INSTRUCTIONS
for

THE
CELEBRATED ORIGINAL

PHOTONBOX ™

PINHOLE CAMERA
MODEL D

"CURIOUSLY CURVED"

PHOTONBOX ™

Contents

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Introduction

If you're new to photography and/or darkroom work, always remember the two most important words on the cover of the *Hitchhhiker's Guide to the Galaxy*: Don't Panic. This instruction book may look intimidating, but it's much simpler than you think. Most of this is common sense; I've included much of the information as a kind of reference manual for people just getting started. Basic instructions are in this main section; details are in the Appendix.

You don't need to be an Ansel Adams to get immense satisfaction from the process and to produce impressive pictures. The following three sections give you all the basics. You'll find that after a little practice, they'll actually take longer to read than to carry out.

1. Exposing the negative
2. Developing the negative
3. Making a print from the negative

The supplies listed below are all you'll need, besides the camera and a tripod. Please see the Appendix for details and suggestions about where to buy them.

Red light bulb

Three developing trays or developing drum

Two or three developing tongs

Film or photographic enlarging paper

Developer

Fixer

Changing bag (for reloading; see picture on page 5)

Everything necessary for a day's shooting expedition can be carried in a small backpack. If I had collapsed this antique tripod further, it could easily have been strapped to the pack.

1. Making the negative

Here are my essentials:
> *camera (Model B shown) and case*
> *tripod*
> *paper (or film)*
> *changing bag*
> *light meter (not shown)*
> *timer (not shown; on wrist at the moment)*
> *beverage of choice (not shown)*

Loading the camera

You can shoot either film or paper (normally used to make prints) in a pinhole camera. The procedure for loading both materials is the same, of course. Developing is obviously different and both methods will be described later.

You can load the camera in any totally dark room, even a closet. Be sure no light comes in at the bottom of the door (lay a towel or rug at the gap). Windows can be covered with two or three black plastic trash bags (left flat and taped to window frame.)

To open, grasp the bottom of the camera firmly with one hand and the top with the other. At the back of the camera, the top is slightly larger than the camera itself (yellow arrow). Grasp this with your thumb and pull upwards. It is held firmly in place by powerful magnets, but once it starts to lift, it will move suddenly, so hold on to it firmly. It's always a good idea to do this over a soft surface.

Cut a piece of 8x10″ film (or paper) in half lengthwise (to 4x10″). I use a standard paper cutter with an adjustable stop. I'm sure OSHA would have something to say about using sharp blades in total darkness, but I just say be careful.
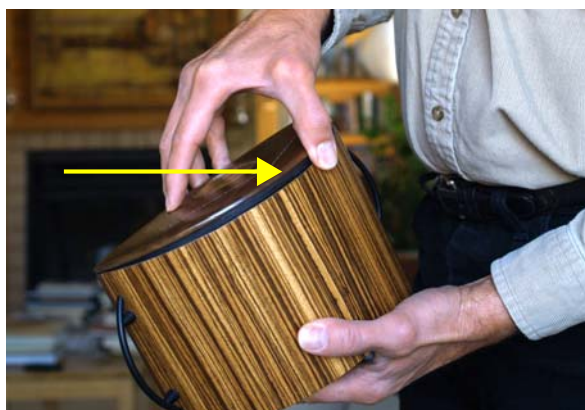
It's easy to load it by curving it inward, placing one edge against one stop, and then uncurling it to fit the other edge inside the opposite stop. Although film varies a little in size, it is not necessary for it to be tightly wedged against the bottom of the stops. If it is slightly oversize, it will stay in place if pushed down only gently.

Practice by loading the 4x10 test negative (and the 4x5 adapter) into the camera with the lights on.

You'll notice two very thin strips mounted beside the retaining strips. These elevate the film slightly above the back and allow you to slip a fingernail under the edge of the film for easy removal.

Top view of camera showing proper position of film (shown in red). Notice how it rests on top of the thin strips beside the retaining strips.

