Multiple-stone lithography
by Lois Hoefert Aring

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF APPLIED ART
Montana State University
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Abstract:
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The larger size of the multiple-stone lithograph also enables an artist to experience new techniques and
creative freedoms as well as utilize all methods previously found to originate images on conventional
-sized stones.

Much experimentation was done to find designs which would be pleasing aesthetically and could be
printed in sections. Problems in registering, overlapping, and printing were encountered and
satisfactorily solved, Multiple-stone lithography was found to be a time-consuming but interesting and
effective way to create large decorative prints with a minimum of physical effort.
MULTIPLE-STONE LITHOGRAPHY

by

LOIS HOEFERT ARING

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of

MASTER OF APPLIED ART

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ABSTRACT

Many phases of lithography were experimented upon and discarded before the idea of printing from several stones onto a single sheet of paper was conceived. The print produced in this manner is larger than any created by most graphic art methods, so could be seen effectively at a distance. It is conceivable, then, that lithographs produced by this method could be of value for decorative purposes.

Arranging several average-sized stones to produce such a print enables any artist to create large lithographs on stone independent of physical limitations. A single limestone of the same proportions as the prints done for this thesis would weigh between two and three hundred pounds. This would make the execution of lithographs of a comparable size impossible in a private studio or classroom not equipped with a lift. Metal plates were not considered satisfactory substitutes for stone because of the many problems encountered in their use.

The larger size of the multiple-stone lithograph also enables an artist to experience new techniques and creative freedoms as well as utilize all methods previously found to originate images on conventional-sized stones.

Much experimentation was done to find designs which would be pleasing aesthetically and could be printed in sections. Problems in registering, overlapping, and printing were encountered and satisfactorily solved. Multiple-stone lithography was found to be a time-consuming but interesting and effective way to create large decorative prints with a minimum of physical effort.
INTRODUCTION

Lithography is a creative process which involves the mastery of several associated skills such as etching and printing the stone. It affords stimulating technical problems lacked by many other art media; the chemistry of the process itself is interesting. Some physical labor is necessary to produce a lithography of any size, but this, too, can be enjoyable, because the finished product gives a great sense of accomplishment and satisfaction.

During the first three months of this study much time was spent gaining experience and a knowledge of the medium. Many preliminary color lithographs were executed, some of which can be seen in Figure 2. A particular problem involving creative experimentation and the development of technical procedures not previously studied at Montana State College was sought. Such a problem would not only be of significant value to the experimenter as a creative endeavor, but would provide those interested in lithography with material for further investigation.

Some work was done with color and transparent overlays, but this did not prove to be effective due to the character of lithographic ink. Much finer results are attainable in this direction in the medium of serigraphy.

Cotton, rayon, and various other fabrics were used to print upon in an effort to find out how lithography would adapt itself to textile printing. It was hoped that such things as napkins and curtains could be decorated in this way. The printed fabrics were washed, and it was
apparent after four or five washings with a mild detergent that the ink would fade. Several stones were printed in succession on a piece of cloth to simulate a curtain during this experiment. From that came the idea of large prints executed by using several average-sized stones combined to form one image.

Felix Brunner writes:

Graphic art is the art of small-sized pictures. It is primarily intended to be viewed at the distance from hand to eye. Unlike flat areas, lines become indistinguishable at a distance. For this reason graphics are usually kept in a portfolio rather than hung on walls.

The implication that graphic prints were necessarily small constituted a challenge to demonstrate that large lithographs were feasible. They would involve new and interesting problems in lithographic procedures which had not been previously explored at Montana State College. Multiple-stone lithography, as it shall be called, would also provide the experimenter with invaluable creative experiences and technical knowledge.

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Figure 2. Preliminary Lithographs
THE HISTORY OF LITHOGRAPHY

The printing process known as lithography was discovered by a Bavarian playwright, Aloys Senefelder, by accident in 1798. It first found favor in Germany where it was used mainly as a means of pictorial reproduction and illustration. The earliest fine art lithographs done in that country were produced by Adolf von Menzel. His work exerted a tremendous influence on the development of lithography as an art form throughout Europe.

At this time the French Revolution was occurring and lithography was found to be the precise medium needed for the reproduction of political drawings and cartoons. Honoré Daumier was the first to use the process as a form of mass communication. Being a prolific artist, approximately 5,000 lithographs are credited to him which were circulated throughout France, greatly advancing the popularity of lithography as a fine art form. Other artists to achieve perfection in the medium during the nineteenth century were Gavarni, Delacroix, Redon, Goya, and Toulouse-Lautrec, whose magnificent posters were the first lithographs to incorporate several colors. Notably, these are Frenchmen, with the exception of Goya from Spain.

