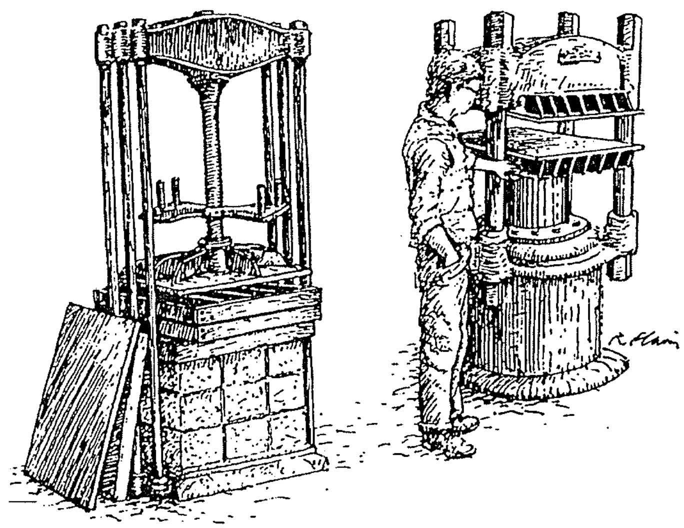
Timothy Barrett, "Western Papermaking" I & II Video Scripts University of Iowa 1994

PAPERMAKING
Five Videotapes • Written by Timothy Barrett



JAPANESE STYLE PAPERMAKING I
Simple Equipment and Techniques

JAPANESE STYLE PAPERMAKING II
Traditional Equipment and Techniques

JAPANESE STYLE PAPERMAKING III
Professional Equipment and Techniques

WESTERN PAPERMAKING I
Classroom Equipment and Techniques

WESTERN PAPERMAKING II
Professional Equipment and Techniques

WESTERN PAPERMAKING I

Classroom Equipment and Techniques

Videotape Script, University of Iowa Center for the Book, ©1994

This tape offers an intermediate approach to making western hand made paper in a well equipped classroom or personal studio workshop. Introductory texts for beginners, are cited in a bibliography which accompanies this tape.

Viewers with a particular interest in western papermaking using professional equipment and techniques should consult the other tape in this series.

It is a natural assumption that paper is made in the mould as the sheet is formed. In fact, the quality and character of any sheet are determined well before sheetforming, during the selection and preparation of the raw material.

Fibers used in modern western papermaking can be divided into two groups. The first group includes commercial pulps or pre-processed materials like rag half-stuff, cotton linters, and sheet pulps of flax, abaca, sisal and hemp. These materials have been cooked and often bleached by the manufacturer, leaving less control to the papermaker, but they are easier to work with and less expensive. Later in this tape we will be working with the rag half-stuff.

The second group is "raw fiber" and includes such materials as cotton, flax, abaca, sisal, and hemp. All of these fibers are new, naturally colored, unprocessed materials that generally require cooking before beating. However, these fibers allow the greatest range of finished paper characteristics.

Cooking proceeds as shown in the Japanese style tapes in this series and includes presoaking the fiber overnight, mixing an alkali into warm water, heating to boil, cooking and rinsing.

Cooking will help separate the fiber, lighten its color, and improve the permanence of the finished paper by removing non-cellulosics. Compare this sheet made directly from the raw flax fiber with a sheet made from cooked and well rinsed fiber.

Precutting western raw fiber before soaking and cooking makes subsequent steps much easier. Occasionally fiber can be purchased pre-cut, as is the case with the flax fiber on the left.

More readily separated fiber like raw cotton, flax and hemp can be cooked in lime or soda ash. Fibers more tightly bound by lignin, waxes and gums – such as sisal and abaca are likely to require a stronger solution made from lye.

A typical cooking solution would contain between 5 and 15 grams of chemical per liter of water. One liter of solution is required for each 60

grams of dry fiber. Manufacturer's safety recommendations should be followed with all chemicals.

The key fiber preparation tool in western papermaking is the Hollander beater. Beaters vary in design but all have the same key components as this small laboratory beater. The tub is fitted on the inside with a midfeather, backfall and bedplate. The bedplate consists of a set of bars mounted vertically in the bottom of the machine. The roll bearings are positioned so the flybars on the roll pass just above the bars of the bedplate. An adjustment mechanism is used to vary the distance between the moving flybars on the roll and the stationary bedplate. Fully assembled, when the machine is filled with water and fiber and turned on, the roll will draw the fiber underneath where it is forced to pass between the bedplate bars and the moving flybars on the roll. The fiber/water mixture is thrown over the backfall where it returns for continuing passes under the roll. Normally the hood would be in place during operation.

