Tamarind Technical Papers

Tamarind Institute, 108 Cornell Avenue, S.E. Albuquerque, New Mexico 87131 (505) 277-3901

Number 2 / July 1974

METHODS OF IMAGE TRANSPOSITION

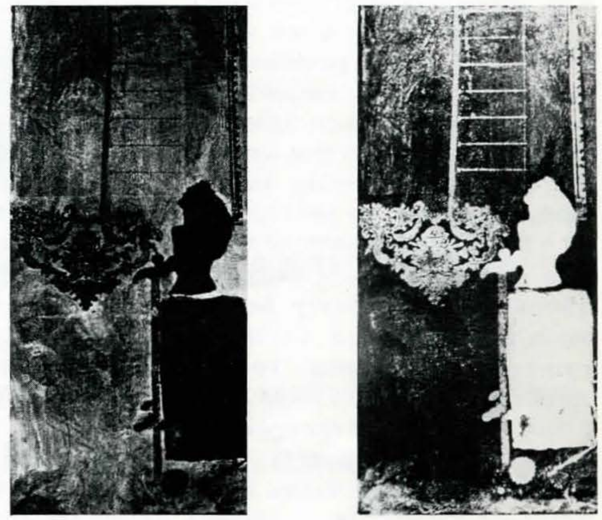
Few processes in lithography are as fascinating as those involving the transposition of images. The complete reversal of a drawing, with white becoming black and black becoming white, has an air of magic about it.

For an artist, image transposition can be a gateway to a wide range of new possibilities, possibilities which are all but unlimited in lithography. As with all such complex technical processes, the artist must be wary of its hypnotic fascination, for when image reversal is used without reason, or as an end in itself, it can easily lead to tricky and superficial results.

Among the five methods of transposition described in TBL (sections 15.20 through 15.26, pages 404-408), the one first used at Tamarind was the relief method, a process in which the original drawing is first put physically in relief, then cut away with a snake slip or hone. [1] The task of honing the drawing down is slow and time-consuming, a fact which has both advantages and disadvantages. Some artists welcome the fact that in the relief method they are in complete control of the process, and that in each part of the image they may choose between complete or partial reversal. Others find it far too laborious, and prefer a process in which the printer may transpose the image without the artist's direct technical participation.

The shellac reversal method (illustrated in TBL, photo-sequence 15.6, a. through k.) is such a process.[2] Although far simpler than the relief method, it requires great accuracy on the part of the printer. Given such accuracy, it is entirely reliable, but if the shellac film is either too thick or too thin, if it is at all uneven, or if the printer's timing is not precise, the results can be unpredictable. For certain kinds of work, where accidents can be accepted and used by the artist, this precarious control can at times be an asset rather than a liability, aesthetically akin to the fortuitous partial reversals that occur in solarized photographs.

The relief and shellac methods of transposition can be used only on stone; neither can be used on metal plates. Because the gum and oxalic acid methods of image transposition (described in TBL, sections 15.25 and 15.26) have serious limitations, Tamarind printers sought to develop a metal plate reversal process which would be at least as dependable and effective as the shellac reversal on stone.



The transposed image.

Details, left and right, the image as drawn and after reversal.

A method making use of an acrylic polymer emulsion was first developed at Tamarind by Jean Milant in 1969 (too late for inclusion in TBL, by then already at press). [3] Milant's aim in his research was to find a way to reverse images drawn on aluminum plates. Early in 1970, responding to artist William Pettet's need for a method which would permit interlock of complexly drawn color areas, Paul Clinton developed a polymer drawing process deriving directly from Milant's research. [4] Subsequently, Harry Westlund undertook research which extended the possibilities of polymer reversal to encompass zinc plates. [5] Since that time polymer reversal processes have been regularly employed at Tamarind and in other workshops.

Although it is probable that acrylic polymer emulsions made by other manufacturers could be used in this process, all of Tamarind's experience has been with Liquitex, manufactured by Permanent Pigments, Inc. The distinction between Liquitex Polymer Medium, Liquitex Matte Medium (flatted with colloidal silica), and Liquitex Matte Varnish (made matte with hard wax and colloidal silica) must be carefully noted. They are not interchangeable.

In the article that follows John Sommers describes current practices at Tamarind.

POLYMER TRANSPOSITION
by John Sommers

Like the shellac reversal method, the polymer reversal process is based upon creation of a mask which will cover counteretched negative areas with a material insoluble either in water or lithotine, but which has a solvent compatible with lithographic procedures.

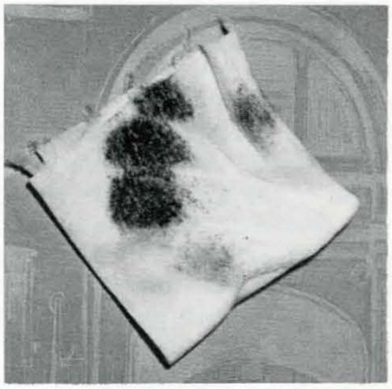
In earlier experience with polymer reversal techniques, many problems have been encountered, including incomplete reversal of negative areas caused by incomplete counteretching; or acid-tint effects in flat areas due to heavy buffing, improper curing times, diluted masking materials, and/or overly strong burn-out etches. Incomplete burn-out of former image areas was sometimes encountered when a printing element had formerly been in a lacquer base. Such problems and variations in results have prompted continuing research into methods which might lead to total stability and predictability in polymer transposition.