The dashed line indicates the light baffle near the top of the camera. And of course, the 4x10 and 4x5 film formats can never be used simultaneously. They are both shown here only to indicate relative positions.
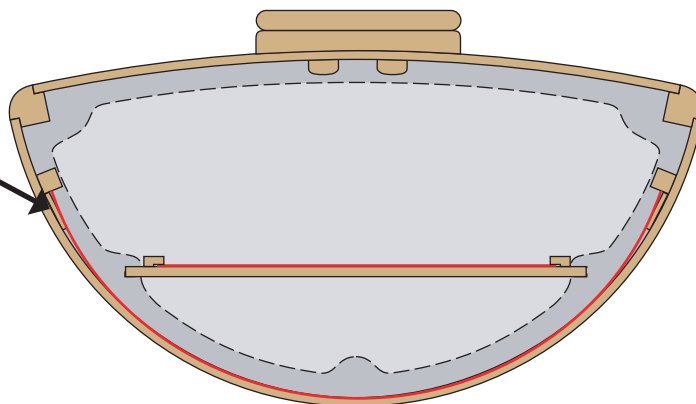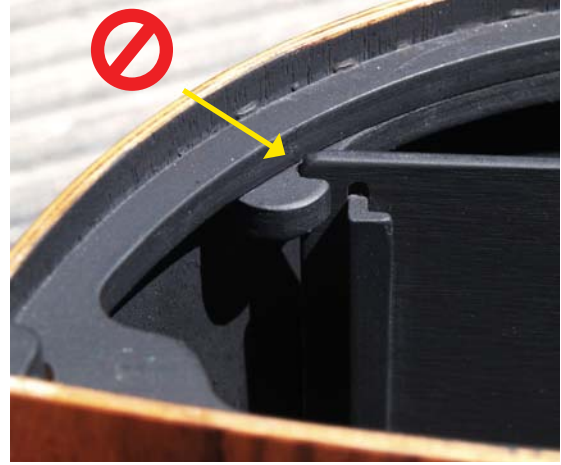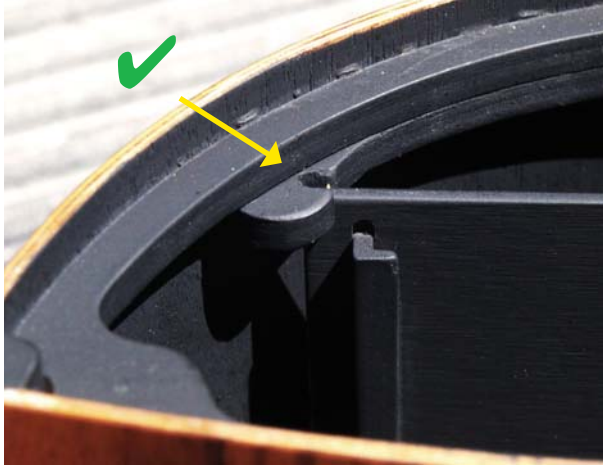
When using the 4x5 adapter, it must be fully inserted into the slot in bottom of camera. If not, the lid will not close completely.

Tip:

I find it easiest to have the adapter already inserted in the camera before turning off the lights and then to insert the film into the adapter in the dark.

Using a changing bag. This is essential if you don't want to run back to a darkroom between shots. It's basically a black, double-layered cloth bag with two elastic arm holes and zippers.

Aiming the camera *(Model B shown)*

Mount the camera on a tripod or place on a level surface. By sighting along the inlaid lines or the brass markers on the top, you can see the left and right edges of the composition. But it's best to err on the side of including too much. You can always crop later. You'll have to estimate the vertical coverage (55 degrees).

4x10" film — sight along wood inlays

4x5" film — sight along brass inlays
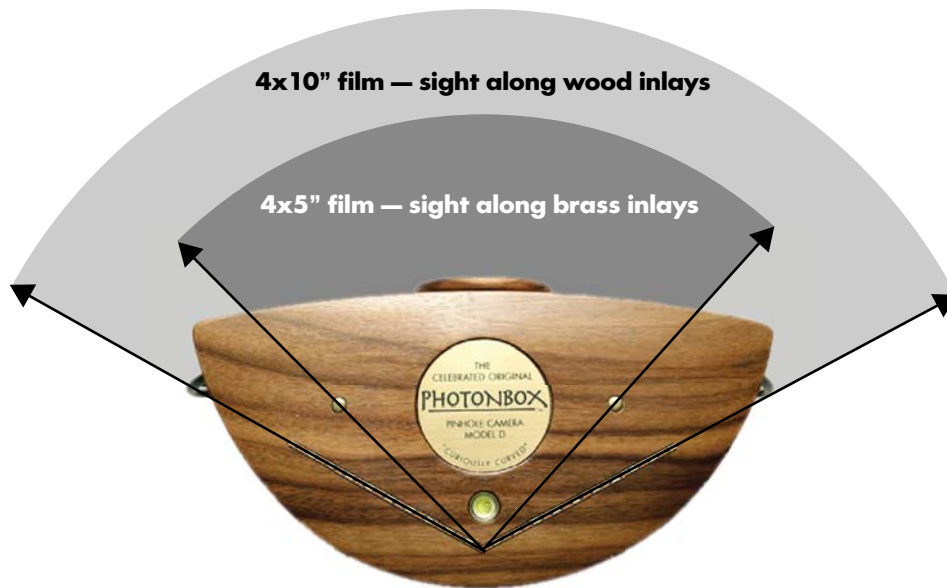
Tip:

