A SURVEY OF THE CONTENT OF THE INDUSTRIAL-ARTS
GRAPHIC-ARTS AREA IN THE COMMONWEALTH OF
PENNSYLVANIA SCHOOLS

by

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VARIOUS ACTIVITIES IN THE GRAPHIC ARTS

BLOCK PRINTING

TYPICAL GRAPHIC ARTS SHOP

SILK SCREEN WORK

BOOKBINDING

Reproduced from THE GRAPHIC ARTS by Johnson and Newkirk, MacMillan Company, N. Y.
The graphic arts as a significant part of our modern industrial world is making a contribution to our present and future civilization. We must assume that experience is one of the important bases for learning and that learning through such means is the way to personal expression and to the ability to understand, manipulate, and evaluate environment. In a highly technical society, both expression and appreciation become increasingly complex, a fact which calls for a wide understanding of fundamental techniques. The young people of today should learn about the graphic arts as a part of their general education and as a possible future vocation or avocation. A clear picture of the graphic arts and their products not only adds interest to living but improves consumer appreciation for the products of this great industry.

The teacher of industrial arts may feel that the vast complexity of the modern commercial methods of printing and its related fields make it impossible for him to present a feasible program; but careful study will show that, with only a few exceptions, modern methods are little more than refinements and mechanizations of the original hand processes, the principles of which may be readily understood and practiced. Thoughtful practice makes possible not only personal expression by these methods, but brings a clearer understanding and a better appreciation of the basic principles of mechanical production.
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A generation ago it would have been a relatively simple job to outline in detail the content of industrial arts or any one of its predecessors, manual training and manual arts. One would have considered the job completed upon analyzing one phase of industry, perhaps woodworking, and this from a local and vocational viewpoint.

Today the problem is vastly more complicated. The complexities of an industrial age itself influence our daily living. Since this influence is so strongly felt in everything we do, industrial arts should prepare the youth for interpreting a complex society by offering a broad, comprehensive program geared to an industrial age. This preparation cannot be achieved successfully by the making of a few models in wood and a few plates in drawing.

The content of industrial arts expands daily, with new inventions and discoveries, new materials and products, and new problems arising from the effect of industry upon society. Many schools limit their graphic arts offering to type-setting and press-work. These schools do not offer an adequate perspective of the graphic arts program. Less expensive and very important are experiences such as papermaking, bookbinding, ink making, printing by silk screen and planographic methods, block cutting and the like. Pupils should receive a broader scope of the graphic arts.
Purposes of the Study

Because the method of representing ideas is by means of the graphic arts and has been so ever since man was able to scratch pictures on stone and clay, and because of the extent to which the graphic arts are used in everyday life, there is reason to determine the content and the trends of the graphic-arts area in present-day schools.

With this in mind the purposes of this study are:

1. To determine the content of the graphic arts in the public schools.

2. To determine the equipment necessary to operate a satisfactory program.

3. To determine to what extent industrial-arts teachers believe there is need for instruction in graphic arts.

4. To determine why some schools do not include the graphic arts in the industrial-arts program.

5. To determine the trend of graphic-arts teaching.

6. To set up minimum content standards for the graphic-arts area.

7. To make available any information that may be of assistance to educators and others interested in the industrial-arts program of the public schools.

Location of the Study

This study has as its primary aim the survey of the industrial-arts graphic-arts area in Pennsylvania schools. Pennsylvania was
chosen because it is one of the states more advanced in the teaching of the graphic arts. The study will include a sampling of the junior and senior high schools. Since Pennsylvania requires all such schools to provide a general-shop program in grades seven, eight, and nine, before certification as standard schools, then all schools which received a questionnaire will at least have the background of a general industrial-arts program from which to answer.

Need for the Study

To many people the art and science of the printer are unknown fields. The drama of typesetting, newspaper work, and binding belongs to the mysterious crafts, yet the symbol of the printed word is one of the most significant things in our civilization. Understanding of the processes and techniques by which type becomes a usable symbol is a valuable educational experience.

The problem arises as to what the public schools are doing to assist the pupils in becoming acquainted with this rich field. Since one of the major general objectives of the industrial-arts program is to make a contribution to the general education of youth, it would seem necessary to include the graphic arts in the
industrial arts program. Struck says: (16:180)*

By the time students have completed their work in industrial arts they will have built up a background of insights, understandings, and skills that form a relatively broad background for more specialized trade training.

The precept that the field of graphic arts is rich in educational and inspirational possibilities is well stated in the myriad of references that fill our literature. Graphic arts offers many opportunities for relating its experiences to other fields such as history, English, art, mathematics, and science.

Horace Mann, who has been responsible for many of the ideas that form the background of our present school system, has the following to say about printing: (6:24)

Every school boy or girl who has arrived at the age of reflection ought to know something about the art of printing. Printing, the mother of arts, puts us in communion with the great minds of the past and present, preserves the philosophy of the ancients for the future generations. The loftiest spires of mental attainment may be reached through the musical click of the marvelous presses. Printing heralds news of the dying dynasties and broadcasts the uprisings of new and hopeful empires. It flies to seek every soul born into the world.

Through the column of a trade magazine an unknown author relates this thought about printing: (6:24)

Printing is the great constructive force in the modern civilized world. It plays the indispensable part in the dissemination of news, in the expression and progression of political ideas, science, art, music, and broadens the scope of everything it touches. Its service is vital in up-building and sustaining business through advertising.

*The first number indicates the reference in the bibliography; the second number refers to the page of the reference.
Since graphic arts is representative of so many industries and occupations, ranging from the professional field and skilled trades to that of the semi-automatic machine operator, its exploratory and occupational guidance possibilities are rich. An expansion of the field due to new methods, devices, demands, and a low ratio of apprentices has created a shortage of skilled craftsmen in the field.

It seems logical to suppose that the study of an art that has been so inseparably connected with the development of civilization should yield desirable results when used as instructional material. Here should be both stimulus and food for educational growth. The rapid development of printing and its allied processes has played such an important part in the climb of man from the level of barbarians to the present relatively high state of civilization, that some knowledge of its history, its men, its relative arts, its possibilities and production methods should be a part of the mental equipment of every educated person.

Materials and Procedure

This study is made largely from a survey of industrial-arts shops, opinions of shop teachers, and the state department of education. Data were secured from two sources: 1) The Pennsylvania State Department of Education Syllabus for Industrial Arts; 2) a questionnaire sent to one hundred sixty schools of Pennsylvania.
The questionnaires were sent to schools by random selection of towns and cities of 1500 and over in population.

**Definition of Terms**

The definitions of the following terms used in this study are offered to clarify their meanings and connotations.

1. **Area:** An area is a zone or principal section of work in the industrial-arts program. Examples are metal-work area, general drawing area, crafts area. Area may be thought of in two ways: a principal part of the work in the general shop program; and, as a part of one of the principal zones. The examples listed before are parts of the general program, while the following are examples of parts of a principal area: wood turning, bench work, and finishing.

2. **Graphic Arts:** Graphic arts refers to a comprehensive field which includes many basic processes and products in addition to printing. Graphic arts includes those methods and processes (hand and mechanical) which produce a number of copies of pictorial, decorative, or typographical arrangements on paper or other surfaces.

3. **Industrial Arts:** Industrial arts is one of the practical arts, a form of general or non-vocational education, which provides learners with experiences, understandings, and appreciations of materials, tools, processes, products, and of the vocational conditions and requirements incident generally to the manufacturing and mechanical industries. These results are achieved through
design and construction of useful products in the shops, supplemented by readings, investigations, discussions, films, reports, and similar activities characteristic of youthful interests and aptitudes in things industrial.

4. **Typography:** The act or act of composing and printing from type. There are three major phases to typography -- composition, imposition, and presswork.

5. **Composition:** Is the process in which type characters are assembled in their proper order for printing. It includes such operations as laying out, setting type, removing type, tying forms, pulling proofs, correcting forms, distribution, and cleaning cases.

6. **Imposition:** The process of placing the pages in the form so that they will be in proper order and position when the sheet is printed and folded, is called imposition. It consists of such operations as placing the form, locking up, planing the form, testing for lift and re-justifying.

7. **Presswork:** The process of actually printing on materials such as paper, cloth, wood or felt by hand operated machines, or by automatically operated machines is called presswork. It consists of such operations as inking, make-up, placing form, taking impression, simple feeding, register feeding, slip sheeting, scoring, and single and multi-color printing.
Limitations

The study is limited by the percentage of returns of the questionnaire. A return of one hundred percent would have given a truer picture of the program. The adequacy of interpretation of the raw data as received will constitute a limitation for which the author must assume full responsibility.

Personal interviews of the shop teachers would have made the survey more complete and the study more objective, but this was impossible due to the state selected for the survey. The author thought that Pennsylvania was typical of the states teaching graphic arts in the public schools.

It is believed that the data are ample and sufficiently valid so that the study will throw some light upon the trends and problems of the graphic arts in Pennsylvania and throughout the nation.
CHAPTER II
HISTORICAL BACKGROUND OF THE DEVELOPMENT OF THE GRAPHIC ARTS

In 1940, the five-hundredth anniversary of the invention of printing from movable type in Europe was celebrated in the Western World and at the same time the three-hundredth anniversary of its introduction to the North American Colonies. The Western World had its introduction to printing in Mexico in 1539. These dates call attention to the fact that printing, as it is now known, is a relatively recent development. Prior to the invention of printing lie several thousands of years during which man recorded his thoughts and passed on records of his deeds to other persons and to other ages by primitive methods.

The "graphic arts" are the processes by which records and thoughts are given visible form, through pictures, writing, and the various forms of printing. A study of the "graphic arts" includes the processes, the occupations, the materials and tools employed, and the nature of the products by means of which records in the various forms of printing are made.

ANCIENT RECORDING

The Origin and Development of Letters

The sign or gesture language was probably the first method of communication developed by early man. It is difficult to imagine
a civilization without an alphabet and without any means of writing or recording thoughts except by word-of-mouth, although alphabets for languages which were without them have been created within the memory of men living today for the education of primitive people. Sign language did not disappear as civilization advanced with the development of the alphabet. It is still used among all peoples in place of the voice.

As man advanced, crude oral languages were devised. The languages varied among the various tribes of people. Men with keen memories, known as seers, shamans, or medicine men, handed down orally, from generation to generation, the experiences of early man, his historic and religious traditions, and his way of life. Man was not satisfied to depend entirely on the memories of a few people. He soon learned that men forget and that the more often a story was repeated, the further it was likely to deviate from the original. The words of religious songs and medicine chants were those most frequently handed down. These words were not to change if they were to keep their original value. Later, picture diagrams were devised to aid in recalling the principal events and ideas in correct order and to insure their proper meanings.

The cairn was one of the earliest forms of memory-aid. It was used to record, for the tribe, an event of importance. The cairn was a collection of stones and their placement in a pile as a representation of an event to serve as a reminder to those people who already knew of the event.
As tribes became larger and more numerous, it became necessary to identify personal and tribal property. It was also necessary to mark the graves of the dead so that they might be remembered. Modern brands and trade marks are an outgrowth of the early system of marking personal belongings. The marks at first were crude, but soon took the form of simple pictures. Flint and other crude instruments were used to cut, in stone, inscriptions for graves, landposts, love letters and other forms of messages. Maps of the tribal camps were drawn in pictorial style. As these characters became more common and man became more adept, details were dropped and the pictures began to be standardized and to take the forms of symbols. Each tribe began to identify sounds and words with each symbol or emblem.

As characters passed from the pictorial to the symbolic stage, their original and direct meanings became more and more doubtful. They did not now have clear direct meanings, but merely suggested thoughts or concepts. Symbols were adopted as they had meanings for a group or a tribe. Through identification of all these symbols with certain tribes, with each tribe having somewhat different symbols according to use and whim, the differences among the spoken and written languages became more pronounced. The forms of the characters slowly changed until a system of standard phonetic symbols was accepted; for example, the ancient Aztec scripts show examples of definite change from the pictographic to the phonetic writing. These pictures were not translated
according to sense, but only according to the sound of the Aztec words.

As time went on, the sound symbols became more and more simple in form. As the carvers became more familiar with the symbols, shortcuts were taken in the cutting of the characters in stone. Several of the present alphabets had their origins in the development of a fairly standardized set of such sound symbols and their combinations into words.

Development of the Alphabet

Cuneiform writing was probably originated by the Chaldeans. The Chinese had used clay tablets and clay stamps earlier, but the clay tablets were first found in Mesopotamia. Cuneiform writing was found inscribed on clay tablets and cylinders, and on the monuments of Assyria and Babylon. Since these countries lie in the Orient, in the Near East or in Asia Minor, it is quite possible that the Chaldeans, Assyrians, and Babylonians got their ideas from the Chinese.

The word "cuneiform" means wedge-shaped. The inscriptions were wedge-shaped and were made with wedge-shaped tools; therefore the letters owe their name, in part, to the tools originally used in making them.

Clay tablets were used in preference to stone because they were easier to work with, easier to store, and easier to move
about. After the writing was completed, the clay tablet was cured by drying it in the sun.

Hieroglyphics, or picture writing, was another form in the early stages of writing. The Egyptians were probably the originators of hieroglyphic writing. Their tombs, pillars, buildings, temple walls, palaces, and whatever might serve as a place for records, were decorated with hieroglyphic writing.

The name "hieroglyphic" is of Greek origin. It is derived from hieros (sacred) and gulphi (to carve), meaning "sacred carving". True hieroglyphics were used only for decorative purposes and their use was limited to members of the upper classes. This form of hieroglyphics was called "hieratic writing", and was introduced about 2500 B.C. A simplified form of hieroglyphics was developed later, for every-day use by the lower as well as the upper classes. This form was called "demotic writing", and was introduced about 900 B.C.

The Phoenicians simplified the Egyptian hieroglyphics largely because they were great traders and needed a form of record which could be written rapidly. Efficiency rather than beauty was important in their hieroglyphics.

The Phoenician's hieroglyphics were different from those of the Egyptians in that a system of phonetics or sounds was developed for each symbol or combination so that the symbol could not only be read or vocalized but could be varied for added meanings. Their original alphabet consisted of twenty-two letters, nearly all


consonants. The Greeks changed the Phoenician alphabet by adapting fifteen of the original letters and adding nine more of their own, to make a total of twenty-four. Later, the Romans used eighteen of the Greek letters and added seven more of their own, to make twenty-five. The Anglo-Saxons added two more letters, but dropped one of them later, so that the present English alphabet consists of twenty-six letters.

Materials and Processes Used in Making Early Records

The Egyptian's early form of paper was made from the papyrus plant. This plant grew abundantly in the fertile soil of the Nile Valley. The paper was made by soaking the fibers of the papyrus plant in water, laying them at right angles to each other and then pressing them. The resulting paper when dry was quite rough. To overcome this roughness, the paper was rubbed with a stone to produce a smooth finish. Later, the Greeks and Romans used papyrus for their records.

Parchment and vellum were the next forms of paper developed in the evolution of writing materials. This material was used in rolls called scrolls. Parchment is made by splitting and scraping the skins of animals. Vellum is made in the same manner except that the skins of young animals were used, giving a finer texture. Vellum and parchment were the only forms of writing material used throughout the latter part of the Roman Empire and the whole of the Dark Ages. Two important disadvantages of parchment and vellum
were that they were very expensive to make and that the supply was very limited. Old skins were cleaned and re-used — thus many of the classics were lost under written trash.