This article reports upon recent research and current procedures at Tamarind in making polymer reversals of images drawn on stones and metal plates.

(1) As a necessary first step in the process, the image on the printing element must be placed in fresh ink to assist in ease of washout through the polymer mask. If the printing element is (or has been) in lacquer base, complete removal of that base and all residual lacquer is imperative before proceeding with a reversal. If any residual lacquer is allowed to remain in the image during transposition procedures, it will not be affected by the ink washout or by the burn-out etches, and hence will roll up as a grey image or as scum in the new negative areas. This problem is most often encountered with a plate in photo lacquer, since that material is among the most difficult to remove completely.

Because a complete washout of the residual lacquer will require much buffing and rubbing of the plate surface, it is critical that a very thorough gum coating be established. Three to four fresh gum films should be applied to the printing element, buffed down tightly with cheesecloth, and fanned dry after each application. Each film that is applied will reinforce the one that preceded it, giving added protection against abrasion during repeated washout. Each application will also serve to minimize the permeability of former gum films. Only after this composite gum film is firmly established should the ink be washed out with lithotine and the lacquer removed with lacquer thinner. Tamarind uses Lacquer 'C' solvent (Lith-Kem-Ko) and/or Hancolite Glaze Cleaner (Handschy Chemical Co.) for this purpose. When working with these solvents one should protect one's hands with gloves and work in a well-ventilated area to minimize breathing of fumes.

After several cleanings with fresh rags and the final solvent, the printer should again clean the surface using a soft, white cotton pad. The stain on this pad after cleaning will indicate the completeness of the lacquer removal. Several cleanings with fresh pads should follow, continuing even after removal appears complete. It should be remembered that the residual lacquer at this dilution is colorless, and that even an invisible remainder may be sufficient to cause subsequent scumming if it is allowed to remain. Photo lacquer, while more tenacious in its hold on the plate, is also more visible on the white cotton pad, and its removal is thus more easily determined.



After it is certain that all residual lacquer has been removed, asphaltum is rubbed into the image and the image is rolled up in fresh black ink (when working on a plate, only distilled water should be used during the roll-up). Talc is applied to the image and buffed in well. It is often advisable to put the image in slight relief, using alternate layers of ink and rosin on stone (or ink and talc on a plate). Such a slight build-up will assist in raising the image above the polymer mask that will later be applied. A final, thorough application of talc will then serve to protect the image both while contact paper is applied and, later, during the washout through the polymer mask.

(2) The second step in the process is to mask all negative areas that are to be excluded from reversal. After washing off any excess talc and fanning the element dry, clear untextured contact paper is used to mask margins and/or any interior areas that are not to be reversed. A gum film should not underlie the contact paper, as such a film would be dissolved by the counteretch solution, causing the contact paper mask to lift. It is possible either to apply the contact paper in a single sheet, then cutting out the mask over areas to be reversed, or to pre-cut pieces of contact paper, applying

Left: Applying the contact paper to the margins of the image. **Right:** Burnishing the edges of the contact paper for firm adhesion.

them where needed. In either case, a burnishing tool of polished metal or bamboo is used to burnish down all edges of the contact paper mask.

(3) The stone or plate is now counteretched. A range of counteretching materials exists for each printing element. The character or delicacy of the image should determine the choice of counteretch.

On stone, an acetic acid counteretch (one part glacial acetic acid to fifteen parts distilled water) may be used for strong images which will withstand its corrosive effects. An alternative for use on stone is a citric acid counteretch (one-quarter level teaspoon of citric acid monohydrate crystals to ten ounces of distilled water). The counteretching action of the citric acid mixture is slower than acetic acid; it does not actively react with the stone to bite away its grain (taking delicate passages with it in the process), but only lifts the adsorbed gum film, revealing the sensitive stone beneath. Additions made after use of a citric acid counteretch are not resting on a layer of salts resulting from a chemical reaction, and thus may be etched in a manner similar to fresh drawings. When used in the reversal process on stone, the non-corrosive nature of the citric acid counteretch assures reversal of the most delicate passages, as they emerge from the counteretch procedure intact.

The counteretch is applied generously in a large pool and moved about with a large brush. The bristles of the brush must move over the surface, contacting all parts, their abrasion assisting in removal of the adsorbed gum film. After one minute, remove the counteretch with a sponge and fresh water. This counteretch procedure is repeated three times; the stone is

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Number 2 / July 1974

Editor: Clinton Adams

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Tamarind Technical Papers are published at irregular intervals by Tamarind Institute, 108 Cornell Avenue, SE., Albuquerque, NM. 87131. No part of this publication may be reprinted without written permission. Subscription rates: four issues, $12.00. Single copies, $4.00. Tamarind Institute is a division of the University of New Mexico operated in association with Tamarind Lithography Workshop, Inc., Los Angeles.

The editor acknowledges the assistance of Garo Antreasian, Professor of Art, University of New Mexico, who has made a number of helpful suggestions with respect to the form and content of the technical papers. References to TBL in articles and footnotes are to *The Tamarind Book of Lithography: Art and Techniques* (New York, Abrams, 1971). Unsigned notes and articles are writen by the Editor.

