |
| Merriam | 75 | others | yes | no |
| Parsons | 100 | - | no | yes |
| Russell | 50 | all areas | some | no |
| Salina | 75 | castings-others | yes | no |
| Topeka | | | | |
| School A | 75 | castings-others | yes | no |
| School B | 100 | - | no | no |
| Ulysses | 50 | models-others | yes | no |
| Wichita | | | | |
| School A | 75 | shop projects | yes | no |
| School B | 10 | all areas | yes | no |
| School C | | | | |
| Teacher A | 75 | others | yes | no |
| Teacher B | 100 | - | yes | no |
| School D | | | | |
| Teacher A | 100 | others | yes | no |
| Teacher B | 75-100 | others | yes | no |
| School E | 95 | castings-others | yes | no |
| Winfield | 75 | others | yes | no |

hour during the school day, giving everyone an opportunity for one course of mechanical drawing.

School (C) and (D) of Wichita have two instructors each in their drawing department. Three of these instructors teach only two hours of drawing per day, while the other instructor, teacher (B) at school (D) has 111 students in five hours of drawing. This makes an average of 22 students per hour.

Table II indicates the number of courses offered, but does not list the number of sections for each course. This makes the table difficult to interpret. To explain the difficulty, take school (A) at Wichita which has a total enrollment of 150 students and a class average of 30 students, this indicates 5 sections being offered within the three courses.

On Table III the drawing items that are furnished by the schools are listed as the questionnaire returns indicate. Only 6 of the schools represented do not furnish a complete drawing set for each student. This set of drawing equipment includes a drawing board, T square, 30-60 and 45 degree triangles, and a box of drawing instruments. The schools that furnish drawing sets and drawing paper charge each student enrolled in drawing a fee that pays for the paper and use of school owned equipment. If there is a loss or damage of equipment the student is required to replace the drawing set to its original condition. The average fee is approximately $2.00 per student. Seven schools furnish each student the first drawing pencils, if they are lost or destroyed, the student must purchase replacements.

The drawing paper used by 97% of the schools is either 11 x 15 or 11 x 17 inches. Chanute and Topeka, school (A), use 9 x 12 inch paper for their mechanical drawing. Russell has the largest paper size at 15 x 22

TABLE II

SIZE OF DRAWING CLASSES

| SCHOOL | No. of courses | Enrollment Total | Class Average |
|---|---|---|---|
| Altamont | 3 | 154 | 51 |
| Anthony | 1 + 6 wk. | 34 | 17 |
| Augusta | 4 | 65 | 16 |
| Bonner Springs | 2 | 30 | 15 |
| Chanute | 5 | 75 | 15-20 |
| Derby | 2 | 100 | 20 |
| Dodge City | 1 | 24 | 12 |
| Emporia | 2 | 43 | 22 |
| Junction City | 4 | 56 | 15 |
| Kansas City | | | |
| School A | 6 | 110 | 20 |
| School B | 5 | 145 | 29 |
| Liberal | 2 | 45 | 18 |
| Marysville | 2 | 54 | 13 |
| Merriam | 6 | 122 | 23 |
| Parsons | 4 | 91 | 15 |
| Russell | 1 | 25 | 12 |
| Salina | 5 | 123 | 24 |
| Topeka | | | |
| School A | 8 | 110 | 27 |
| School B | 1 | 30 | 15 |
| Ulysses | 2 | 34 | 17 |
| Wichita | | | |
| School A | 3 | 150 | 30 |
| School B | 3 | 110 | 20-28 |
| School C | | | |
| Teacher A | 2 | 46 | 23 |
| Teacher B | 2 | 46 | 23 |
| School D | | | |
| Teacher A | 2 | 41 | 20 |
| Teacher B | 5 | 111 | 22 |
| School E | 3 | 110 | 22 |
| Winfield | 3 | 89 | 20-25 |

inches. The reason for having large paper is that all views can be drawn at a larger scale, which makes drawing less difficult for a beginning drawing student.

Other additional information obtained from this questionnaire was varied according to size of school, time allotted for drawing, and grade level of students enrolled in drawing. The freshman and sophomore students dominated the grade level for mechanical drawing. Therefore, the architectural drawing course is reserved for the junior and senior students.

The audio-visual material used, other than models, castings, and blocks, were educational films and film strips, which are produced by the larger industries for advertisement of their products.

All of the schools listed offer a full year course of drawing except Anthony and they offer a 6 weeks architectural drawing course. In this 6 weeks period the student is required to become acquainted with the equipment and draw floor plans for an understanding of that part of architectural drawing, so it may be utilized in the woodwork department the following 6 weeks.

Table IV indicates subject material that is taught in the mechanical drawing courses, as tabulated from the questionnaire. Only ten of the subjects listed are taught by all 27 instructors that returned the questionnaire. These ten subjects are the basic fundamentals of drawing and can be used in the other areas of the student's educational program.