Without the development of paper, extensive use of the written language would not have been possible. Papermaking was invented to satisfy the need for a material which would be lighter, more convenient to handle, carry and store, and which could be supplied inexpensively and more plentifully. The Chinese had been experimenting with paper made of rags, of linen and silk, and from bamboo long before the birth of Christ. In 220 B.C. they were using silk rolls instead of bamboo and wood. About 25 A.D. they had developed a "near paper" made of silk fiber. Ts'ai Lun is given credit for the invention of papermaking, in the year 105 A.D. Almost 1,000 years elapsed between the invention of paper and its journey westward. When the Chinese Empire was invaded by the Arabs, the Chinese prisoners taught their ancient art to their captors. The art of papermaking then spread throughout Asia Minor and, later, to Europe.

During the Han Dynasty, 206 B.C. to 25 A.D., the process of sealmaking advanced the art of printing. Seals were widely used for marking documents to make them authentic. Prints were also made by applying ink to a stone, which had an inscription carved on it, and then laying paper on the stone and rubbing it. This process paved the way for the printing of books from inked wooden blocks. Today, prints are made from wooden blocks, stone, and linoleum in practically the same manner as the people made their prints centuries ago.
The Far East has employed the same forms of writing for more than two thousand years. The Chinese characters do not always represent a sound as our letters do, but fall into six classes:

1) pictorial, giving a picture of the thing depicted;
2) ideographic, in that they indicate or suggest the idea in the mind of the reader;
3) two characters, the meanings of which blend into the meanings of a compound;
4) inverted characters;
5) borrowed characters, which have another meaning attached to them in that they neither suggest nor indicate a picture;
6) phonetic symbols.

Since the Chinese did not have an alphabet, printing from movable type was for them impracticable, but they knew of this method as early as 770 A.D. There are 4,000 basic characters in Chinese writing. With this large number of characters, wood-block printing was found more practicable than the use of movable type. The first records of block printing date back to about the year 770 A.D.

The Japanese, at about the same time, were experimenting with block printing. The religious influence had a great effect upon block printing in Japan, as indicated by the "Buddhist Charms", printed by the Empress Shotoku. These sheets were printed from wooden blocks on bamboo paper, and were distributed about the country in a million tiny pagodas. Carter stated that: (4:38)

... the by-products of her act became one of the world's greatest civilizing forces. It is typical of the international character which printing always possessed that this first printing project was in an Indian language in Chinese characters and carried out in Japan.
The first printed book of which we have knowledge is the "Diamond Sutra". This book consists of a collection of Buddhist scriptures printed from wooden blocks. A copy was found in almost perfect condition in the caves of the Thousand Buddhas at Tun-Huang. These caves had been sealed up more than 900 years ago. Since this book was so far in advance of technique, there must have been a long period of evolution prior to the printing of it. Carter wrote about the book that: (44:41)

... it is less crude than any of the European block printing of the pre-Gutenberg days. The book consists of six sheets of text and one shorter sheet with woodcuts, all neatly pasted together to form one continuous roll sixteen feet long. Not only excellent technique, but the size of the sheets as well, shows that this is no primitive bit of printing like the Charms from Japan.

Printed at the end of the book appears the statement that the book was ...

... printed on May 11, 868, by Wang Chieh, for free distribution, in order in deep reverence, to perpetuate the memory of his parents.

By the year 807 A.D., printing was so far advanced in China that paper money was printed and widely used throughout the empire. The term "convenient money" was applied to money printed by a government office. This was the first form of block printing encountered by foreign visitors and may possibly have been carried to Europe by way of Asia Minor.

The gradual development of paper, wood-block printing, and ink, brought printing closer to some of the modern graphic methods.
MODERN RECORDING

No definite line can be drawn between ancient and modern recording. The latter may be said to have started with the Renaissance in the fourteenth and fifteenth centuries in the Occident and much later in the Orient. In fact, it is still being developed in the latter at the present time. Only in the last few years has a typewriter for transcribing Chinese been developed.

Medieval Recording

During this age in Europe, numerous manuscripts were made by the scribes in the monasteries. These scribes were generally monks who devoted their entire lives to the copying of books. The books were hand-printed with quills and reeds. The work was arduous and time consuming, with many of the books requiring years to complete, because these works were generally illuminated and mechanically of a very high standard. As artistic products, they were frequently very beautiful. The Scriptures, church doctrines, church music, and the ancient classics were most often portrayed in the books. Today these books are scarce and valuable.

Invention of Movable Type

China, beyond all doubt, must be given credit for the invention of movable type. During the period of Ching-li's Reign, 1041-1049, Pi Sheng made movable type, but not in the way that it is known today. Each character was made of baked clay. These characters
were clamped in an iron frame for printing. This method was convenient for the making of thousands of copies, but not feasible for the making of several copies. When the type was not in use, it was kept in wooden cases each labelled with paper.

Later, movable type was made of tin. The individual characters were strung on wire and then made fast in columns in the form in order that books might be printed from them. This kind of type did not prove satisfactory. It did not take ink readily, and deteriorated rapidly.

Still another method of making movable type was that of using wooden blocks, which were engraved with individual characters. These blocks were sawed into small individual pieces of type. These were finished off with a knife on all four sides, and compared and tested until they were exactly the same size and height. The type was then placed in the columns of a form, and the spaces filled in with wooden plugs so that the type would be immovable. When the type was absolutely firm, the ink was rolled on, and the printing began.

Type molds and movable type were used in Korea during the half century before Gutenberg's invention, but alphabetic type and the printing press are distinctly European additions to the art of printing to which the East can lay no claim.

The first mention of a type foundry in Korea was probably in 1392. The Korean annals of this date contain the statement: "A department of books was established, which had as its responsibility the casting of type and the printing of books". (4:170)
Very little was accomplished by this department until the year 1403. The King, Tai Tsung, deplored the fact that so few books were being printed and, therefore founded an establishment for the making of type and the printing of books. The carrying on of the work was placed in the hands of officers who were responsible for the progress of the department. The metal for the type was furnished by the government. Carter related a description of this event from a book dated 1409: (4:171)

In the second moon of the first year of Yung-lo (1403), the king said to his attendants, 'Whoever is desirous of governing must have a wide acquaintance with the laws and the Classics. Then he will be able to act righteously without and to maintain an upright character within, and thus to bring peace and order to our land. Our eastern country lies beyond the seas, and the number of books reaching us from China is small. The books printed from blocks are often imperfect, and moreover it is difficult to print in their entirety all the books that exist. I ordain therefore that the characters be formed of bronze and that everything without exception upon which I can lay my hands be printed, in order to pass on the tradition of what these works contain . . . However, the costs shall not be taken from the people in taxes. I and my family, and those ministers who so wish will privately bear the expense.' . . . The casting began on the nineteenth day of the same month, and within a few months several thousand type had been cast.

Carter wrote: (4:179)

It is a strange fact that the nations the symbols of whose languages present more difficulties to the typographic printer than those of any other languages in the world, should have been the first nation to invent and develop the art of typography.

The Korean system spread to China and Japan, and was the method in use in these lands by which strong monarchs sought to further education and literature. It was not, however, commercially successful.
By the nineteenth century, movable type had been almost entirely displaced by the older block printing which, in its turn, has given way in the larger centers to European typography.

Most evidence points to Johann Gutenberg, a German, as the first European to use single-letter movable type successfully. DeVine, in his book on the invention of printing in Europe, wrote:

The inventor of printing did not invent paper and did not originate engraving on wood. He was not the first to print upon paper, he was not the first to make printed books, it is not certain that he made the first press, it is not probable that he was the first to think of or make movable type. What he did was to invent the type mold -- the first therefore to do practical and useful work.

It appears that the type mold is the secret to successful typographical printing. The Koreans had developed the type mold, but theirs was different from that invented by Gutenberg. His mold would make type so uniform that the pieces would lock together easily and keep their alignment. The Korean type depended upon either a wax plate or bamboo strips and probably a metal rod fitted into grooves in the type in addition, to hold them in place. Song Hyon, writing between 1495 and 1507, thus described the Korean process: (4:176)

Characters were cut first from beech wood, these were the models. Then sand was taken from the shore of the sea where the weeds grow. This was placed in a trough and the wooden letters pressed against it. In this way the negative moulds were made, from which the type were cast. Over these was placed a cover with openings, and melted bronze poured in. When this cooled, it became type. Where irregularities occurred such as sharp corners, they were worked over afterwards with a file. The single type were held in columns by bamboo strips, so that they could not get out of line . . .
The first book of any size to be printed in Europe with movable type was the Gutenberg Bible, printed by Gutenberg and his associates about 1456. He had a great deal of trouble in starting his printing shop, which was destroyed by the government because the officials and the clerics feared the education of the masses through relatively easy access to books. Gutenberg lost his shop several times through legal proceedings, because of debts. He finally died penniless, with several people claiming his invention.

Prior to the invention of movable type, many men were experimenting with ways of producing books more quickly and inexpensively. Several books were printed from solid blocks of wood. These books were known as "block books", but the method was too slow, laborious, and inflexible.

After Gutenberg's Bible, other books followed in fairly quick succession. One of these was the "Psalter", printed by Fust and Schoeffer in 1457. From these small beginnings, printing spread relatively rapidly over Europe. Conrad Sweynhey and Arnold Parmartz, in Subiaco, in 1465, were Italy's first printers. A press was started in Paris by Ulrich Gering, Michael Friburger, and Martin Crantz in 1470. Nicholas Hetelaer, at Utrecht, produced the first printed book in Holland, about 1473. William Caxton printed the first book in England in 1477, in a shop adjoining Westminster Abbey.

In the Western World, Mexico has the honor of setting up the first printing press. There is some dispute over the identity of the first printer, but Juan Pablos is known to have produced a book in 1539. It was a full hundred years later when the first person
established a press in the North American Colonies. Stephen Daye started a press in Cambridge, Massachusetts, in 1639. Although he printed a leaflet, "A Freeman's Oath", in the same year, Benjamin Franklin is recognized as the Father of Printing in the United States. There were two historic printing presses, that of Benjamin Franklin, Philadelphia; and that of the Pietists in Ephrata, Pennsylvania. There is a reproduction of Franklin's printing shop in The Franklin Institute, Philadelphia, with original printing presses in the exhibit. The Pietists operated their printing press from about 1745 to 1827.

The Invention of the Slug-Casting Composing Machine

For over four centuries after Gutenberg's invention, the art of printing grew and spread around the world but was under a heavy and costly handicap. Each letter of the hand-set kind of type had to be placed together in a line to form words. These lines were placed together to form a page. After the page had been printed, the pieces of type had to be distributed, one at a time, to the proper place in the job case. This meant double work; composing and distributing.

In the nineteenth century, as America became industrialized, improvements in papermaking, in printing presses, and in other machines stimulated the publication of books and newspapers. Type-setting remained at the handcraft level in which Gutenberg had developed it four hundred years before. To progress, some means of overcoming this slow process of composing and distributing had to be developed.
Many attempts were made to mechanize these operations which were performed by hand. One of the last and most elaborate efforts was that of the author, Mark Twain. The machine he financed was finally abandoned in 1902, after experiments which had lasted for twenty years.

In 1822, Dr. William Church, of Boston, devised a type-setting machine which caused the pre-cast type, stored in individual containers, to be released by keyboard action into composed lines. Justification of the lines had to be done by hand. The type on the Church machine was not distributed after the printing but was remelted and recast. Here was the first suggestion of the modern Linotype.

Ottmar Mergenthaler, who had come to America in 1872 from Hachtel, Wuerttemberg, to work in his uncle's electrical instrument shop, had many opportunities to study patent-office models of great variety. His first undertaking was that of improving a writing machine, which had been devised by C. T. Moore in 1876. Out of his efforts eventually came the Linotype, typewriter, dictating machine, and the phonograph -- though all grew commercially through separate channels. The writing machine was a failure, due to its crude mechanisms. While experimenting with different models of this writing machine, he visualized a machine wherein the individual type-molds or matrices might be assembled with a keyboard, into line, a cast quickly made from a relatively soft metal, and then the matrices distributed back to their original containers. This became the
basic principle of the first commercially successful Linotype of 1886, and is still basic in the similar machines built today. It is called the principle of the circulating matrix, for which Ottmar Mergenthaler receives full recognition.

In 1890, Mergenthaler produced the Model I Linotype. It differed from the one of 1886 in that it was all mechanical, while the one of 1886 used a blast of air to carry along the assembling matrices.

Through the past half-century, the developments have grown with the expanding activities of printing and publishing. Thus, the development of the Linotype and its type equipment has been a direct cause of and has then kept pace with the tremendous growth in the use of the printed word throughout the past sixty years.

Later, the monotype and the Intertype machines were developed. As made and used today, these two kinds of machines are so similar that the layman can distinguish between them only by their nameplates. An operator of one can easily handle the other kind with very little trouble.

Methods of Printing

Letterpress printing is the oldest of the modern methods of printing. Even with the great advances in the other methods, it still predominates in volume of work done and is superior to the other methods in many of the effects it produces. Letterpress printing is done from an inked surface which is in relief, such as a piece of type. The printing surface is made by cutting away all the
parts that are to remain unprinted, allowing the figure or design to stand out in relief. Rollers deposit ink lightly and evenly on the surface, and this ink, in turn, is deposited on the paper under pressure to complete the printing.

Movable type solved the problem of printing the individual letters of words, but bookmakers were confronted with another problem -- that of printing of pictures or illustrations. For that reason, the printer had to develop a means of printing this type of material. The wooden block went through a period of evolution until the various modern intaglio methods were developed.

**Intaglio printing** is done from depressed surfaces, the image being below the surface of the metal plate. Intaglio means "to cut into". Line engraving was the first of the intaglio methods to be practiced. Goldsmiths first discovered the possibilities of using engraved depressions as a form of printing. They found that by filling depressions in fine metals with ink, wiping off the surface and pressing paper over the inked engraving, they could reproduce the work in reverse. They found that the finest scratches would print satisfactorily. Silver and gold were too expensive, so the printers turned to copper, which was relatively soft and easy to work with the graver or cutting tool. The drawings were made in reverse on the copper, and cut to various depths and thickness of line — giving the proper intensity of light and dark in the print. Martin Schongauer was the first man to engrave his name on a plate. The exact date is unknown.
The first school of engraving was started in Italy by Tomasso Finiguerra in 1460. Urs Graph, Durer, Callot, Van Dyck, Rembrandt, and many others popularized the art.

Etching had its start early in the sixteenth century, by Daniel Hopfer in Augsburg, Germany, in 1504. Hopfer was a "Waffenmaler", a decorator of weapons. The etcher's tools and processes have changed very little since their invention. The workshops which carry on this work today are similar to those of the sixteenth century.

Relief printing plates had their start with the wood-block carvings. In 1839, Daguerre developed a method of making plates by a photographic method. This method has since been highly developed and has played a most important part in the reproducing of photographs and other illustrations. Pictures in magazines, newspapers, and books are nearly all halftones or line etchings.

Planography includes the methods of printing from flat surfaces. There are three ways of producing this type of printing; the lithographic stone, the metal plate, and the gelatin collotype plate. Use of the lithographic stone is a slow process and is used principally in the production of large calendars, maps, and billboard signs. Use of metal plate, or offset lithography is rapidly overtaking the printing from type and relief plates. The gelatin process is used for the reproduction of portraits and fine paintings.