Above left: A rabbit hair brush is used to apply the counteretch. **Center:** The Liquitex is poured on the stone. **Right:** The Liquitex is spread evenly over the surface.

Below: The polymer coating is buffed with clean cheesecloth.

then washed with fresh water and fanned dry.

Aluminum and zinc are counteretched most successfully with Richgraphic Counteretch #0108, mixed two ounces to the gallon of distilled water. Most other counteretches for aluminum contain hydrofluoric acid and are too corrosive to be used without grain damage and image loss. A truly gentle counteretch for zinc has yet to be formulated.

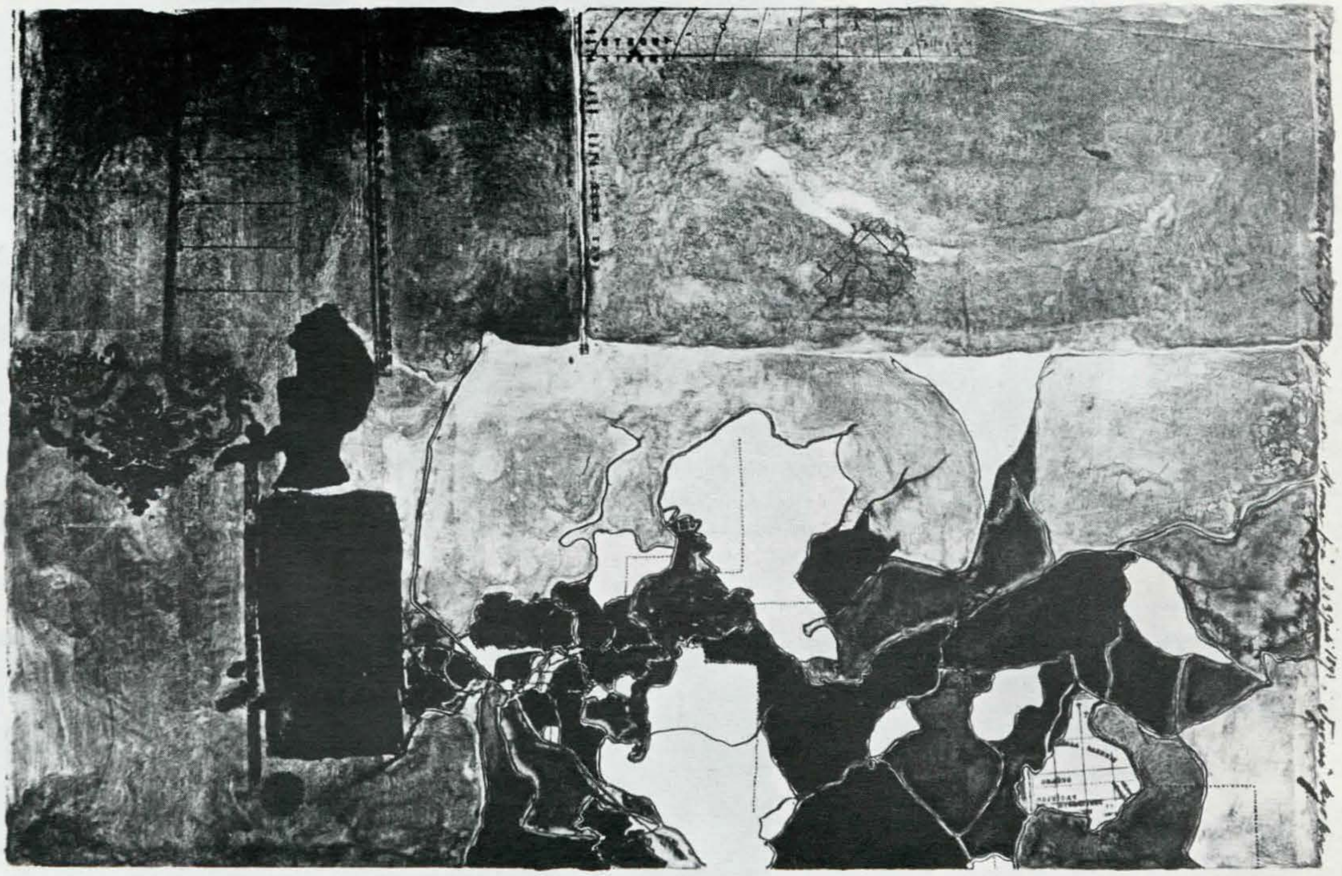
The Richgraphic counteretch mixture is flowed onto the plate and moved about with a soft brush for two minutes. Again, the soft abrasion of the brush assists in removal of the adsorbed gum film and keeps fresh counteretch material in contact with the grain surface. The solution is removed with a zinc or aluminum counteretch sponge; the procedure is repeated three times; the plate is washed with the appropriate sponge and distilled water, and is then fanned dry.

(4) The polymer mask is now applied. As work begins the following materials should be at hand: several new pieces of cheesecloth cut into 30 inch lengths and formed into soft pads; a quarter section of a new sponge, dampened and squeezed out; a sheet of plastic, foil, or waxed paper in which later to wrap the sponge; and a jar of Liquitex Polymer Medium.

