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A handbook of intaglio techniques

David Dickinson

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A Handbook of Intaglio Techniques
by
David C. Dickinson

Candidate for the Master of Fine Arts
in the College of Fine and Applied Arts
of the Rochester Institute of Technology.
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Advisor: Lawrence M. Williams
DEDICATION

To Joanne, without whom this study would not have been completed.
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INTRODUCTION

The intaglio process is one in which the ink-carrying areas are below the surface of a metal plate, usually copper or zinc. The most common methods of incising the furrows and indentations are engraving, dry-point, aquatint and etching; the latter being the most popular.

Intaglio is distinguished from the other printing techniques by the method of printing; for when the plate has been intagliated by one or more of the processes described above, the plate is dabbed all over with printing ink, which is then rubbed off again with muslin, leaving the ink only in the furrows and indentations. A piece of paper is then dampened and placed on the plate and both are rolled through a press, not unlike a mangle. The damp paper is forced into the intaglio and picks up the ink. In the print the image will be reversed and the intaglio will stand up in relief.

This, very simply is the way an intaglio print is made and upon which is based the many variations which will be dealt with later in some detail.

It is the intention of this thesis to explain these techniques and some of the many variations in as clear and as precise a manner as possible, hopefully
avoiding some of the pitfalls that arise from these varied processes, in other words to write a readable text on the intaglio process.

The prints produced for the visual part of the thesis are illustrated in the appendix, plates IX through XIV. In these prints I have in fact used many of the techniques described in this written text, particularly the use of a photographic process, which is used to a limited extent in all six prints. The photographic process, at the point of starting the thesis was not too familiar to me. It was therefore my intention to familiarize myself to some degree with this technique, a technique which I believe to be useful and worth knowing. Producing a thesis presented as good an opportunity as any to learn and familiarize myself with this technique. Other techniques which are described in the thesis are also evident in the thesis prints and these techniques are noted on a page preceding each plate.

I am indebted to the many printmakers with whom I have had the good fortune to work during the past fifteen years, both here at R. I. T. and elsewhere.
CHAPTER I

THE STUDIO OR WORKSHOP REQUIREMENTS

General Outline

The room should be as large as possible with a concrete floor in order to hold the weight of a large press, which may weigh as much as 2,000 pounds or more. However if a wooden floor is all that is available, the press can be erected across heavy wooden planks in order to distribute the weight more evenly.

It is a very necessary precaution to have the room well ventilated, as some of the materials used in printmaking release harmful fumes.

The studio should of course be well lit and have plenty of power points. A 220 volt outlet may be needed for the hot plate or an electrically driven press.

Sinks are an essential part of the shop. They should be large enough to take a full size sheet of metal (24"x36") or at least up to the size limit that one intends to work. The plumbing should preferably be of plastic, however, if not, plenty of water flushed down after the acid will prevent damage.
Equipment.— An area for cleaning plates will be needed. A metal or wooden box, big enough to take the largest plates is filled with sawdust which soaks up the solvent used to clean the plate. The sawdust will need to be changed when it is saturated with solvent and ink.

There are four basic solvents used in intaglio: Kerosene or mineral spirits are used for cleaning up the ink and removing hard and soft grounds from the plate, lacquer thinner or alcohol is used to remove aquatints or photo resist, benzine is used to thin liquid ground and to clean the plate and ammonia is used for cleaning and removing grease from the plate.

The work benches should be of a sturdy construction. One will be needed for the acid baths, it must be covered with an acid resistant surface. An asbestos sheet will be needed for the hot plate inking bench, a working table, a clean surface for examining prints, and another for color printing. Store acid, metal, paper, et al under the benches.

The aquatint box (Plates I and II) is designed to create a disturbance of air inside the box and thereby distribute an even coating of fine resin powder onto the plate. The air is moved by either a hand driven fan or by air forced into the box from a compressor, bellows or an old vacuum cleaner. Situate the box in a corner away from any drafts.
A tray will be needed for soaking the paper. It must be big enough to take the largest sheet of paper that will be used. A draining tap facilitates changing the water, which must be done whenever the water becomes dirty and loaded with sizing from the paper. Next to the bath there must be a clean surface for blotting the wet paper. A heavy rubber mat or a sheet of stainless steel is a useful item for storing damp paper under, when an edition is being printed. These paper areas should be as far away as possible from the inking and cleaning areas.

The hotplate has a flat surface and the bigger the better for inking large plates. They are made in sizes up to 30x36 inches. The larger hotplates operate on 240 volts, use up to 4,000 watts, have a heat spread from zero to 550 degrees fahrenheit and weigh 100 or more pounds.

A hotplate can be easily made by welding a one-half inch thick steel plate to four or more metal legs, depending on the size of the plate. The legs should not be more than twelve inches apart. Their length will depend on the height of the heating device to be placed under the hotplate. For gas there should be three inches clearance between the source of the flame and the steel plate. And there should be as close a contact as possible with an electrical element.

Next to the hot plate there is a palette for mixing the printing ink and a flat surface for wiping the plate.
The palette can be an old litho stone or a sheet of plate glass, say one foot square or larger. Additional palettes will be needed for color inks.

Two or more large palettes for viscosity and color rolling (color etching and printing). These palettes should be set up on a separate bench or table with an area adjacent to them for placing the plate. The palettes must be at least one-half inch plate glass, perfectly flat and large enough to cover the circumference of the largest rollers to be used. The rollers are made of rubber, plastic or gelatin; plastic being the most durable. They should be as large as possible, as the size of the plate will be limited by the width and circumference of the rollers. The usual lithographic plastic rollers are a firm thirty durometers and are quite adequate for surface rolling. However two rollers are needed for viscosity rolling, one extra hard (fifty durometers) and one soft (fifteen durometers). The English equivalent is hard sixty shore and soft twenty shore. An assortment of smaller rollers is useful for applying color to small areas of the plate.

In addition to the above, two leather brayers will be needed for applying the hard and soft ground. They should be approximately four inches long by two and one-half inches in diameter.

Trash cans should be accessible, made of metal and
emptied daily. If they contain rags and paper soaked in solvent, spontaneous combustion can result if they are left for long periods of time.

A fire extinguisher should be at hand (the nozzle type) and safe to use on electrical appliances: CO2 for example. A first aid box is also standard equipment with preparations for treating burns and neutralizing acid in addition to caring for minor cuts.

The Press - This is the most important and also the most expensive item in the print shop. Consideration should therefore be given to the choice of a press.

The dimensions of the press bed (up to thirty-six by sixty inches) will determine the size of the print. A bed of sufficient size to print the largest plates likely to be used should, in addition to the plate size, include at least two inches extra across the width for a paper margin around the print. It should be one foot extra in length to allow for the width of the press rollers. The bed, usually made of solid steel, should be of sufficient thickness to prevent it warping. For a bed twenty inches wide, the thickness should be one-half inch, at thirty inches wide, one inch thick and one and one-eighth inches thick for a thirty-six inch bed. Safety stops should be fixed under each end of the bed to prevent the bed being thrown out. The press should be geared if the bed is over
twenty inches wide with a gear ratio of eight to one or better.

There are two heavy steel rollers, one above and one below the press bed. The thicker the diameter the more even the pressure. Generally a twenty inch bed will have four inch diameter rollers and double on the larger presses. On the older presses the rollers were made of cast iron and the press frame was also cast in iron. In Great Britain presses are still being cast from copies of the original molds. They are tremendously heavy, weighing over 3,000 pounds for the larger presses. By comparison the new steel framed American presses are light; 1,500 pounds or less. Available on many of these new presses is a set of calibrated adjustment gauges, which allows the return to any given pressure setting without running test prints. On some of the new presses type-high relief blocks may also be printed. And lithographic stones can be printed on the Dickerson combination press in addition to wood and intaglio plates. An extremely light press at 415 pounds, the Dickerson is motorized and will fold for storage, or it can be dismantled for easy transportation. The bed size is twenty-seven by forty-eight by three-quarter inches and made of extremely hard chipboard.

The Blankets.—Three is the usual number of blankets,
however, up to five blankets can be used for making embossing from deeply bitten plates. The blankets should be the same width as the press bed, so as not to put undue strain on the center of the rollers. Their length can vary, however they must be long enough to completely cover the paper used, plus an extra twelve inches to go under the rollers.

The first blanket is the thin sizing catcher (one-sixteenth inch) made of lambswool. It takes most of the wear as it goes on top of the dampened paper. Over a period of printing, it becomes saturated with sizing from the paper, and will then need to be washed and stretched. It is a good idea to have two of these blankets on hand so that one is always clean and dry.

The second is the thick cushion blanket (one-quarter inch) made of pressed felt. It is very soft and cushiony giving a uniform pressure over the print area, pushing the damp paper into the intaglio of the plate. An extra cushion blanket may be needed for deeply bitten plates.

The final blanket is a hand woven blanket (one-eighth inch thick). It goes against the upper roller and absorbs the wear and tear. All these blankets are sold by the yard and come in widths up to thirty-six inches wide.

Metal Plates

The two basic metals in common use are copper and
zinc, however, soft steel, copper alloys, aluminum, etc. can be used with varying results. The plates should generally be eighteen or sixteen gauge (i.e. one-eighth or one-sixteenth of an inch thick). Engravers' copper, zinc and magnesium are sold in sheets up to twenty-four by thirty-six inches. Full sheets are the most economical way of buying metal, and then cutting the plate to one's own size on a metal cutting guillotine or even with a pair of metal snips. However if no means of cutting the metal is available, the plates can be purchased by the square inch. There is of course a cutting charge. They have a polished surface and the backs are pre-coated with an acid resist. They are the most expedient plates to use as other types of plates may need to be polished (charcoal and metal polish) and the backs painted out with an acid resist.

**Copper.**-- It is an attractive metal of a gorgeous color, comparatively hard and tough. It is ideally suited for all use in the intaglio processes. It is the best metal for engraving, dry-point and mezzotint. Depending on the work, copper will stand an edition of 100 or more printings. The plate surface wipes down quickly and cleanly during inking, and for color printing there is little adverse reaction between the copper and the ink, a point worth remembering if the plate is to be editioned in yellow or some other light color.
Zinc.— This is a much softer metal than copper and about a quarter the price. It etches faster than copper and gives a thicker, more ragged line. It engraves easily. However a dry-point burr is soon flattened out after a few printings and so are light aquatints.

The softness of zinc prevents editions being printed much past fifty, unless the plate is steel faced. This is done after the plate has been drawn and a finished proof pulled. The facing is done commercially by an electrochemical process in two steps. The zinc is first coated with a thin film of copper and then steel or nickel plated. As a result of this double process some delicate details in the plate are lost.

The printing ink tends to stick to the surface of zinc. As a result it is much harder to wipe. Colored inks other than the earth colors have a chemical reaction with the plate. Zinc oxide released from the plate mixes with the ink and makes for example yellow turn slightly green or a white to have a gray tint to it.

Soft Steel.— This is a hard metal capable of printing 500 or more prints without losing any detail. It has a surface texture that holds a thin film of ink not unlike a fine aquatint. This tone makes steel unsuitable for sharp clean-cut work. However, if only small areas of pure white are required, the ink can be wiped out with a
rag before printing. The natural aquatint quality of steel makes possible rich tonal areas without laying an aquatint ground. The plate is just straight bitten. A difficult metal to engrave, steel is however a fine metal for dry-point.

Colored inks are not affected at all by steel. It is therefore a good metal to use for color printing. As steel rusts easily, it must be protected with a thin film of oil or grease.

A Brief Outline of Some Other Metals

Magnesium—This is a very light and brittle metal. It is used extensively in the commercial printing industry. Its brittleness prevents dry-point being used as the burr breaks away. Its lightness makes it difficult to work on and print. It etches rapidly and seems to have no adverse effect on the acid when used in the same bath as zinc. There seems to be no adverse effect on colored inks and magnesium should be capable of printing a large edition.

Aluminum—This is a very light and soft metal, easy to engrave and dry-point, but as it is so soft its image will soon be lost. With care twenty prints can be taken. It is a good metal for color printing.

Brass—Although it costs more than zinc, it is still much cheaper than copper and yet has many of the same qualities as copper. There are no bad effects on
colored ink and should be capable of printing a large edition.

All plates should be kept under a thin film of oil when not in use so as to protect them from the corrosive atmosphere that exists in the print shop.