Lithography was first developed by Alois Senefelder in 1796. He experimented many years with limestone, trying to reproduce musical scores. The process developed by Senefelder spread rapidly into the larger cities in Europe and into the American Hemisphere.
Other printing processes which incorporate certain features of letterpress, planographic, or intaglio printing, yet differ from these three basic processes are very useful in the graphic arts field. Some of these processes include thermography, embossing, die cutting, pen ruling, tin box printing, music printing, silk screen painting, rubber stamp making, and the various methods of duplicating. Two of these methods are used more frequently than the others. They are the silk screen process and the duplicating process. The remainder of the processes are important in the business, the commercial, and the industrial fields, but each has certain limitations and is suited almost exclusively to the special purpose for which it was developed.

Silk screen processing, in the United States, was developed by John Dilsworth, Charles M. Peter, and Edward Owens, all of Portland, Oregon. By "silk screen processing" is meant the forcing of paint or color through the open meshes of a fine screen or fabric whereon is painted or blocked a design to be reproduced or processed. The silk screen process because of its simplicity, economy, and unlimited application to most surfaces, has been accepted as a practical, as well as an artistic method of color reproduction in many industries. It is also accepted in the graphic arts field in its entirety.

Three methods of duplicating in common use are the stencil process, the gelatin process, and the spirit process. In the stencil process, the stencil, which consists of a fibrous tissue sheet coated with a waterproof composition, is the duplicating medium. To make a stencil of the sheet it is simply necessary to push aside the
coating, leaving only the fibrous material, which permits ink to pass through but at the same time holds the stencil together. The stencil may be prepared with the typewriter, or a stylus. The stencil is then placed on a cylinder which has a pad soaked with ink and the paper fed through the machine. The ink is deposited on the paper through the fibrous material.

The gelatin process employs a gelatin roll or plate. The information is typed, written, or drawn on a sized paper, with a special carbon or ink. The gelatin is dampened with water and the copy sheet placed face down on the gelatin. The back of the sheet is rubbed lightly and then removed from the gelatin. The printing is done by feeding clean sheets of paper into the machine. The roller squeezes the paper against the gelatin plate. Another method is to lay the paper on the gelatin plate and rub over the surface lightly, then remove it. In either case the printing is completed by the impression offsetting on the paper.

The spirit or fluid duplicating process consists of a fluid and a special carbon copy sheet. The information is drawn, typed, or written on the surface of the master sheet, with the carbon placed behind the sheet so that the impression will be on the back side of the master sheet, in reverse. The master sheet is then placed on a cylinder, so that the back of the sheet faces up. The paper is dampened on the top side, with a special fluid, as it is fed through the machine and the roller makes possible the contact of the paper and the copy sheet. The impression is offset upon the paper.
Modern Production

Modern production demands speed, accuracy, and beauty. Today, demands are made upon the graphic arts which were undreamed of by the people of a few decades ago. To meet this demand, huge power presses, type-setting machines, high speed printing machines, and machine-made paper, have been developed.

SUMMARY

In summarizing the development of printing, Carter stated:

Of all the world's great inventions, that of printing is the most cosmopolitan and international. China invented paper and first experimented with block printing and movable type. Japan produced the earliest block prints that are now extant. Korea first printed with type of metal, cast from a mould. India furnished the language and the religion of the earliest block print. People of Turkish race were among the most important agents in carrying block printing across Asia, and the earliest extant type are in a Turkish tongue. Persia and Egypt are the two lands of the Near East where block printing is known to have been done before it began in Europe. The Arabs were the agents who prepared the way by carrying the making of paper from China to Europe. Papermaking actually entered Europe through Spain, though imported paper had already come in through the Greek Empire at Constantinople. France and Italy were the first countries in Christendom to manufacture paper. As for block printing and its advent into Europe, Russia's claim to have been the channel rests on the oldest authority, though Italy's claim is equally strong. Germany, Italy, and the Netherlands were the earliest centers of the block printing art. Holland and France, as well as Germany, claim to first have experimented with typography. Germany perfected the invention, and from Germany, it spread to all the world. Great Britain and the United States, the two countries that today do the bulk of the world's printing, are the two great nations of the world that lay no claim to having had a part in the invention, at least in its early stages, and have contented themselves with such later developments as the power press and the linotype.
CHAPTER III

THE DEVELOPMENT OF THE GRAPHIC ARTS AS
A MANUAL-ARTS SUBJECT IN THE
UNITED STATES FROM 1890 – 1924

In 1890 handwork as an element in the education of youth was not new; it had been advocated hundreds of years before. Printing had not been considered a possibility for educational ends prior to that year. Woodwork was taught in practically all American public and private schools where manual-training was included in the curriculum.

The earliest record that can be found of printing as a manual-arts subject comes from Harry E. Wood, director of vocational education, Indianapolis, Indiana. The date is December 5, 1890, when the committee on supplies, for the Indianapolis Board of Education, recommended the purchase of printing presses and materials at a cost not to exceed $350. This record shows that printing was started in Indianapolis more than fifty-seven years ago. Mr. Wood undertook to teach the subject in addition to mechanical drawing and woodworking. The outfit was very small. In setting up a graduation program not sufficient type was available, and spaces and quads were used in place of some letters, necessitating a double run on the press to print in the missing letters. Such were the difficulties under which printing started in that school.

Mr. Wood has a cherished photograph of his print shop as it appeared in 1905 in School No. 9. This picture was taken by Professor Ben Johnson, then supervisor at Seattle, Washington, who
was much impressed with what Mr. Wood was doing and wanted to present to his board convincing evidence of the educational value of printing. On the basis of the photograph and samples of work printed by the boys in Mr. Woods' school, Mr. Johnson was able to start printing in the Seattle public schools. By 1924 there were twelve well-equipped printing centers in Indianapolis, where full-time teachers were employed, and nearly fifteen hundred students enrolled in the printing classes.

In 1896 printing was started as a school subject in Chicago. It was mainly taught as an outline. Printing is now taught in most of the Chicago high schools, in most of the junior high schools, and in a great number of the grammar schools.

Cleveland, Ohio, opened its first school printshop in 1907 with two presses, a cutter, type and materials which cost about $800.

The first school printing in Gary, Indiana, was undertaken in 1907. Within a period of a few years two schools had been equipped with a pilot press, a small paper cutter, a few cases of type, and other necessary materials. Later these two printing outfits were combined into one plant. By 1924 the equipment was evaluated at approximately $10,000.

At Steele High School, Dayton, Ohio, a printing class was organized in 1910, with meager equipment consisting of a Chandler press, two type cases, type, a small quantity of necessary materials, and three library tables.
Printing was first introduced in the high school at Vancouver, Washington, about 1910. The late George H. Brackett was the first instructor. The equipment was sufficient for classes of twenty boys. The students printed practically everything needed for the schools. Superintendent C. W. Shumway said, "We would be very much lost without our printing department." A course in journalism was provided in connection with the publishing of the school paper.

About 1912 printing was introduced into the Atlanta High School, Atlanta, Georgia. The department was very popular from the beginning, and grew rapidly. The work was divided into two parts, the composing room and the pressroom. When the success of printing was established in the high school, a department which inventoried about $20,000 was opened in the Technological High School. It was not until 1924 that printing was introduced into the junior high schools of Atlanta, with full-time teachers in each one. The junior high schools did not do any work for the board of education since the Technological High School produced most of the printing for the board, but the junior high schools furnished practically all the forms, records, and other printed material for their respective schools, and each school printed its own paper. Many of the students who finished the junior high school course entered the high school printing course and specialized in that phase of work. The schools operated very closely with the printer's union of Atlanta.
The high school in Sioux Falls, South Dakota, started printing September 1, 1916. Superintendent A. A. MacDonald claims that the study of printing had been successful from the beginning, and that the training the students receive in the printshop in accuracy, system, spelling, composition, and paragraphing is most important.

Los Angeles, California, claims 1918 as its starting point in the introduction of printing in the school shop. By 1921 they had forty schools offering printing as an industrial-arts subject, with all of the senior high schools and most of the junior high schools offering the area. An average of eighteen students were enrolled in the classes.

Salt Lake City started printing instruction in 1921. The outfit, in one school only, was quite complete, costing $9,000.

While one would think that Philadelphia, the home of Benjamin Franklin, the Father of Printing in the United States, should be found among the first to introduce printing instruction in the public schools, it was not until 1911 that printing was introduced in one elementary school serving seventh and eighth grade boys.

William H. French, secretary of Barnhart Brothers and Spindler, in 1887, was the first person to consistently urge printing instruction in the schools, and he was largely responsible for the courses opened in Indianapolis. Ever since the printing courses at Indianapolis have proven successful, Mr. French has been convincing school administrators of the value of including a printing course in the manual-arts program in the public schools.
A recent survey made by American Type Founders shows that the greatest development in school printing has taken place within the past twenty years, and that the school printshop has become larger and better equipped in every way. The number of students taking courses in printing is greater now than formerly. In many schools printing is a required industrial-arts subject, but the majority of the schools offer it on an elective basis.

The junior high schools in many cities offer a course in graphic arts. The term "printing" is rapidly becoming obsolete, and the term "graphic arts" is used in its place, since a broader program is offered than the old idea of composition, imposition, and presswork. Graphic arts is claimed to be the ideal study in the junior high school, and while only a very small percentage of the students later follow printing as a gainful occupation, it is a great help no matter what line of endeavor may be selected by the individual.

Where graphic arts courses are offered a majority of the school papers are produced in the printshop. A student-body organization is usually responsible for preparing the material that constitutes the paper. The art department and the English department also take a hand in the preparation of the material for the publication. The former prepares illustrations, and the latter is responsible for the correct usage of English. This highly developed state of integration of the various departments did not exist when printing was first introduced into the schools. In the early days
of printing the equipment was very meager, consisting in most cases of a hand press, a few fonts of body type, and the necessary working materials. The cost of such an outfit was considerably below $100.00 but was sufficient as an experiment. From such small beginnings has come one of the most popular courses of the industrial-arts program.

The school graphic-arts equipment installed in recent years is more in keeping with the regular commercial establishments, and the course provides for instruction in bookbinding, silk screen processing, making of inks, papermaking, and many other basic processes and products in addition to typography.

Table I, page 38, shows the development of printing as a manual-arts subject in the public schools and gives the date when printing was first started in each of a number of representative cities.
### Table I

Composite Table Showing the Development of Printing in the Public Schools in the United States from 1890 to 1924.

<table>
<thead>
<tr>
<th>Year Started</th>
<th>Location of School</th>
<th>Number of schools offering printing by 1924</th>
</tr>
</thead>
<tbody>
<tr>
<td>1890</td>
<td>Indianapolis, Indiana</td>
<td>15</td>
</tr>
<tr>
<td>1896</td>
<td>Chicago, Illinois</td>
<td>53</td>
</tr>
<tr>
<td>1906</td>
<td>Philadelphia, Pennsylvania</td>
<td>8</td>
</tr>
<tr>
<td>1907</td>
<td>Gary, Indiana</td>
<td>25</td>
</tr>
<tr>
<td>1907</td>
<td>Cleveland, Ohio</td>
<td>8</td>
</tr>
<tr>
<td>1908</td>
<td>Canton, Illinois</td>
<td>2</td>
</tr>
<tr>
<td>1909</td>
<td>New York City, New York</td>
<td>24</td>
</tr>
<tr>
<td>1909</td>
<td>Boston, Massachusetts</td>
<td>16</td>
</tr>
<tr>
<td>1909</td>
<td>Seattle, Washington</td>
<td>3</td>
</tr>
<tr>
<td>1910</td>
<td>Vancouver, Washington</td>
<td>24</td>
</tr>
<tr>
<td>1910</td>
<td>Jersey City, New Jersey</td>
<td>4</td>
</tr>
<tr>
<td>1910</td>
<td>Dayton, Ohio</td>
<td>3</td>
</tr>
<tr>
<td>1910</td>
<td>Atlantic City, New Jersey</td>
<td>5</td>
</tr>
<tr>
<td>1911</td>
<td>Washington, District of Columbia</td>
<td>13</td>
</tr>
<tr>
<td>1911</td>
<td>Columbus, Ohio</td>
<td>3</td>
</tr>
<tr>
<td>1911</td>
<td>Albany, New York</td>
<td>2</td>
</tr>
<tr>
<td>1915</td>
<td>Toledo, Ohio</td>
<td>12</td>
</tr>
<tr>
<td>1915</td>
<td>Richmond, Virginia</td>
<td>1</td>
</tr>
<tr>
<td>1916</td>
<td>Sioux Falls, South Dakota</td>
<td>5</td>
</tr>
<tr>
<td>1917</td>
<td>San Diego, California</td>
<td>40</td>
</tr>
<tr>
<td>1917</td>
<td>Burlington, Vermont</td>
<td>1</td>
</tr>
<tr>
<td>1918</td>
<td>Spokane, Washington</td>
<td>15</td>
</tr>
<tr>
<td>1918</td>
<td>Los Angeles, California</td>
<td>1</td>
</tr>
<tr>
<td>1921</td>
<td>Salt Lake City, Utah</td>
<td>1</td>
</tr>
<tr>
<td>1922</td>
<td>Gooding, Idaho</td>
<td>1</td>
</tr>
<tr>
<td>1924</td>
<td>Wilmington, Delaware</td>
<td>1</td>
</tr>
</tbody>
</table>
CHAPTER IV

A SURVEY OF THE INDUSTRIAL-ARTS GRAPHIC-ARTS AREA IN THE COMMONWEALTH OF PENNSYLVANIA SCHOOLS

Pennsylvania was chosen for this survey for several reasons: 1) The author received his training in the graphic arts area in one of Pennsylvania's State Teachers Colleges and thought the course excellent in content and presentation; 2) The author had the opportunity to teach in Pennsylvania and has had some contact with the problems of trying to incorporate a graphic arts area in the industrial-arts program; and 3) He has come in contact with many schools which offer graphic arts in the industrial-arts program and has developed a respect for the teachers' opinions concerning the feasibility of teaching this vitalizing area in the industrial-arts curriculum.

A questionnaire, Appendix A, was mailed to one hundred sixty schools selected at random to cover the entire state. These schools were selected without regard to size and type -- whether junior or senior high. The red dots on the map of Pennsylvania, page 40, show the locations of the schools returning the questionnaire. The state has been covered fairly thoroughly as indicated by the dispersion of the dots.

The questionnaire consisted of two parts: Form A -- For teachers now teaching graphic arts; and Form B -- For teachers not now teaching graphic arts. The questions and statements asked on the questionnaire were stated in such a manner to obtain a truer
DISTRIBUTION OF QUESTIONNAIRE RESPONSES
picture of the graphic-arts area as an integral part of the industrial-arts program in the public schools.

Analysis of the Questionnaire

Responses to the questions will be grouped in the analysis so as to give a total picture of the graphic-arts area. The overall picture was stated in the purposes of the study — page 2.

Summary of the Schools Reporting and the Number Offering Some Type of Graphic-Arts Instruction

Of the seventy schools reporting, only five had no industrial-arts program, due principally to the lack of qualified instructors. Table II shows that four schools were junior high schools exclusively. The same was true of the five schools offering only senior high school courses. Fourteen schools were on a combined junior high and senior high school basis.