Beating is essential in western papermaking because of the control it gives the papermaker. In these specimens made from raw flax, short beating times typically give a soft, opaque sheet which generally has a rougher formation quality and surface. Prolonged beating times give a hard, translucent, and more evenly formed sheet.

Regardless of the raw material, changes in paper qualities result because the fiber is gradually shortened, fibrillated, softened, opened up, and plasticized in the presence of water. All of these effects produce more sites where water molecules can attach. As beating continues, the fibers become better prepared to bond more and more tightly with each other during sheetforming, pressing and drying.

The best way to understand beating, and papermaking itself, is the following procedure for making test sheets. This is also a standard method recommended for evaluating a new pulp, or a new or recently rebuilt beater.

In this case we are working with 350 grams of Cheney 865 cotton half stuff. The fiber was soaked 20 minutes in 5 liters of water , added to 20 more liters in the running beater, and allowed to circulate for 5 minutes. Roll to bedplate pressure was then applied, in this machine, by adding a standard weight to a lever arm that forces a moveable bedplate toward a stationary roll.

As soon as this pressure was applied, the starting time was noted. Twenty minutes later, two 400 milliliter samples are taken.

Each sample is used to make a sheet in the deckle box. The water used throughout this tape is alkaline and has been treated to remove iron, chlorine and particulate matter. These sheets are couched onto a previously dampened felt and tagged, noting beating time and "a-d" for air dried and "r-d" for restraint dried. Both notations are in preparation for two different drying methods. Meanwhile the beater continues running and every 20 minutes two additional 400 milliliter samples are taken and made into sheets. This routine continues for a total of 160 minutes. It might continue longer if the papermaker is interested in especially hard, translucent papers.

When all sheets are made, the pile is taken to the press and squeezed to expel excess water. This press is capable of generating around 50 tons of pressure, indicated as 30 on this gauge. Considerably less pressure would be adequate, if the sheets were stacked 1-up instead of 4-up.

After pressing, the pile is removed from the press and the sheets are parted from the felts. For each beating time, the "a-d" sheet is set onto mesh racks to air dry unrestrained. The "r-d" sheets are accumulated for restraint drying in the stack dryer.

The stack dryer is set up so each piece of handmade paper is sandwiched between at least two blotters. The blotters, in turn, are sandwiched between two sheets of fluted tri-wall board. When the entire assembly is in place, a plastic shroud attached to a fan is drawn up over the top tri-wall board. This is followed by a board, an inner tube, and another board. Finally a screw jack is used to put pressure on the entire pile. The fan is turned on, gently forcing air through the flutes in the cardboard.

The moisture in the handmade paper is drawn into the blotters, from there into the tri-wall board and then through the flutes, into the airstream. The net affect is to dry the paper while it is under pressure and the result is a perfectly flat sheet. The compressed inner tube helps keep pressure on the stack as it shrinks during drying. In a day or two the sheets will be dry and can be removed.

Once the beater test sheets are dry, the effects of increased beating time and drying method are apparent. The air dried sheets shrink much more than the restraint dried sheets, especially at longer beating times. Before proceeding, the tags are removed from each sheet and all relevant information is written directly on the sheet.

The air dried sheets can be flattened by spritzing with water to make them relax. The highly beaten sheets often need a bit more water. Once the sheets are dampened, a second felt is moistened and placed on top, followed by a sheet of plastic used to wrap the entire pile. After the paper is left to humidify overnight, it is loaded into the stack dryer where it will dry within a day.

When the beater test sheets are dry they can be compared for differences in color, surface, translucency, hardness and other characteristics. The air dried sheets shrink more and have a rougher surface when compared with the restraint dried sheets.

Although not apparent on camera in these specimens, prolonged beating times can give radically different papers from the same starting fiber.

By viewing the test sheets with a backlight, the gradual improvement in formation quality can be seen.

Later, when planning production of a batch of paper, desired qualities can be identified in one sheet of an array of test sheets, and the approximate required beating time noted.

For artists working with paper pulp as a medium, beater test sheets can be the first step in developing a personal pallet. For anyone who takes the time, this exercise is a fascinating lesson in the interrelationship between cellulose fiber and water during papermaking.

To make full size sheets, a beating time of 60 minutes was chosen, and a series of identical loads were beaten.

Pulp was added to the vat until test sheets stood between 2 and 3 millimeters high after the deckle was removed.