**Acids**

The acids used for etching can be very dangerous and should therefore be handled with great care especially when mixing. Neat acid will damage the skin very rapidly. The fumes are also just as corrosive, the acid should therefore be used in separate room or as near to the ventilation system as possible. It is of the utmost importance to remember that the acid is always added to cold water.

Acid acidently splashed on the skin or clothing should be washed off immediately with plenty of cold running water. An excessive inhalation of acid fumes results in depression, nose bleeding, a feeling of sickness and giddiness, and can result in fainting, by drinking a glass of bicarbonate of soda mixed with cold water, the acid is neutralized and the stomach settled. Deep inhalations of fresh air will clear the lungs and giddiness. Acid splashed in the eyes must be washed out immediately with cold water.

Secure all loose fitting clothing so that it cannot accidently be dipped into the acid.
The acid baths.—Photographic trays although not completely acid resistant will, with care, last a number of years. The bath should be big enough to take the largest plate likely to be used. A quick cheap way to make an acid bath is to make a wooden frame out of four by one inch pine with a sheet of masonite for the base. The inside is then lined with a heavy plastic sheeting. A double layer can be used as a safety precaution. For a permanent bath the wooden frame is coated on the inside with fiber glass and resin. A draining tap at the base of the bath will facilitate the emptying and storing of the acid when it is not in use.

Nitric acid.—The most common acid used in the intaglio processes is a good all around etchant for most common metals. It is the acid used for zinc and oftentimes copper owing to its expediency. With a fast boiling action, nitric bites outwards as well as downwards. This outward action known as underbiting causes the line to widen giving it a somewhat ragged quality. Closely drawn lines tend to fuse into one, as the acid resist between them is eaten away. A fine aquatint ground left in this acid too long will break away entirely owing to underbiting. The gas bubbles(hydrogen) that appear over the etching areas of the plate, prevent the acid biting evenly, resulting in
an uneven bite known as grevé. This effect can be eliminated by using a feather to brush away the bubbles as they form.

**Dutch Mordant.** - (hydrochloric acid plus potassium chlorate) Although much slower than nitric this acid when used on copper bites a clean sharp line with little or no underbiting and no gas bubbles are formed. The potassium oxidizes the copper and the hydrochloric strips away the oxide as it is formed on the plate. This acid normally reserved for copper can also be used on other metals. On zinc it gives a somewhat finer bite than nitric but is considerably slower. There are also gas bubbles formed which should be brushed away for an even bite.

**Ferric chloride.** - This is an extremely slow but an accurate biting acid for fine delicate work on most metals. There are no gas bubbles formed, however, a precipitant is formed in the etching areas, preventing the continued attack by the acid. This sediment must be removed, either by agitating the bath every few minutes or by turning the plate face down, supporting the corners on feet made of ball ground or any acid resistant substance. The precipitant will then fall clear of the plate and the continued action of the acid will be assured.

**Mixing the Acid**

There is no hard and fast rule as to the strength of
the acid. It is a matter of personal choice whether a strong expedient acid is used at some sacrifice to delicate detail or whether a slow weak acid is used to maintain that delicacy. The following mixtures are intended to serve only as a guide. Add the acid to cold water and agitate for a few minutes before using.

**Nitric acid for zinc.**—A medium strength mixture of ten parts water to one part nitric acid (reagent strength i.e. 70% acid) for fine aquatints, texture transfer, fine drawn lines and photoengraving.

A strong mixture of six parts water to one part nitric acid for line work, coarse aquatints, and open bite.

For copper, brass and soft stell, mix four parts of water to one part of nitric acid.

**Dutch mordant.**—Potassium chlorate crystals are dissolved in warm water. Before adding the hydrochloric acid (reagent strength, i.e. 70% acid) let the water cool. On adding the hydrochloric acid the mixture will turn slightly yellow.

For copper and brass, mix three parts of potassium chlorate to eighty-two parts of water and add fifteen parts of hydrochloric acid.

For soft steel mix: four parts of potassium chlorate to seventy-six parts of water and add twenty parts of hydrochloric acid.
Ferric chloride. - Photoengraver's strength is sold ready mixed at forty-two degrees baume and is at working strength for all metals except aluminum.

By adding twelve ounces of hydrochloric acid to one gallon of ferric chloride, aluminum and stainless steel can be etched. Aluminum will also etch in a solution of one part hydrochloric acid added to four parts of water.¹

Nickel can be etched in ferric chloride or more expediently in a solution of one part nitric acid plus one part hydrochloric acid to three parts water.²

Note: Solutions containing high concentrations of hydrochloric or nitric acid break down the ground when used for deep biting. And large areas of metal exposed to the action of the acid evolve considerable heat.

Different metals must never be used in the same acid bath as dissimilar metal ions in the acid causes poor etching.

The strength of the acid will vary from day to day. It is affected by such things as the temperature of the room, the heat produced by the action of the acid itself (warm acid has a faster action, however it soon loses its strength).

If the acid is left exposed to the air for long periods of time, the water evaporates making the solution stronger. The only sure way of knowing the strength is to make a test strip prior to biting the plate.

²Ibid., p. 17.
Paper

Paper is such a commonplace item, too easily taken for granted. However paper in printmaking should not be taken for granted; for the quality of the print depends upon the specific texture and quality of the paper used.

According to history a Chinese man, T'ai Lun, invented paper in 105 A.D. The invention was the result of looking for a way to use the scraps woven cloth, then used for writing. So T's'ai Lun, beat the scraps into a mass of individual fibers, mixed the mass with water, and poured it onto a screen. When the water drained, there was a matted sheet of fibers - or paper. Today hand-made papers are still made in much the same manner. ¹

A skilled craftsman measures a given amount of pulped rag fibers into the paper mold. Then with a to and fro motion he shakes the mold and forms a sheet of paper. The mold itself is made of a fine wire mesh stretched over a wooden frame. The water mark is made by attaching a wire insignia with the maker's name to the inside of the wire mesh. The resulting relief makes the paper correspondingly thinner and hence the translucent water mark. As the paper is made each sheet is stacked between felt, and then latter the whole pile is placed in a large press. This way the excess water is removed and the pulp made into a sheet of paper. ²

²Ibid., p. 8.
At this point the paper is like blotting paper and is referred to as waterleaf or copperplate. In order to make the paper surface harder it is dipped into a vat of warm gelatin, a process known as sizing. After sizing, the paper dries slowly in a drying loft.¹ In addition to the hand-made papers, mold made papers are almost as good, but much cheaper. Made in much the same manner as hand-made paper, the main exception being that the molds are not shaken by hand.

The surface texture of the paper comes under three main categories:

H.P. (*not pressed*) and C.P. (*cold pressed*).-- Both papers have a smooth finish, made by pressing the damp paper between polished sheets of metal, either heated for H.P. or cold for C.P. Both surfaces are excellent for printing fine detail, rich blacks and for color that has been rolled onto the surface of the plate.

*Not.*-- The *not* means that the paper has not been pressed. The slightly rough surface of this paper prevents rich blacks and fine detail printing it's best. The print will often have a dry look to it. Note that English not papers are often listed as rough in the United States.

*Rough.*-- This is *not* a suitable printing paper and should be avoided. Note that this paper is listed as extra rough in the United States.

¹Ibid., p.7.
The paper should normally be sized for most printing jobs. However, for deeply bitten plates and for rich velvet blacks use H.P. waterleaf or copperplate paper.

The weight of English paper is determined by the weight of a ream (500 sheets of paper). For a paper size twenty-two by thirty inches the weight should not be less than ninety pounds. A good average is 140 pounds. Extra heavy papers of 200 or 300 pounds are used to hold a heavy embossing from a deeply bitten plate.

The Continental system of weighing paper is by grams per square meter of paper. For example a sheet of paper twenty-two by thirty inches at 250 grams has the approximate weight of a 140 pound English paper of the same size.

The most common named paper sizes are: Royal, twenty-four by nineteen inches, Imperial, thirty by twenty-two inches, Double Elephant, forty by twenty-seven inches and Antiquarian, fifty-three by thirty-one inches.

The paper should always be handled with clean hands. It should be stored flat, out of the light and the humidity should not exceed seventy per cent. The same is true for storing prints.¹

A Short list of some Good Printing Papers

Arches cover stock. — French, mould made, 100% rag with a smooth finish in white. Available in three sizes: twenty-two by thirty inches, 250 grams in weight, this size

¹Ibid., p. 16.
also comes in a buff color. Twenty-nine by forty-one inches is 250 grams and thirty by forty-one inches is 300 grams in weight.

**Crisbrook.** - English, hand-made, 100% rag with an H.P. or Not finish in brilliant white. Available in one size only: twenty-two by thirty inches, 140 pounds in weight. It is also available as a waterleaf paper.

**J.Green.** - English, mould made, 100% rag with an H.P. or Not finish in white. Available in three sizes: twenty by twenty-five inches, 68 and 106 pounds in weight, twenty-two by thirty-one inches, 90, 140 and 300 pounds in weight and forty by twenty-seven inches is 133 and 246 pounds in weight. All sizes are available as a waterleaf paper.

**Rives B.F.K.** - French, mould made, 100% rag with a semi-smooth finish in white. Available in two sizes: twenty-two by thirty inches, 240 grams in weight and at 250 grams as a waterleaf paper. Sold also in rolls of 42 inches by 260 yards at 260 grams in weight.

**Importing**

For importing any equipment or materials for printmaking into the United States, write to: Bureau of Customs, Washington, D.C. 20226. They will send pamphlets, and all necessary forms.
CHAPTER II

ETCHING TECHNIQUES

The first dated etching is of 1513, but the great period of etching came with the Seventeenth Century, reaching its peak with Rembrandt. The process has been popular ever since.¹

The plate is first covered with a coating of acid resisting ground, then drawn into with a needle, exposing the metal wherever a line is wanted. The plate is then put into an acid bath. The acid eats away the exposed metal, establishing a line into the plate surface. Subtlety is given by varying the time the exposed lines are in the acid. The lightest lines are stopped out with acid resist after a few minutes. The plate is re-exposed to the acid until the medium-dark lines are stopped-out in their turn and so on.

Preparing the Plate

The Bevel.--- When the plate has been cut to the desired size, a forty-five degree bevel is made along the edge of the plate. This protects the blankets from being cut during printing and also makes for an easier and cleaner wiping, as rough edges hold the ink. Hold the

plate firmly on the edge of the work bench facing up and draw a medium file along the edges of the plate at an angle away from the body, and pointing inwards at an angle of forty-five degrees curve off the edges. Repeat the same process with a smooth file. Brush off the filings from the plate surface, as they will leave scratches if rubbed into the plate.

The bevel is completed by smoothing out the tooth marks made by the files, first with the scraper and then the burnisher with the help of a little oil. The slight burr where the bevel meets the surface of the plate must be burnished out or the print will have a slight tone around the edges. If preferred the bevel may be put on the plate after it has been in the acid. It must however be beveled before a print is taken.

Cleaning.— Before any etching ground is applied to the plate, it must be clean and free of grease. Any grease left on the plate tends to undermine the ground and allows the acid to break through, an effect known as foul biting. Frech chalk and ammonia rubbed vigorously together over the surface of the plate for a few minutes strips away the grease and cleans the plate. Wash off with plenty of water. It will be noticed at this point that the water on the surface of the plate remains as an even film. This
is the proof of a grease free plate. Dry off the water quickly with blotting paper or a compressed air hose, as minerals in the water will if left on the plate slightly etch it. Liquid detergent or benzine will also clean the plate.