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Lithography was used largely for illustrative purposes in the United States for many years. A few artists created some lithographs of merit, but most work was commercial in nature. During the twentieth century the United States has grown to be the leader in the development of commercial lithography. It has become the fastest growing process of color reproduction and is used extensively. It is economical, fast, and reproduces with great fidelity. By the use of offset lithography anything that can be photographed can be printed without employing metal type. Posters, labels, books, and packages are printed by this method. Besides the immense commercial industry it has developed into, lithography is a popular means of creating fine prints today. Contemporary lithographers still use stones and basically the same procedures as those used by Senefelder and the acclaimed lithographers previously mentioned. It is with this type of printmaking, as opposed to commercial lithography, that this thesis is concerned.

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A DESCRIPTION OF THE PROCESS

Unlike the other graphic art processes which are either intaglio or relief, lithography is a planographic process. This means it is done on an entirely flat surface, printing being made possible by the chemical properties of the substances employed. Senefelder first referred to it as "Chemical Printing", which is what it is in fact. The name was later changed to lithography; litho meaning stone, and graphy, writing or drawing.

The process is based upon the principle that grease and water do not mix. This repulsion of one for the other is explained in terms of differences in viscosity by Hayter. A more complete explanation of why lithography works is found in a book by Ralph Mayer. According to this theory, the action that occurs is adsorption—the adhesion of a liquid, gas, or solid to the surface of another. This relationship is so strong that the adsorbed layer cannot be washed off or dissolved, but must be removed by actually discarding a layer of the substance—in this case stone—by grinding. Adsorption can only occur in matter whose molecules form a particular pattern, or line up parallel and in the same direction. They are then said to be polarized. The crayon or tusche

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applied to the stone in drawing contains grease and causes an adsorbed layer of fatty acids to form underneath. The adsorbed fatty acids are polarized and repel the non-polarized deposits of acid and gum arabic applied to the stone. When a roller laden with greasy ink is passed over the entire stone the non-polarized areas which have been treated with gum arabic and acid repel the grease and hold water. The ink is attracted only to the adsorbed layer of fatty acids formed where crayon marks were placed.4

The stones used for lithography are very fine grained limestone composed mainly of carbonate of chalk. They are quarried in the Jura Mountains of Bavaria.5 Grey or blue and yellow limestone occurs naturally, the grey or blue being somewhat superior due to hardness and less porosity. Four stones, numbers E 119, E 106, E 120, and E 124, belonging to the Montana State College School of Art, were used for this study. They are grey in color, weigh approximately 50 pounds apiece, and measure 17 by 13, 19 by 13, 18 by 14, and 18 by 14 inches, respectively.

Zinc and aluminum plates are considered to be satisfactory substitutes for stone by some contemporary printmakers. A plate of either of these metals is proportionally lighter than a stone and can be more easily transported and handled. Zinc or aluminum can be obtained in sheets of various sizes so it would be possible to execute prints as large as the


press bed used would allow. According to most lithographers, however, the disadvantages of metal plates overrule these factors. The darker color of the metal makes it difficult to perceive values and control contrast. No scraping techniques can be employed in drawing nor can corrections be easily made upon the completed image. Metal plates are grained by machine; only in large cities, or by sending them to a lithographic supply house, can these plates be regrained and readied for a second drawing. They are expensive. Many printmakers have found drawing on a metal plate to be an unpleasant experience and not to be compared to the fine tactile quality of stone.

A particular sequence of steps must be followed in the preparation of a lithographic stone before it is printed. Some deviation can be found among authorities on the subject, but most follow a procedure similar to that which will be discussed. The activities outlined here are those followed in creating the lithographs described in this thesis.

First the stone is ground down to remove the top layer containing grease from the previous image and to give it the desired degree of smoothness (Figure 4). Unlike metal plates, a stone may be resurfaced easily and economically and hundreds of times before it can no longer be used. Grinding is done with powdered carborundum, running water, and a metal disc known as a levigator. Carborundum can be bought in several grain sizes, determined by the standard mesh through which it was strained. The first grinding is done with a coarse grain, usually #120, to rapidly remove both stone and grease. It can then be ground with #180 grain for
Figure 4. Grinding the Stone

Figure 5. Drawing the Image

Figure 6. Etching the Stone

Figure 7. Tracing and Registering
an average surface texture, or if a smoother one is desired, with #220 or #320. The final grinding of all stones used for the experimentation on multiple-stone prints was done with #180 grain carborundum. This was intended to save time and act as a control measure to aid in the comparison of prints.