Cameras with a curved film back exhibit an interesting phenomenon of distortion: horizontal lines above and below the center line of the frame will bow outwards. So the key to shooting a landscape that includes a horizon is to level the camera (with the built-in bubble level), placing the horizon in the center of the frame. Here are two examples of what happens when shooting objects with straight lines:
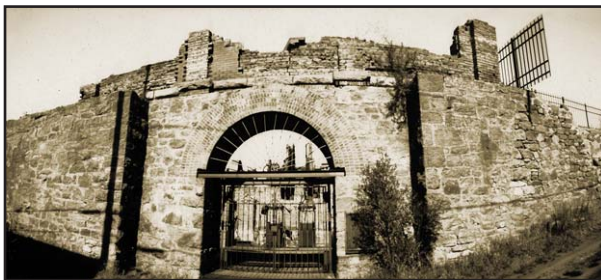
This flat wall, photographed straight-on, shows extreme distortion. Interestingly, if you curve this print into a semicircle and place one eye at the center (replicating the positions of the aperture and film when in the camera), the distortion disappears.
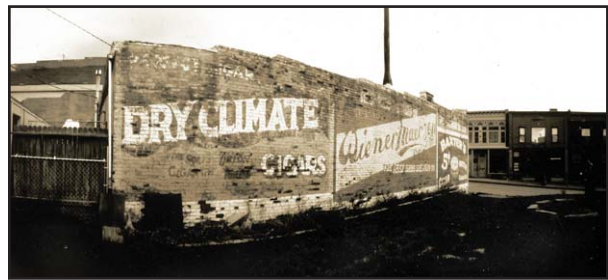
A flat wall photographed at an angle shows moderate rectilinear distortion.

Far from being a disadvantage, this kind of distortion can be used to create unique images unobtainable with a "normal" camera.

When shooting with the 4x5 adapter, there is no rectilinear distortion at all. This works really well when photographing architecture for accurate reproduction. See the format comparison photographs on the next page.

Comparing the two film formats from a Photonbox Model D pinhole camera

These two pictures show two notable characteristics of pinhole cameras. Both exposures were taken with the same camera in the same position. The only difference was the two film formats, mounted in their respective positions in the camera.

Standard 4x5" format on a flat film plane shows light fall-off at corners caused by increased aperture-to-film distance at corners. But there is no linear distortion in any dimension. The difference in size of the subject is due to the different focal distances between the 4x5 adapter and the curved 4x10 film plane.

Panoramic 4x10" film on a curved plane from same position shows rectilinear distortion. (These buildings are in a straight row.) In landscape photography, distortion is not so obvious. Although the aperture-to-film distance is constant, there is slight light fall-off due to the extreme angle at which the light rays penetrate the aperture. Even though the aperture diaphragm sheet is only $\frac{1}{1000}$ of an inch thick, the microscopic tunnel effect still exists.

Exposure

In the Olden Days, cameras had no shutters. The photographer removed the lens cap, counted out the seconds, and replaced the lens cap. That's how you do it with a Photonbox pinhole camera. With exposure times of anywhere from 5 seconds to several minutes, any slight error in timing will have a negligible effect on exposure.

Basic exposure charts

The following exposure times work well for me. I arrived at them after a few test exposures. Your times will probably vary, depending on the factors listed in the following *Section 2: Developing the Negative*. But they should serve as a starting point. I've left the last column blank for you to use if you want to record readings from your light meter for reference.

Note: I can't explain the discrepancies between the two media for the longer exposures. I hadn't used enlarging paper for a long time when I wrote this, and my notes may have been seriously in error. The times in the film chart are the ones I've used for years. One of these days I'll find the time to do more tests on enlarging paper.