**Hard Ground**

**Liquid hard ground.**—This is the most expedient ground to apply. It can be brushed on with a large soft brush. The larger and softer the brush, the more even the coating. The brush should be well loaded with ground before applying. Brush on freely and quickly. The plate when grounded should have a dark golden brown color to it. If it is too thick it will look black and very dense; or if it is too thin the color of the metal will be visible. A more even coating can be achieved by flooding the plate with ground and then standing the plate on edge to drain off the surplus. Once the ground has dried the plate is ready to work on. The liquid ground will need to be thinned if it becomes too thick to brush on evenly. There are manufactured preparations made especially for this purpose such as Dixon Etching resist thinner. However the resist may also be thinned with benzine which in addition to thinning also speeds up the drying time of the resist.
Ball ground. -- The plate is first heated on the hotplate which should be at a medium heat of 250 degrees. Place the ball ground on the plate. Let it melt a little and then smear an even band across the plate. Then with a leather brayer (four inches by two and one-half inches diameter) roll out the ground evenly over the surface of the plate. If the plate is too large to be heated all at once, apply the ground on one section at a time. Use little or no pressure and roll quickly allowing the roller to rise as it clears the edge of the plate. Rotate the plate and roll in several directions until the plate is a dark golden brown and slightly transparent. If it is very transparent, it is too thin and will need more ground melted on the plate and rolled out. If the ground appears black and very tacky with a fur-like quality to it, then too much ground is on the plate. To remedy this, heat an old plate for a few minutes. Then roll some of the ground from the roller onto this plate. If it is not too hot it will take a lot of ground from the roller. Re-roll the original plate and repeat as necessary. There is often a heavier build up of ground on one edge or in a corner of the plate. This is corrected by letting the roller cool and then applying it very quickly from the heavily grounded area onto the less grounded area. Repeat until rectified. When the plate has cooled it is ready to draw on.
Smoking the plate.— A better drawing surface is possible by then smoking the plate to give it a black surface. The plate is clamped by one of its corners into a hand vise. Three or more wax tapers are twisted together and lit. The plate is held by the hand vise just above eye level, so that the grounded side is facing down and can be seen. Then with a circular movement, pass the lighted tapers slowly from one corner to the other until the plate has an even coat of carbon on it. Care should be taken not to let the tapers touch the plate or the flame to remain stationary in one area, as this will blister the ground. The corner that has been held by the vise will need to be painted out with liquid ground.

Large plates are too heavy for the hand vise. The plate bends unless the other corner is also supported on something. The edge of a table will do if one kneels on the floor. However a more convenient answer is to construct a holding device that will take a plate up to twenty-four inches wide. This can be done by attaching a twenty-four inch strip of metal to a wall. It should protrude no more than one-quarter of an inch and be about six feet above the floor. Thirty inches above the strip hinge a thirty-six inch length of four by one inch wood and attach a one-quarter inch metal lip across the inside bottom edge. It is between the lip on the wall and the one on the hinged arm that the plate rests face down. Once the plate has
cooled it is ready to draw into.

If the back of the plate is not pre-coated with acid resist, it will need to be painted out with liquid ground or spray enamel. The latter has the advantage in that it will not dissolve readily. Covering the back prevents the acid from biting through the plate.

The edges of the plate must also be stopped out with an acid resist. Masking tape can be used for this. The tape is first burnished down along the bevel, or if there is no bevel yet, about one-eighth of an inch in from the edge of the plate. The tape is then folded down around the edges and under the back. This method insures that there is no under-biting along the edges of the plate.

Transferring a drawing onto the plate.— Make a tracing in soft pencil. Reverse it and trace onto the plate with a hard pencil. Remember the printed image is the reverse of the plate. Red carbon paper placed between the tracing and the plate will leave a clear image. So also will white chalk if the back of the tracing is covered with chalk. Do not press too hard with the pencil or the ground will lift. If the tracing and plate are passed through the press together. The soft lead is transferred onto the plate in reverse. One blanket should be removed as too great a pressure will damage the ground.

Drawing into the hard ground.— Any implement that will remove the ground can be used as a tool in drawing up the plate. A collection of tools in addition to the etching

\[1\text{Infra, p. 40}\]
needle and the scraper might include such items as files, screwdrivers, roulette wheels, sandpaper, steel wool and even sharp stones.

Only the ground should be removed, exposing the metal but not scratching it. At this stage a mistake in the drawing is easily remedied by covering the offending line with liquid hard ground. Drawing is resumed once the ground has dried.

Line etching.—As mentioned, the ground is drawn through with a variety of tools, each tool having its own quality. The choice is up to the individual. However there are points to remember common to all drawing techniques. The tonal qualities of the print will be determined by the depth, width and distance between the lines on the plate. Because of the variation in the acid there is no point in giving time limits and the various depths obtained for any given time. At best one can safely estimate that five minutes would give a light gray and one hour a black. These times apply to zinc, so for copper double the time at least. Broad lines must be bitten deeper than fine ones, as the ink will wipe out of the center of the line during printing producing a double line with a gray tone between. However if the lines are much broader than about one-eighth of an inch, no amount of deep biting will make the line solid. Instead the line itself must be given a tooth that will hold the ink, whether by laying an aquatint
ground into the lines after they have been bitten, or by filling the bitten line with liquid hard ground and then drawing lines close together within the line.

The simplest answer to drawing broad or large solid areas is not to remove the ground completely, but rather to have a series of lines drawn closely together, leaving some small islands of ground, around which the ink will hold.

_Tonal biting._ — When the plate has been completely drawn, including the grays, bite for the lightest tones first. Then remove from the acid, rinse with water, dry thoroughly with compressed air or blotting paper and stop out the light tones with acid resist. Once the resist has dried, the plate is returned to the acid and the middle tones are bitten. Repeat the above until only the blacks are left. An alternate way of tonal biting is to draw only the darkest areas, biting these areas first. Then add the successively lighter areas until the very lightest tones have been added and bitten.

A rough test for the etched line depth is to insert the etching needle into it. If the point just catches when pulled against the edges of the line, it will indicate a light tone. If the needle catches firmly, a black line is indicated.

It happens sometimes that the ground has not been completely removed from some of the lines. After the plate
has been in the acid for a few minutes, it will be seen that there are no bubbles forming over those lines. With copper in the Dutch bath, the lines will remain bright if no action is taking place. While the plate is still in the acid, pour a little neat acid over the offending area. This has the action of breaking through the thin residue of ground that is in the lines. Once the lines are seen to be biting, agitate the bath, thereby distributing the added acid. Never leave the plate in nitric acid for long periods of time without checking. If the ground is seen to be breaking down (it will bubble faster in those areas), remove the plate and stop out the offending area. If necessary it can be drawn into again.

Once the plate has been bitten to the desired depth, remove from the bath, wash and dry it. Remove the ground with mineral spirits, drying the plate in the sawdust box or with a clean rag. The plate is now ready to proof.

Drawing with solvent. In addition to scratching through the ground, it can also be drawn through with rags or brushes dipped in mineral spirit. After the solvent has settled for a few seconds, remove with a clean rag. Smears of resist will be left. These will break down in the acid and when printed will look not unlike scratch marks.

Marbling. Use a tray filled with water, into which is poured a small amount of liquid ground. Stir the mixture and let stand for a few minutes. The oily ground will float on the surface. Lower the cleaned plate face down onto the
oily film so that it picks up only the ground. Dry, stop out the areas not needed, and bite.

Crazy paving. — Liquid ground is applied to the plate and when dry is heated. Then quickly dump the plate into a bath of cold water. The sudden change of temperature will make the ground crack.

Open bite. — The liquid ground is used for drawing. It is brushed on leaving areas of the plate exposed to the action of the acid. As the areas have no teeth to hold the ink, they will print a light gray with a dark line surrounding the area where the ink catches. If the process is repeated several times within the area, each level getting a little deeper, a gray tone is produced with soft lines in it, where the ink catches at the edges of each level.

If large open areas have been exposed, the affect is that of an open bite. If these areas are intended to print as a black, then an aquatint ground will have to be applied before the plate is put in the acid.

Any unwanted areas that the solvent has spread into should be corrected by stopping out with acid resist before biting the plate.

Sand grain. — Place the grounded plate on the press bed face up. Then with a sheet of sand paper placed over the top, roll through the press. Repeat several times, shifting the sand paper each time until the plate has been pitted to
the desired density. The parts not to be bitten are stopped out.

Salt grain.— The rolled hard ground is warmed on the hot plate so that the ground is in a fluid state. Common salt is sprinkled over the ground. When the plate has cooled, stop out unwanted areas. When the plate is immersed in the acid the salt will dissolve, exposing the plate. The effect is much the same as sand grain.

Ruled lines.— A ruler placed directly on the ground will scratch it. To avoid this, tape two or three small pennies to each end of the ruler. This will lift the ruler slightly above the plate surface.

Roulette wheels.— These are mechanical device which makes a dotted line, imitating the appearance of a mezzotint. The wheels are spiked, and come in various sizes from a single row of spikes to thirty-five or more. It revolves on the end of a wooden handle and is rolled over the ground. Cross hatching will produce rich black tones. As the spikes become clogged with ground, a dish of solvent will be needed to clean the roulette periodically.

Tape.— Before the ground is applied to the plate, the lines are drawn with self-sticking acetate fiber tape, such as 'A C S chartmaker tapes'. They come in a width from one-sixtyfourth of an inch up to one inch. The thin line tapes can be curved with ease. Burnish the tape securely

Infra, pp. 30–32.
to the plate and apply a thin coating of liquid hard ground over the entire surface of the plate. Once dry, the tape is removed, exposing the metal for the acid.

**Splashed ground.** - Liquid hard ground is splattered onto the plate by flicking a brush loaded with resist. The areas around the splatter will be etched. This process can be repeated several times. Each biting and splattering makes a successively richer texture.

Splashing alcohol on the plate in addition to the resist makes the ground form rings with fine thread-like lines radiating from it. The plate is left to dry before any unwanted areas are stopped out. By setting fire to the plate before the alcohol has evaporated, the ground boils and bursts into circular spots and irregular dots. Again stop out where not needed.

**Pressure ground.** - While the liquid ground mixed with water is still wet on the plate, the back of an old plate is pressed onto it. As the plate is removed, it pulls some of the ground with it. The resulting texture has a fern-like quality.

**Boiled ground.** - The plate is covered with liquid ground and water, and boiled on the hot plate until the water evaporates. It leaves a texture of irregular dots and circles. Their position and size can be controlled to
some degree by moving the water and ground around with a brush. Stop out where not needed.

**Soft Ground**

Soft ground is applied in exactly the same manner as the hard ground, using a clean roller. The surface of the ground remains tacky when cold enabling it to receive impressions made on it. Care should therefore be taken when holding the plate as a thumb print will reproduce perfectly when printed. Use the weaker acid mixture with this technique.

**Lines.**—Pointed wooden sticks and pencils will make lines. Screwed up paper or cardboard strips scratch the ground easily, making possible a variety of lines and marks.

**Pencil line effect.**—By drawing on tracing paper placed on top of the grounded plate with a fairly soft pencil, pressing heavily for the darks and lightly for the lights, gives a pencil-like effect. When the tracing is removed, the ground will have stuck to the back in proportion to the pressure used.

**Texture transfer.**—Any object that has a texture can be impressed into the ground, and will, when bitten, print. Thin objects, such as leaves, crumpled aluminum foil, lace curtains, etc. are best impressed by running the
grounded plate face up with the texture on it and a sheet of wax paper covering it through the press. The pressure should first be adjusted by removing the middle blanket. Stop out any areas not need before biting.

Photo letter press plates with the backing removed and impressed into the ground by the above method will print as a photographic image in the print. It will however be reversed. Gravure plates transfer and print as a negative.

Any object too thick to run through the press (ie. thicker than one-quarter inch) is pressed by applying one's weight to the object, when the plate is on a flat surface. Biting time will depend on the delicacy of the transfer. A fine texture will soon underbite. The plates should therefore be watched continuously and removed at the first signs of breaking up.

**Aquatint Ground**

This is the technique by which the lightest grays to the richest blacks are made. Finely powered resin is dusted onto the plate, which when melted sticks to it and forms acid resting islands, the acid bites around these islands making a pitted surface that holds the ink. The tone depends on the etching time.

Laying the ground by hand. — Half fill a jar with powdered resin. Lay one or more layers of fine gaze (nylon stockings are excellent) over the top and secure by taping.
By using three jars with a different number of gauze layers on each it is possible to have a coarse, medium and fine sieve. Use the fine for even tones and the coarse for an open rather speckled quality.

Clean the plate and apply the resin by tapping the side of the jar, which should be about twelve inches above the plate. Start from one corner and work gradually over the whole surface from that point. By looking across the plate at eye level, the amount of resin can be seen clearly. The ideal coating would be about fifty per cent resin to fifty per cent plate. A coating that is too thin will be hard to see. Too thick a coating will appear very dense and would be completely acid resisting.

Using the Aquatint Box. — The main advantage of the aquatint box is that it lays a fine even ground. Before the plate is put into the box the air must be set in motion. Using the fan type (Plate I). Turn the handle quickly for about half a minute and return the handle so that the fan is horizontal. The plate is now placed face up onto the fan which acts as a shelf. Allow a few minutes for the resin to settle before removing the plate. Using the motorised type (Plate II). A short blast of air is all that will be needed to set the resin in motion. For a coarser ground place the plate into position before activating the air.