The Liquitex Medium is poured on to the stone or plate and spread about with the quarter sponge until the surface is liberally coated. The quantity of medium used is determined by the area to be covered. This coating is allowed to rest on the surface for a few moments and is then softly buffed down with a clean, soft cheesecloth pad. Buffing of the Liquitex film is critical, since it is here that one begins the building of a flawless and even polymer mask. The buffing procedure that works best uses very

Above left: The contact paper must not touch the polymer surface as it is removed. **Center:** The ink is washed out through the polymer mask. **Right:** the burn-out etch is applied and kept in motion with the brush.

Above right: The gum and asphaltum are washed away. **Below:** Brisk passes of the roller bring up the image quickly.



The stone as originally drawn [T74-183] by John Sommers.

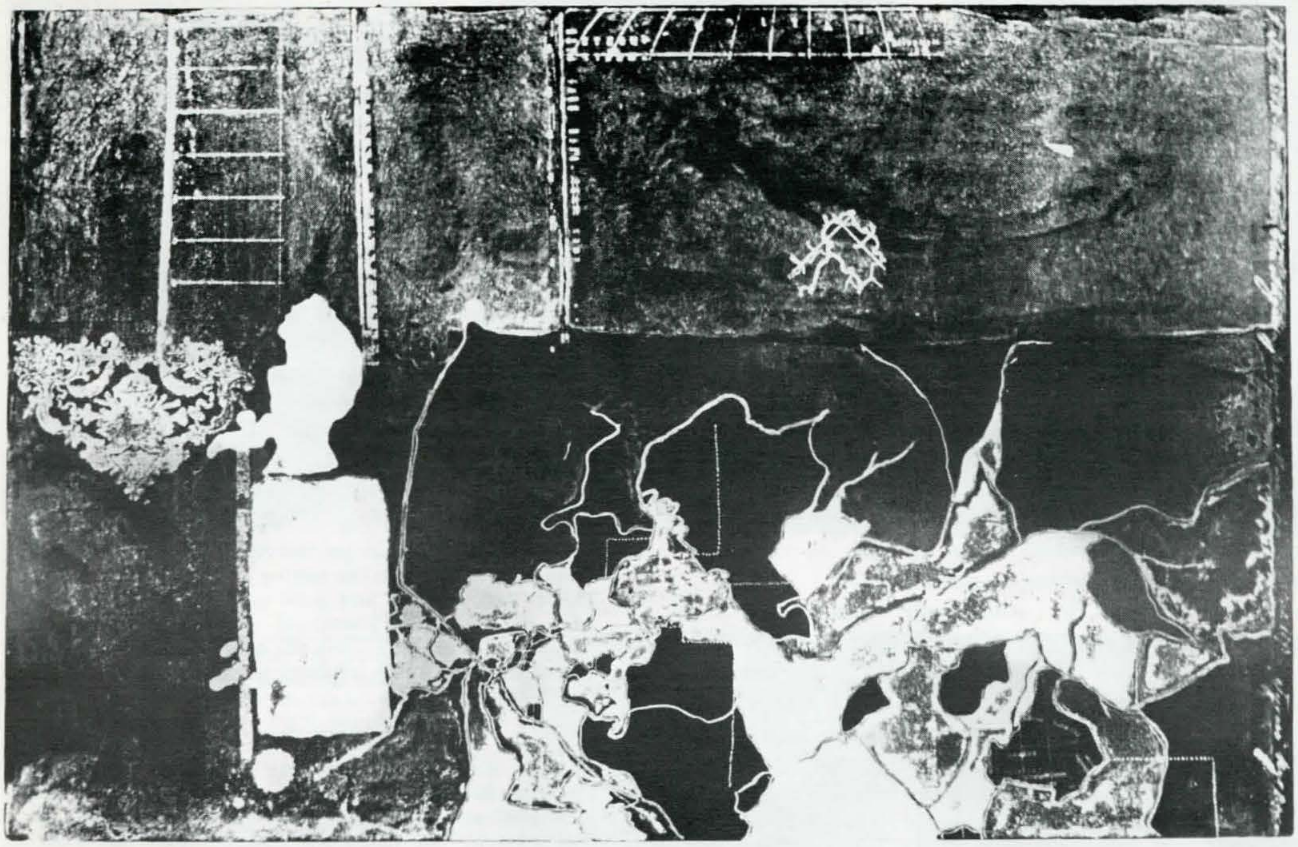
light pressure, first across the plate, then with a circular motion. One must be very sensitive to the drag created under the pad, as that is the index to the thinness of the coating.

In this process a total of five coats of the polymer medium is to be applied to the plate or stone. It is important to note, however, that each coat of the medium must be thoroughly dry before the next is applied. Liquitex Polymer Medium cures as it dries, becoming insoluble to water or to further layers of medium only when it is completely dry. Tamarind practice is to allow each of the first three applications to dry for 35 minutes.[6]

The fourth and fifth applications, which should dry for 45 minutes each, are the most difficult to buff down smoothly and evenly. Extra care must be taken to prevent a build-up of polymer material at the edges and in the corners of the contact paper mask. If only parts of an image are being reversed, each should be treated individually so as to exercise maximum control. As central, open areas of an image will buff quite easily, care must be taken not to buff them too thinly. Tight, closely drawn areas will, on the other hand, tend to collect an excessive build-up of Liquitex unless they are well buffed.