Knots and pills can form on the hands as a result of rubbing during sheetforming. To keep them to a minimum, a bucket of fresh water is kept nearby for rinsing.

Much of the secret to western sheetforming is in the "shake". As soon as the mould is raised and leveled, it is given a series of characteristic shakes or jiggles to even the pulp solution on the surface of the mould. If this is not done precisely and at the right times, the pulp will settle unevenly, leaving a poor quality sheet.

Now the correct shake again. Notice how the far edge of the mould does not go under the surface of the vat mixture.

Overshaking can spoil the sheet.

As can undershaking.

Couching also requires experience to avoid problems. Initially, the trick is setting the mould down on the felt at the proper angle. Notice how the felt is marked to indicate the position of the sheet below.

Insufficient contact between the fresh sheet and the felt can cause the end of the sheet to flip back on itself. This is usually a result of not applying enough pressure from above, or felts that drop off too much at the near and far end. In the latter case, a stick can be placed under one or both ends of the press board. Since the accumulating stack, or "post", is actually resting on two boards, the stick between the two allows the top board to bend when the next sheet is couched. This increases the pressure and contact at the near and far end.

Watching the student and teacher interact can be a very helpful way of understanding problems at the vat and at couching.

So you want the last part to just wash over...

A little bit of it can wash over, yeah.

Okay.

You want your hands in the middle of the sides.

So does it go in steep?

Ah, actually it goes in like this and maybe a little further out too. Just dunk it down. That's good.. Right. Now a little shake; side to side, front to back. Okay, now, what happens is....

It's so uneven.

Well, as you came out it was tipped so it slid that way and then you tried to correct it and all that time it was draining, and you lose time to work with it. So when it comes out it needs to absolutely horizontal and you need to start working with it right away.

Okay.

So let's take the deckle off. Just set it up here. And then you can actually...let me show you how this works: you can actually turn this back in by turning it over and just touching it to the surface....

Mmm.

And most of it should come off. Now, we do have to mix that in really well. And just try it again. If it's not mixed in real well we get these knots and clumps.

Yeah.

Okay, so this time, just ah. When you bring it up....

When I bring it up, I bring it up straight?

You bring it straight up, and it's got to be level. Ah, there's no real hurry until you make a commitment to bring it out and then it's got to come right up. So as you go in, you can go in sort of slowly. That's good. You're starting to pick it up when you're worried about it going under.

Student: When I'm still too high.

And you're starting to pick it up right about here. What you want to do is let it go down further. Let me make one and I show you what I mean. In fact, I'll tell you what I'll do, I'll make one right on top of this. We're going to have to ignore what's there. See, I'd be going fairly slowly. And then when I get down – I bring it right up.

Okay.

And while I'm at it. This shake; it's really more of a gentle kind of jiggle than it is really a shake. If you shake it....

Then you start to....

Then you spoil it. Yeah, so it's really just a little jiggle. So I think, uh, you want to go ahead and let that far edge, even if it goes under, fine – you know, just let it go down a little further, let it go under a little further, before you commit to bringing it up.

Okay.

Now once again, we're going to mix this in. Okay. Okay, now this time I'm going to kind of guide you.

Good.

Alright. Alright, now let it go down. Now pull it up! Alright there you've

got it – see you got plenty of time – side to side – front to back – a little jiggle – whoa-whoa-whoa – see that kind of get creamy?

Yeah.

Okay, whoa-whoa-whoa. You can stop. Good, good.

I tip it down?

Yeah, you can drain it a little bit this way first. Now you can take the deckle off. And now you want to stand it up this way. And just put your right hand on top for now. Just hold it there a little bit. Okay, now you're going to pick it up and set it like this. That's right. Bring it over.

... and I line up.

Okay, right. Just try to approximate where the sheet will be. And as you lean it over....

But I don't touch?

No, not until you're really committed. Okay, now push it down, and just really lean on it, and just roll right across, keep right on going. Good. Okay, that's not bad. Now this happens either because we didn't get the sheet really on top of the last one or because you really didn't put quite enough weight on it.

Okay.

Go ahead and put a felt on top of this and we'll try another. Okay, so, like, it really is underneath the surface quite a bit, I mean a lot of it slices down underneath and then it comes up like that.

So it comes down, and then goes up.

That's right, yeah. You're kind of slicing it in like this until that far edge almost goes under and then its almost as though there's a pivot right at that far side, and it just hinges, right there.

Okay.