The door to the aquatint box should only be open when the plate is put into it and again when it is removed.
Melting the resin. — Once the plate has been coated with resin it is then placed onto a wire mesh tray. For easier handling the plate can be placed onto the tray before the resin is applied. Taking care not to jog the plate, pass the flame from a gas ring or propane torch under the plate. Start at one corner using a circular movement until the resin is seen to melt; it becomes transparent. Then move the heat to an adjacent area, and so on until the resin is melted over the whole plate. If the hot plate is used to melt the resin, dispense with the tray and heat the plate directly on the hot plate. If the heat is applied too long the resin fuses into a solid acid resisting coating.

When the plate has cooled, areas not needed for biting are stopped out. It will be noticed that the resist runs between the islands of resin, making it impossible to keep a sharp edge. To avoid this the plate can be stopped out before the resin is applied.

Biting. — Etch in the weaker acid solutions. The aquatints need less biting time than line etching. It is therefore a good idea to make a test strip, a small piece of metal with an aquatint ground on it. The strip is bitten at one minute intervals, stopping out a band after each minute until ten minutes is reached. Take a print. Match the desired tones with the test strip and bite the plate accordingly. A coarse aquatint will need twice as long in the acid. Very dense and velvety black is a result of two
or more aquatints successively bitten, one on top of the other. The resin is removed between each application, starting with a coarse and long bite of up to twenty minutes and ending with a fine ten minute bite.

**Drawing with the ground.** — Before the resin is melted, draw into it with a comb or any tool. Where the tool has passed, the resin will pile up on either side, making white lines.

**Creeping bite.** — A continuous tone can be made by placing one edge of an aquatinted plate into the acid and slowly lowering it until the whole plate is submerged. This may take as long as ten minutes depending on the range. The end that went in first will be the darkest.

**Lift ground.** — A technique whereby brush strokes are represented as black in the print. It is a positive process as opposed to the negative working aquatint where resist painted on the plate represents a white.

A brush drawing is made with a suger solution and covered with resist which is unstable on the suger. When immersed in warm water the suger dissolves freeing the resist only where there had been suger.

Mix a solution of suger saturated in water and add black poster paint to give it color. An equal amount of gum arabic and poster paint mixed together will also make a lift ground.¹

With the solution, draw the image on a clean plate. When completed, drying is assisted by heating the plate over the hot plate. The whole plate is then covered with a thin coating of acid resist. Once dry, submerge the plate in a tray of warm water. Rub gently to assist the sugar in lifting. When the image has completely cleared, dry the plate and apply an aquatint ground to it. Bite to the tones required, stoping out as needed.

If applied properly, the finest brush movements will be reproduced. It is however essential that the sugar be applied thickly and the resist thinly.

The aquatint ground can be applied before the sugar and resist. It is then essential that the sugar is allowed to dissolve unaided, rubbing would damage the aquatint.

Removing the resin. — Lacquer thinner is the most convenient, as it removes the stop out in addition to the resin.

Burnishing. — Etch the plate for a solid black. Then with the scraper and burnisher remove the aquatint until the desired tones are reached. In this manner tones have a soft, luminous quality to them. The effect is not unlike a mezzotint.1

Asphaltum aquatint. — Powdered asphaltum has a much finer grain than resin. It is applied in the same manner as a hand laid aquatint, however a finer sive is used. When melted it changes from a dark brown color to a black. Etch in the same manner as for a resin aquatint.

1 *Infra*, pp. 50-32
Spray aquatints.—Aerosol cans containing spray enamel will render an aquatint-like quality when sprayed onto the plate.

Stand the clean plate vertically against a board or lay the plate on the floor. Holding the can about twenty-four inches away from the plate, aim at one corner, moving the spray with short dusting strokes until the whole plate is covered with an even coating of the desired density. The plate of course should not be completely covered with the enamel as this would resist the acid and no aquatint would result. A fifty per cent covering is ideal.

By varying the amount of enamel sprayed, tonal gradations are possible with one biting. If the plate is sprayed heavily in one area and then faded out into a lightly sprayed area, the resulting effect in the print will be the reverse of the plate. The heavily sprayed areas will print as a gray and the lightly sprayed will print as a black. Biting time is the same as for a regular aquatint.

Spraying textures.—Perforated textures such as metal grids and screens, can be transferred to the plate by spraying through them, and onto the plate. The sheets are available in a variety of mechanical patterns. A sheet of metal perforated with dots for example, has a somewhat blown-up photographic look when transferred to the plate.

The clean plate is placed on a flat surface. The screen is laid on top. It may be necessary to clamp it
down. If the screen is not in close contact, the spray will spread under the perforations making the transferred pattern fuzzy. Spray a solid and even coating, covering both the screen and the plate under it. When the screen is removed the plate will be covered with the transferred pattern around which the acid will etch. The depth of bite required to produce a black will depend on the area of exposed metal, i.e. the larger the area the deeper the bite. A large area will need a light aquatint sprayed into it, after the desired depth of bite is reached. To make a grey, spray an aquatint before the plate is etched and bite accordingly. By rotating a dot screen and superimposing the dots on the dots, moiré patterns are obtained. This can be done between bitings or in one biting.

**Stencils.** — Cut stencils are laid on the plate and then sprayed, either solid or as an aquatint. With an aquatint different stencils can be laid down at various points during the spraying or they can be moved to a new area on the plate. In this manner, a variety of tones are attained. By laying lengths of doweling on the plate, lines with soft edges are made, as some of the spray gets under the doweling.

**Contact paper**. — Self adhesive plastic shelf covering, when adhered to the plate makes an acid resist that will not break down even after many hours in the acid.
It is therefore the perfect resist for biting right through the plate. Starting in one corner, rub down the 'contact' working diagonally over the plate until the whole plate is covered. The areas intended to be bitten are cut out with a sharp knife and then peeled off exposing the metal. Clean sharp edges are an inherent quality of this technique. As stated the plate can be bitten right through. This will take about six hours. With zinc in the strong acid, there will be considerable under biting. To compensate for this, rebate the cut line one-sixteenth of an inch in from the intended edge. This technique is also useful with aquatints and deep biting. In fact whenever a sharp clean edge or broad line is needed,

Tape is also acid resisting and will make white lines if an aquatint is applied around it.

**Carbon paper.**— Place a sheet of typewriter carbon paper on the plate and draw onto the back of the carbon. The carbon will transfer to the plate surface, making an acid resist. Apply an aquatint over this and etch. The resulting image will be white lines on a black background.

**Litho crayon.**— The wax litho crayon acts as an acid resist and can be used to draw with directly on the plate. By adding a fine resin aquatint first, a good drawing surface is made.

**Drawing with the acid.**— Pour a small amount of neat nitric acid on the plate or drop it on with an eye dropper,  

1Supra, p. 32.
deeping away from the fumes (orange smoke). A lot of heat is produced and the acid neutralizes itself very quickly and will need to be renewed several times. The effect produces a pitted, bubbled surface. Very subtle tones are possible using this method on a plate with an aquatint ground. Using a feather, apply the acid first on the intended dark areas working into the lighter areas. A second feather is used at the same time to apply water, which controls the acid strength.

Reversal. — Etch shallow lines, textures, etc. into the plate, ink and wipe the plate thoroughly giving a final polish to the surface with clean newsprint. Leave to dry on the hot plate. It will take about an hour before the ink is burnt into the lines. Once cooled, the plate is immersed in the acid and the surrounding metal bitten below the surface of what was previously the intaglio (i.e., the intaglio lines are now raised lines). Apply an aquatint now and etch to the desired tone. When the plate has been cleaned, the surfaces are polished with a burnisher, taking care not to damage the aquatint around the raised lines.

Ink transfers. — As stated above printing ink makes an acid resist. If such things as blocks of wood, bricks, etc., are inked with a roller and then a clean roller is passed over them, the ink will transfer to the roller, and can then be offset onto the etching plate by passing the roller over it. An alternate way is to take a print and
while the ink is still wet, offset it onto the plate by passing both the print and plate through the press. A coated paper should be used as this will not absorb the ink. Litho stones and plates can also be transferred in this manner. Especially good transfers are possible when transfer paper is used. A print from an etching plate can also be transferred in this manner. Remember the ink will resist the acid and will therefore print as a negative. Reinforce the wet ink by dusting the plate with resin or powdered asphaltum. The surplus is knocked off or blown away, the remaining powder sticking only to the ink. When heated, the powder will melt, forming a strong acid resist, capable of a deep etch.

Reworking.— After the plate has been proofed, some form of reworking is inevitable. The only techniques that cannot be successively reapplied are ones involving tape and printed transfers, as these techniques need a clean smooth surface to stick to. Areas of the plate can be scraped out completely and re-drawn or a different technique applied in its place. Each stage in the development of the plate is known as a 'state'.

Transparent ground(hard and soft).— This enables the drawing already on the plate to be seen through the ground. Applied in the same manner as before, it has the exception that the ground is first melted and then rubbed
into the areas already etched. The rest is then rolled in the normal manner. If the ground is not rubbed into the lines, the roller will pass over them missing in places. As the ground is transparent, it is difficult to see if an even coating has been applied. Adding a little dark ground will help overcome this problem.

**Stopping out.** — Previously etched areas not intended for re-biting are stopped out with acid resist. However they have the unfortunate habit of etching further even though they have been stopped out. This is because the resist thins along the edges of lines and around the islands of an aquatint enabling the acid to get through. This action can ruin a previously good aquatint and widen a line. It is safer therefore to apply two coatings of resist to these areas and remove the plate from the acid if any action is seen to be taking place.

**Re-biting ground.** — If lines have not been bitten deep enough and are too complex to re-needle, mix a stiff paste of French chalk and water, or use gouache and fill the already bitten lines with the paste. Wipe down and carefully roll a thin coating of dark hard ground onto the plate. Pick up the ground as needed from another plate along side, this prevents the ground from becoming too thick. The chalk filled lines stops the ground from filling the lines. Latter when the plate is in the acid the chalk lifts. Re-exposing the lines too be etched deeper.¹

¹Ibid., p. 40.
**Dragon's Blood.**—A technique that has its main usage with photoengraving (Chapter V). It prevents the raised dots from being excessively underbitten. It may also be used to retard underbiting with any intaglio process, where there are small raised areas that would otherwise underbite.

After the plate has been etched just deep enough for it to have a slight edge around the etched areas, it is removed from the acid, washed and dried and then covered with powdered resin in one direction so that the powder is brushed up to the edges over which the brush passes, while the rest of the plate is brushed clean. The resin is then melted and the operation repeated in the opposite direction and so on until all four edges have been filled with resin, thus making an acid resisting wall around the unetched areas. The plate is then further bitten and the whole operation repeated again and so on for as many times as needed depending on the depth of bite required. This produces a successively stepped bite.

**Filling holes.**—If per chance the plate has bitten right through in some small areas, these can easily be filled with plastic metal, such as 'Liquid Steel'. By placing a piece of masking tape on the plate surface over the hole which is to be filled, before filling the hole from the back, you can prevent the plastic oozing onto the plate surface.
CHAPTER III

PRINTING IN BLACK AND WHITE

Mixing the ink

Powder.—Make a pyramid out of the powdered pigment. Open up the top and pour in a mixture of three parts heavy to one part thin plate oil and mix into a thick paste with a putty knife. Keep the ink as thick as possible, at this stage. Once the paste has been made, grind down with a muller. Push and pull the muller in a rocking motion for about fifteen minutes. There should be no hard lumps of pigment left on the ink palette.

Medium plate oil is now added to bring the ink to the right consistency. As a rough guide the ink should fall slowly from the putty knife.¹

Canned ink.—Extract enough ink from the top of the can with a putty knife. Do not dig the knife into the center of the can, but rather skim an even layer off the entire surface and mix for a few minutes. Test for consistency and add medium oil if necessary. Water should be put on the ink in the opened can and the lid sealed with tape. This will prevent a skin from forming.

¹Ibid., pp. 25-26
Types of blacks.— French black for example is a dense rather cold black. Frankfurt black is a warm black. Changes can be made by adding a small amount of blue to the ink for a cold blue-black or a little burnt sienna to make a warm brownish black.

Inking the plate

Applying the ink,— Heat the plate on the hot plate using a low heat. The plate should feel warm and not be too hot to handle. The use of heat softens the ink helping it spread into the etched lines. The ink is spread over the entire surface of the plate, even if all the plate has not been bitten. Use one of the following methods:

1) Apply the ink with a dabber made out of a piece of rolled up felt and taped so that it does not unwind or with a pad of screwed up tarlatan (stiff muslin). Then with a circular movement push the ink over the plate and into the etched areas. It is important to make sure that the ink is in fact into the intaglio. A few extra minutes spent at this stage will prevent a print being pulled that has white lines where black should be.