Timing an exposure.

I found this $2 kitchen timer at my local Goodwill store. It's perfect for timing exposures as well as developing.

FILM, 100 ASA

CONDITIONS	TIME	LIGHT METER READING
Bright sunlight	6 seconds	
Partly cloudy	16 seconds	
Overcast (no shadows)	1 mins 30 secs	
Dawn/dusk	3 mins 45 secs	

ENLARGING PAPER

CONDITIONS	TIME	LIGHT METER READING
Bright sunlight	40 seconds	
Hazy sun (soft shadows)	60 seconds	
Overcast (no shadows)	90 seconds	
Heavy overcast (no shadows)	$2^1/_2$ minutes	
Dark overcast, rain	$3^1/_2$ minutes	

When shooting with enlarging paper, you'll get best results when shooting in indirect light — cloudy or overcast. The reason is that photographic paper is not capable of recording the wide range of brightness rendered by direct sunlight; it can blow out the highlights and make the shadows excessively dense. Cloudy conditions and twilight produce a very good tonal range. Shooting with film will avoid this problem under any lighting conditions.

Remember that standard photographic paper is not sensitive to red or orange light. (That's why you can use a safelight with it.) So if you shoot, say, a red sign with black lettering, the whole thing will register as black, and the lettering will disappear. You should also consider this when photographing things like old rusty metal (something I encounter often with locomotives and old mine buildings).

Exposure Tips:

Free exposure calculator! Whether you want to design and build your own pinhole camera, calculate exposures for changing light conditions, or even change the pinhole diameter on your Photonbox camera to produce shorter (or longer) exposures, be sure to get a free pinhole calculator for your computer, courtesy of Lenox Laser. It's available for both Macintosh and Windows, and you can download it free from their website: www.lenoxlaser.com.

Time exposure magic! Because the exposure times with a pinhole camera are so long, you'll soon find that you can easily produce a minor miracle: you can make people (and cars and other moving objects) disappear. With a three-minute exposure on a street scene, for instance, anything moving past your camera will either be extremely blurred or will simply not appear in the image at all.

2. Developing the paper negative
(For film developing, see page 10)

Besides the length of time your lens cap is removed, your exposures will depend on such things as

- type of enlarging paper
- type of developer
- dilution of developer
- your agitation technique in the developer
- length of time in the developer

But don't worry. Concentrate on remembering just three things:

1. Use the exposure guide chart above to establish a starting point for your own working methods.
2. Mix and use your chemicals according to the instructions on the packages.
3. Adjust your exposure times to produce a good negative and take notes as to what works for you.

You should place the negative into the developer face down and agitate it slightly (rock the tray) to make sure no air bubbles are trapped. Then you can turn it over and inspect the image as it develops. It should take no more than about 2 minutes.

Then pick it up with your developer tongs, let it drip, and drop it face down into the water tray (or stop bath if you choose to use it). Don't put your developer tongs into the water/stop bath. Agitate for a few seconds, and use your second tongs to pick it up and place it into the fixer.

After about a minute you can turn on your regular room lights. Leave the negative in the fixer for a few more minutes and then rinse with clean water for another couple of minutes (either in another tray, a sink, or just hold it under the faucet).

You can dry it with paper towels, hang it on a clothesline or blow dry it with a hair dryer. In any case, RC paper takes just a few minutes to dry.

See Appendix for more details.

3. Making a print

At this point you will have a negative image on paper. (It is commonly thought that a "negative" is a piece of clear film, but the word really just means that the tones are the opposite of normal.)

There are two ways of doing this. The traditional way, dating from the very early days of photography, is to make a "contact print" from this paper negative. In the darkroom, place a fresh piece of enlarging paper (same size as the negative you just developed) and place it in emulsion-to-emulsion contact with the negative on top. Lay a piece of glass on top to keep them in contact. Then turn on an overhead light briefly. This will expose the image from the negative onto the new sheet of paper. (You'll have to make tests to establish an esposure time.) Process as usual and you will now have a positive print with which to impress your friends.

But computers now give us another option. Just scan in the negative, turn it into a postive (For instance, in Photoshop: *Image Menu > Adjustments > Invert*), adjust the levels, brightness and contrast to your taste and print out as normal. Oh yes, you will also have to flip the image horizontally to make it "read" the same direction as the original scene. (See Apendix for details.)