The levigator is a steel disc about eight inches in diameter and weighing 23 1/2 pounds. It is moved rapidly by a rotating handle in a circular motion, counterclockwise. Care must be taken to keep the grinding even all over the stone so that the surface will be completely flat. A minimum of three to four grindings is necessary to properly clean and grain a stone. The edges must then be rounded—first with a rasp, then with a pumice stone—to prevent damage to the paper during printing and to guard against the formation of ink deposits as the ink is applied. Preparation of the stone for drawing requires from 15 minutes to half an hour, depending upon its condition and the texture desired. The stone must then be fanned dry or leaned securely in a dust-free place until it has thoroughly dried.

Figure 5 shows the creating of an image on the stone, which is the second step. This may be done by drawing on paper with a lithographic crayon and transferring it to the stone in the press, or it may be done directly on the stone. The first method is referred to as "transfer lithography", the second as "crayonstone lithography". After some experimentation, the crayonstone method was found to be more pleasing and more

6Arms, John Taylor, op. cit., p. 159.
applicable to the problems discussed herein. One multiple-stone lithograph done by the transfer method has been included and can be seen in Figure 19. Poor results were obtained because the registering, etching, and inking processes were much harder to control. Drawing is most easily done with commercially prepared lithographic crayons, pencils, and a liquid substance called tusche. The latter is applied with pen or brush and can more closely resemble painting than drawing (Figure 12). Crayons and pencils are available in several hardesses—number one soft, number five hard, etc. These media are composed of grease and wax and contain lampblack to enable the artist to visualize tonal qualities while drawing. An example of a crayon lithograph can be seen on page 6. Experiments were made with other greasy substances such as lipstick, bacon grease, Crisco, and Vasoline, but these were found to be less satisfactory than the commercially prepared drawing materials.

Etching the stone is the third step (Figure 6). This is done with nitric acid and gum arabic solution simply to prevent the areas not drawn upon from picking up ink. Etching does not eat away, but acts as a desensitizer, penetrating the surface and carrying the gum arabic deeper into the stone. This provides the adsorbed layer necessary for the repulsion of grease and absorption of water described earlier. The standard etch is composed of one ounce gum arabic in solution and 25 drops of nitric acid. The amount of acid used may vary depending upon the fineness of the drawing, the temperature of the room, and the stone itself. Most lithographers achieve the strength etch they desire by testing it on one
corner of the stone before applying it to the drawing. The etch is blotted with absorbent newsprint paper, dried, and allowed to stand at least six hours before printing begins.

Commercial lithographic ink, available both in black and in colors, can be obtained at lithographic supply stores. The black is somewhat stiffer than the colored inks and often requires thinning with lithographic varnish. Ground glass can be added to colored ink to stiffen it to the proper consistency for printing.

A smooth-surfaced paper, generally not clay coated, is best for printing lithographs. Any paper with a nap or coating tends to come off on the stone under pressure. An imprint is left on the stone by papers with an obvious weave, so they too should be avoided. Firmly woven cotton cloth such as percale was found to be a fair substitute for paper, but creates an entirely different effect because of its greater absorbency. Most authorities recommend dampening the paper before printing to soften the fibers, but dry paper was found to be satisfactory for some designs.

Printing is done on a large hand-press. First the etch is washed off with water, then the crayon image is removed with turpentine through a coat of freshly applied gum arabic solution. The stone must be allowed to dry, then washed again with water. A sponge is used to keep the stone damp at all times before a print is pulled. The surface of the stone is inked with a leather-covered roller; the paper, a blotter, and a heavy fibre-board or 'tympan' are placed on top. The stone is run through the press and the print is removed and pinned on a bulletin board to dry.
Figure 8. Rolling Ink Onto the Stone
Figure 9. Placing Paper for a Print

Figure 10. Operating the Press
Figure 11. Pulling the Print
Four steps of the printing procedure are pictured on page 14. The number of prints made of a particular image is called an edition, and may range from ten to fifty or more. Editions of multiple-stone lithographs done in conjunction with this paper were small. Demand for the use of the press, plus the extra expense and time involved, made larger editions impractical.

Lithographs of more than one color are printed by the same methods. A stone is drawn upon and etched for each color separately, then printed. Figure 1 is an original lithograph printed in two colors.
MULTIPLE-STONE PRINTS

Because of the complexity of organizing one visual concept on three or four separate surfaces, small drawings were executed as the first step in preparing a multiple-stone lithograph. The shape of the stones used was an important factor in creating many of the compositions, influencing the choice of large, blocky areas and geometric shapes. Drawing directly on the stones promoted a freeness of line and texture resulting from the medium itself. Final concepts of largeness were considered which advanced techniques similar in style to painting. Tusche was applied with large brushes in wide, free strokes on several compositions. In others crayon was used in much the same way; both techniques intended to exploit the size of the drawing surface and final image. Compositions IV and IX were drawn in finer detail, but with the same concepts of largeness and freedom.