<table>
<thead>
<tr>
<th>Type of School</th>
<th>Number</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offering Graphic Arts:</td>
<td>23</td>
<td>32.8</td>
<td></td>
</tr>
<tr>
<td>Junior High Exclusive</td>
<td>4</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Senior High Exclusive</td>
<td>5</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Combined Junior and Senior High School</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Offering Graphic Arts</td>
<td>47</td>
<td>67.2</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td></td>
<td>37</td>
</tr>
</tbody>
</table>
Table II also shows that twenty-three of the seventy schools, or 32.8% give instruction in some phase of graphic arts in the industrial-arts program and forty-seven or 67.2% do not offer this phase of work.

Teachers' Opinions Concerning Graphic Arts in the Industrial-Arts Program

As a part of this study it was thought desirable to secure the opinions of industrial-arts teachers concerning the importance of graphic arts in the industrial-arts program. Since all the industrial-arts teachers who received their training in any one of the State Teachers Colleges in Pennsylvania since 1936 will have had training in teaching of graphic arts in the public schools, they will have a personal philosophy concerning this area as a part of the industrial-arts curriculum. The State Department of Education recommends that graphic arts be taught in the industrial-arts program, but each teacher will have developed likes or dislikes for this area, and in many cases the opinion of the teacher determines what areas are actually taught in the industrial-arts program. This is true in Pennsylvania because the State Department of Education does not dictate the specific industrial-arts courses which must be taught, but only that a general shop must be operated in the junior high school, with at least three different areas represented. It is therefore up to the school and the instructor to determine what that particular school will offer in the industrial-arts program. It is one of the main purposes of this study
to determine how many schools offer this area (printing), how many schools do not offer instruction in the graphic arts, why the schools which do not offer graphic arts do not include it in their programs, and to determine if graphic arts should be included in the program.

It may be assumed that many teachers will profess a desire for a more diversified industrial-arts program, of which graphic arts is a part, but will make little effort to develop such a program. This may be due to: 1) professional decay; 2) poor salesmanship; 3) limitation of funds; 4) insufficient training.

Table III indicates that sixty-three or ninety percent of the teachers are in favor of having a graphic-arts area in the industrial-arts program. Only seven or ten percent were not in favor of adding the graphic arts in the industrial-arts curriculum.
TABLE III

Showing the Opinions of Industrial-arts Teachers Concerning Graphic Arts in the Industrial-arts Program and Giving Percentages.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>%</th>
<th>No</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do you think graphic arts should be a part of the industrial-arts program?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Form A</td>
<td>23</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Form B</td>
<td>40</td>
<td>85.1</td>
<td>7</td>
<td>14.9</td>
<td>47</td>
</tr>
<tr>
<td>Total Form A and B</td>
<td>63</td>
<td>90</td>
<td>7</td>
<td>10</td>
<td>70</td>
</tr>
</tbody>
</table>

2. Is there a definite reason why graphic arts is not included in your present shop program?

| Form B                                                                   |     |    |     |    |       |
| Do you expect to add this area in the near future? Form B                | 35  | 74.5| 12  | 25.5| 47    |

The reasons listed by the seven teachers opposed to graphic-arts instruction in industrial arts, are summarized as follows:

Time is not sufficient for a field so large.

Facilities required usually do not fit well in that basement hideaway given over for the industrial-arts shop.

I have yet to hear of a place in operation that can stay away from production work.

To include graphic arts in a general-shop program would demand too much of an expenditure to run a successful course. To teach graphic arts is a full time job for one instructor and I do not believe many instructors would desert the more interesting phases of shopwork for graphic arts.
Not in junior high. It will only provide school tickets, programs, etc., and take a lot of extra time of the teacher.

Might mention my strong dislike for graphic arts was created at California State Teachers College, Pennsylvania, where 90% of the students who took the course vowed they would never teach any phase of "print shop".

These comments are not very convincing when compared with the remarks made by the forty teachers who expressed the belief that graphic arts should be a part of the industrial-arts program.

The annotations made by the forty teachers are summarized as follows:

Because it represents one of the major fields of work in every community. Culture through the ages has gone hand in hand with its advancement.

Any good teacher of industrial arts will endeavor to present to his pupils as many kinds of working media as possible.

A good course in graphic arts meets many of our industrial-arts objectives better than some of the other units. Also in my opinion the related learning units of graphic arts are very high.

In my opinion graphic arts has a great place within the industrial-arts program because of its important place in the American way of life.

Printing is a vital force in the field of education.

The fact that industrial arts is exploratory in nature and that graphic arts is so adaptable to an industrial-arts program make it a desirable phase to study and teach.

It teaches a very important trade in our everyday life. It should be taught as an industrial-arts subject the same as ceramics, plastics, and the other phases. Its value in teaching English is very important.

It can provide the experiences, understandings, and appreciations that should be attained from a well rounded industrial-arts program.
I believe that it would help the student to realize the importance of the printed word.

Graphic arts is the one area in which a really true-to-life situation can be simulated by the program.

As one reads over these reflective thoughts the importance of the graphic arts area of instruction to the industrial-arts curriculum, as an aid in integrating the pupil, becomes very apparent. Concerning the integration of the pupil, Struck had an important connotation: (16:588)

Integration, as an educative process, consists in bringing out the unity and relatedness in the complex elements of life experiences to the end that the learner shall be able to respond to his environment courageously, creatively, and effectively.

Of the forty-seven teachers answering Form B of the questionnaire, thirty-five said there was a definite reason why graphic arts is not taught in the industrial-arts curriculum at the present time. Twenty-two of these teachers said graphic arts would be added to the industrial-arts program in the near future. Reasons for not including graphic arts in the industrial-arts program are shown in Table IV. It may be assumed as indicated from Table IV that most teachers believe they must have a large room or vacant area before starting a graphic-arts course. This need not be true. Many interesting phases of the graphic arts may be presented in the general shop without much additional space.
TABLE IV

Showing Reasons for not Including Graphic Arts in the Industrial-Arts Program, and Showing Percentages.

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Number</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No room available</td>
<td>27</td>
<td>58.7</td>
<td>46</td>
</tr>
<tr>
<td>Cost of such a program too high</td>
<td>5</td>
<td>10.8</td>
<td>46</td>
</tr>
<tr>
<td>Will lead to production work</td>
<td>3</td>
<td>6.5</td>
<td>46</td>
</tr>
<tr>
<td>Lack of funds</td>
<td>3</td>
<td>6.5</td>
<td>46</td>
</tr>
<tr>
<td>Not feasible as a course</td>
<td>3</td>
<td>6.5</td>
<td>46</td>
</tr>
<tr>
<td>No request for the course</td>
<td>2</td>
<td>4.4</td>
<td>46</td>
</tr>
<tr>
<td>Other industrial arts courses</td>
<td>1</td>
<td>2.2</td>
<td>46</td>
</tr>
<tr>
<td>more important</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tight curriculum</td>
<td>1</td>
<td>2.2</td>
<td>46</td>
</tr>
<tr>
<td>Course should be taught under vocational education instead of</td>
<td>1</td>
<td>2.2</td>
<td>46</td>
</tr>
<tr>
<td>industrial-arts education</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Administrators' Opinions Concerning Graphic Arts in the Industrial-Arts Program

Since the administration must approve all courses in the system, it was thought advisable to determine the opinions of school administrators concerning graphic arts in the industrial-arts program. As with many teachers, administrators will express a favorable opinion of adding graphic arts but will do little if anything to aid the instructor in providing for this area of instruction. This may be due to: 1) Lack of funds; 2) Lack of space; 3) Not
having been sold on the importance of graphic arts.

As indicated on Table V a vast majority of the administrators are in favor of graphic arts as a course in the industrial-arts program. Of the six administrators indicating a dislike for graphic arts, two gave no reasons and the others are summarized as follows:

The union will not allow the school to teach graphic arts.
The cost will be too high to offer such a course.
Do not see the need for any form of industrial arts.

TABLE V

Showing the Opinions of School Administrators Concerning Graphic Arts and Giving Percentages

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>%</th>
<th>No</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the school administration in favor of graphic arts being taught in the industrial-arts program?</td>
<td>41</td>
<td>87.2</td>
<td>6</td>
<td>12.8</td>
<td>47</td>
</tr>
</tbody>
</table>

Kenneth W. Brown, Assistant Director, Division of Fine and Industrial Arts, for the School District of Philadelphia made the following remarks concerning the teaching of graphic arts in their industrial-arts program:
Unfortunately, your questionnaire finds us in a stage of development where we are again beginning to introduce graphic arts into the industrial-arts program. Only four of the forty-one junior and senior high schools in the city have graphic arts. As soon as equipment becomes more plentiful this program will be greatly expanded throughout the city.

No indication was given as to what happened to the other four schools which had been teaching graphic arts in 1924.

The following remarks were made by Miles M. Kostenbauder, Director of Vocational Education, Milton High School, Milton, Pennsylvania:

This school term is the first term to have a recognized junior high school and also a full time industrial-arts instructor in grades 7, 8, 9. I do hope that it will not be too long until we can add some of the graphic-arts work in our junior high school.

Two years ago we established a vocational department in our senior high school, that is in grades 10, 11, and 12. Graphic arts was not included in this program because our survey did not show a need for graphic arts on a vocational basis. At the time our vocational program was instituted, our industrial-arts program in the senior high school was discontinued temporarily due to lack of space.

I do hope that it will not be too long before we have adequate space to have a good industrial-arts program for the senior high school students who are not interested in the vocational department offerings.

When such time comes, if I am still on the scene, I assure you that the graphic arts will be included in the industrial-arts program.

Up until ten years ago Milton schools had no form of shop or hand work. I feel that we have made much progress, but much more remains to be done.
Johnson and Newkirk made the following statement about graphic arts in the public schools: (12:v)

The graphic arts as a significant part of our modern industrial world are making a contribution to our present and future civilization. The young people of today should learn about the graphic arts as a part of their general education and as a possible future vocation or avocation. A clear picture of the graphic arts and their products not only adds interest to living but also improves consumer appreciation for the products of this great industry.

Survey of the Graphic-Arts Course Now Taught in the Schools as to Content, Time Spent in the Area by the Various Grades, and the Basis of Shop Organization -- Whether on a General or a Unit Shop Basis.

It was deemed essential to find out the content of the various graphic-arts areas taught in the junior and senior high schools. Many instructors have been teaching the traditional "printing" for many years and do not realize the various other possibilities which make a graphic-arts program more interesting and diversified. The results from this survey will be used as a guide in making a content description, Appendix A.

Table VI, page 51 shows the content taught in the thirty-seven junior and senior high school programs. All the schools teach composition, imposition, and presswork. Approximately 75% of the schools offer some instruction in bindery, linoleum block cutting and printing, and stock cutting. Such interesting phases of graphic arts as silk screen work, process of making paper, and the making and printing of wood cuts, are taught by approximately 10% of the schools. Two of the schools teach the use of the mimeograph
duplicator, and one school offers work on the multigraph duplicator.

Not one of the thirty-seven schools offers any instruction in any of the following areas in the graphic arts: etching, spirit duplicating, stone lithography, engraving plates, stone photolithography, photo gelatin printing, making of stereotype plates, making of electrotype plates, wax engravings, photo engravings, half-tone plates, soft-ground etchings, crayon etchings, and making aquatint prints. These areas are all desirable, but there is not sufficient time to provide any appreciable amount of instruction in each area, especially when set up on a general shop basis. These areas would not need to be taught each year, but the easier ones could be taught in the beginning of the junior high school and progress to the more difficult ones in grades nine or in the senior high school. Then, after the pupil has made a project or two in each area, he could concentrate on one or two of them in his last semester of graphic arts. Too much time is spent on typography in the junior high school. As soon as the individual has progressed satisfactorily in composition, imposition, and platen-press work, he should be allowed to work in the other phases of graphic arts; otherwise, the pupil will gain the wrong impression about the graphic arts — that it consists of typography only.

At the same time, it was thought desirable to find out how much time was devoted to the instruction in graphic arts in the various grades. Table VII, page 53 shows the length of periods
TABLE VII

Showing the Number of Periods per Week and the Length of Periods in Minutes for the Various Grade Levels.

| Grade | Length of Periods | Number of Periods per Week | | Grade | Length of Periods | Number of Periods per Week |
|-------|------------------|-----------------------------| |-------|------------------|-----------------------------|
|       | 50               | 1 2 4 5 6 8 17              | |       | 60               | 1 2 4 5 10               |
| 7     | 3                | 1 1 1                       | | 7     | 2                | 1 1                       |
| 8     | 8                | 1 3 1                       | | 8     | 4                | 2 2                       |
| 9     | 9                | 2 1 5 1                     | | 9     | 6                | 1 1 4                     |
| 10    | 10               | 1 2 5 2                     | | 10    | 5                | 4 1                       |
| 11    | 9                | 1 1 5 1 1                  | | 11    | 4                | 3 1                       |
| 12    | 8                | 1 5 1 1                    | | 12    | 5                | 1 3 1                     |
and the number of periods per week of graphic-arts instruction. In the junior high school approximately two-thirds of the schools have fifty-minute periods and the average number of periods per week is four. The remainder of the junior high school classes are of sixty minutes duration, and the average number of periods per week is three. The ratio for the length of periods is the same in the senior high school, but the classes average five periods per week.

One school reported the length of periods as ninety minutes for grades 10, 11, and 12, with the classes meeting five days per week.

One school offers instruction in the graphic arts, to each class, thirty-five periods per week — every alternate week. When no graphic-arts instruction is offered the pupils are taking related subjects classes. This arrangement is offered only to grades eleven and twelve.

Many teachers have expressed ideas pro and con about a course in graphic arts in the general shop. With this in mind it was thought desirable to know on what basis graphic arts is taught in the schools. Table VIII, indicates there are four schools which offer the course on a general shop basis, five on a unit basis, and fifteen which have a general-shop program for the junior high and a unit-shop program for the senior high school. Most of the schools which offer industrial arts on a unit basis are located in the larger cities, which have more money for building space and
equipment. It must not be forgotten that the main purpose of the
general shop is to provide multiple industrial contacts at a mini-
mum cost.

**TABLE VIII**

Showing the Type of Shop Organization Used
in the Instruction of Graphic Arts.

<table>
<thead>
<tr>
<th>Shop Organization</th>
<th>Number</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General shop</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Unit shop</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Combination</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

Survey of What Should be Taught in the Graphic-Arts Area in the
Junior and Senior High School Industrial-Arts Program

Many industrial-arts teachers feel the need for areas which
they are not teaching, but do not add these areas due to one or
more of the following reasons: 1) Lack of space; 2) Lack of funds;
3) Lack of initiative; 4) Lack of professional growth; 5) Lack of
cooperation on the part of the administration.

This part of the survey was included to aid in setting up an
interesting graphic-arts course for the junior and senior high
schools — one which will lean away from the traditional "printing
course" and become a true part of the general education program,
which is one of the major objectives of industrial arts.
Table IX, page 57, is self explanatory in that it shows the number of teachers who think the various areas should be taught in the junior and senior high school, or whether it should not be taught in the school.

Only one teacher listed areas other than those listed by the questionnaire. These were: 1) The History of Graphic Arts; and 2) The Vocational aspects of the occupation.

It is interesting to note that approximately half of the teachers think etching, making and printing of wood cuts, making and printing of linoleum cuts, book binding, and the process of making paper should be included in a graphic-arts course.
TABLE IX

Showing the Opinions of Industrial Arts Teachers Concerning What Areas Should be Taught in the Junior and Senior High School.

Statement: Following is a list of the various areas in the graphic arts area. Indicate after each item whether you think it should be taught in the junior high, senior high, or not at all. Add any items which have been omitted, which you think should be taught.