2) Apply the ink with a piece of cardboard dragging it across the plate in several directions. This is a fast expedient method of inking.

3) If the plate is not deeply etched, the ink can be applied with a soft roller. It may be necessary to rub the ink into any line that has been missed.
Wiping the plate

**Tarlatan.**—Two pieces of cotton will be needed that should be at least eighteen inches square. Rub each piece against itself to remove some of the starch and fold the corners inward to make a pad that fits the palm of the hand comfortably. While the plate is still on the hot plate, take one of the pads and remove the top layer of ink in straight wipes from one edge to the other. Rotate the plate and wipe the reverse direction. Repeat until the plate has been wiped equally in all directions. Turn the tarlton so as to start with a clean area each time the plate is turned and until the etched image can be seen.

Remove the plate from the hot plate and complete the wiping with the second pad of tarlton this time using a fast circular motion with just the weight of the hand. It will be noticed that the faster the action and the lighter the pressure the more readily the ink is removed. It will also help to warm the pad on the hot plate. The pad must be perfectly flat. If a ridge forms, it will drag the ink from a bitten area. The plate will hold a slight tone in the white areas. This plate tone is varied to some extent by the amount of wiping. Before a print is taken, the beveled edges are cleaned with a rag, removing all traces of ink. This makes for a clean sharp print.
Hand wiping. — Should the plate tone be too heavy, it can be removed by hand wiping. Rub French chalk into the palm of the hand, especially the side of the palm. Clap and rub the hands to clear the loose chalk. Make sure that no chalk falls onto the plate. The plate should be wiped cold with light, fast movements. The edge of the palm is passed over the plate. Rotate the plate and wipe from different directions, reapplying the chalk to the hand as it becomes black with ink. Hand wiping will remove all traces of plate tone, or as much tone as needed can be left on the plate.

Newspaper wiping. — This is for the same purpose as hand wiping only more expedient. It is much harsher on the plate and is not suited for delicate work, as the paper pulls away the ink too easily.

Cut or tear a small square of newspaper and rub gently over the plate in circular motions. Keep the paper flat and use only the flat of the hand. Never push down with the finger tips as this will remove too much ink from the intaglio. Replace the paper as it becomes loaded with ink.

Small areas of plate tone can be cleaned out to a white. Use a small piece of tissue paper stuck to the tip of the finger by spitting on it. Then gently rub it over the area to be lightened.
Retroussage.— This is a technique used to enrich the blacks by pulling up the ink after the plate has been wiped. Make a sausage of soft linen or muslin. Warm the plate. Hold the sausage at one end and very lightly pass the loose end over the plate in all directions. By dragging the ink up from the lines a very dense and black print is made.

Damping the paper.

Before the paper is printable, it must be soaked in water to soften the size. The length of time a paper is left to soak depends upon the amount of sizing in the paper. Twenty minutes is normally long enough for most hand made papers. Thick, heavily sized papers need to soak overnight. After soaking, the paper is removed from the bath. Let the water drain off for a few seconds before placing between clean dry blotting paper.

Brush or roll the top sheet of blotting paper so as to soak up the surplus water from the paper underneath. If more than one print is planned, soak as many sheets as needed and store them under a rubber mat (Chapter I, p. 5). Waterleaf or copper plate paper has no sizing. It will therefore crumble to pieces and disintegrate if it is left in the water. This paper is submerged in the bath and then quickly removed and placed between blotters.
Preparing the press

Setting the pressure. - If a print has never been taken, the pressure will need to be set. Loosen the pressure screws evenly on both sides until the blankets can be passed under the roller and tighten them again evenly until they are hand tight. Take a clean plate and draw a line across it with litho crayon and pass it through the press with a sheet of paper over the plate. A clear sharp impression should be made on the paper from the crayon. If it is too light, increase the pressure until the correct impression is made. When one side prints lighter than the other, the pressure is uneven. Tighten the pressure screw on the offending side.

Marking out the press. - First roll the press bed out to one end and clean off the bed with benzine and a clean rag. Then place the blankets in position and roll back the bed until the blankets catch under the roller. Pull back the rest of the blankets over the roller.

Mark out the area of paper to be used on the press bed with masking tape. Only the corners need be marked. The plate is then positioned within these marks so as to leave a larger margin at the bottom of the plate.

Taking the print

Warm the plate before printing, as this will loosen
the ink. Position the plate face up on the press bed. Carry the paper from the damping area by holding it from corner to corner. It may help to hold one of the other corners between the teeth. The paper should be held with hinges made of thin card, as the hands will be dirty from inking. Register the paper to the previously marked out corners, printing side down (detected by holding the paper to the light and reading the water mark the correct way around). Bring down the blankets and smooth out making sure there are no folded corners or wrinkles. Crank the bed through the press with a steady even action. When the print has passed through completely remove the blankets by folding them back over the roller again. Lift the print from the plate using the hinges to hold the two end corners, with a slow gentle rocking action.

**Drying**—There are three basic methods for drying a print. The first method is to stretch the print on a board with gum tape, taping all four edges. The print will dry flat, with a rich surface. But because of stretching, the embossing is lost and the print must be cut out, losing the hand made edge of the paper.

The second method is placing the print between blotters and under a heavy board. The print will take longer to dry and some of the ink will offset onto the blotter, thereby losing some of the richness in the print. Providing the
weight is not too heavy, the embossing will not be lost.

The third method is to let the print dry in racks for twelve hours or so, until the ink is touch dry. Then resoak and flatten between blotters under a heavy board, changing the blotter at least once before removing the print. This method gives the best quality of the first and second method. Note: waterleaf paper will not need resoaking.

Cleaning up. -- If another print is to be taken from the plate, it need not be cleaned. In fact the second print is easier to ink, as some ink is always left in the lines. However, if it is the last print of the day, the plate must be washed out with solvent. Make sure that all the ink is removed as dried ink in the lines will give a poor print quality.

If the plate is not to be used again for some time, it should be given a thin coating of oil and wrapped in paper. A fine aquatint for example exposed to the air will over a period of time oxidize, completely destroying the aquatint.

The tarlatan if it is not too dirty is opened out and draped over a line to dry, so that it can be used again. The blankets should be removed and hung up to dry if a lot of printing has been done. The hot plate, inking palettes and putty knife must be cleaned. And any unused ink, if wrapped up in greaseproof paper will save for a day or two.
Editions

Once the edition number has been decided upon, each print is then recorded with the edition number just below the plate mark on the bottom left-hand side of the print. Assuming the edition is ten, number each print as follows: 1/10 ie. the first print out of an edition of ten; 2/10, 3/10 and so on, the last print being 10/10. Additional prints are marked artist proof or a/p. Once the edition and artist proofs have been pulled, the plate is either destroyed or marked in such a way that additional prints cannot be taken without being detected.

The signature and date of execution are written in the bottom right hand corner. The title is in the middle between the edition number and signature. The above should always be written with a lead pencil.

Matting

The mat serves to protect and enhance the print. It should be white, gray or buff. Colored mats should never be used as they too easily become part of the print rather than enhancing it.

A good quality acid free mat board should be used as cheap board has a high acidic content which will eventually stain the print. 'Museum board' is the best quality matting available.¹

¹ Dolloff and Perkinson, Works of Art on Paper, p. 25
Draw the window of the mount lightly in pencil to a size that allows one-quarter of an inch extra all around the print. Extra space will be needed to include the signature on the bottom edge. The margins should be at least three inches with an extra one-half inch at the bottom. A sharp mat knife is essential if a clean bevel is to be cut. Use firm even pressure keeping the angle of the knife constant. If possible cut each edge in one single movement. Do not over-cut at the corners.

The cut mat is now hinged along the top edge to the backing (also acid free) with a strip of gummed cloth tape. The print is held in position in the mat by attaching it to the backboard with two hinges attached to the back of the upper edge of the print.

Saving a print

It sometimes happens that a print is perfect except for some small imperfection. White specks are the most common. These can be covered by taking a small amount of ink (thinned with oil) on a brush and touching up the offending white spots.

Definition of an original print

I. It is the exclusive right of the artist-printmaker to fix the definite number of each of his graphic works in the different techniques: engraving, lithography, etc.

II. Each print, in order to be considered an original,
must bear not only the signature of the artist, but also an indication of the total edition, and serial number of the print. The artist may also indicate that he himself is the printer.

III. Once the edition has been made, it is desirable that the original plate, stone, wood-block, or whatever material was used in pulling the print edition, should be defaced or should bear a distinctive mark indicating that the edition has been completed.

IV. The above principles apply to graphic works which can be considered originals, that is to say, to prints for which the artist made the original plate, cut the woodblock, worked on the stone or any other material. Works which do not fulfill these conditions must be considered 'reproductions'.

V. For reproductions no regulations are possible. However, it is desirable that reproductions should be acknowledged as such and so distinguished beyond question from the original graphic work. This is particularly so when reproductions are of such outstanding quality that the artist, wishing to acknowledge the work materially executed by the printer, feels justified in signing them.

The definition of an original print agreed at the Third International Congress of Artists, Vienna, September, 1960.

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CHAPTER IV

COLOR ETCHING AND PRINTING

The addition of color should have a creative function and not just added to make a pretty print or to hide a weak print that is not working in black and white. The intention should be to make a color intaglio from the start.

The same techniques as described in Chapter II are used to make the plate or plates and they are printed in the same manner as set out in Chapter III unless stated otherwise.

Single Plate Color Printing

Single color.— The plate is simply inked in a color other than black.

Inking separate areas.— Two or more colors are applied in different areas of the plate. Separate ink dabbers and tarlton pads are used for the various colors. It will be found that certain colors are more difficult to wipe than black. By adding a little easy wipe compound, or thinning the ink with a small amount of medium plate oil, the removal of the ink will be made easier.

Starting with the darkest color, first apply and wipe, taking care not to get the ink into the area of another color.
If it does, clean out with a rag soaked in benzine. The second color is applied and so on. A light color migrating into a dark color is not as noticeable as a dark color getting into a light. Where colors meet each other they inevitably mix producing a soft edge to the colored forms.

**Inking areas through stencils.**—This is the same as above except that the inking and wiping is done through separate stencils for each area. It may be necessary to touch up small points if the stencils have not registered perfectly. This is done by stippling with a brush.

**Tinting.**—The plate is first inked in one color and wiped. Then one or more different colors are applied where needed, and in turn wiped. They will mix with the main body of color underneath, giving a tinted-like quality.

**Surface rolling.**

The surface of the plate can be rolled and printed as a relief. In this case the etched lines print as white. However by inking the intaglio and rolling the surface, two separate colors are possible.

The ink to be rolled must be thinned with linseed oil until it will fall off the putty knife easily. Spread the ink across a clean palette a little wider than the width of the roller. The ink is then worked out evenly on the palette
with the roller. The amount of ink on the palette and roller is determined by the sound of the roller passing over the pallette and by the look of the ink. A loud sucking noise and a dense gooey look to the ink indicates too much ink. A very transparent ink film with no sound is a result of too little ink. The correct amount of ink varies between these two extremes. The hard roller should be used with enough width and circumference to cover the plate without coming back on itself. A roller with a diameter that is too small deposits most of its ink charge with the first revolution, leaving only a little ink for the remainder of the plate.

Ink and wipe the intaglio in the normal manner. Place on a clean flat surface and pass the roller over the plate. Using a steady pressure for the length of the roll. To prevent the roller skidding as it comes up onto the plate, a strip of metal the same width as the plate is butted up to the south edge of the plate and the rolling started on this strip. If the rolled ink has enough oil in it, it will not pick up any of the stiffer intaglio ink.

Gradated rolling:— Two or more colors are blended together on the same roller. The colors are mixed the same way as for surface rolling, the exception being in the manner they are spread onto the palette. Instead of a horizontal
band, the different colored inks are spread in thin vertical strips traversing the length of the palette, each color butting up to the next. Then with a clean putty knife flatten out the ridge that forms where they join.

Pass the roller carefully over the palette with no lateral movement, until the roller is evenly charged. Then shift the roller about one-half inch to the right and continue rolling until the colors begin to blend together. Go back to the center, roll for a few minutes. Then shift one-half inch to the left. Repeat as needed until the colors blend evenly together. At this point the roller is usually charged with too much ink to roll straight onto the plate. Roll out instead onto a clean palette and from there go to the plate.