Approximately 80% of the instructors teach at least one unit on the history of drawing. This is usually obtained from the history chapter in the textbook being used. The instructors that are concerned with drawing courses usually teach the material they think is most important, and from the history with which they are familiar. The other twelve instructors

TABLE III

DRAWING MATERIALS

| SCHOOLS | Basic Paper Size | Articles Furnished: Sets | Pencils | Paper | Comp.-Div. |
|---|---|---|---|---|---|
| Altamont | 11 x 17 | yes | no | no | yes |
| Anthony | 11 x 15 | yes | no | no | - |
| Augusta | 11 x 15 | yes | yes | yes | yes |
| Bonner Springs | 12 x 18 | no | no | yes | no |
| Chanute | 9 x 12 | yes | no | no | - |
| Derby | 11 x 17 | yes | no | no | yes |
| Dodge City | 11 x 15 | yes | no | no | yes |
| Emporia | 11 x 15 | yes | yes | yes | yes |
| Junction City | 11 x 15 | no | no | no | no |
| Kansas City | | | | | |
| School A | 11 x 17 | yes | yes | yes | yes |
| School B | 8½ x 11 | yes | no | yes | yes |
| Liberal | 11 x 15 | no | no | no | no |
| Marysville | 11 x 15 | yes | yes | yes | yes |
| Merriam | 11 x 17 | no | no | yes | no |
| Parsons | 11 x 22 | no | no | yes | yes |
| Russell | 15 x 22 | yes | no | yes | yes |
| Salina | 11 x 22 | yes | - | - | - |
| Topeka | | | | | |
| School A | 9 x 12 | yes | no | no | yes |
| School B | 12 x 18 | no | no | no | no |
| Ulysses | 11 x 15 | yes | no | yes | yes |
| Wichita | | | | | |
| School A | 11 x 17 | yes | no | no | yes |
| School B | 11 x 17 | yes | no | no | yes |
| School C | | | | | |
| Teacher A | 11 x 17 | yes | no | no | yes |
| Teacher B | 11 x 17 | yes | no | no | yes |
| School D | | | | | |
| Teacher A | 11 x 17 | yes | yes | yes | yes |
| Teacher B | 11 x 17 | yes | yes | yes | yes |
| School E | 11 x 17 | yes | yes | yes | - |
| Winfield | 11 x 15 | yes | - | yes | yes |

do not teach history as a special topic, because they are interested with only the fundamentals of drawing.

Thirty per cent of the instructors do not teach graphs and charts in mechanical drawing because the students have had this type of material in the junior high school subjects.

The instructors teaching architectural drawing checked all items on the questionnaire pertaining to architectural drawing and nine instructors added field trips to the list. The field trips were taken to homes and buildings being constructed within a short distance of the drawing classroom. The trips were taken to the constructions so the students could visualize, at full scale, what they had been drawing from the textbook.

Pipe drafting is being taught by fewer instructors, in mechanical drawing, than any other subject listed on the questionnaire. The six instructors that teach pipe drafting do so in the large city schools, possibly because there is a greater need for this type knowledge in the more heavily populated areas.

Only about 30% of the drafting instructors teach freehand sketching today because of two obvious reasons, there is not enough time in mechanical drawing to do justice to sketching, and the art teacher presents sketching as part of the newly developed art programs. Ulysses and Liberal offer sketching if there is a demand.

Cabinet drawings and pictorial drawings are two of the subjects that are taught by only eight instructors, the reason for this lack of interest toward the subject is that the subjects are difficult for the freshman or beginning draftsman. These subjects compared very close in Table IV because a cabinet drawing is a type of pictorial drawing. They could be used in the woodwork department as drawings for furniture projects.

TABLE IV

SUBJECTS OFFERED

| SUBJECT | No. Schools Offering | No. Schools Not Offering | No. Schools Part Time |
|---|---|---|---|
| Sheet layout | 27 | - | - |
| Tools and equipment | 27 | - | - |
| Opportunities | 27 | - | - |
| History | 15 | 12 | - |
| Alphabet of lines | 27 | - | - |
| One-view drawings | 27 | - | - |
| Lettering | 27 | - | - |
| Dimensioning | 27 | - | - |
| Squared paper method | 27 | - | - |
| Orthographic projection | 27 | - | - |
| Auxiliary views | 22 | 5 | - |
| Assembly drawings | 17 | 10 | - |
| Sectional views | 27 | - | - |
| Prints and reproductions | 24 | 3 | - |
| Oblique drawings | 20 | 7 | - |
| Patterns | 22 | 5 | - |
| Isometric drawings | 17 | 10 | - |
| Perspective drawing | 21 | 4 | 2 |
| Fasteners | 21 | 6 | - |
| Pictorial drawings | 8 | 19 | - |
| Cabinet drawings | 8 | 19 | - |
| Sketching, freehand | 9 | 16 | 2 |
| Pipe drafting | 6 | 21 | - |
| Graphs and charts | 7 | 20 | - |
| Architectural | 21 | 3 | 4 |
| Floor plan | 21 | 6 | - |
| Elevation | 21 | 6 | - |
| Details | 21 | 6 | - |
| Perspective | 21 | 4 | 2 |
| Other | 9 | 18 | - |