Designs were created not only as an artistic experience but to experiment with the method being used as much as possible. Sections were arranged in a variety of formats to provide sufficient knowledge of how each could be registered and printed. Compositions were chosen in which the selections would overlap considerably or just touch. Some overlap was necessary in most cases to promote continuity, but it was held to a minimum to utilize as much of each stone's surface as possible. Various drawing techniques were employed, including crayon, pencil, tusche, scraping, and spattering. Color was used sparingly because of the added time and work involved in producing a many-colored print; if three stones
were needed to achieve the desired dimensions, three more would have to be used for the addition of one color to the entire design (Figure 15). In some prints, as in Composition VIII on page 32, the effect of several colors was achieved by using one stone for one color, one for another, a third for another, etc.

Register marks, usually used only for color prints, had to be made on all multiple-stone drawings to insure the exact relationship of one section to the next. By placing small marks (+) in diagonally opposite corners of the stone, it was possible to align perfectly several sections of the drawing in any direction (Figure 14). This was done after the stones had been etched and dried so that a large piece of clear plastic could be placed over the stones for planning. The design was traced onto the plastic from one stone including register marks, as pictured in Figure 7. The plastic was placed so that the design from the first stone correctly related to that of the second, and one register mark was traced onto it from the plastic. In this way two stones, or sections of the design, could be made to share one mark. After the complete design had been formed by tracing from all stones, the register marks were traced from the plastic onto printing paper, cut to the dimensions of the full composition. Holes were then cut in it to show the register marks during the printing procedure. A paper punch was used whenever possible, being much quicker than cutting the standard triangles with a razor blade. By this method as few as four holes could be used for a print composed from four stones (Figure 13).
Figure 13. Print Showing Register Marks

Figure 14. Stages of a Multiple-Stone Print
All parts of planning the design and preparing the paper had to be carefully studied, as the stone prints the reverse of the actual drawing. Printing on large sheets of paper posed a problem because the press bed could only facilitate sheets 28 inches wide when exactly centered. Long prints such as those in Figures 17 and 18 had to be printed so that the paper could hang over the end of the press bed. The paper had to be tightly rolled and fastened with paperclips while printing the lithograph in Figure 23. These large sheets of paper were carefully placed on the stone to prevent possible smudging. Cutting and bending the paper at the edges of the stone during printing also had to be prevented; this would distinguish one section of the design from the next and ruin the print. The pressure bar, that part of the machine which directly presses on the stone, had to be large enough to cover the entire image but smaller than the stone. Several sizes are available that can be inserted into the machine.

Matting the multiple-stone lithographs for viewing by the Examining Committee was done in the traditional manner. Heavy, pebble-grained mat-board was special-ordered by the Associated Students' Store of Montana State College. Sheets measuring 40 by 60 inches, not normally stocked, were required to mat several of the lithographs effectively.

The particular materials and procedures used in executing each of the multiple-stone lithographs for this thesis are outlined on the following pages.
Stones: three; numbers E 119, E 120, and E 124.

Technique: tusche and crayon drawing, re-etched through ink during printing.

Etch: 25 drops nitric acid to one ounce gum arabic solution; re-etch, approximately 75 drops nitric acid to one ounce gum arabic solution.

Ink: black; raw sienna tint and transparent white.

Material: four prints on cotton percale, six on damp Basingwerke paper, two on 80 pound Printflex paper, one on glazed cotton, and three on damp white wrapping paper.


Dimensions: 15 by 34 inches.

Printing procedure: seven printings; three sections printed in black, three sections printed in raw sienna, and one overlap printed in black.
Stones: three; numbers E 119, E 120, and E 124.

Technique: tusche and crayon drawing, spattered tusche.

Etch: 25 drops nitric acid to one ounce gum arabic solution.

Ink: brown mixed from chrome yellow, rose red, and cobalt blue; red mixed from vermillion red, rose red, zinc white, and transparent white.

Material: six prints on damp 36 pound white ledger paper, four on 60 pound Printflex, four on 80 pound Printflex, and two on damp white wrapping paper.


Dimensions: 14 3/4 by 32 inches.

Printing procedure: four printings; three sections printed in brown, one diagonal overlap printed in red.
Figure 15. Composition I

Figure 16. Composition II
Stones: four; numbers E 106, E 119, E 120, and E 124.

Technique: tusche and crayon drawing.