Print the picture from your computer as you would any other image.

Appendix

Darkroom Supplies

Just a few years ago, all these supplies were readily available in camera shops everywhere. That's no longer the case, unfortunately, although they can still be found in a surprising number of places. However, a simple phone call or mail order via the Web can bring these right to your door.

I buy my supplies from Freestyle Photo Supply (www.freestylephoto.biz) in Hollywood, California. They have a huge selection of traditional (i.e., chemical) photographic supplies.

My favorite film speed for shooting in my cameras is ISO 100, which they supply from several manufacturers. If ordering enlarging paper to use in your camera, buy **RC ("resin coated") paper for convenient processing, and it must be satin finish, matte finish or semi-matte finish** paper. Glossy can produce reflections inside the camera during exposure.

Cutting the paper

The easiest (and safest) way to cut the paper to size in the darkroom is to use a small paper cutter available at hobby, craft and scrapbooking stores.

Darkroom set-up and procedure

I've set up temporary darkrooms in hotel bathrooms in a matter of minutes. Replace one of the regular light bulbs in the bathroom with your red bulb, lay out the three trays, pour in your chemicals and you're ready. As far as a safelight is concerned, a simple red nightlight bulb ($7^1/_2$ watts) is easy, cheap and available at all hardware and home improvement stores. You don't need one of the standard photographic darkroom safelights, although they will produce a brighter light. (Many bathrooms have only fluorescent tube fixtures, so you may want to invest a couple of dollars in a "clamp light" fixture as pictured.) Keep the light at least five feet away from your paper.

A cheap, portable safelight

Remember: Don't use a safelight with regular film!

Mixing the developer

Developer (it will probably say "print developer" on the package, as opposed to "film developer") is never used full strength from the package. The mixing and dilution ratios will be printed on the package. You'll find that about 16 ounces (or 500 ml) will give you sufficient liquid for an 8x10" tray.

LIQUID DEVELOPER Developer that comes as a concentrated liquid is the easiest to mix (just dilute enough for a trayfull at a time.) Discard when finished. You'll know it's exhausted because it will turn yellow. The disadvantage of liquid developers is that once the bottle is opened, the concentrate tends to go bad in a few months.

POWDER DEVELOPER If you buy powder developer (Kodak's Dektol is the most common) it will keep for a very long time in its powdered form. But the instructions on the package will just tell you how to mix up the whole batch at once. I extrapolated the mixing instructions for a single tray of Dektol like this: 23 grams of powder dissolved in 475 ml of warm (approximately 90–100°F water. Let cool to room temperature. I use a small postage scale to measure that weight, but you can also figure that it comes out to about 5 rounded teaspoons full. ***But don't use that spoon for food again!***

You will need to be careful when using the tongs. (By the way, many old time photographers didn't even bother with tongs. You could always spot them by their fingers stained dark brown.) I use just two tongs — the first one (color coded with red handle) never touches anything except the developer. The second tongs (color coded with blue handle) goes between the water bath (or stop bath if you use one) and the fixer. So when your negative is fully developed, pull it out with the first tongs, hold it briefly over the developer to drain most of the liquid, and then drop it face down into the water bath without allowing the tongs to touch the water. Then use the second tongs to handle the negative from then on. The purpose of this is to prevent the developer from becoming contaminated with fixer.

| *Developer* | *Water or stop bath* | *Fixer* |
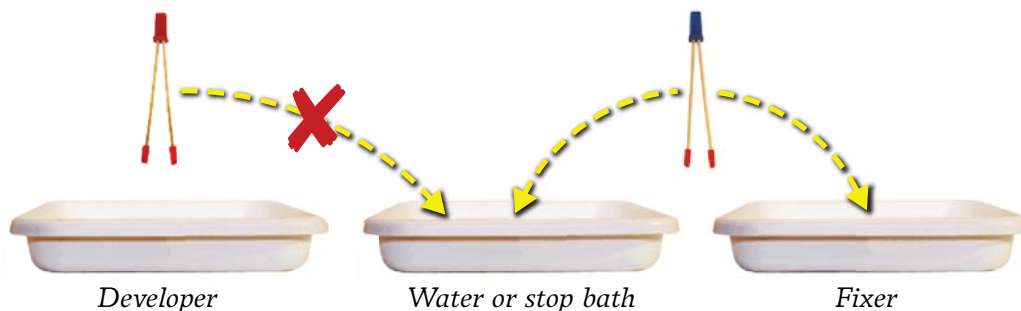
Although you will discard your tray of developer at the end of the day (or earlier, if it turns dark yellow from processing many sheets), the fixer will keep for a long time. At the end of the session, pour it back into its storage bottle. Eventually it will become exhausted. The only way to positively tell when this happens is to use a chemical called Hypo-Chek. From its tiny squeeze bottle, put one drop of the liquid into your tray of fixer. If the drop just disappears, your fixer is still good. If the drop of Hypo-Chek turns milky white, discard the fixer.