Each application must be buffed with a fresh cheesecloth pad. Each pad must be washed and snapped out immediately after use to prevent the Liquitex from drying permanently (and insolubly) in the cloth. The quarter sponge is kept from drying between applications by wrapping it tightly in foil or plastic. After the final application the sponge should be washed very thoroughly.

When the polymer film has completely cured the contact paper is removed. As a precaution against any damage to the inked areas of the stone or plate, talc should now be applied (both rosin and talc on stone) and buffed in well. A



The image after transposition.

coat of gum arabic should then be spread with the hand so as to detect any fragments of residue from the contact paper which may remain on the surface. These (if any) should be massaged away with the gum, the gum wiped up, and fresh gum applied. This gum film is buffed down smoothly and tightly, and the stone or plate is fanned dry.

(5) Now, with the Liquitex mask firmly in place and the contact paper removed, the process of washout, burn-out, and roll up may begin.

The old ink is first washed out with lithotine. Slow, careful, persistent work is required, since the ease of the washout will vary with the thickness of the polymer mask. Adequate amounts of lithotine, soaking, and slow, steady work will serve to release all of the ink from the image. A final washout with a white pad and lithotine will assist in determining the cleanliness of the image. Once it is clean, the stone or plate is wiped and fanned dry.

(6) The next step is to burn out the exposed grease reservoirs in the original image areas.

Tests have shown that strong burn-out etches are of no greater efficiency than repeated mild etches and, further, that too strong an etch can cause unwanted acid-tinting in areas where the polymer film may have been too thinly buffed.[7] If the original image on the stone or plate has been seated for a long time, very deep grease reservoirs will have been formed (particularly on stone and zinc) which will require repeated applications of the burn-out etch. As the etch is applied it should be massaged into the reservoirs with a sponge; grease reservoirs not completely destroyed by the burn-out etch will return as incomplete or scummy reversal images. Such problems generally cannot be corrected.

Burn-out etches for stone are mixed with

eight drops of nitric acid to one ounce of gum arabic. Such an etch will have a pH of ± 1.5 when mixed in quantity. The pH should not go above 2.0 or below 1.0.

Burn-out etches are usually applied three times. The first application is made with a brush, sponge or pad. Some rubbing of the image with the pad will further release unseen grease and help to seat the etch. After two minutes, the used up etch should be removed and a second etch applied. The third application is made in the same way, however after two minutes of agitation on the surface, it is "dragged down" with a cheesecloth, not removed, and allowed to rest on the printing element for fifteen minutes. The element is then washed off, fresh gum arabic applied, and tightly buffed down. The gum used at this point should be of the highest possible pH; gum with a pH approaching 3.0 is dangerous, since activation of its acid content with water during the wash off can cause water burn in the newly-forming, unstabilized grease areas.

Burn-out etches for aluminum consist of phosphoric acid and hydrogum. The acidity should not go below a pH of 2.8. Cellulose gum is used as the burn-out etch on zinc; this gum has a pH of ± 3.5 (Handschy Chemical Co.). A small amount of acidified cellulose may be added if a very heavy image is to be burned out, but not more than 25% of the total by volume. The procedure for application and manipulation of burn-out etches on metal plates is the same as on stone.

(7) Lacquer thinner is now used to remove the Liquitex mask through the fresh gum arabic or hydrogum film. The lacquer thinner is poured on to the element, and the polymer film is gently massaged with a clean wash out cloth. Two or three applications will suffice. Complete removal of the polymer mask is essential. Visual observation will determine when this has been done.

(8) In preparation for the roll up of the reversed image, two coats of asphaltum are applied, buffed smooth and fanned dry.[8] Distilled water should be used in washing off the plate, so as to prevent water burn from salts present in tap water. The use of clean paper pads in the washing of the new negative areas will prevent contamination with gum sludge. Advance preparation of a roller and ink slab with a generous amount of ink will also assist in preventing water or sludge burn. So as to provide good grease content to the newly opened areas, an ink having such a content should be used (such as Charbonnel Noir a Monter). Speed is essential; from wash off to first roller application, one's movements should be rapid and calculated.

(9) With the new image now rolled up, the final step in the process is establishment and stabilization of the new grease reservoirs. The adsorbed gum film in the new negative areas must also be fortified.

On stone, rosin the image well, apply talc and buff. On plates use only talc. Apply the first etch with a soft brush, using etches as follows:

Stone: nine drops nitric acid in two ounces of gum arabic (pH ± 2.8).[9]

Aluminum: one-third plate etch (pH ± 2.4) to two-thirds hydrogum (pH ± 4.8).

Zinc: equal parts cellulose (pH ± 3.5) and hydrogum (pH ± 4.8).

After an application time of about three minutes on stone (one and a half to two minutes on plates) the etch is buffed down tight. The element is allowed to rest for a half-hour to an hour, after which it is freshly gummed, washed out, rolled up on an asphaltum base, and given a second etch. Strength of the second etch will be comparable to the first. If desired, the new image may be put in a lacquer base prior to proofing.