Viscosity rolling.—(Plate VI) This is the technique whereby two colors are rolled onto different levels of a previously inked intaglio plate, giving three colors in all plus the admixture of intaglio and rolled color. There are special qualities that must be present in the plate if this technique is to be used. As will be noticed in Plate VI, the plate has been bitten to three distinct levels plus line, aquatint et al added to each level.

Procedure.—The intaglio is first inked and wiped in the normal manner, Plate VI, figure 1. The plate is
now rolled with the hard roller in the same manner as described under surface rolling with the exception that the ink must now fall freely from the putty knife. As the roller passes over the plate, it deposits ink only on the relief (level A, figure 2). The hardness prevents the roller entering the lower levels.

The soft roller is now charged with a stiff ink (straight from the can). It must be solid enough to hold the underside of the putty knife for a few moments before slowly falling. Turn the plate through ninety degrees and start the roll on a clean strip of metal, applying a firm, even and downward pressure for the length of the roll. The low viscosity of the ink from the hard roller rejects the viscous ink on the soft roller, thereby preventing a mixture of ink on level A. However owing to the soft quality of the second roller, it penetrates to the lower level B (Plate VI, figure 3) and deposits a film of ink in these areas. Level C is too deep for the soft roller and therefore leaves only the intaglio to print.

Note 1. The stiff ink on the soft roller pulls some of the ink out of the intaglio lines. It also picks a little of the ink left by the first roll. It must be a one roll effort, as the roller now has two other colors on it, and must be cleaned and recharged with ink before it can be used again. More ink must be added to the palette to allow for the loss during cleaning.
Note 2. -- When rolling with the hard roller, chose the direction that affords the greatest amount of relife to support it. This will minimize the roller accidently entering a lower level. And for the soft roller, select the least amount of relife support, thus helping it penetrate to the lower level.

Note 3. -- (Plate VI, figures 4 and 5). These figures illustrate two problems in viscosity rolling. The first is an area that is too large, thus enabling the hard roller to enter the lower level. The second is an area too narrow for the soft roller to enter.

The first problem is overcome by placing a small piece of paper in the offending area before rolling. The second problem is overcome by notbiting the offending area so deeply next time. As once it is too deep, nothing can be done about it.

Stenciled color. -- One or more colors are rolled onto the plate surface with the aid of stencils. For each color cut a separate stencil one-sixteenth of an inch larger than the area intended to be rolled. This larger opening is to allow for the thickness of the stencil, the roller will not penetrate right to the edge. When cutting a mask, make it one-sixteenth smaller. Cut the stencil out of paper or use acetate for added strength and durability.

After the plate has been inked and wiped in the normal manner, register the stencil onto the plate. This can be
done simply by placing the stencil into position. When the plate is rolled the stencil will stick to the ink and wrap around the roller. However, peel it off, and the stencil can be reused. A mask can only be registered in this manner. By using stops for the plate and hinging the stencil with tape, the plate is easily registered under the stencil every time. Start the roll at the taped end, and clear the stencil completely before lifting the roller. Small lines cut in the stencil are painted through with a brush. When only a small section of the plate is to be rolled, mount the stencil in a window mount allowing enough space for a small roller to fit. One corner of the mount is registered to one on the plate.

**Color edges.** — The bevel of the plate can be rolled with a color that is different from the rest of the plate. Use a stiff ink on a small hard roller and roll at the same angle as the bevel; thus no ink touches the plate surface.

**Cut out plates**

Cut out plates have the advantage that several colors can be printed in one printing. The white space between the plates can be aesthetically pleasing, adding another dimension to the print.

**Cutting.** — The plate can be cut out with acid using the 'Contact Paper' method\(^1\), or by mechanical means using a jigsaw. The saw blade with fourteen teeth to the inch is

\(^1\)Supra, pp. 41-42.
preferable. The plate may be cut before or after etching, if it is cut before, the acid underbites the edges. And cutting the plate after it has been etched, the feet on the jigsaw scratch the surface. However by covering the surface with self adhesive transparent plastic, or masking tape if the cuts are straight. The plate is protected.

If the center of a plate is to be cut out, drill a small hole and insert the saw blade through it. The diameter of the drill and the width of the saw reduces the size of the inner plate, giving a white line when printed. For a close fit discard the inner plate, and place a larger plate underneath the opening. Then with the etching needle score around the opening marking the plate underneath. The plate is cut along these marks and filed to fit perfectly.

Registration.——Mark out the press bed where each plate goes with masking tape, or use a sheet of blotting paper marked with a hard pencil.

Thin inset plates.— Thin gauge copper(twenty-four gauge or thinner) is cut to the exact size of a deeply etched area in a main plate. Inked in a different color, the inset plate is laid into the etched area and printed.

Multiple Printing

Color is added to the print by printing from two or more plates inked in different colors, each plate printed, one at a time, onto the same sheet of paper.
As each plate contains a different part of the total image, some means of registering each part onto the plates must be used. Two methods are outlined below.

**Tracing.**-- The information for each plate is drawn on tracing paper in separate colors, then transferred to the plates which should be cut to the same size. Using the corners of the plates for registering, transfer each color to the appropriate plate and etch.

**Offsetting.**-- The first plate is drawn and etched, and printed. While the paper is still damp, it is offset onto a second plate cut to the same size. The print and plate are registered in the same manner as printing wet on wet (below). The transferred ink is used as a guide for drawing the second plate. By immersing the plate in the acid for a few seconds. And then removing the ink, which will have left the metal shiny while the rest of the plate has been dulled by the acid. The plate can now be aquatinted or grounded with transparent ground. The second plate may also be made into a negative of the first, as described under ink transfer\(^1\).

**Printing wet on wet.**-- All the plates are inked ready to print. The first plate is positioned on the press and printed, leaving the end of the paper held under the roller. Lift the blankets and fold them back over the roller, lift the print and fold it back over the blankets. Place a metal

\(^1\) *Sutra*, pp. 43-44
square along two edges of the plate. Remove the plate, taking care not to shift the square, and position the next plate so that the respective corner is fitting into the right angle of the square. Remove the square and put the paper and blankets back down. Print, and repeat the process with as many plates as there are. Four is about the limit. Expediency is vital as the paper dries and shrinks. Safe the paper more than normal or use a heavy waterleaf paper.

**Printing wet on dry.**—The first plate is printed and the print left to dry overnight. Then resoak the print the next day for the same amount of time, so that it expands to the same size. The next plate is inked, positioned on the press and the print registered onto it by means of pins through the back of the diagonally opposite corners of the print. Position the pins to the corresponding corners on the plate. Then withdraw the pins and print.

**Note.**—Certain colored inks dry faster than others. Generally it is the lightest ones, so ink the plates with these colors last as they otherwise dry before printing them.

Inking and wiping the plates cold will slow the drying of the inks. Adding more plate oil to the ink will also slow the drying.
CHAPTER V

PHOTOENGRAVING

The following is a positive photographic process that can be used to transfer a photograph onto an intaglio plate.

Making the Positive

A Line Positive

A line positive is any graphic image composed of solid, dark areas against a clear background. There are no middle tones between black and white.

Use a high contrast film such as Kodalith Ortho Film, Type 3, which develops no intermediat tones, and a negative with a sharp contrast.

Load the negative into the negative carrier of the enlarger, emulsion side down (matt side) and enlarge to the desired size. Focus the image with the lens wide open, when it is in focus, close the lens down to f/8, and turn off the enlarger.

The only light source must now be from a Kodak Safe-light Filter No. 1a (light red) with a fifteen watt bulb.

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Test exposure. -- From a sheet of film cut a strip two inches wide and position it on the register board, emulsion side up. Mask of all but one inch of film with a piece of card, set the timer for a five second exposure and turn on the enlarger. Move the card down one inch every five seconds, exposing a new section of film each time. After about six exposures, develop the test strip. Select the exposure that produces the best image: the black areas should be sharp and dense, the transparent areas clean and clear. Use this exposure to make the final positive.

Processing Solutions

The temperature of the following solutions should be about sixty-eight degrees Fahrenheit.

Kodalith Liquid Developer. -- Dilute both solution A and B with three parts of water before mixing them together in equal parts. Pour about one inch of the mixture into a tray large enough to take the sheet of film to be developed.

Kodak Stop Bath SB-1a. -- Dilute one part of Kodak Acetic Acid (23%), with eight parts of water. Pour about one inch into a second tray.

Kodak Fixer. -- Into three quarts of water add the contents of one packet of fixer, mix and add water to make one gallon. Pour an inch or so into a third tray.

2 Ibid., p. 28.
Processing the Film

**Developer.**—Place the exposed film in the tray by dragging it through the developer emulsion side down and then quickly turning it over, emulsion side up. Agitate the tray continuously by raising and lowering first one side. Then working around the tray raise and lower each side in turn¹. Develop for about three minutes until the image is seen to be complete. Lift the film from the developer and look through it at a safelight, if it needs to be darker, develop it further². If not, transfer the film to the stop bath.

**Stop bath.**—Agitate for ten or fifteen seconds³ before transferring the film to the fixer.

**Fixer (Hypo).**—Agitate for several seconds. Then let it sit for about a minute before turning on the room lights. Let it sit for a further two or three minutes before washing⁴.

**Wash.**—Wash the film for twenty minutes in a bath of continually running water⁵.

**Dry.**—Gently sponge off the surplus water from both sides of the film and hang from one corner to dry⁶.

A Halftone Positive

A halftone positive is an image which has the appearance of having tonal gradations from black to white. This is done by breaking up the continuous-tones of the negative into solid dots of varying size. The dots and the clear film around them

⁴Ibid. ⁵Ibid., p. 11. ⁶Ibid., p. 15.
fuse visually and give the illusion of intermediate tones.

The halftone image is made by exposing the film through a contact screen and then processing it as a line positive.

The contact screen is a precise, crisscross pattern of lines on film. Screens are made in various rulings from 65 to 200 lines to the inch. Coarse screens of 65 and 35 lines are easier to use than the fine, (133 lines or more). Not all screens are as mechanical as the ruled dot screens. For example, the mezzotint screen is composed of short worm-like lines.

The screen and film go emulsion to emulsion and must be in close contact with each other, a vacuum register board will assure this contact. However, if the film and screen are pressed between a sheet of glass and foam rubber, a reasonable contact can be made from the coarse screens.

After the main exposure, four or five times longer than for linework; a second non-image flash exposure is needed to bring up the dots in the highlights. Make the flash exposure, about ten seconds; with a safelight suspended from the ceiling. A light yellow filter No 00, and a seven and one-half watt bulb must be used in the safelight.

The dots in a good positive should range from a dense, small dot in the highlights to a small, clear opening in the shadows.

1Kodak, Basic Photography for The Graphic Arts, p. 38.
2Ibid., p. 6.
3Kodak, Photographic Materials, p. DS-3.
4Kodak, Basic Photography for The Graphic Arts, p. 39.
5Ibid., p. 24. 6Ibid., p. 39.
The Following is a Guide to Exposure Faults in Halftones

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>CAUSE</th>
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<tr>
<td>No dots in the highlights</td>
<td>Flash exposure too short.</td>
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<tr>
<td>Dots to large in the highlights</td>
<td>Flash exposure too long.</td>
</tr>
<tr>
<td>No dots in the shadows</td>
<td>Main exposure too long.</td>
</tr>
<tr>
<td>Dots to large in the shadows</td>
<td>Main exposure too short.</td>
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An Outline of Some Other Halftone Techniques

**A duotone.** - Two positives are made. The first is basically a normal positive, except that the development is cut short by a few seconds. This keeps highlights open. The second positive is given twice the exposure and developed until strong detail appears in the highlights. A plate is made from each positive. Inked and printed in separate colors, one on top of the other.

If the duotone is dot screened, set the screen angle at forty-five degrees for the first positive and at seventy-five degrees for the second to avoid moire patterns. A mezzotint screen is not angled.

**Kodalith Autoscreen.** - This is a film that has the halftone screen built-in, it is therefore used without further screening. The main exposure is about twice that for a line positive. The flash exposure is about thirty seconds.

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with a greenish yellow filter No OA and a fifteen watt bulb\(^1\).

To make an enlargement of a halftone image, place the Auto film and negative in contact with each other and expose to the white light from the enlarger. This screened positive is in turn contacted, this time on to Kodalith Ortho Film, Type 3, thus making a screened negative. Which is then enlarged on to a new sheet of film, producing a positive that is composed of a blown-up halftone image.