Using film instead of enlarging paper

Enlarging paper is cheap, convenient to work with and easy to find, but when used to photograph a subject in sunlight, it will give you a very contrasty image. You can shoot sheet film in your camera as easily as paper, and it will give you a full-tone image as well as considerable increase in emulsion

speed. It's available from several sources. (See "Darkroom Supplies" on page 7.) The major drawback is that it must be handled in total darkness. Loading and unloading the camera is easy, but processing is something else.

It can be done in a series of trays, just like enlarging paper, but this is quite difficult and downright sloppy. And remember, it has to be done in total darkness. It's easier to use a processing drum or tube. I found a perfect 8x10″ drum (originally intended for processing color prints) for $1 in the bargain bin of my local camera store. Of course it can develop two 4x10″ negatives at a time, loaded side by side. I also found a motorized roller base made by Unicolor. With a processing time of 14 minutes, it's nice to be able to start the development and then do other things until it's time to change chemicals. This stuff always seems to be available on eBay. Go to the *Camera & Photo* section, and then to *Processing Equipment*.

Processing film

I've been using Kodak D-76 developer, with a modified mixing technique, similar to how I handle the Dektol in small quantities. (D-76 is also a powder.) I don't shoot enough to make it worthwhile to mix up a gallon of stock solution as described on the package. So I estimate how much I'll need for a day or a weekend of shooting and mix just that amount of working solution from the powder.

My developing drum takes 125ml of liquid per load. I dissolve 9 grams of D-76 powder in 125ml of 120 degree water for each drumload of negatives. (Cool to 68˚ before using.) I use a small postal scale (available from stationery and office supply stores), but if you don't have one, a rough volume measurement for this amount is two rounded teaspoons. My development time is 14 minutes with moderate agitation.

Whatever the size of your drum or tray, using that same ratio of powder to water will give you a good starting point. (This dilution is for single use only; discard after using. If you're really picky, you can use Kodak's D-76 Replenisher to re-use the developer, but I don't think it's worth the effort.)

Using concentrated liquid developer is a little faster (you don't need to dissolve powder in hot water and then let it cool). But it won't keep as long in its original bottle as powder will. Personally, I don't use enough of it to be worthwhile. If I do go the liquid

A small postal scale is ideal for measuring developer. Just remember to allow for the weight of the paper or plastic cup that will be holding the powder (hanging from the clip).

route some day, I will probably try my old favorite, Agfa Rodinal. Agfa went bankrupt recently, but Freestyle Photo magically keeps it in stock. It's extremely concentrated and survives for a long time in its little brown bottle.

Image adjustments in the computer

I always use Adobe Photoshop for image adjustments, although other software programs will also allow you to do this. For the sake of demonstration, here are the basic steps to follow in Photoshop. Most other image editing software will have similar controls. Photoshop allows you to make an infinite number of fine adjustments; the controls shown here are just the beginning.


◀
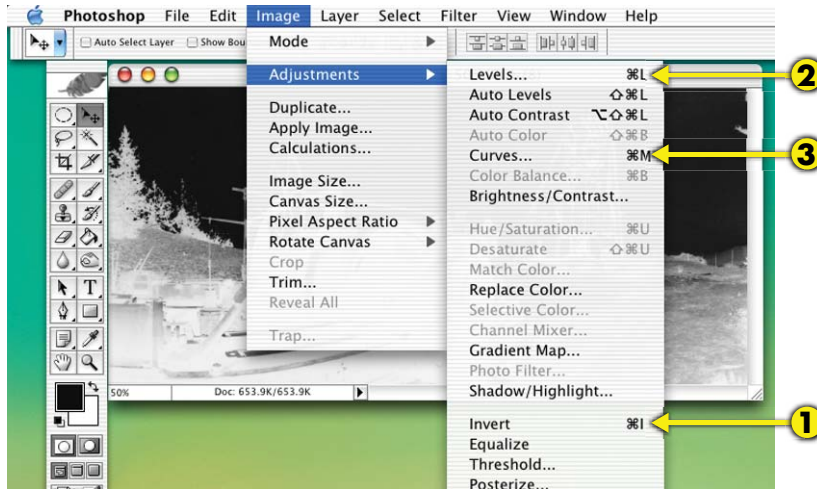
After scanning your negative into your computer and opening it in Photoshop, pull down the Image menu to Adjustments. The three basic controls you'll need are Invert, Levels and Curves, used in that order.