<table>
<thead>
<tr>
<th>Areas</th>
<th>Jr. High</th>
<th>Sr. High</th>
<th>Not at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platen press printing</td>
<td>18</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Cylinder printing</td>
<td>0</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>Rotary printing</td>
<td>0</td>
<td>4</td>
<td>34</td>
</tr>
<tr>
<td>Hand lever printing</td>
<td>17</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Engraving</td>
<td>1</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>Etching</td>
<td>3</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Stone lithography</td>
<td>2</td>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>Multigraph printing</td>
<td>1</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Photo-lithography</td>
<td>1</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>Gelatin lithography</td>
<td>3</td>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>Silk screen work</td>
<td>10</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Rubber stamp making</td>
<td>3</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>Duplicating</td>
<td>4</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>Wood cuts</td>
<td>7</td>
<td>11</td>
<td>19</td>
</tr>
<tr>
<td>Wood engraving</td>
<td>4</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>Linoleum cuts</td>
<td>18</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Stereotype plates</td>
<td>0</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Electotype plates</td>
<td>0</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Photo-engraving</td>
<td>0</td>
<td>4</td>
<td>33</td>
</tr>
<tr>
<td>Bindery</td>
<td>17</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Making of paper</td>
<td>9</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

Additions:
History of graphic arts
Vocational aspects
Survey of the Major Equipment Which Would be Necessary for a Reasonable Program for the Junior and Senior High Schools

Since a graphic arts program cannot be taught satisfactorily without equipment, it was deemed necessary to find out what equipment is necessary for a reasonable program in graphic arts. Most teachers listed the equipment which would be needed to operate the areas they thought should be taught in graphic arts. Therefore Table X will seem to be very similar to Table IX. This is justifiable because a certain area cannot be taught without the equipment essential for that type of work. Since the teachers listed those areas which they thought important, they naturally would list the equipment necessary to teach those areas.
TABLE X

Showing the Equipment Necessary to Operate a Reasonable Graphic Arts Program for the Junior High and the Senior High.

Statement: List the major equipment you think is necessary for a reasonable program for the junior high and the senior high schools.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Jr. High</th>
<th>Sr. High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composing sticks</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Type cases</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Pica sticks</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Galleys</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Imposing stone</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Reglet and cases</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Wood furniture</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Metal furniture</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Proof press</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Hand lever press</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Hand feed platen press</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>Automatic platen press</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Type stand and cabinet</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Hand paper cutter</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Power cutter</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Mitering machine</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Saw trimmer</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Linotype</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cylinder press</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Slug cutter</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Silk screen equipment</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Bindery equipment</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Block carving tools</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Melting pot</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Engraving press</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Lithographic stone</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Photo-lithographic equipment</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Wire stitcher</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Paper perforator</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Paper drill</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Drying rack</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Engraving tools</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Multigraph duplicator</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Gelatin lithographic equipment</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Rubber stamp machine</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Duplicating equipment (spirit, mimeograph, and hectograph)</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Papermaking equipment</td>
<td>9</td>
<td>14</td>
</tr>
</tbody>
</table>
Survey of the Additional Equipment Which Would be Desirable and Effective at Reasonable Cost

With the fact in mind that all industrial arts teachers do not have all the equipment which they think desirable, this part of the survey was included. Most of the teachers listed only one additional piece of equipment which they thought would be desirable at a reasonable cost. Several teachers did not list any additional equipment as being desirable. This may have been due to the fact that some of the teachers were satisfied with the number of different areas offered, and that they had sufficient equipment.

Table XI shows the number of teachers wishing the additional equipment.

**Table XI**

Showing Additional Equipment Considered Desirable at Reasonable Cost

**Question:** What additional equipment would be desirable and effective at reasonable cost?

<table>
<thead>
<tr>
<th>Additional equipment</th>
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Survey of the Trends in the Graphic Arts Area

It would seem plausible that the industrial-arts teachers who have been teaching graphic arts for several years would be the individuals who know what is happening in this area of industrial arts. Only 17 of the 23 teachers answering the questionnaire gave an opinion concerning the trends in graphic arts. The opinions may be classified as follows: seven teachers said the teaching of graphic arts was increasing in popularity; eight teachers said the old term "printing" was being replaced with the new term "graphic arts"; one teacher said the popularity of the course had remained constant in his school; and one teacher said his classes were decreasing in size.

The eight teachers who said printing was expanding and becoming more diversified, to be included under the general term of graphic arts, indicated their opinions of the trend in the following manner:

That printing composition as we think of it is giving way to graphic arts in a broader sense.

Toward expansion - taking in somewhat larger field known as graphic arts instead of using the old term "printing".

I believe graphic arts is increasing in popularity, and more interesting areas are being added. There is no reason why it cannot be introduced as easily as any of the other branches of industrial arts.

Towards more areas.

The trend seems to be toward the exploration of all phases of graphic arts instead of merely hand composition and platen-press printing.
Toward wood cuts, linoleum cuts, engraving, dry point, and silk screen work.

Away from production work and toward a more thorough learning of fundamental processes in the various phases of graphic arts.

American Type Founders have released the following information:

Evidence is piling up that there will be a considerable increase in the number of schools teaching printing. The size of many printing departments will be larger, and offset lithography will be a subject of growing importance in many schools.

Research and questionnaires have become the common means of acquiring information on future activities and trends. The woods are full of them. But the facts to support the foregoing statement were not gathered by a questionnaire, or, indeed, by any definite attempt to find out anything. They were the spontaneous and unsolicited response to a simple offer of helpfulness on the part of a manufacturer to whom such an offer was natural and customary service. For that reason, the information obtained is the more significant, indicating a definite interest and trend of thought on the part of printing teachers and school officials who are anticipating their needs and problems of the postwar period.

However, this growing movement within educational circles undoubtedly is due to a recognition of the value of instruction in the graphic arts.
CHAPTER V
SUMMARY, RECOMMENDATIONS, AND IMPLICATIONS

Summary and Recommendations

Since sixty-three, or 90% of the teachers answering the questionnaire are in favor of a graphic-arts course in the industrial-arts program, it may be assumed that it should be included in all industrial-arts curriculums. A composite picture of the sixty-three teachers' opinions is as follows:

Any good teacher of industrial arts will endeavor to present to his pupils as many kinds of working media as possible. Since graphic arts represents one of the major fields of work in every community and culture through the ages has gone hand in hand with its advancement, graphic arts has a great place within the industrial-arts program. Graphic arts has acquired an important place in the American way of life and is a vital force in education. Since graphic arts is exploratory in nature, is so adaptable to an industrial-arts program, and meets many of our industrial-arts objectives better than some of the other units, it is desirable to include this area in the industrial-arts curriculum. It provides the experiences, understandings, and appreciations that should be attained from a well rounded industrial-arts program. Finally, its value in teaching related work such as English, history, science, and mathematics is very high.

Students should be able to build up a background of multiple industrial contacts. There is no other way but by a comprehensive industrial-arts program, which would not be complete without a graphic-arts area. Again quoting Theodore Struck: (16:180)

By the time students have completed their work in industrial arts they will have built up a background of insights, understandings, and skills that form a relatively broad background for more specialized trade training.
Those teachers who have developed a dislike for graphic arts should not prevent their students from coming in contact with this area. Teachers who restrict their course content by excluding graphic arts when popular opinion shows the need for it are defeating the ideals of creative teaching and general education.

Many schools do not include instruction in graphic arts in the industrial-arts program because of lack of space. Several schools list one or several of the following reasons for not teaching graphic arts: 1) The cost of such a program is too high; 2) The program will lead to production work; 3) Not feasible; 4) No request for the course; 5) Other industrial-arts courses more important; 6) Graphic arts should be taught in vocational education instead of industrial-arts education.

It is not always necessary to start a new area in industrial arts with a new room, new equipment, and the best of everything. Many industrial-arts shops were started by the "piece-meal" method. When the cost is pro-rated over a period of years, graphic arts is found to be less expensive to maintain than some of the other units. Much of the equipment used for instruction in graphic arts can be made in the shop. The production problem, if it is such a bad feature, may be solved by utilizing the club period or by having a special class to do the work. The importance of the graphic arts is known to everyone. Civilization depends upon printing and without it the world has lived in the Dark Ages.
There is no area in the industrial-arts program more important than the graphic arts.

We must provide a more interesting program in industrial arts and also in graphic arts. A course embracing only typography is not justifiable for general education. Graphic arts must include more than composition, imposition, and platen-press work. Such areas as etching, lithography, engraving, and aquatint will add greatly in re-vitalizing the "printing" course.

Most teachers feel that only hand operated equipment is necessary for a suitable graphic-arts course in the junior high school, and that power driven and production equipment could be used to advantage in the senior high school.

The trend for graphic-arts instruction in the industrial-arts program is increasing very rapidly. The term "printing" is being replaced with a broader term "graphic arts".

Appendix B contains descriptions of several important phases of graphic arts which are not usually taught in the industrial-arts program but which should be included to make a more diversified program. These areas need not all be taught in the same year. The easier areas could be handled by the seventh grade, and the more difficult ones by ninth grade or in the senior high school. Each student should be permitted to make at least one project in each area. By doing this the pupil will more fully understand the whole graphic-arts area.
Implications

It is hoped that this study will throw some light upon the need, the content, the equipment necessary, and the trends of graphic arts as taught in the industrial-arts programs of the Pennsylvania junior and senior high schools. It is certain that the schools are lagging far behind industrial methods, and that they are not meeting the needs of youth in building up a background of insights, understandings, and skills which form the background for avocational and vocational interests. Since industrial arts is to be functional, schools should try to keep abreast of modern industrial developments and provide more exploratory content in the graphic-arts area. This applies not only to the schools of Pennsylvania but also to all the schools throughout our nation. There is a definite need for graphic-arts instruction in the colleges of the west coast. Many teachers in the west have no idea what constitutes the graphic arts, and have no formal education preparing them to teach this necessary phase in the industrial-arts program. It is hoped that in the near future Oregon State College will be able to add graphic arts to their already well established industrial-arts curriculum to better prepare teachers for the industrial arts.
A fine example for any youth with ambition is to point to those men who contributed liberally to the advancement of the human race—those who made the world better because they gave generously of their best efforts.

A few of the outstanding figures are shown on this page. In early life each had training at type setting—commonly known as printing—the art preservative of all arts.

Employing the practical method to obtain an education is recognized as the most efficient in our public institutions today. School printing ranks very high as a medium of education.

The opportunities for the youth to get an education by means of the type case are as good now as in former years, perhaps better. Schools everywhere are offering a course in printing because of its educational advantages. It is a fascinating study and every boy likes it. Educators familiar with printing endorse it, claiming it is one of the most valuable studies the schools offer.

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1927
Printing

as a school subject has been taught in this country for many years. At the present time there are perhaps four thousand schools—elementary, junior high, senior high, normal, and vocational schools, colleges, universities, and trade schools—in which courses in printing are offered. Strictly speaking, only trade schools properly prepare for the trade; while in schools where prevocational and vocational training is carried on a step in that direction is taken. Most public schools which offer printing consider the study as a means toward general education; normal schools and universities generally offer it as a part of teacher training, or as an important part of a course in journalism.

The value of printing for education is generally recognized. Practically every educator, who is at all familiar with the possibilities of a good course in printing, will give testimony to its intrinsic value—in fact, all the schoolmen who have supplied data for this book and who represent educators in every section of the country have stated that printing is one of the most popular courses the schools offer.

Printing as a study in elementary and secondary schools had its beginnings in various experiments; its phenomenal growth has come only after a thorough tryout has shown its worth. Not only does printing help the students who actually take the course, but the entire school is benefited by the school printshop. The very fact that schools everywhere are introducing printing courses speaks for the general popularity of the subject.

It may be interesting to read something about early school printing in this country, the reasons why courses were first introduced in public schools and institutions of learning, the aims of the courses, and the various prevailing ideas concerning printing at various significant times.

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1927
BIBLIOGRAPHY


November 17, 1947

To the Industrial Arts Teachers of Pennsylvania:

In 1940 the Western World celebrated the five-hundredth anniversary of printing in Europe, and the three-hundredth anniversary of its introduction to the North American Colonies.

The graphic arts include the processes by which records and thoughts have been given visible form, through pictures, writing, and the various forms of printing. A study of the graphic arts includes the processes, the occupations, the materials, the tools employed, and the nature of the product.

Many schools include a graphic arts area in the industrial arts program, but there are many more which do not. With this in mind, a survey is proposed to determine the minimum content which should be taught in a satisfactory program, the trends in the teaching of the graphic arts, and why some schools do not include graphic arts as a part of the industrial arts program.

To make this survey as valid as possible, we wish a return for every questionnaire sent out. Your cooperation is very necessary. It is reasonable to believe that you will be interested in this study because of your interest in shop work and a desire to add professionally to the industrial arts field. Please supply the necessary information on the enclosed questionnaire and return at your earliest convenience. A self-addressed envelope is included.

It is our plan to make a summary of this study available to all who participate. A report will be made either by direct mailing or through one of the professional magazines serving the industrial arts field.

We wish to express our appreciation and thanks for your cooperation.

Very truly yours,

Ray A. Schwalm
Coordinator
P.S. You may be curious why a person from Oregon is making a survey of the schools in Pennsylvania. My original training was at the State Teachers College, Millersville, and I was a resident of Pennsylvania for 21 years. My interest still lies in the industrial arts program of your state and Pennsylvania was chosen because it is one of the more advanced states in the teaching of the graphic arts.
QUESTIONNAIRE ON THE INDUSTRIAL-ARTS GRAPHIC-ARTS AREA

Form A

For those teachers who are now teaching graphic arts or have done so previously, please fill out this questionnaire.

Check one of these:  I am now teaching graphic arts ________.  
I am not teaching graphic arts now but have done so before ________.

Answer the following questions to the best of your ability. The survey will depend upon your accuracy:

1. Do you think graphic arts should be a part of the industrial arts program? ______________________

2. How long have you been teaching graphic arts in this school? ___

3. Is graphic arts offered in the junior high? ___ senior high? ___

4. Is graphic arts offered in the general shop? ___ or unit basis? ___

5. After each grade list the approximate time spent in the graphic arts area. 7___ 8___ 9___ 10___ 11___ 12___

6. In your opinion what is the trend in the graphic arts area? ____________________________

7. Following is a list of the various areas within the graphic arts area. Indicate after each item whether you think it should be taught in the various grades. Add any items which you think should be taught.

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<td>Gelatin lithography</td>
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<td>Making of paper</td>
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8. List the major equipment you think is necessary for a reasonable program for the junior high and the senior high schools.

<table>
<thead>
<tr>
<th>Junior High</th>
<th>Senior High</th>
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</table>

9. What additional equipment would be desirable and effective at reasonable cost?
10. Following is a list of operations which might be taught in the graphic-arts area in the schools. Indicate after each item whether you **teach** it in junior high, senior high or not at all.

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Form B

For those teachers who are not teaching graphic arts now, please answer the following questions:

1. Do you think graphic arts should be a part of the industrial arts program? Why?

2. Is there a definite reason why graphic arts is not included in your present shop program? Do you expect to add this area in the near future?