Etch: 30 drops nitric acid to one ounce gum arabic solution.

Ink: black with viridian green and transparent white added.

Material: three prints on damp Basingwerke paper, 12 on 80 pound Printflex.

Edition: 15 prints.

Dimensions: 16¾ by 37½ inches.

Printing procedure: four printings; four sections printed in black-green.
Stones: three; numbers E 124, E 119, and E 120.

Technique: crayon and pencil line drawing.

Etch: 15 drops nitric acid to one ounce gum arabic solution.

Ink: green mixed from viridian green, chrome yellow, and zinc white;
    yellow mixed from chrome yellow and transparent white, chrome
    yellow and vermilion red, and chrome yellow and viridian green.

Material: five prints on 32 pound white ledger, five on 80 pound
          Printflex.

Edition: 10 prints.

Dimensions: 16 by 37 inches.

Printing procedure: six printings; three sections printed in green, one
    section in yellow, one in yellow-orange, and one in yellow-green.
Figure 17. Composition III

Figure 18. Composition IV
Stones: three; numbers E 119, E 120, and E 124.

Technique: textural crayon drawing on paper, transferred to stone.

Etch: 25 drops nitric acid to one ounce gum arabic solution applied over ink.

Ink: black.

Material: three prints on damp white wrapping paper, three on 80 pound Printflex, and two on damp Basingwerke.

Edition: eight prints.

Dimensions: 15½ by 34½ inches.

Printing procedure: three printings; three sections printed in black.

Because of problems arising from the design, etch, and registering, this print was unsuccessful.
Figure 20

Stones: three; numbers E 124, E 120, and E 106.

Technique: crayon, pencil, and tusche; spattered tusche; scraping.

Etch: 30 drops nitric acid to one ounce gum arabic solution.

Ink: black.

Material: Japanese Aazen paper.


Dimensions: 15 by 48 inches.

Printing procedure: three printings; three sections printed in black.
Figure 19. Composition V

Figure 20. Composition VI
COMPOSITION VII

Figure 21

Stones: three; numbers E 124, E 120, and E 106.

Technique: tusche painting.

Etch: 30 drops nitric acid to one ounce gum arabic solution.

Ink: blue mixed from cobalt blue, zinc white, transparent white, and black; green mixed from viridian green, chrome yellow, zinc white, and transparent white; brown mixed from vermilion red, rose red, cobalt blue, and transparent white.

Material: damp black construction paper.

Edition: eight prints.

Dimensions: 18 1/2 by 28 inches.

Printing procedure: four printings; one section printed in blue, two sections in green, and one overlap in brown.
Stones: three; numbers E 124, E 120, and E 106.

Technique: crayon, pencil, and tusche drawing.

Etch: 25 drops nitric acid to one ounce gum arabic solution.

Ink: raw sienna tint and transparent white; green mixed from viridian green, zinc white, and chrome yellow; purple mixed from rose red, vermillion red, cobalt blue, and zinc white; red mixed from vermillion red, rose red, and raw sienna tint.

Material: buff detail paper.


Dimensions: 27 1/2 by 20 1/2 inches.

Printing procedure: six printings; two sections printed in different mixtures of raw sienna and transparent white, one section in green, one section in purple, one section in red, and one section in green with red added.
Figure 21. Composition VII

Figure 22. Composition VIII
Stones: two; numbers E 120 and E 124.

Technique: pencil line drawing.

Etch: 10 drops nitric acid to one ounce gum arabic solution; re-etched over ink with 20 drops nitric acid to one ounce gum arabic solution.

Ink: black.

Material: Basingwerke paper.

Edition: 10 prints.

Dimensions: 32½ by 24 inches.

Printing procedure: four printings; four sections printed in black.
Stones: three; numbers E 120, E 124, and E 106.

Technique: crayon and pencil drawing; large tusche shapes.

Etch: 35 drops nitric acid to one ounce gum arabic solution on tusche;
     20 drops nitric acid to one ounce gum arabic solution on crayon.

Ink: tan mixed from black, cobalt blue, raw sienna tint, vermilion red,
     rose red, and zinc white; blue mixed from cobalt blue, tan mixture,
     and zinc white; brown mixed from black, cobalt blue, vermilion red,
     and rose red.

Material: 20 pound bond paper.

Edition: 12 prints.

Dimensions: 25½ by 27½ inches.

Printing procedure: three printings; one section printed in blue, one section in tan, and one section in brown.
Figure 23. Composition IX

Figure 24. Composition X
LITERATURE CONSULTED


Arnold, Grant, Creative Lithography and How to Do It, Harper and Brothers Publishers, New York, 1941.