▶

First, invert the negative image to make a positive. This will make it easier to judge the next steps.


◀
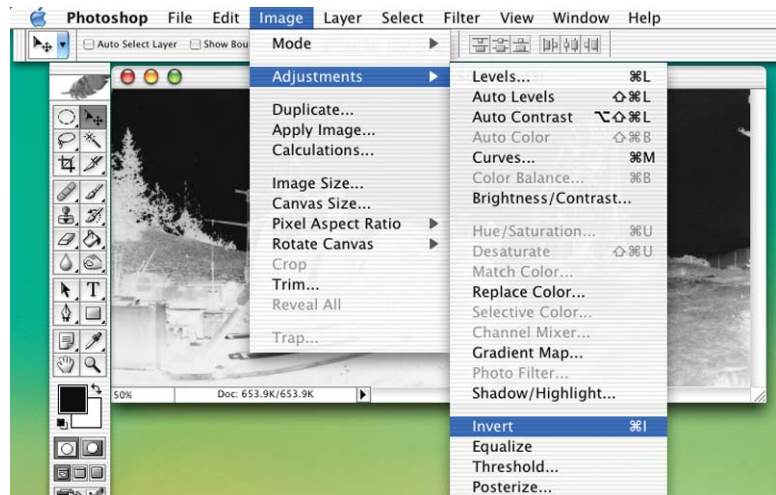
Now you have a positive image.

You could print this as is, but chances are your tonal range could use some improvement.

Next, go to the Levels adjustments. ▶
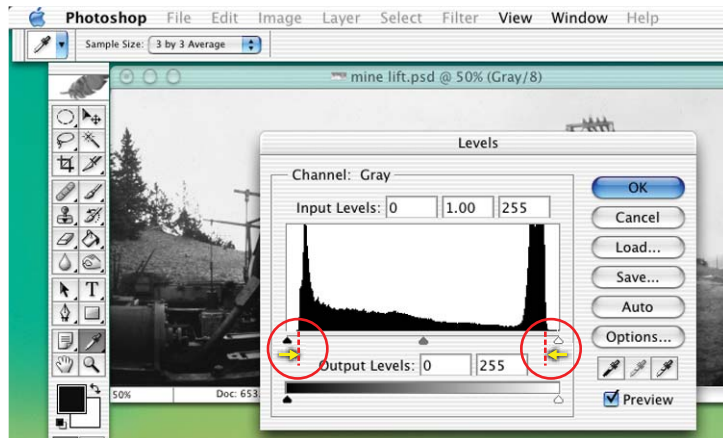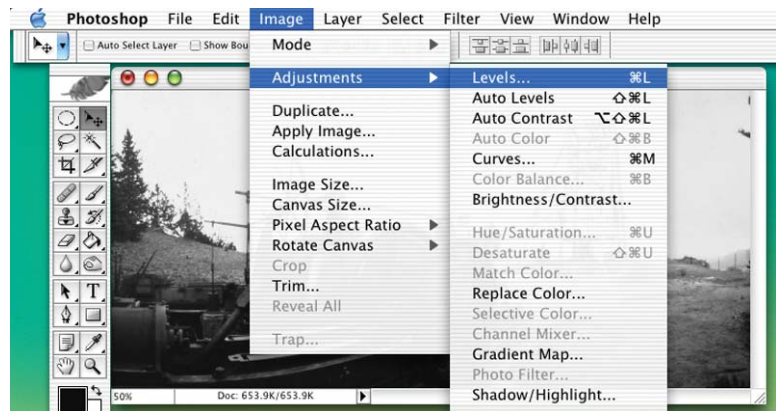
◀ *This histogram window will open. The graph will look different, depending on your image. Move the small black triangle until it is directly beneath the left-most end of the graph. Move the white triangle directly beneath the right end of the graph. This sets the black and white points of the image. If you have checked "Preview," you'll see the changes immediately.*

▶

Pull down the Image > Adjustments menu again to the Curves window. The curve at first will be a straight diagonal line.