3. Is the school administration in favor of graphic arts being taught in the industrial arts program? If not there must be some reason. Could you state this reason?
The following pages contain descriptions of various areas within the graphic arts which in the past have not been taught in the printing course but which are a major part of the graphic arts. The areas included have been simplified in such a manner that the boys and girls in junior and senior high school can perform the operations. Expensive equipment is not necessary to do these interesting phases of graphic arts. The author has not attempted to catalogue certain phases for each grade level but has divided them into two groups — those which are suitable for junior high school and those more appropriate for senior high school application. The instructor should appraise them to see if his students are capable of performing the necessary operations, not forgetting that as an industrial-arts course graphic arts should also be exploratory in nature.

To aid the instructor in the selection and appraisal of those graphic arts areas listed immediately following, the next several pages are devoted to descriptions of tools, processes and procedures necessary in the making of projects in these areas.

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Crayonstone Lithography

Materials and Tools

Lithographic stones (Blue Gray) (8" x 10") (5" x 6")
Crayons (Litho) (Grades 1-2-3-4-5-)
Liquid Tusche
Abrasives
  Sea sand (rough grinding)
  Quartz (final graining)
  Pumice stone (polishing)
Nitric acid
Gum arabic crystals
Pumice sticks
Sponges (three)
Lithographic inks and reducing varnish
Paper (soft book paper, 60 pound stock, or charcoal paper)
Paint brushes (2" -- two clean ones)
Lithographer's leather roller
Tracing paper (unglazed)
Pencils (hard and soft)

Graining the stone

The larger stone is laid face up on a table and dusted with sea sand, with a small amount of water sprinkled over it. The small stone is carefully placed on the larger one and moved about in a circular motion. Whenever the stones begin to adhere to each other, a little water is added. This grinding should be followed by another one, using quartz as the abrasive. If a very smooth finish is desired, a third grinding or polishing may be given with pumice stone. The surface of the stone should be polished with a pumice block instead of being grained, in preparing it for lettering or for using tusche.
Drawing the stone

The drawing is made on a piece of tracing paper and is reversed by placing a piece of carbon paper behind it. The face of the drawing is covered with carbon from a soft lead pencil, then laid face downward on the surface of the stone and the lines traced with a hard lead pencil. The design or lettering will appear on the stone after the paper is removed. Care must be exercised that the hand does not touch the surface of the stone. The drawing is sketched on the stone with a litho crayon, using the pencil lines as a guide. The work should be started with a hard crayon (No. 5) and continued with softer crayons where blacker areas are desired.

Etching the stone

The etch solution is prepared by dissolving gum arabic crystals in water to a creamy consistency and adding enough nitric acid to make the solution foam slightly on the stone. This solution is brushed on the stone and allowed to dry over night. When ready to use it is washed off with a sponge and water. The stone remains chemically clean, with the image fixed on it.

Gumming the stone

A second gum solution of the same consistency, but without the acid, is prepared and brushed on the stone after the etch has been thoroughly removed, and allowed to dry. The gum penetrates the fine
pores of the stone, protects it during the printing process, and prevents the spread of the grease in the lines.

**Printing** *

The gum on the surface is washed off with a sponge and water, and the stone covered with a thin film of water. The stone surface should never be allowed to dry during the printing process. The plate is inked by passing an inked lithographer's leather roller over the surface of the stone several times until the lines are well built up. A piece of damp paper is laid over the stone and covered by two or three sheets of some tough dry paper and press-board.

If a press is not available, printing may be done by running a clean rubber roller back and forth over the back of the paper or by rubbing with the convex side of a tablespoon or with a bone folder. The printing may be done on the proof press if the stone is less than type high. The impression can be adjusted by placing cardboard or sheets of paper under the stone to make it type high.

* Some lithographers remove the black crayon from the stone before proceeding with the printing. Since the grease in the stone is the part that makes lithography possible, that portion which remains on the surface may be removed with a cloth and turpentine. Care must be exercised not to cause the lines to smear, so the surface must be kept dampened with water.
Preserving the drawing

The drawing on the surface of the stone may be preserved for further printing by brushing a quantity of the gum solution on the surface of the stone and allowing it to dry before storing. The gum is sponged off when the stone is again wanted for printing.
Linoleum Blocks

Linoleum-block printing, as the name signifies, is done with linoleum designs which must be mounted type-high on wooden blocks if the block is to be printed on the printing press. It may be used unmounted and printed by hand on a linoleum press, clothes wringer, or by rubbing with the back of a tablespoon.

Materials and Tools

Battleship linoleum is the most common variety used. Inlaid and glazed linoleum are not well adapted for linoleum-block cutting. Battleship linoleum may be purchased in thickness varying from one-eighth to one-fourth inch. The rough surface of the block should first be sanded with fine sand paper. The harder the surface, the more detail can be cut into the block, but it is more difficult for the tools to cut. Hard linoleum will stand more impressions and longer runs than the softer variety.

Tools for cutting linoleum blocks consist of gouges, veiners, and chisels of various sizes. Good tools may be made from steel umbrella ribs. There are also many commercially made tools. A small selected range of sizes of veiners, gouges, and chisels is all that is needed. The tools must be kept sharp in order to obtain a clean cut to permit the linoleum to print clearly.
Woodcuts

Materials and Tools

Blocks of close-grained hard wood, such as maple, birch, cherry, may be used in exactly the same manner as linoleum.

The same tools as used in linoleum-block cutting may be used in making woodcuts. The tools must be kept very sharp in order to cut across the grain. While it is difficult to cut, flat grain wood block offers possibilities for fine detail and great endurance for many impressions.

Wood Engravings

Materials and Tools

Wood engravings are cut on the end grain of maple or boxwood with engraving tools or burins. The resulting print may contain very fine lines and accurate shading.

The block may be held in place by a bench stop or by clamping it to the work bench. Mistakes may be corrected by drilling a hole at the point of the error and gluing a dowel or peg into the hole. The hole must be large enough to remove all the damaged portions. The peg or dowel is then covered with glue and tapped snugly into place. It is cut and scraped to obtain a smooth surface, after which the patched portion is re-engraved.
Making the Drawing

The drawing should be a line drawing with as little detail as feasible. The drawing can be made on tracing paper, but is much better to make the drawing directly on the block, as the detail and the individuality of the drawing are thus preserved. If the drawing is made directly on the block, it should be prepared very carefully. One method of preparation is to cover the block with white ink or poster paint. Another method is that of covering the block with black India ink, after which the parts to be cut away are painted with white paint. This process enables the worker to see the effect of the black print as he cuts the design.

Transferring the Drawing

If the drawing is to be transferred, it may be done by either of two methods: 1) by placing a sheet of carbon paper between the drawing and the block; 2) by making the drawing with a very soft lead pencil, then placing the drawing face down on the block and rubbing the back of the design. If the drawing is transferred by the first method, you must remember to reverse the drawing; otherwise the print will be reversed. The paper with the drawing on it should be tacked to the block at the corners, to prevent slipping while tracing.
Cutting the Block

The block should be clamped to the table, or set against a bench stop. The free hand should never be placed in front of the block, or the path of the cutting tool. The cutting must never take the form of vertical lines cut straight and deep into the block. The sides of the cut should slope, becoming deeper as the worker gets into wide valleys. Vertical cuts make the block weak and the detail is liable to break off in printing.

Paper

A soft uncoated paper should be used in block-printing, to make good impressions. Such papers as newsprint, antique book paper, antique cover stock, paper toweling are satisfactory, but the best paper for block prints is the paper which comes from the Orient.

Ink

Good prints may be made with printer's ink, with oil colors, or with water colors made for the purpose. Any of these inks may be used when the printing is done by hand. When the printing is to be done on the press a printer's ink with an oil base should be used.
Printing

Previous to the time of printing the paper should be slightly dampened and let stand in a stack under slight pressure for several hours, thus softening the fibers and producing a richer color. One method is to dampen a sheet and lay a dry sheet over it, which is continued until enough paper is prepared for all the prints desired.

Printing from type high blocks may be done in the platen press in the same manner as type is used. If the block is to be printed by hand it may be inked with a brayer, or with several small rollers if various colors are applied to the same block. Blocks may be inked by using small brushes, or by the use of smooth leather padding.

The prepared paper is laid over the block, several sheets of hard cardboard or pressboard are laid over it and the whole placed under a copying press, block-print press, or run through a clothes wringer. Areas of solid color should not show spots or streaks in a good print. If no form of press is available the paper may be covered with a sheet of tough paper and rubbed with a burnisher, or the back of a tablespoon. The resulting print may be just as good as that produced by any other means.
Color Prints

Color prints may be obtained in several ways: 1) By using a different block for each color; 2) Blocks are sometimes printed over tints to give two colors; 3) Several colors may be applied to one block.

If a different block is used for each color, the key block is cut first, containing enough outline to guide the placing of the other blocks. Each block must be of the same size as the key, and must register with it so that the blocks may be interchanged in the chase to print in the proper place without changing the position of the guides.

If a press is not used a wooden form may be made so that each block will be held in the same position when printing.

If a tint is used prior to printing the design, the tint is produced by printing from a solid block, and after the ink has dried the engraved block is printed over the tint to produce two colors.

Several colors may be applied to one block by using a small brush and painting in the areas for each separate color.
RELIEF LINE ETCHING

Etching in line is the simplest and least expensive method of making photoengraving plates. The subject to be reproduced by line etching must consist of black and white only. Pen and ink sketches, printed words, or any subject made up of solid lines or masses can be reproduced by this process.

The commercial procedure is first to photograph the subject or drawing. The negative is developed, fixed and dried. The printing plate, prepared sensitized zinc plate, is exposed, developed, fixed, and washed in the same manner as a photographic print. The plate is then brushed with dragon's blood, a resinous powder which adheres only to the printed parts of the plate. The image is burnt in by heating over a gas flame. The plate is then placed in a bath of weak nitric acid which acts on the unprotected portion of the plate, biting into it and leaving only the black portion of the original in relief. Since the acid would undercut the edges if allowed to bite to the desired depth, the plate is removed after a shallow depth has been reached. It is washed, dried and dragon's blood is again brushed on from several directions to pile up against the sides of the etched areas. The powder is heated until it adheres to the plate, after which the plate is placed back into the acid. When the desired depth of etching has been reached through this process the plate is routed, trimmed, and mounted before it is ready for use on the printing press.
Since the commercial process would be rather difficult to perform in most school shops, the following steps could be accomplished and the principles of relief line etching taught satisfactorily:

1. Prepare a zinc plate by squaring, polishing, and cleaning it chemically.

2. Paint the image, in reverse, on the metal with lithographic ink in solution form.

3. Sprinkle the plate with dragon's blood, which adheres to the inked surface. Brush off the surplus rosin powder.

4. Heat the plate. This causes the powdered rosin to melt and combine with the ink, forming an acid resist.

5. Cover the back of the plate with asphaltum or shellac to prevent the acid from eating into the back. When the plate is dry place it in a solution of nitric acid (weak solution). Allow the plate to remain in the solution until it is etched approximately one-thirty-second of an inch deep. Remove the plate, wash and dry it.

6. Brush rosin in four directions against the edges of the image. Heat the plate. This causes the rosin to adhere to the edges, thus protecting them from undercutting when being etched. Etch the plate another one-thirty-second of an inch in depth.

7. Repeat the process in step 6 so there will be three successive steps in the depression, each step approximately one-thirty-second of an inch deep.
DRY-POINT ETCHING

The dry-point is not actually a form of etching. It is more nearly a type of engraving than of etching, although the term etching is commonly applied to it. No acid is used as in etching, nor is a burin used as in line engraving. The design or picture is drawn on a polished copper plate. The bare copper is scratched with a stylus, similar to the etcher's point, having a sharp needle or diamond point. The action of the dry-point tool plows a furrow and throws a burr, which prints with a characteristic fuzzy or shadow effect. The burr is removed in places where the artist wants fine lines, and is left on the plate where a darker effect is desired. The burr wears off after a few impressions, since the pressure of printing breaks down the tiny pieces of copper.

Prints may be reproduced for greeting cards or other subjects by dry-point on celluloid. This is a better medium than copper for the average junior high school pupil. Landscapes lend themselves very well to this medium.

1. Sketch the drawing in pencil or ink on paper.

2. Reverse the drawing on the back of the sheet by placing a piece of carbon paper back of the drawing with the carbon side against the paper, and tracing over the drawing with a pencil or stylus.

3. Cut a piece of celluloid, from .02 to .05 inches in thickness, a little larger than the drawing and tack it over the carbon drawing.
4. Trace the drawing by scratching the lines into the celluloid. The dry-point needle is the only instrument used. These needles can be bought, or they may be made from phonograph needles mounted in hardwood handles. The point must be sharpened occasionally to produce the fine delicate lines that are desirable. The blackness of the printed lines depends upon the width and depth of the lines. Cross-hatching or a series of fine lines may be used for shadows and dark areas. The closer the lines are to each other, the darker the print will appear to be. The plate is trimmed with a pair of scissors before inking and printing.

Inking the Plate

1. Polish the plate. Be sure that all grease spots are removed.

2. Heat the plate slightly, and apply etcher's ink with a felt roller or an ink dabber and rub the ink in with the fingers until all the lines are filled.

3. Cool the plate and wipe off the excess ink with a cloth, leaving the ink in the lines.

4. Polish the plate with the heel of the hand.

5. Retroussage the plate by drawing a soft cloth over the surface. This action draws the ink up in the lines and makes it possible to secure a certain soft effect in the print. The plate is now ready for printing.

Printing the Plate

1. Prepare the etching paper in advance by dipping alternate sheets in water, then stacking them between plates of glass where they remain overnight. Waxed paper should be placed around the stack to prevent the edges from drying out. There should not be any free water left in the paper.

2. Warm the plate slightly and place the damp paper over it, with several pieces of etcher's felt on top.
3. Pass the material through the clothes wringer or etching press. The pressure of the rollers will force the paper into the inked lines. The ink sticks to the surface of the paper and is drawn out of the depressions when the paper is removed.
Hand-made paper is usually heavier and of greater bulk than that produced by machine. Its fibers are thoroughly matted in both directions, giving it a quality of equal toughness throughout. Since it is produced slowly and in limited qualities, and is of beautiful texture, it is usually much more costly than machine-made paper. Its cost therefore confines its use to certain books of limited editions, and to etchings, lithographs, and woodcuts.

For a description of how to make the mold and deckle, paddle, and masher see page 120, Johnson and Newkirk, "The Graphic Arts".

**Making Rag-paper Pulp**

1. Dust the rags (linen or cotton) to remove as much dirt as possible.
2. Remove all buttons, hooks, and other non-cloth materials.
3. Shred the rags very fine. Have enough pieces of rags to fill a ten-quart pail about one-third full.
4. Fill the pail two-thirds full with water, and let stand for a day.
5. Add one-quarter pound of lye to the rag-water mixture and boil for three hours. Stir with the wooden paddle. Let stand for a day so that the rags will fall apart more readily.
6. Break the rags with the masher, and then beat with the wooden paddle.
7. After the rags are sufficiently beaten wash with fresh water. Do this several times because all the lye must be removed. To test to see if the lye is removed wet a piece of red litmus paper, if the paper remains the same color the lye has been removed, if the paper turns blue, then washing must be continued.

8. Add bleaching powder to water and pour it over the rags. Allow the rag pulp to stand in this solution for several hours. Thoroughly rinse out the bleaching powder with water.

9. Drain most of the water from the rags and put them through a food chopper three times. Use a coarse cutter for the first time and a very fine cutter for the second and third times. Place the pulp in a pail, add water, and let stand overnight.