**A process camera.**—The process camera makes a negative from the original copy. It can enlarge or reduce the copy as needed. If this camera is used to copy a photography from a book, it should not be necessary to screen the copy, as the original is printed, it will already have been screened. Once the negative has been made it must be contact printed to make a positive.

**Methods that do not require a darkroom.**—Black and white photographs printed in a magazine on shiny paper can be removed by applying several thin coatings of polymer to them, let each coat dry before applying the next. Then when the polymer has dried, the paper is dissolved away with water, leaving only the ink on the transparent polymer. Acetate will also make a positive if it is drawn on to with a dense black ink.

\(^{1}\)Ibid., p. 23
Transferring the Positive to the Plate

The following process uses Kodak photosensitive resist KPR3, Kodak ortho resist developer and Kodak photo resist dye.

Sequence of procedure

1. Cleaning.—— The grease and oxide film must be removed from the plate surface. Scouring powders such as fine pumice or carborundum mixed with ammonia are applied with a soft cotton pad and rubbed vigorously. Wash with plenty of water using a clean pad. It is important to remove all traces of abrasive. Dry.

2. Acid cleaning.—— For copper, immerse in a solution of ten per cent hydrochloric acid for thirty seconds. Wash and dry. For zinc, immerse in a solution of ten percent phosphoric acid for thirty seconds. Wash and dry. Cleaning the plate is very important if the resist is to adhere firmly to the plate. Once the plate has been cleaned and dried, it should be coated with the photo resist immediately.

3. Applying the photo resist.—— All work with the resist must be done in subdued light. Rest the plate on one hand and pour a puddle of resist onto the surface, rocking the plate so that the resist flows evenly over the plate surface. Stand the plate on one edge and let the resist drain for one minute. Turn the plate and drain in the opposite direction. Let stand until dry.

2 Ibid.
3 Ibid., p. 9.
Note. - A build-up of resist forms along the bottom edge of the plate. This build-up is too thick to expose evenly and will therefore break away during development. If the plate has drained properly, it will be no wider than one-eighth of an inch.

4. Baking the resist. - Place the plate face up on the hot plate (cover if near a window or bright light). Bake for not more than ten minutes at a temperature not over 250 degrees Farhenheit. The resist can also be air dried for twenty-four hours.

5. Exposing. - Ultraviolet light is needed to expose the resist. Exposure times will vary with the intensity of the light source. As a rough guide it takes three minutes for a carbon arc rated at carbon type L3596 no. 87.

The positive film is positioned emulsion side down onto the plate. Close contact is needed for a sharp image. The best means is a vacuum table. The pressure set at five pounds, give the vacuum about a minute to draw out all the air from under the positive before exposing. A heavy sheet of glass will do if a vacuum table is not available. Exposing could also be made with sunlight. A test strip would need to be made first.

6. Developing. - Agitate in a tray for two or three minutes. As the resist is transparent it is difficult to see

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Ibid., p. 10.
the image developing. Wash off the softened resist with plenty of cold water. If it is seen that there is a slimy film of undeveloped resist still on the plate, develop it for a few seconds further and wash again.

Note.—Kodak resist and developer dissolve plastic photographic trays. Porcelain or stainless steel baths must therefore be used.

7. Dye.—Pour on a small amount of dye and cover the plate. Wash off with water. The blue dye adheres to the resist in the negative areas making visual the positive image as unprotected metal.

8. Etch.—For copper, etch in ferric chloride. For zinc etch in 10-1 nitric acid. Copper can also be etched in dutch mordant.

Note.—Open areas will etch to the same quality as an open bite unless they are aquatinted. However, the aquatint may fill in some fine details elsewhere in the plate. Therefore if the plate is first bitten for the fine details and then aquatinted for the blacks, nothing will be lost. Fine screened images need careful etching as the fine dots are easily underbitten. For example, a 133 lined screened image on copper should not be etched for more than one hour in ferric chloride.
9. Removing the resist. - Use lacquer thinner, paint stripper, or trichloroethylene.

CHAPTER VI

TECHNIQUES NOT REQUIRING THE USE OF ACID

Engraving

Engraving is the earliest of the intaglio techniques. The earliest dated print is 1446. Durer is the greatest original artist in this medium, which was later used mainly for illustration and reproducing paintings and other works of art.¹

Essentially a linear method, engraving is the act of incising the metal, usually copper, with a tool pushed into the plate like a plough into the earth, throwing up small shavings and leaving a line which has a v-section.

The tool, called a burin, is made of a highly tempered steel rod with four facets along its length, ending in either a square or lozengeshape, depending on the angle at which it has been cut. Fifteen degrees will make a lozenge and forty-five degrees a square.² The burin, about five inches long is bent from a wooden handle at an angle of between fifteen and forty-five degrees, whatever is the most comfortable to use.³ By heating the steel rod just below the wooden handle until it glows red, it can be bent to any angle. Then, while it is

¹Murray, Art and Artists, p. 99.
²Brunsdon, Etching and Engraving, p. 74. ³Ibid.
glowing, the burin is plunged into cold water to maintain the temper of the steel.

The burin comes in a variety of sizes, the low numbers producing a very fine and delicate line and the high numbers making a broad and deep cut. Sizes six, eight, and ten are three of the most useful. The very fine ones bend and break easily if they are used incorrectly.

**Drawing on the plate.**—The strain on the eyes caused by the glare from the polished surface of the copper can be removed by dipping the plate in a ten to one solution of nitric acid for thirty seconds before the engraving is begun. This will also make a surface upon which a soft pencil can be drawn and used as a guide for the burin. Or a tracing may be transferred to it by laying a sheet of typewriter carbon paper face down between the plate and tracing paper. Another method is to trace the original onto the plate using carbon paper before the plate is dipped into the acid. The greasy carbon will act as an acid resist and the drawn line will remain shiny in contrast to the rest of the plate. This has the advantage in that there is no drawing to smudge.

**Sharpening the burin.**—The two underneath edges of the rod are sharpened, one edge at a time, by pushing and pulling the tool across an oil stone with the addition of a little oil. The edges must be held flat and pressure exerted evenly along the length of the burin, taking care not
to round the edges. The burin is then held near the tip and the cutting facet rotated on the stone in a circular motion, with pressure and a firm wrist. The cutting facet must be sharpened evenly. This operation will need to be repeated many times during the cutting of the plate, as the point will wear quickly.

**Holding the burin.**—This is a matter of the individual's own comfort. However, a method that I have found is to place the rod of the burin flat on the table, the handle resting in the palm of the hand and held in position by the last four fingers. The thumb and index finger then fit along the rod and hold it firmly near the tip.

**Cutting the plate.**—The burin is held at a low angle so that only the tip cuts into the surface of the plate. If the angle is too steep, it will dig in and catch. The driving force is applied by the palm of the hand to the handle of the burin. The thumb and index finger serve only to hold the burin rigid. Finish the stroke and withdraw the burin with a slight forward and lifting action. If the stroke is allowed to taper out of the line, it will leave a cut that ends in a shallow point. Pulling the burin back at the end of a stroke will leave a burr at the end of the cut which must be removed with the scraper. A forward and lifting action with the scraper will remove the burr without scratching the plate.
For cutting curves hold the burin firmly in position with one hand and rotate the plate with the other. The burin is not moved; only the plate is, resulting in a curve being cut. A curve cut otherwise will result in a broken and jagged line. The plate is much easier to turn if it is resting on a leather cushion filled with sand. Tones are created by spacing the lines far apart for a gray or close together for a black and very light tones are made by light broken cuts.

**Printing.**—A good stiff ink must be used to bring out the full quality of the engraved line and retroussage will insure a fine rich print.

**Corrections.**—Mistakes are corrected by removing the offending line with the scraper and burnisher. Some consideration should be given to see if it can be incorporated into the design. An engraved line is extremely difficult to remove. If one cannot incorporate it, it is removed by holding the scraper at a slight angle in one hand with the fingers of the other pressing down onto one side of the three sided tool, so that one of the sharp edges near the point comes in contact with the plate. Scrape in all directions until the depth of the line has been reached. After the line has been removed, the marks left by the scraper must be burnished. The burnisher with the help of some thin oil and firm pressure smooth out these marks. The surface is then
polished again, first with charcoal and then crocus paper and oil. If a deep cavity is left, the back of the plate can be hammered onto an anvil until the front surface is level again. A deep indentation will print. Lines can also be filled in with the use of a soldering iron. The rough surface left by the solder is polished smooth and flush with the rest of the plate.

**Drypoint**

This is the simplest technique. It consists of drawing on the plate, usually copper, with a hard steel point or a diamond tipped point. The quality of a dry-point lies in the burr. The shaving of metal turned up at the side of the furrow catches the ink and prints with a rich soft quality. It is also the most direct and spontaneous of any intaglio process.

Dry-point can also be used to reinforce an engraving or an etching. The plate is prepared in the same manner as for an engraving. Any tool that will scratch the metal and throw up a burr will do. Screwdrivers, sharp stones, knives, even an old ax can be tools capable of sensitive use. The traditional tool, the dry point needle has a diamond tip. If a steel needle is used, it must be periodically sharpened on an oilstone.

**Drawing with the needle.**—The depth and width of
the line is made by varying the pressure and angle of the
tool. Held in much the same manner as a pen or pencil at
an angle of thirty to ninety degrees, pressure is exerted
with the index finger or thumb, depending on the direction
of the needle. Held vertically, the burr is even on both
sides of the line. It is crisper and finer than a line
made at an angle of sixty degrees where the burr is pushed
up from one side only. At thirty degrees the single burr
is broken and ragged. The burr is left on the plate. However
delicate lines are produced when the burr is removed with
a scraper. The plate must be steel faced if a large edition
is planned,¹ as the burr is lost after thirty or so printings
depending on the drawing.

Printing.— The same as for engraving.

Mezzotint

Mezzotint was invented in the Seventeenth Century.
It became the great reproductive process of Eighteenth
Century England, where the portraits of Reynolds and Gains-
borough were reproduced by this medium.²

Mezzotint gives a rich, velvety print. Every shade
of tone is obtained from the deepest blacks to the whitest
whites.

The copper plate is first covered with a mass of small
burred dots, made by the chisel-like mezzotint rocker,

¹Suhr, p. 11.

²Murray, Art and Artists, p. 100.
whose curved cutting edge is serrated by fine teeth spaced sixty to 100 teeth to the inch. In this state the plate would print as a solid, rich black. The grays and whites are obtained by scraping the burr with the scraper, or polishing the plate smooth with the burnisher.

Applying the ground. — The mezzotint ground is applied by holding the rocker vertically and with even pressure rocking it over the plate in one direction and then at right angles to that line, and so on. Avoid going back over any line, as it has the effect of blurring the ground. When the whole plate has been covered, a proof print is taken. The print should be a rich black. If there are light spots, these must be gone over again, remembering to select a new angle so that the rocker does not blur the lines already in the plate. The ground may also be applied by an apparatus consisting of a rigid pole on which the mezzotint rocker is fastened at one end, while the other is free to travel along a grooved rail which in turn is clamped to the work bench at one end, the other supported by legs. The plate is marked out with chalk, the special apparatus protractor denoting the angles for a coarse or fine ground. The plate is then covered with the rocker marks in all the indicated directions. Pressure is applied to the pole of the apparatus with one hand, while the other rocks the handle of the rocker. The end of the pole travels along the rail at measured amounts and insures an even ground. ¹

¹Ibid., pp. 79-80.
**Drawing on the plate.**—Once the ground has been laid and a solid, very rich black proof pulled, the plate is ready to draw on. If it is required to transfer a previously made drawing, this can be done by tracing with typewriter carbon, or the plate can be drawn on directly with a soft pencil, taking care not to use too much pressure which would damage the burr of the mezzotint. The scraper and burnisher act like an eraser on a pencil drawing. The scraper is held flat with the plate surface and the burr removed for the grays. This tone will depend on the amount of scraping. A light even pressure must be applied so as not to cause hollows, which will hold the ink during printing. And for the whites the burnisher is used with the help of a little oil until the area is smooth. For very fine detail, an old etching needle with the point rounded and polished can be used. Use the roulette wheel for drawing back into the whites. The single spiked roulette is invaluable for producing fine dark lines in the whites.