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1. The relief method was introduced at Tamarind by artist Frederick O'Hara in the spring of 1961.
2. The relief, shellac and gum methods of transposition were all in use at Tamarind between 1961 and 1970, the choice depending upon the character of the artist's work. Since 1970 the polymer acrylic process has been the method of choice.
3. Milant, Jean. Aluminum Plate Reversal (1969), an unpublished research report, Tamarind Technical Archives. Because of the highly corrosive properties of the hydrofluoric acid counteretches then used on aluminum, Milant developed a method which did not use a counteretch, but depended instead upon the high pH (9.2) of Liquitex Matte Varnish to remove the adsorbed gum film on negative areas.
4. Clinton, Paul. Polymer Drawing Process (1970), an unpublished research report, Tamarind Technical Archives.
5. Westlund, Harry. The Polymer Reversal Method: its Limitations and Characteristics Applied to Zinc Plates (1971), an unpublished research report, Tamarind Technical Archives. In this report Westlund described the dilution of the Liquitex medium with 40% water, the use of a counteretch prior to application of the polymer, short curing times, light buffing, and strong burn-out etches. As in the process earlier described by Milant, Westlund made use of Liquitex Matte Varnish.
6. Drying times as determined at Tamarind Institute were at very low humidity (from eight to sixteen percent). At higher humidity, the curing times given in this article may have to be extended.
7. If in some circumstances acid-tinting is desired, it is possible to control the buffing of the Liquitex film so as to produce it.
8. If in doubt as to the condition of the new image to be rolled up, it may at times be desirable to apply a lacquer base before using asphaltum.
9. For a discussion of the consequences of the pH of etches made by the drop method, using gums which vary in their initial pH, see Tamarind Technical Paper Number 1, page 4.

John Sommers, Tamarind Master Printer and Associate in Art, UNM, is Tamarind Studio Manager. Photographs by **Mel Buffington.**

A SUPERIOR SCRAPER BAR

Few elements of equipment can more directly affect the printing of a lithograph than can the scraper bar. No matter how fine the artist's drawing or how precise the printer's processing of the stone, use of a faulty scraper bar can only lead to coarse or streaked impressions.

Traditionally, scraper bars have been made from seasoned straight-grained maple and covered with heavy leather (see TBL, section 13.3, pages 347-9). Such bars require constant care and maintenance so as to keep them in condition for fine printing. The leather must be frequently dressed and cleaned; often it must be tightened to compensate for stretching. Leather lacks the capacity to recover from nicks or dents that may occur in use. Above all, suitable leather of high quality has become increasingly difficult to obtain, and price-inflation has been severe.

Replacement of leather with Chemplast Teflon tape (one inch wide, 3/32 inch thickness) results in a far more durable scraper bar. Although the initial cost is high, Teflon wears exceedingly well in very heavy useage. It has a remarkable capacity to recover from dents, and suffers no permanent harm even under the extreme test of printing to the edges of the stone. Unlike leather, it may quickly be wiped clean of tympan grease and needs no special treatment to keep it in condition for daily use.

The re-covering of existing wood bars with Teflon rather than leather thus represents a considerable step forward. It does not, however, solve a further problem. Straight-grained maple of consistent and even hardness has, like good leather, become very difficult to find. The other hardwoods which might substitute for maple are in equally short supply; the woods that are available are usually low in quality, improperly cured, warped, or have flaws that will lead to uneven wear.

Recognizing these problems, Bruce Porter undertook a Tamarind research project to develop a new type of scraper bar possessing superior printing qualities and great durability.[1] His aim was to find a material from which a solid, unitary bar might be formed, eliminating both the wood and its leather or Teflon covering. Porter's prior experience as a toolmaker made him aware of the problems that would be inherent in the use of metal, and he therefore chose to investigate the possibility of using a piece of solid plastic. As Teflon in the required amount would prove prohibitively expensive, Porter's attention turned to other plastics.

Several prototype bars were made and tested. As a result of these tests and subsequent Tamarind experience over a period of more than a year, we may now recommend use of high density polyethelene, 67 shore D hardness. This material, which has a compression strength of 2000 pounds per square inch, will not break or dent and may be easily machined with standard tools used for wood.

Although such polyethelene bars can be used directly in contact with the tympan sheet, the bars in use at Tamarind have been covered with Teflon strips, just as wood would be. Our experience thus far has led to the conclusion that there is value in retention of the Teflon covering, for in this way the extreme hardness and rigidity of the polyethelene is combined with the compressibility and cushioning qualities of the Teflon. Maintenance of such bars is quick and easy.

In order to avoid wear of the Teflon covering it is important that the polyethelene bar not be milled to a narrow sharp crest. A slightly rounded or blunted top edge produces a bar that combines good wear with superior printing quality.

High density polyethelene, like Teflon tape, may be obtained from most commercial plastic distributors. A recent price of a sheet of the polyethelene, 3/4 x 48 x 96 inches, is $160.82. The Teflon tape, 1 x 3-32 inches, is sold in 6-1/2 pound rolls at $9.05 lb. The cost of a 24-inch polyethelene bar, Teflon covered, would thus total $3.69 at current prices (labor excluded).

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1. Porter, Bruce. Experimental Scraper Bars (1973), an unpublished research report, Tamarind Technical Archives.

ESTIMATING TIME IN THE PRESSROOM

Creative work cannot be forced in time. However long it may take to bring a fine lithograph into being, that is the amount of time that must be provided. There can be no debate on this.