10. Beat the pulp again with the paddle until a very fine, creamy consistency is obtained.

Making the Paper

1. Pour the pulp into a large dishpan or wooden tub.

2. Slide the assembled mold and deckle into the pulp with the edge down. When within a short distance of the bottom, turn the mold and deckle horizontally and carefully withdraw it from the water.

3. If the pulp is evenly distributed over the screen the deckle is removed and a piece of papermaker's felt laid over the mold.

4. Transfer the pulp from the screen to the felt by rubbing gently on the felt, which will press the water out of the pulp and cause it to adhere to the felt.

5. Lift the felt from the mold carefully. Place a second piece of felt on the other side of the pulp.

6. Put the felt-protected paper-pulp through a clothes wringer three times. Adjust the rollers with slight pressure for the first time and increase each time for the other two.

7. Remove both pieces of felt and hang them up to dry.
Drying the Paper

1. Place the sheet of paper between two pieces of cloth sheeting and iron with a medium hot iron until the paper is smooth and dry.

2. The paper is now ready for use in block printing, etching, and for wood cuts. It is no good as a writing paper for ink.

Sizing Paper

1. Melt a half-dozen sheets of gelatin in a pint of hot (not boiling) water with a half-ounce of alum added.

2. Apply the sizing with a soft camel-hair brush, spray gun, or by dipping the sheet in the solution while it is warm. A thin coat of liquid will adhere to the paper, which seals the pores.

3. Hang the paper up to dry.

Coloring Paper

1. The paper may be made any desired color by adding fabric dyes in liquid form in small amounts to the pulp while in the tub.

Finishing Paper

1. A linen finish may be given to paper by placing the paper between pieces of heavy linen after sizing and partial drying, and then place under heavy pressure. The longer the paper remains under pressure the more pronounced will be the design in the finish.

2. Many finishes may be obtained in this manner, such as leather, burlap and others by using the corresponding materials.
1. A watermark may be made in the paper by fastening to the screen a pattern of 22 gauge copper wire, using strands from the brass screen to hold it in place. When the mold and deckle is dipped into the pulp the copper wire design will form the design in the paper and will be clearly visible when the paper is dry.
SILK-SCREEN PRINTING

Industry is using silk-screen printing more each year. The Chinese used this process many years ago to print designs on cloth, but it has not been used in our country very extensively until within the last decade. This printing can be done on either curved or flat surfaces. Silk-screen processing may be done on metal, wood, cloth, oilcloth, glass, and paper, in fact on just about everything. Making Christmas cards, book markers, book plates, checker boards, and etching glass tumblers are some of the favorite shop projects in silk-screen printing.

Making a Frame

The frame should be at least two inches wider and six inches longer than the stencil it is to hold. A small printing frame may be constructed by nailing together four pieces of inch thick by inch wide pine or similar stock, using any type of corner construction as long as it is rigid. If a larger frame is needed the wood should be thicker and wider to prevent bending when stretching the silk. The edges should be chamfered slightly to prevent tearing the silk. After the frame is made all corners and any rough spots should be sanded to prevent damage to the silk. The whole frame should be given several coats of shellac. Angle irons may be fastened on the top side of the frame to give additional support. The wood used may be spruce, cypress, pine, or basswood provided it is kiln dried and free from knots, warpage, and other imperfections.
The Printing Base

The frame rests upon a base to which it is attached by hinges. The surface of the base must be absolutely flat, because any unevenness or warping will cause imperfect printing contact. The base should extend several inches beyond the edge of the frame, on all sides. If a rigid table is available the base board may be dispensed with as the frame may be fastened directly to the table.

Assembling the Printing Frame

Tightly tack a piece of Number 12XX silk bolting cloth to the bottom side of the frame. Always start tacking the silk at the upper left corner of the frame and finish at the lower right corner. This enables you to grasp the loose end for tightening down to the frame, stretching with one hand while tacking with the other. Stretch the silk over the frame in a drum-like manner. The tacks should be placed about every half-inch and staggered. If the silk has never been used it needs to be washed with warm water to remove the sizing. The wetting of the silk will also help to tighten it on the frame.

Ordinary brass door hinges or pushpin hinges should be used to attach the frame to the base. The hinges are first fastened to one of the long sides of the frame a few inches from the ends. The frame is then placed in position on the base and the other side of the hinges fastened to the base. If the hinges are properly
fastened the screen can be raised and lowered without a side plate. By removing the hinge pins the operator may detach the frame from the base without removing the screws.

Making the Squeegee

Purchase a strip of hard rubber three-eighth of an inch in thickness and approximately two inches wide, for the squeegee. Fasten the rubber in a piece of wood with screws. A straight, stiff piece of cardboard may be used as a squeegee for short runs. To prevent the squeegee from falling into the paint when not in use drive two nails into the ends which will then rest on the frame when not in use. The edge of the rubber should always be sharp. If worn down it must be sanded.

Cutting the Stencil (single color)

There are many kinds of stencils. The type of stencil discussed in the steps immediately below is known as Nu-film. Follow the steps carefully:

1. Make the copy. Make a small "x" in each corner of the copy. These marks are called registration points.

2. Place the Nu-film sheet over the copy, film-side up, and fasten.

3. Locate the four registration points on the film with a stencil knife so that they correspond to the four marks on the master copy.

4. Cut in a tracing manner with the stencil knife and peel the unwanted portions of the film from the backing sheet.
5. Should you cut through the backing sheet the stencil is not ruined, but if the centers of letters happen to be cut out they must be placed in their proper position when fastening the film to the stencil screen.

Cutting the Stencil (multi-color)

When making multi-color prints the procedure is more complicated. Usually a stencil is made for each color. The following procedure should be followed when using film:

1. Make the original copy, or use another picture.

2. Decide upon the sequence of colors. The order of colors should be written on the original. The lighter colors are always printed first, and the darker colors printed on top of the lighter colors.

3. Center the original under the screen.

4. Fasten the registry guides on the base.

5. Locate the registration marks on the original.

6. Cut a piece of film large enough to cover the area to be printed.

7. Fasten the original on a cutting board with tape or tacks.

8. Fasten the film on the original with tape.

9. Locate the registration marks on the film, if the film is as large as the original.

10. Cut the stencil for the first color. If two colors are adjacent, the first stencil should be slightly overcut on the adjacent sides, so that it will print one-sixteenth inch beyond its true boundary. This boundary is provided so that when the second color is printed, any slight discrepancy which may occur in the registration will not result in a conspicuous gap.
11. Insert the original with the film attached under the screen.

12. Lower the screen and adhere the film.

13. After printing this color repeat the process with the next color.

14. Make as many stencils as are needed to reproduce all the colors on the original.

**Printing**

Before the screen is ready for printing the stencil must be fastened to it. This particular type of film is fastened with lacquer thinner, or adhering fluid. The following steps should be followed for the best results:

1. Place several newspapers on the base.

2. Place the film on the base in the position desired and lower the screen.

3. Take two pieces of rag, one large and one small, preferably cotton rags (old undershirts are best), and wet the small one with adhering fluid. Wet a small portion of the screen by taking a single stroke and dry it immediately with the large rag. Continue in this manner until the entire film is adhered, wetting the small rag as often as necessary. Allow the screen to dry for approximately ten minutes.

4. Remove the backing paper by starting in one corner to slowly peel it off. Peel the backing paper in such a manner as to see the film at all times to prevent tearing any portion which might not have adhered properly. Should any part of the film not be fastened properly, turn the screen over and wet that portion with the adhering fluid and dry immediately. This should insure proper adhesion.

5. With blocking-out fluid, block out any portions of the screen which are not covered by the film.
6. Locate and fasten register guides. These may be pieces of heavy paper or any material of approximately the same thickness as the material being processed.

The screen is now ready for printing. The media used for printing depends upon what type of material is being processed. If wood or metal is used, the surface should have a sealing coat to insure proper adhesion, fineness of line, and detail. The following steps are essential:

1. Place the printing media on the screen.

2. Place a piece of the material to be processed under the screen.

3. Lower the screen, and move the squeegee across it, pulling the printing media with it. As the media crosses over any open portions of the film it is transferred to the material below the screen.

4. Raise the screen and remove the printed material.

Cleaning the Screen

1. Remove the pins from the hinges. Do not allow the printing media to remain on the screen very long when not using as it dries fairly rapidly and will clog and ruin the silk.

2. Place several pieces of newspaper under the screen.

3. Wash the screen with a prepared film remover.

4. Remove the film and dry it. This may be filed for future use.

5. Wash the screen with turpentine, kerosene, or lacquer thinner, depending upon the printing media used.

6. Wash the screen with soap and warm water. Dry the silk.
BOOKBINDING

Modern forms of bookbinding were started when books began to be made on separate leaves of paper, vellum, or parchment. These sheets, folded once were sewed through the fold upon cords or tapes, which in turn, were fastened into covers to protect and keep the leaves flat.

The binding of books can be adapted to the limitations of any kind of workshop. Expensive equipment is not needed to bind books as the home-made kind will work as well as the commercially made kind. Both the amateur and the expert will find possibilities within the field to meet almost any type of interest or ability. This work may vary from a simple pamphlet to a full leather binding or may extend into inlay work, hand tooling, and ornamentation with gold leaf; also marbling and gilt edging.

Here is an excellent opportunity to cause the student to become interested in the manufacture of paper, the history of books, and the ancient manuscripts which are housed in famous museums.

In this field each individual will find work suitable to his ability and can experiment with simple or elaborate bindings. Newspapers, magazines, blank papers, and sheet music, may be bound for convenience or protection.
Avocational as well as vocational interests may be met through the binding of books. From either interest, binding includes repair work, re-building or rebinding of old books, or the complete binding of new books. Variations from the binding of books, which can be accomplished with the same materials and equipment and which will appeal to the student include novelty book covers, notebook covers, portfolios, bridge score pads, and many other articles for use about the home, church, school, or library.
There are three major types of binding. Each one will be covered as to materials and equipment needed, and the procedure necessary to do the binding.

Padding

Pads serve as a temporary form of binding. They are made of single sheets, usually blank or printed forms, glued together along one end.

Materials for padding are simple, few, and inexpensive. The following materials are sufficient for padding sheets up to six by nine inches. Larger sheets may be padded by securing larger pieces of wood.

1. Two pieces of wood, 1 x 7 x 10 inches.
2. The printed or blank sheets to be bound.
3. Clamps or a woodworker's press or a paper press.
4. Soft paint brush
5. Binder's tabbing compound, paste.
6. Super (if paste is used instead of compound).
7. Required number of pad boards cut about one-eighth inch over-size.

The sheets to be bound should be cut to allow at least one-eighth inch trim on all three sides. Procedure for padding:

1. Place the sheets in their proper order (pads that contain carbon paper, or printed papers which need to be placed in a special order) and count the number for each pad. Place a pad board, cheap grade of cardboard used to give strength, between each stack of papers.

2. Place the pads in one pile and jog evenly.
3. The edge to be cemented is trimmed evenly with a paper cutter (or by fastening the pads in a vice or between boards and trimmed with a large chisel). A sanding disc has proved satisfactory in some cases.

4. Clamp the pile of pads between two boards slightly larger than the pads. The edge to be cemented should be even with the two boards.

5. Apply the tabbing compound to the edge which has been trimmed and leave them in the press until the compound has hardened.

A coat of paste, glue, or rubber cement may be used instead of the tabbing compound. When using these adhesives a piece of super (sized cheesecloth) should be placed over the surface to be pasted. This gives additional strength to the pad and usually requires two coats of the adhesive.

6. Cut the individual pads apart with a sharp knife.

7. Trim the individual pads to the proper size.

**Wire Stitching**

Small magazines and booklets are frequently bound by saddle stitching or side stitching on the staple binder or even a small hand stapler.

**Saddle stitching:** Most thin magazines and booklets are bound by this method and work that is to be bound in this manner must be printed in such a way that it will fold in the center.

1. If the papers are not folded, do so.

2. Collate and assemble the papers by placing one fold within the other until the complete book has been put together.

3. Add the cover and open the book to the middle.
4. Staple through the entire book. At least two staples must be used; more if the book is large.

5. Trim the book.

Side stitching: Pamphlets or books made of single sheets (not folded) are bound by this method.

1. Collate and assemble the sheets and jog them so the back edge will be even.

2. Staple along the back edge of the book.

3. Fasten the cover. The cover for this type of book is usually made of two pieces of heavy paper or cover stock. The top piece is creased so that it will open easily. Both of them are pasted about one-half inch in from the back edge of the book.

4. Place the book in a press and let dry.

5. Trim to size.

Case Binding

Most commercial books are case bound. The cover case is made up by itself and pasted over the book. In true binding, the cords or tapes on which the signatures are sewed are in turn fastened in a sewing press so that the sewing is more easily accomplished. A signature is a folded sheet of paper. If a sheet were folded across the narrow side the result would be a four-page sheet called a "folio". If this were folded once more it would be half size but would contain eight pages and would be known as a "quarto". Folding again would be called an "octavo" and would contain sixteen pages. The cords or tapes are later fastened into the cover, holding it to the book.
The materials necessary for binding may be purchased at any binder's supply house.

1. Binder board or thin, hard, compositors board is used for the cover.
2. Book cloth or buckram is used to cover the book. Leather, linen, khaki, oilcloth, and denim are also suitable as cover material.
3. Super, a heavily starched cloth, is used for reinforcing the back. It is a wide-spaced coarsely-woven material which allows the glue to penetrate.
4. Binder's cord which is made from loosely twisted long-fibered hemp linen tape may also be used.
5. Linen or silk thread, No. 18/2 is used for sewing the signatures.
6. Paste. A good grade of paste must be used in the binding. Hot book binder's glue may be used. The glue or paste must be flexible when dry.

Most of the book binding equipment may be made in the school shop.

1. Sewing frame
2. Trimming frame
3. Backing cords
4. Paper press
5. Clamps
6. Cutting chisel
7. Flat-headed hammer
8. Paper cutter (this is not essential but speeds up the work).

Preparation for sewing: The method of preparation for sewing depends upon the material to be bound. Magazines to be bound are first pulled apart by removing the staples or wire stitching. The sections are collected, depending upon the original form.

Old books which need re-sewing are cut apart very carefully, and the old glue removed without destroying the paper. Torn sheets are repaired. Single sheets may be pasted to a guard strip which is wide enough to fold over the back of the signature.
Newly printed sheets are made up into signatures and numbered consecutively, ready to be sewed. The pages and sections of the book must be collated before the book is bound.

**Making the first book:** It is suggested that the student begin bookbinding by using blank pages, folded to the desired size and assembled into not more than eight signatures of sixteen pages each.

1. **Make the end papers.** These papers give a finished appearance to the book and help to hold the cover to the book. Two sheets are cut from heavy cover stock, exactly the same length and twice the width of the signatures. These are folded through the center and placed on each side of the book. These end papers are sewed upon the cords or tapes in the same manner as the signatures.

2. **Sew the signatures on the cords or tapes.** If tapes are used three will suffice, but if cord is used, five are preferred.

3. **Trim the edges.** The tail of the book is trimmed first, then the head and lastly the fore-edge.

4. **Round the edges.** The book is laid on its side on the bench and the back is rounded by pulling the top sections away from the back, while the center of the fore-edge of the book is pushed back with the thumb, until the back is rounded.