**Printing.**—The same as for engraving except that special care must be taken not to damage the delicate burr thrown up by the mezzotint rocker and excessive retroussage will result in a muddy print. The whites can be polished with a Q-Tip and some very small whites may need to be cleaned out with a sharpened match stick.
Metal graphic

Metal graphic is an intaglio process that builds the image onto the surface of the plate by adhering thin metal and assorted textures with a metal adhesive, such as epoxy. It is an additive means of applying the design as opposed to the subtractive methods of removing metal from the plate. These techniques may be used in combination with any or all other intaglio processes.

The plate. - The first requirement is the base plate upon which the image is to be built. Some thought should be given here as to the demands of the design. A total usage of metal graphic is suited best to aluminum. The epoxy adheres well to this metal. A design requiring only limited usage of this technique would suggest that zinc or copper would be the metal to use.

As the plate is built up, the thickness will increase. To help compensate for this build-up, a thinner gauge base plate should be used in the region of eighteen to twenty-four gauge, depending on the thickness of the materials to be adhered to it.

The adhesive. - For an adhesive, any brand of epoxy that is in two parts (one the adhesive and the other the hardener) will work. The drying time will vary from a few hours to three days. Drying may be speeded up by heating the
completed plate.

The textures.-- Almost anything may be adhered to the plate. The only limitation is the thickness. The combined depth of the plate and textures should not exceed one-quarter of an inch for a normal printing press. A plate that is too thick will break the rollers on the press, in addition to cutting the blankets. A converted press that has heavy springs above the top roller will absorb the shock of a thicker plate, which may be up to two inches thick. Many blankets and pulped paper are used to pick up the ink in such deeply embossed plates.

The following materials were used to make Plate III (see appendix): twenty gauge aluminum base plate, thin copper sheets, an old etched zinc plate, household aluminum foil, aluminum grid, wire, wire mesh, scrap metal and the texture transfer into the epoxy itself. The plate was later cut to shape. In addition to the above such items as coins, cogs, gaskets, etc., could have been used.

Making the plate.-- To assure a strong bond between the base plate and the materials, they must be clean, free of grease and their surfaces scored to make a tooth for the epoxy. Rubbing vigorously with a coarse sand paper will make the tooth. Ammonia and french chalk are suitable cleaning agents. Any delicate or fragile materials such as aluminum foil cannot be scored. They should, however, if possible be cleaned. If only part of the plate is intended
for metal graphic, the tooth is applied by scoring with a dry point needle only in those areas.

Thin brass, copper, etc. is cut to the desired shape with scissors. It may also be etched before or after it has been applied to the plate. Aluminum foil is cut or torn. It may then be crumpled making a texture in the foil that will hold the ink. I have found it helpful to shape and position the objects on the plate before the epoxy is applied. Once decided upon a diagram can be made and the parts removed.

Having mixed the epoxy according to the manufacturer's instructions, apply a liberal amount to the surface of the new cleaned and scored plate with a palette knife. Only those areas that are intended to receive the metal textures should be coated. A thin coating is applied to one side of the textures. Should any of them be too small for a palette knife, a toothpick can be used instead. Working with one part at a time position, epoxy side down, and apply slight pressure. A weight may be required to keep the larger parts flat. Care should be taken to insure that the weight itself is not in direct contact with any adhesive. A piece of aluminum foil under the weight will prevent this. If the foil sticks it can be scraped off.

The epoxy leaves a texture when it is sandwiched between the plate and thin copper or aluminum foil,
similar to that produced by a liquid when pressed between two sheets of glass. This texture will not be apparent until the epoxy has dried and the plate is run through the press. The pressure is then great enough to mold the metal to the epoxy texture. Epoxy itself when left to dry on the plate will wipe cleanly, holding the ink only around the edges and in any texture produced during its application.

I have found it helpful to lightly glue a piece of aluminum foil over the top of very rough textures such as wire screening. It will not interfere with the texture under it, but it will help with the wiping.

The textures may overlap or be built on top of each other. They may be removed before the epoxy has dried and reapplied again. Any surplus epoxy should be removed with lacquer thinner before it dries as once dry it cannot be removed.

When the plate is finished and the epoxy has dried check and file down any high or sharp points. Adjust the pressure and run the plate through the press three or four times without ink. This will flatten out any air bubbles and force the thinner materials into the texture of the epoxy. Two sheets of blotting paper over the plate will protect the blankets from any sharp points that have been missed. Cut blotting paper is evidence of a sharp point which must be
filed before printing.

Invariably there are edges and corners that have not adhered completely. Ink and solvent seep under weakening the bond and bleeding when a print is pulled. These gaps must be sealed with fresh epoxy applied with a toothpick while the plate is warmed on the hot plate. When warm the epoxy will flow into these gaps. When dry the plate is ready to print.

Related techniques

Techniques to be used separately or in combination with metal graphic texture transfer. While the epoxy is still soft it can be embossed. The area on the plate to receive the embossing is covered with a thick layer of epoxy. A sheet of aluminum foil placed over it, is then smoothed out. Onto this is laid the textures from which the transfer is to be made. Wire, leaves and coins are taken through the press in the same manner as a regular texture transfer. However, extra care will need to be taken to protect the blankets and press bed as the epoxy is wet it will bleed if the pressure is too great. The pressure must be decreased so that the plate and textures on it just clear the roller. As it is passed under it, the addition of a cushion blanket will then deliver the necessary pressure to imprint the texture into the epoxy. A sheet of blotting paper between the plate
and blanket will insure that no epoxy escapes onto the
blanket. After the transfer has been made, remove the
textures from the aluminum foil which is now embossed
and holding the epoxy under it to the texture of the transfer.
Do not remove the aluminum foil. Any epoxy that has escaped
can be removed with lacquer thinner before the epoxy has
dried and once dry any excess aluminum foil can be rubbed
off. It will break away where there is no adhesive.

Fiber glass.-- Fiber glass has an organic texture
and may be purchased as a kit from any auto department.
It comes complete with epoxy and fiber glass mat.

The mat is first cut to the approximate size of the
desired image with scissors. A heavy coating of epoxy is
applied to the plate corresponding to the approximate
size of the cut fiber glass mat. With a stiff brush the fiber
glass is stippled into the wet epoxy. It is the valleys
between the fibers that hold the ink and by filling in these
valleys with more epoxy the amount of texture can be controlled
and hence the tone.

As the epoxy spreads when the fiber glass is applied,
control over the image size is only approximate. This can
be compensated for by applying a thin film of grease to the
negative areas of the plate after the epoxy has been applied
to the positive, so that the two substances build up to each
other defining the exact size of the desired image. The epoxy
and fiber glass that spread will not adhere to the grease
and once dry can be cut or rubbed free.
Plate IV (see appendix) was made by adhering with epoxy small zinc plates to a cut and shaped base plate. Once dry these small plates were protected with grease and the fiber glass applied around them. Later the excess fiber glass was cut away from the inset plates. The solid areas were added by applying fresh epoxy to the dried fiber glass selectively and dusting with sharp sand which sticks to the wet epoxy and produces a rich aquatint quality. Carborundum or metal filings could be used for the same purpose. The surplus is brushed away before inking.

Plate V (see appendix) had deeply bitten straight bite areas that were later filled with epoxy, fiber glass, crumpled aluminum foil and plastic metal. Smooth areas in the epoxy were also engraved with a burin. The textures were built up to the same level as the rest of the plate and no adjustment in pressure was needed when printing.

Solder.—Metal solder may be used as an alternative to epoxy for applying the different metals to the plate surface. Or the solder may be allowed to flow on the plate making its own texture.

Solid solder should be used with the appropriate flux. A blow torch is excellent for supplying the heat. However, care should be taken with zinc. It melts easily. This melting can be used but is difficult to control. Both surfaces must be cleaned with steel wool before the flux is applied and
the solder floated onto them. Place the two soldered surfaces against each other and re-apply the blow torch until the solder flows again. Any gaps that exist around the soldered parts must be sealed with fresh solder.

**Printing.** — The increased thickness of these plates necessitates that the pressure on the press be decreased by a corresponding amount. The press should be no harder to crank than with a normal plate. An extra cushion blanket will be needed to push the paper down to the greater depths that exist in these plates. The paper should be of a good quality rag of at least 120 pounds. I have found copper plate paper to be the best. It stretches and molds to the contours of the plate more easily. Sized paper, if used, should be soaked for several hours.

When inking the plate extra care should be taken to make sure that the ink is into the intaglio. Wiping is standard. Owing to the variety of relief, these plates lend themselves to viscosity rolling.

**Collographs.** — This is a similar technique to metal graphic. The base plate is cardboard. The textures are paper, lace curtains, and so forth. The adhesive is a general purpose glue. The plates are not as strong and editions are limited from such plates.
CONCLUSION

I have tried to explain some of the varied techniques that can be used in the intaglio process and have illustrated the text with photographs of prints that contain organic forms within hard edge inorganic shapes. I believe it is precise and avoids many faults that usually accompany such a technique manual. The conclusion? - if you read this manual, you should be able to set up a work shop and produce an intaglio print.
BIBLIOGRAPHY

Sources consulted


PLATE I  AQUATINT BOX—fan driven

Door for removing plate—

Fan and platform for plate—

Handle—

Resin—

PLATE II  AQUATINT BOX—compressed air driven

Resin blown over and onto plate standing on runged tray—

Air forced through holes—

Resin—

--- thin metal

--- Door for removing plate

--- To air supply
PLATE III  Phoenix plate and print
PLATE IV
Survivors plate and print
PLATE V

Silence plate and print
PLATE VI  Viscosity rolling

Level A
Level B
Level C

Figure 1 - Intaglio plate inked and wiped

Figure 2 - Rolling level A

Figure 3 - Rolling level B

Figure 4 - B level too large

Figure 5 - B level too small
PLATE VII

"I will darken the earth in the clear of day"

(Techniques used and type of metal: zinc plate with copper inset diamonds, sprayed aquatint and sprayed textures. Size is 23 x 20)
PLATE VIII

Three Plus One

(A cut out zinc plate printed in three printings wet on wet. The inset diamond plates were placed into a blank key plate of the same dimensions as the print. Yellow was printed first, the inset plates removed and the red plates put in their place and printed. Next the key plate was removed and the main plate put in its place, which was in three sections, the inner plate inked in blue-black and the outer plates in brown. There were also four more diamond plates added which were inked in blue-black. The bevel of the plate was rolled in red. Techniques used: ruled lines, etched tape lines, spray aquatint, spray texture, reversal in the diamond plates. Size is 18½ x 22/)
PLATE IX

Earth-Rises

(Cut out plate, single printing. The center of the plate was made on copper by burning a splashed ground which was later scraped and burnished. The dark band is a result of deep etched lines. The plate cut, and an aquatint added to the sun. An outer plate was made of zinc with a sprayed dot texture etched into it. The screen was rotated, stencils laid over it and sprayed again, and the process repeated for a third time. A photoengraving made from an unscreened kodalith etched on copper in feric chloride completed the print. Size is 19 x 24).
PLATE X
L. E. M.

(Cut out zinc plate, single printing. Sprayed textures and aquatint. Deep bite on diamond plate using 'contact paper' as a resist. The intaglio was inked in silver with a gradated roll on the surface. The triangles are rolled stenciled color. And silver edging was rolled onto the bevel. The lower inset plate is photoengraved on zinc, using an unscreened kodalith. Size is 36 x 24.)
PLATE XI

Untitled

(Cut out plate on zinc in two printings. Reversal technique used to make part of the center plate, the misregistration showing up as a white. The duotone photographic image was made through an eighty-five line mezzotint contact screen. Other techniques used were sprayed textures and aquatint, pressure ground and taped lines. Size is 15 x 24).
PLATE XII

Three Plus One Mark II

(Cut out plate printed in two printings, wet on wet. Only the light blue was in the first printing. Etching technique was neat nitric acid. The diamond plates are photoengraved on copper and etched in feric chloride. These were made by using an enlarged tint screen to screen first a positive and then a contact negative may be made from this. The negative and the positive registered and were contacted onto another sheet of kodalith. Each plate was inked and then rolled. Other techniques: the lower plate - 133 line screened, photoengraving and aquatint and inset plates. The lower and outer plates were rolled in gold. Size is 27 x 22.)
PLATE XIII

Moon Rocks

(Cut out plate printed in three sections on separate sheets of paper, then torn and joined together on a cardboard backing. Techniques used: photoengraving, spray textures and sugar lift. Size is 30 x 47.)
PLATE XIV

M. F. A., n.

(Cut out plate, single printing. Techniques used: photo-engraving, aquatint, soft ground, texture transfer, line etching, engraving, deep bite, sprayed texture. Size is 24 x 36.)