Approximately 60% of the instructors teach isometric, assembly, and oblique drawings in the last 12 weeks of the mechanical drawing course. This is to give the student a working knowledge of these types of drawings so he can use them in a transfer of learning situation toward other subjects.

Fasteners are taught by 21 instructors, as the results indicate, and it is assumed that these instructors also teach woodwork and realize the necessity of knowing all common fasteners and their proper utilization. Fasteners should be clearly understood by a student if he wishes to enroll in other advanced drawing courses, or mechanical subjects.

Patterns are offered in the last 6 weeks of the school term by 75% of the instructors, because it is a beneficial subject that can be utilized in the general shop areas of leather, plastic, and metals.

The ten subjects, listed on Table IV, that are being taught by all instructors listed on the questionnaire are as follows: Sheet layout, tools and equipment, opportunities, alphabet of lines, one-view drawings, lettering, dimensioning, squared paper method, orthographic projection, and sectional views.

Recommendations. It is recommended that the drawing subjects be practical and offered to both boys and girls. It is suggested by the author that more current material be made available to teachers and administrators for the improvement of instruction and the organization of courses of study. However, drawing programs or departments will vary according to schools and location, but basically there are fundamental principles that will remain the same in organizing any drawing program. The extent of a drawing program should be limited only by the students and educational facilities.

A more detailed questionnaire distributed over a larger area would improve these results and make them more reliable, because different states have varied requirements.

It is also suggested by the author that a state wide drawing department survey might prove the results of this questionnaire unreliable. The percentages shown on the tables could be 2 or 3 per cent above a true average.

Liberal, Kansas
July, 1959

Mr. John Doe
Mechanical Drawing Instructor
Kansas Public School
Town, Kansas

Dear Mr. Doe:

Could you spare a few minutes of your time? As a special favor to me and as an aid toward the development of a better teaching method for mechanical drawing in our high schools, would you please complete and return to me the enclosed questionnaire?

This questionnaire is a device to help select a practical and better understood technique toward the teaching of mechanical drawing.

Complete or check the questions that apply to you or your school system. Give estimated results where necessary and personal suggestions will be appreciated.

Please use the stamped, self-addressed envelope for returning the questionnaire.

I thank you very much for your answers and time. It will help me toward completion of my research material.

Sincerely,

Fred J. Hill
Mechanical Drawing Instructor
Liberal High School
Liberal, Kansas

Approved:

_____

C. L. Hill, Dept. Head
Industrial Arts Education
Oklahoma State University
Stillwater, Oklahoma

School _____ City _____ State___

Instructor _____ Degree__

Number of years in teaching profession _____ Drawing _____

Subjects taught at present in addition to mechanical drawing -------

_____

Drawing textbook used _____ Date copyrighted _____

Period or duration of course taught:

( ) Other, describe _____

( ) six weeks
( ) half year
( ) full year

Subject matter covered in full year course:

( ) Sheet layout
( ) Tools and equipment
( ) Opportunities
( ) History
( ) Alphabet of lines
( ) One view drawings
( ) Lettering
( ) Dimensioning
( ) Squared paper method
( ) Orthographic projection
( ) Auxiliary views
( ) Assembly drawings
( ) Sectional views
( ) Prints and reproductions
types _____
_____

( ) Oblique drawings
( ) Patterns
( ) Isometric drawings
( ) Fasteners
( ) Perspective drawings
( ) Pictorial drawings
( ) Cabinet drawings
( ) Sketching, freehand
( ) Pipe drafting
( ) Graphs and charts
( ) Architectural
( ) floor plan
( ) elevation
( ) details
( ) perspective
( ) other ____

Total number of enrollment _____ _____

Average class size _____ _____

What is your basic size for drawing paper _____

Percent of drawings copied from textbook _____

Number of hours drawing taught per day _____

Is architectural drawing offered _____

Do you offer other types of drawing _____ What _____

Articles furnished by school ( ) sets, ( ) paper, ( ) pencils

Are dues or fees charged _____ Amount _____

Grade level of students _____

Are students male ( ), female ( ), or both ( ) _____

What audio-visual materials are used _____

Your personal opinion will be appreciated on the remainder of this sheet

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