5. **Backing.** Place the book in a backing press and clamp. The top edge of the backing board should be away from the edge of the book a distance equal to the thickness of the cover board. Start hammering at one end of the book with light glancing blows aimed toward the outside of the book. This hammering should be done on both sides of the center of the back. This operation forms the joint into which the cover fits. When the backing is completed a light coat of glue is brushed on and a piece of super large enough to extend within one-half inch of each end is placed over the back. The super should be about four inches wide. Another light coat of glue is applied over the super to help hold it in place. As soon as the glue becomes tacky the back should again be hammered to force some of the glue down into the signatures.
6. Headbands are applied merely for appearance. They are glued to the head and the foot of the back and trimmed.

7. Lining paper is placed between the cover and the back of the book to provide for a loose bending back. A piece of kraft paper is cut a little less than the length of the book and three times the width of the book. This piece is given an accordion fold and one end carefully glued to the back of the book.

8. Make the cover. Cut two boards allowing one-eighth inch overhand on the three open sides and the same amount of clearance from the joint. Place the boards in position. Fasten two pieces of gummed tape to the top board, then around the back to fasten to the back board. Press the gummed paper down between the covers and the joint. Remove the boards and lay on the back side of a piece of cover material. Allow one-inch space all around the outside of the two cover boards, and mark with a pencil where to cut. Cut the material, remove the gummed tape, and glue the boards in position. Bring the spare cover material over the back and glue it to the inside of the cover boards. Be sure to have neat corners. Rub the outside of the cover boards with a bone folder to remove any wrinkles, and place the cover under pressure over night.

9. Case the book. This means to fasten the cover to the book. Place the cover flat on a table, and place the book on one side of the cover in its proper position. Place a piece of waxed paper between the end sheets. Before gluing the cords to the end sheet they should be combed so they will lie in the book without showing a bulge. Glue the cords and super to the end paper, and then spread glue over the entire surface of the end paper. Bring the cover down on the end sheet evenly. Turn the book over and repeat the same operations. Run the bone folder thru the joint several times to force the cover material down on the book. Clamping boards should be placed in position and the book placed under pressure for twenty-four hours. The clamping boards have a piece of band iron fastened on the ends to make the joint permanent.

10. Finish the book. Titles and decorations may be added to the cover to add to the appearance.
ELECTROTYPE PLATES

Electrotype plates are more durable and more accurate than stereotype plates. They are well adapted for fine halftones and color plates. The shell is made of copper, which is harder than type metal, and can therefore stand many more impressions than the type form itself.

Preparing the Form

The form is locked up in a heavy chase. Care must be taken so that the form is well planed and that no damaged characters are included. The type should be well cleaned so that its face is clear and no dirt remains under the feet. A woodcut may be used just as well as type.

Molding *

The first step in making the mold is to prepare the case, which consists of a thin metal plate. A frame of metal is placed on the metal plate. The frame should be about one-fourth inch thick, and should be large enough to take the form. The case and the frame are then placed on a galley, and warmed. Engraving wax is poured

*Another process similar to the wax method is the lead molding method. The impression is made in a sheet of specially prepared lead about one-sixteenth of an inch thick, under enormous pressure on a hydraulic press. This method is not applicable to the industrial-arts program.
over the metal plate to the height of the metal frame. A sharp straight edge is drawn across the surface of the wax as soon as it has cooled. The metal strips are removed, and the edges of the wax are beveled. The second step is to dust the entire surface of the wax and the form, and then press the form into the wax with a paper press, until the proper depth has been attained. The third step is to remove the excess wax pushed up by the form, and fill in the vacant areas with a hot soldering copper and wax.

The Leading Process

Wet graphite in powder form is evenly brushed into the mold to serve as an electrical conductor so copper may be deposited upon the mold to form the shell in the plating bath.

The Plating Bath

The bath consists of a tank containing an acidulated solution of copper sulphate. The mold after wet leading is suspended by a hook from one edge in the bath. The hook serves as the negative pole and is connected to the negative pole of the battery or generator. A plate or bar of copper is attached to the positive pole of the battery and suspended in the tank. The mold is known as the cathode and the copper as the anode. The electric current is turned on and passes thru the liquid from the positive pole to the negative pole, depositing copper on the mold. The mold should remain in the bath from four to twelve hours depending upon the
thickness of the shell desired. The ordinary shell is approximately .012 inches thick.

When the copper shell is of the required thickness it is removed from the bath and immersed in hot water, which melts the wax and the shell may be stripped off.

Backing Up the Shell

The shell at this stage is very thin and cannot be used for printing. It should be scrubbed thoroughly on both sides, then placed face down on a flat metal table. A flux is applied to the back of the copper and the shell placed in a metal box with sides approximately one-fourth inch high. Tin foil is laid over the back surface of the shell and heat is applied, causing the tin foil to coat the entire back of the shell. A hot metal backing of lead is poured over the shell, the melted tin foil serving as a bond between the shell and the backing.

Mounting

The cast is scraped or shaved to make it flat. High spots on the printing surface may be routed out, and then the mold is mounted type high on a block of wood. The electrotype is then ready for printing.
**Line Etching**

Line etching differs from etching in line in that line etching is one of the processes used in intaglio printing and etching in line is used in relief printing. In line etching the design or image is recesses in the plate; while a plate made by etching in line, the image remains on the surface and the surrounding parts are lowered by the acid biting into the metal.

**Etcher's Tools**

The etcher's tools, press, and methods have changed very little since their invention. The principal tool employed is the etching needle, which has a hard steel point. Other tools are the burnisher, scraper, roulette, and etching press. If no etching press is available a clothes wringer with level rolls will serve the purpose just as well.

**Preparing the Plate**

1. Polish and bevel the edges of a smooth piece of copper.
2. Clean the plate chemically by means of acetic acid.
3. Wash off the surface. From this point on until ready for inking the plate should not be touched by the hand, or greasy spots will form.
4. Dry the plate and warm sufficiently to melt the etcher's ground,* when the ball of ground is held to the surface.

*A common method of preparing the ground is to melt together in a double boiler one part of gum mastic, one part of dry asphaltum, and two parts of beeswax. The mixture is poured out into cold water and tied up in a silk bag through which it strains as it is used.*
The ground may be applied by spreading in a thin layer with the ball, or it may be applied with a dauber.

5. When cool, the ground is smoked with a candle until it is rich black. Be sure not to let the flame stay in one spot too long otherwise the ground will become burnt.

6. With a brush cover the edges and the back of the plate with liquid ground. This is done to protect the edges and back from the action of the acid.

Transferring the Image

1. The drawing may be made directly on the plate with the stylus (etcher's needle) if desired.

2. Another method is to make the original pencil drawing on paper. Dampen the paper and remove any excess water with blotting paper. The damp drawing is placed face downward over the plate on the grounded side. Place several felt pads over the paper and run the whole through the clothes wringer or etching press. The pencil marks will be transferred to the surface, marking the lines of the image faintly in reverse.

Drawing the Image

1. Cut the image through the wax coat with the etcher's stylus. Place a piece of wood over the plate as a hand rest to prevent damage to the ground. The stylus should expose the bare copper but not scratch it.

Biting the Plate

1. Prepare the acid bath. Use a 20 to 30 percent mixture of nitric acid and water. Be sure to pour the acid into the water to prevent a dangerous explosion.

2. Place the plate in the bath. A loop of waxed string makes an excellent cradle to hold the plate in the bath. Rock the plate gently in the bath to prevent the bubbles from staying on the plate. If this is not done the lines will be rough and uneven. Fine lines will be etched sufficiently deep in a few minutes, after which the plate should be removed from the bath.
3. Wash the plate under running water and let dry thoroughly.

4. Stop-out those lines which have been etched deep enough with a stopping-out fluid. Use a fine brush. Let dry.

5. Place the plate in the acid again for the second etching. This process is continued until all the desired line gradations in the plate have been obtained.

**Inking the Plate**

1. Polish the plate after the ground is removed. The ground is removed by warming the plate and wiping with a cloth. A final cleaning with gasoline will remove all traces of the ground.

2. Heat the plate slightly, and apply etcher's ink with a felt roller or an ink dabber and rub the ink in with the fingers until all the lines are filled.

3. Cool the plate, and wipe off the excess ink on the surface of the plate with a cloth, leaving the ink in the lines.

4. Polish the plate with the heel of the hand.

5. Retroussage the plate by drawing a soft cloth over the surface. This action draws the ink up in the lines and makes it possible to secure a certain soft effect in the print. The plate is now ready for printing.

**Printing the Etching**

1. Prepare the etching paper in advance by dipping alternate sheets in water, then stacking them between plates of glass where they remain overnight. Waxed paper should be placed around the stack of paper to prevent the edges from drying out. No free water should remain in the paper.

2. Warm the plate slightly, and place the damp paper over it, with several pieces of felt on top.
3. Pass this material through the clothes wringer or etching press. The pressure of the rollers will force the paper into the inked lines. The ink sticks to the paper and is drawn out of the depressions when the paper is removed. This print is called the first state of the plate, every change in the lines on the plate constitutes a state after it is printed. The etcher uses each state as a guide in making corrections. Several corrections are usually necessary before the desired results are obtained.

Making Alterations and Corrections

1. Make any additional lines which are necessary by applying a transparent ground. Since the lines may be seen through the ground the new lines may be drawn in the exact place. A second etching follows.

2. A second method of adding lines or of deepening those already etched is to use the dry-point stylus directly on the copper.

3. To remove any undesired lines, scrape away the undesired line and then raise the surface from the back to bring the restored area on the level of the remainder of the plate, then re-polish.

Many etchers after they have printed the desired number of copies destroy the plates by cutting lines across the face of the plate in different directions, to prevent its use. Several prints of this nature are almost as valuable as the original.
The process of line engraving differs from etching in that the lines are cut into the plate by tools. The plate is first polished and the design sketched directly on the plate. It is next cut with a tool called the burin or graver. The lines are cut in varying depths and widths and in various combinations to make up the design and gradations of color. A deep line will hold more ink, giving depth and richness and making the color darker. Several lines engraved close together, or crossing one another, will produce a wide black area.

**Inking the Plate**

1. Polish the plate. Be sure that all grease spots are removed.

2. Heat the plate slightly, and apply etcher's ink with a felt roller or an ink dabber and rub the ink in with the fingers until all the lines are filled.

3. Cool the plate and wipe off the excess ink off the surface of the plate with a cloth, leaving the ink in the lines.

4. Polish the plate with the heel of the hand.

5. Retroussage the plate by drawing a soft cloth over the surface. This action draws the ink up in the lines and makes it possible to secure a certain soft effect in the print. The plate is now ready for printing.

**Printing the Plate**

1. Prepare the etching paper in advance by dipping alternate sheets in water, then stacking them between plates of glass where they remain overnight. Waxed paper should be placed around the stack to prevent the edges from drying out. There should not be any free water left in the paper.
2. Warm the plate slightly and place the damp paper over it, with several pieces of etcher's felt on top.

3. Pass the material through the clothes wringer or etching press. The pressure of the rollers will force the paper into the inked lines. The ink sticks to the surface of the paper and is drawn out of the depressions when the paper is removed.
SOFT-GROUND ETCHING

A soft-ground etching is a process which reproduces the shaded effect of pencil drawings.

1. Polish and bevel the edges of a smooth piece of copper.

2. Clean the plate chemically with acetic acid.

3. Cover the plate with etcher's ground which is mixed with tallow to keep it soft. (An amount of tallow equal to the hard ground is added)

4. Make the drawing on a thin piece of moderately rough paper.

5. Dampen the paper and lay over the ground. Fold the edges of the paper over the back of the plate and allow to dry.

6. Trace the drawing with a soft or medium pencil. The use of a bridge over the plate will prevent the plate from being ruined by the pressure upon it. The pressure of the soft pencil causes the soft ground to adhere to the back of the paper. As the paper is removed it picks up the ground wherever the pencil strokes have pressed upon it. The fibrous texture of the paper, the degree of hardness of the pencil, and the pressure exerted, all influence the size and the number of the particles of the ground picked up by the paper. The design appears on the plate in areas of bare copper. The plate is then ready for etching.

Etching the Plate

1. Prepare the acid bath by using a 20 to 30 percent mixture of nitric acid and water.

2. Place the plate in the bath. A loop of waxed string makes an excellent cradle to hold the plate when removing it from the bath. Rock the plate gently back and forth to prevent the bubbles from staying on the plate. If this is not done the lines will be rough and uneven. The grain of the paper will show in the etched line.
Inking the Plate

1. Polish the plate. Be sure that all grease spots are removed.

2. Heat the plate slightly, and apply etcher's ink with a felt roller or an ink dabber and rub the ink in with the fingers until all the lines are filled.

3. Cool the plate and wipe off the excess ink on the surface of the plate with a cloth, leaving the ink in the lines.

4. Polish the plate with the heel of the hand.

5. Retroussage the plate by drawing a soft cloth over the surface. This action draws the ink up in the lines and makes it possible to secure a certain soft effect in the print. The plate is now ready for printing.

Printing the Plate

1. Prepare the etching paper in advance by dipping alternate sheets in water, then stacking them between plates of glass where they remain overnight. Waxed paper should be placed around the stack to prevent the edges from drying out. There should not be any free water left in the paper.

2. Warm the plate slightly and place the damp paper over it, with several pieces of etcher's felt on top.

3. Pass the material through the clothes wringer or etching press. The pressure of the rollers will force the paper into the inked lines. The ink sticks to the surface of the paper and is drawn out of the depressions when the paper is removed.
Aquatint is purely an etching process which has been developed in an effort to reproduce paintings done in water colors. The print is made up of light and dark and some of the areas are outlined by etched lines. The important difference between aquatint and other processes is in the method of laying the ground.

1. Draw or paint a sketch in several definite tones.

2. Clean a copper plate and dust with fine particles of rosin from a bag, which contains powdered rosin, held about two feet above the plate. Be sure that the dust is not disturbed.

3. Gently heat the plate but do not overheat otherwise the dots of rosin will run together.

4. Shellac the back of the plate and the edges for protection from the acid bath.

5. Trace the lightest areas of the drawing and transfer it in reverse on to the plate. Asphaltum varnish is applied to all the areas that are to remain light.

6. Etch the plate for one minute. Remove the plate from the bath and dry. Use the same bath as used in making a line etching.

7. The next lightest tones are traced, transferred, and painted with varnish. Etch the plate for three minutes. Continue this process until all the tones have been etched.

8. Finish the plate by washing with gasoline and then with turpentine. The plate is now ready for printing.

Inking the Plate

1. Polish the plate. Be sure that all grease spots are removed.
2. Heat the plate slightly, and apply etcher's ink with a felt roller or an ink dabber and rub the ink in with the fingers until all lines are filled.

3. Cool the plate and wipe off the excess ink on the surface of the plate with a cloth, leaving the ink in the lines.

4. Polish the plate with the heel of the hand.

5. Retroussage the plate by drawing a soft cloth over the surface. This action draws the ink up in the lines and makes it possible to secure a certain soft effect in the print. The plate is now ready for printing.

Printing the Plate

1. Prepare the etching paper in advance by dipping alternate sheets in water, then stacking them between plates of glass where they remain overnight. Waxed paper should be placed around the stack to prevent the edges from drying out. There should not be any free water left in the paper.

2. Warm the plate slightly and place the damp paper over it, with several pieces of etcher's felt on top.

3. Pass the material through the clothes wringer or etching press. The pressure of the rollers will force the paper into the inked lines. The ink sticks to the surface of the paper and is drawn out of the depressions when the paper is removed.