Yet in the collaborative relationship, where an artist and a master printer work closely together, making use of the complex facilities of a lithographic workshop, it is evident that consideration must be given to time as a factor--and often a limiting factor--in determination of the work that can be accomplished within a given period of weeks or months. Any means which will permit the making of reasonably accurate projections or estimates will be useful and of value.

How long, for example, is it likely to take to complete a four-color lithograph in an edition of fifty impressions? To what degree do size and techniques affect the time that might be required? When is Artist X likely to finish a project so that Artist Y may begin another?

Questions such as these must be asked--and at least tentatively answered--if a professional workshop is to plan its calendar and establish its pressroom schedule. While recognizing that the time required to proof and print specific lithographs may vary widely through a range of time, estimates must be made upon averages based in past experience, and these estimates must be as reliable as possible, given the uncertainties always present in creative work.

During the 1960s Tamarind collected data with respect to the time required for the proofing and printing of a great many lithographs. As might be expected, the maximums and minimums were widely separated. Even so, the data that were assembled permitted calculation of the average amounts of time that would be required for certain kinds of work, and further indicated that a very high percentage of all work undertaken would fall within a normal range. These data and conclusions drawn from them were published in Calvin J. Goodman's Business Systems for a Lithographic Workshop (1968).[1] Since then Tamarind has continued to accumulate information as to the time required for completion of each edition printed in its workshop. Based on this experience, we have departed quite substantially from the procedures outlined by Goodman in his manual.

We have two objectives:

(1) We want to be able to estimate the amount of time that an artist's project may require for its completion. These estimates when made are not and should not be used to circumscribe the artist's freedom or to force completion of the work within artificial boundaries of time. They are estimates only, and are made primarily as an aid in determining the pressroom schedule--a schedule which is necessarily always subject to change.

(2) After the fact, we want to be able to measure how much time the project actually took and to relate this time to established averages. Measurements made at this point may be helpful in projecting future work by the same artist or other work that is similar in character. In a custom printing situation such information will also be of value when price estimates are given.

Following is a description of current Tamarind practices. On first reading it may seem pedantic to talk about the fleeting moments of time required to print one square inch in one impression, but large amounts of time are made up of very small components, and only an analysis which reduces all data to a common basis is adequate to the task. The calculations, although seemingly complex, are quickly made with an electronic calculator.

As a project progresses a record is kept of

the total printer-time devoted to it (including conferences with the artist, processing of the stones or plates, ink mixing and clean-up, proofing, run-time, etc.). If the printer has an assistant at the press then each hour of press-time equals two printer-hours.

As an example, a 3-run lithograph by Walter Askin [T72-267] required 32 hours of make-ready time plus 16-1/4 hours of run-time, a total of 48-1/4 hours.

The number of impressions in the finished edition (including the bon à tirer, all artist's proofs, the numbered edition, etc.) is multiplied by the number of press-runs.

In our example, there was a total of 32 impressions. 32 x 3 (press-runs) = 96 RXI (runs times impressions).

The total hours are divided by the RXI and multiplied by 60 to convert from hours into minutes. The result is the number of minutes of printer time per impression.

30.15 minutes were required for the printing of each of the 32 impressions in the Askin edition, with the calculation as follows:

$$\frac{48.25}{96} \times 60 = 30.15$$

Thus far we have taken into account the printer-hours required, the number of colors used, and the number of impressions printed. The size of the print is another principal factor in determining total time. Small prints can be printed more quickly than large ones. Our next step is thus to divide the number of minutes that it took to print each impression by the size of the print, expressed in square inches.[2]

The Askin lithograph was 26 x 20 inches (520 square inches)

$$\frac{30.15}{520} = .0580$$

The factor .0580 is then compared to our average for a lithograph of approximately this size.[3] In the case of the Askin lithograph, this is .0600. When .0580 is divided by 600, the result (0.97) indicates that the total time spent in the printing of this edition was 97% of the average amount of time that such a project might have been expected to require.

Reversing these calculations provides a means to estimate printer-time (and press-time) before a project is begun. How long, for example, will it probably take to complete a 5-color lithograph in an edition of 40 impressions, with a sheet size of 22 x 30 inches?

The formula is as follows:

$$\frac{S \times A}{60} \times RXI = T$$

S = size in square inches
A = average time (with decimal and zero restored)
T = total time (printer-hours)

or

$$\frac{660 \times .0400}{60} \times 200 = 96.8$$

The estimate thus reached is, of course, no assurance whatsoever that the project when actually completed will actually have taken 96.8 hours of printer-time. It may prove to take more, or less. Technical problems at the press, corrections by the artist, or changes in image or color could all contrive to consume time; or, alternatively, the project could sail ahead with speed and decisiveness. This cannot be predicted without a crystal ball.[4] The calculations are simply the best means available to make reasonably accurate estimates based in past experience, and as such they have demonstrated their value.

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1. Available from Tamarind Institute ($6.50, postage paid).
2. If metric measurements are employed, this factor can be expressed in square centimeters with equal ease.
3. Our method in determination of these averages was as follows: A graph was constructed with square inches on the horizontal scale and the time factor on the vertical scale. All editions completed in the workshop were entered on the graph by placing a dot at the appropriate intersection of the horizontal and vertical scales. After entering several hundred editions in this manner, a pattern became evident, and it was possible to draw a curve in such a manner as to place approximately one half of the dots below it, the other half above it. This having been done, a table of time standards was prepared by reading off the points of intersection on the curve. These data are given below. It should be noted that because they reflect specific characteristics of the Tamarind workshop (including its printer-training program) they could not be used in another workshop without adjustment. The procedure through which they were determined could, however, be used unchanged.