Good, good, alright, that's much better, good, that's perfect! Now, side to side a little bit, front to back, whoa-whoa- once it goes.... That's good. It's interesting, it's possible to go a little over, you know, to shake it a little too much. And of course it's a little thick there because you still have water in that corner, but that's not bad, that's a good sheet. It's one of those things that, you know, if you're alone, and you turn the sheet back in and just try it a lot, eventually you start to get used to it. Let it drain a little bit, Okay, now this time bring it up and just set it up a little bit further. Once you commit to doing it, really lean on it as you roll across. That looks good, now push down hard as you roll across. Good. Oops!.

Now the other end.

Yeah, maybe too far this way. The pulp's starting to get really thin, and that's part of it. Let me try and make one and see if I can make this work because I think its partly just having enough pressure on it. Normally we'd be adding pulp after every sheet; we're starting to get a little thin, so that can have something to do with it. The moisture content of the felts. How

much moisture there is in the sheet, just before you couch it. A lot of things like that can make a difference... Well, see, I started to have a little trouble at the top, but notice how I really kind of, I really leaned right on top of it..

Yeah.

And that makes a big difference. It's also true that the pile's starting to get big, the felts are drooping a little bit, and they're much larger than they need be for this size paper. We really should have some smaller felts.

Once all sheets have been made they are pressed, for several minutes at 50 tons. While the paper is in the press, the mould and deckle and all other equipment are sprayed free of any wet pulp. If the pulp is allowed to dry, it becomes considerably harder to remove.

After they are removed from the press, the wet sheets are parted from the felts. To make them easier to handle, they are placed between dry blotters. The blotters can be used repeatedly until they become so damp they need to be hung to dry.

After five or ten minutes, the sheets are separated from the blotters. There are three final drying methods to choose from depending on the desired surface and feel in the finished sheet. If hung to dry individually, the paper will have a decidedly rough surface. Small pieces of blotter help eliminate marks from the clips.

For a more eggshell like surface, the sheets are stacked in groups of about 6 sheets called a "spur". In this case, only one spur is made up, but they can be stacked; separated by a felt. The spur is pressed just enough to make the sheets stick together. Both single sheets and the spur are hung to dry in the same fashion.

A third alternative is the stack dryer which will leave the paper with the smoothest surface.

After a couple of days, the spur has dried and can be taken down and parted into separate sheets. The single sheets are also taken down.

Like the beater test sheets, the air dried full size sheets are flattened by spritzing and stacking. They are wrapped in plastic and left overnight and then loaded into the stack dryer.

When all three drying procedures are completed, the finished sheets can be compared for surface feel and handle. Again single dried sheets are the roughest, spur dried sheets have a more medium surface, and stack dried sheets are the smoothest. In addition to being smooth and flat, stack dried sheets also tend to be stiffer and less pliant than single or spur dried sheets.

If the finished paper needs to be resistant to penetration of liquids such as ink or watercolors, internal sizing might have been added to the pulp in the beater. However, if this liquid resistance is needed along with additional strength and abrasion resistance, the paper can be externally sized with gelatin. This is normally done after drying, but before any humidification

takes place to flatten the sheets. Sheets dried by any method can be sized.

In general, a 2.5 percent solution of gelatin is a good starting concentration. 4 liters of size were required in this instance so 100 grams of dry gelatin were added to the water the night before. Before sizing, the solution was heated in a double boiler until warm to the touch. Potassium aluminum sulfate was also added at one percent based on the weight of the dry gelatin. The alum is believed to help harden the gelatin and leave it more resistant to biological attack should the paper become extremely damp or moist.

The sheets are dipped and stacked until all paper is sized or the bath and wet sheets begin to cool. If this happens, there is a danger of them sticking together. Once the pile has accumulated, a felt is placed on top, rubbed from the center out, and followed by a board. Final steps include pressing, parting, hanging to dry singly, humidification and reflattening.

Finished sheets are judged poorer in quality if they have uneven formation quality, or obvious clumps, knots, debris, or water drops. High quality sheets are relatively free from these defects.

Making even moderate amounts of western style paper that is consistent in quality and free from defects is a considerable challenge. There are many different approaches to western papermaking, but steps covered in this videotape are intended to serve as a useful point of departure for those learning the craft. Viewers are encouraged to consult the attached bibliography and to visit our programs and facilities at the University of Iowa Center for the Book.

Center for the Book Paper Facilities, M109 Oakdale Hall, University of Iowa, Iowa City, Iowa 52242 / Phone: (319) 335-4410.