Sq. Inches	Standard	Sq. Inches	Standard	Sq. Inches	Standard
100	.1200	500	.0480	900	.0304
150	.0960	550	.0452	950	.0288
200	.0820	600	.0424	1000	.0272
250	.0740	650	.0400	1050	.0260
300	.0660	700	.0380	1100	.0252
350	.0600	750	.0360	1150	.0244
400	.0560	800	.0340	1200	.0240
450	.0520	850	.0320		

4. Past experience with a specific artist or technical process might be used to adjust the figures given by the formula. Knowledge that a number of Artist Y's past projects have been completed at 90% of the workshop's average time might cause a studio manager to assume that Y's work would require only 87 hours instead of 96.8. Or, conversely, knowledge that one of the five runs will make use of several colors and a complex blended-inking pattern might be reason to assume that more time will be required, perhaps 102 hours instead of 96.8.

FOOTNOTES:
a column of comments from readers

To bring about an interchange of views and technical information among lithographers is a specific aim of the Tamarind Technical Papers. This column will report upon comments and letters received about articles that have appeared in previous issues.

Two such letters were received in response to the article, "Dessin à la Pointe: Lithographic Stone Engraving," which appeared in TTP, Number 1.

Wayne Kimball wrote to tell us that a little better than a year ago he did two or three lithographic line engravings in which he deviated significantly from the "classical" technique outlined in TTP. "The procedure I used," he comments, "was simpler and less time-consuming, and the images were easier to print than any engraving I had previously encountered.

"After graining a stone to a #320 surface, I gummed it with a mixture of cellulose gum and gum arabic and buffed it down tightly with cheesecloth." Kimball did not add red chalk to the gum as suggested in the TTP article, but he notes that this could, of course, be done. "Cellulose gum was chosen because it is not as brittle as gum arabic nor as inclined to chip where lines intersect. After completing the engraving (and my tool was simply a sewing needle mounted in a pin vise), I cleaned the lines thoroughly with lacquer thinner. I then rubbed a couple of films of plate lacquer into the lines and followed this with an asphaltum rub-up of the image. After this, I washed off the gum film with water and rolled up the stone. The image took ink as readily as a crayon drawing, and there was no need to build up the lines with successive layers of ink and rosin, nor did I have to apply a hot etch which might destroy the grain and cause scumming and bridging where lines cross. The stone was given a moderately strong etch (15 to 18 drops of nitric acid in an ounce of gum arabic). Following that, printing went beautifully, and the stone was no more difficult than usual to regrain."

Not long after that, Kimball had a conversation with Bob Evermon who told him of a still different engraving technique which was used extensively in the commercial stone-printing industry in the latter part of the nineteenth century.

In reply to a Tamarind query, Evermon wrote from Vancouver, reporting upon these methods. He notes that he has used them extensively in his own work as well as in class instruction.

He first grains the stone as described in the TTP article. He then gives it a ten drop etch, after which he buffs down the gum and allows it to dry for fifteen minutes. At this point he uses a damp sponge to take off most of the gum, leaving only a little gum-water on the stone. Again he buffs it down until dry. "This is very important," Evermon cautions. "It should look like there is nothing on the stone. You do your drawing now with the micro-film of gum on the stone. In this way the engraving can be done very freely, the needle feeling just as it would on raw stone." The drawing is done as described in TTP, taking care not to incise the lines too deeply.

As the first step in processing the stone, Evermon rubs ink thoroughly into the incised lines. He then sponges the stone with water and rolls it up with a medium black ink. "There may be some scum at this point," he says, "but with good rolling it should not stay. After the stone has been rolled up, use rosin and talc, and apply a mild second etch. I use two drops of phosphoric acid and three drops of nitric in an ounce of gum. The phosphoric seems to clean up the stone very well. When I begin printing I will sometimes print on a lacquer base to bring up the lines a little."

He notes that additions are easily made at this point, and that such additions are often needed because the lines are so very fine. The procedure used in making additions is, first, to roll up the stone quite fully; use rosin and talc; then gum the stone with straight gum ("or maybe two or three drops of acid in the gum if the stone has been scumming"). Buff it down and let it dry for fifteen minutes, then sponge it off as before, and buff down the gum-water just as when the initial drawing was first made. Additions may now be made by engraving as before and the processing repeated.

"In the good old days," Evermon adds, "you would never print from the original engraved stone. You would build up the lines with the repeated applications of rosin and ink [as described in TTP], then roll transfer ink on top, at which point you would transfer the image to a new stone. In this way the lines would be placed on the surface of the stone."

As is so often the case in lithography, these alternate methods--the "classical" method discussed in TTP, as well as those described by Kimball and Evermon--should be considered options of choice. Ultimately it is the specific character of the artist's work, as well as the preference of the printer, that should determine the method to be used.

Tamarind Master Printer **Wayne Kimball** will join the faculty of California State University, Long Beach, in September. Former Tamarind printer **Robert Evermon** now teaches at the Vancouver School of Art.