◀
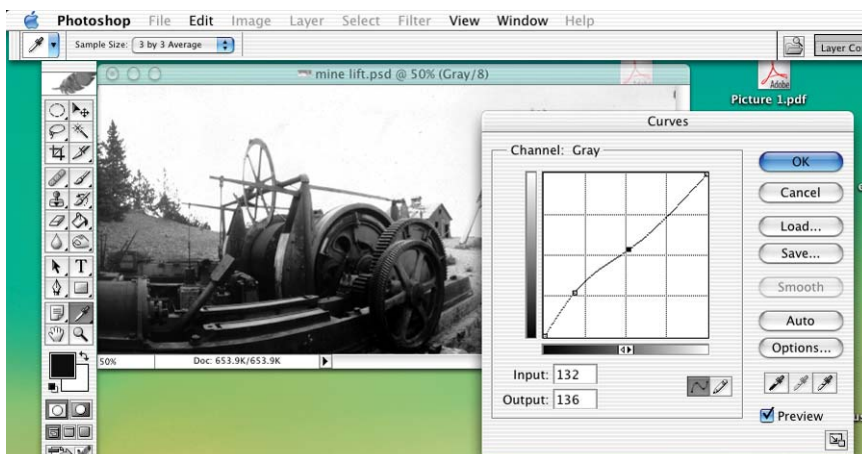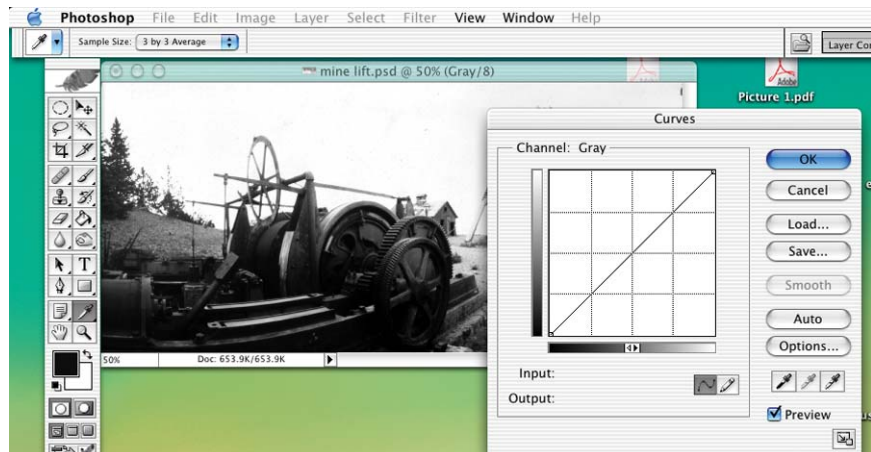
Clicking on the line will make a control point, which you can drag in any direction. In this example, dragging the lower side of the line upward increases the visible detail in the shadow areas. Making a control point in the center prevents the upper part of the curve from moving.

Some thoughts on pinhole aesthetics

In an age of increasing automation and sophisticated technology, the idea of creating a photographic image using nothing but a box with a hole is at once idiosyncratic and reactionary, yet strangely compelling. The essential simplicity of photography at this level was for a long time — perhaps until the invention of electronic circuits — widely understood by almost everyone. After all, cameras were basically just wood, plastic or metal boxes. The viewfinder was just a hole whose function was obvious, and the shutter was nothing more than a little door that opened and closed. Everyone who loaded film into a camera could plainly see how it all worked.

But those days are long gone. Whenever someone shows curiosity about my pinhole cameras, they're mystified by the absence of any moving parts and batteries; in short, there's no "machinery." The most frequent question is something like, "But how does it *run*?" As if rays of light required mechanical or electrical assistance to go through a hole. We have been seduced by technology and brainwashed by the complications of modern life.

With this in mind, I am training myself to see things in a new way. Although I have been making the test exposures with my Photonbox cameras in a purely traditional mode, it's clear that there's really no point in trying to duplicate the results of my expensive digital SLR with a pinhole. Life is complicated enough without using the wrong tool for the wrong purpose.

> "There's nothing quite so facetious as creating an artifical problem and then congratulating yourself for solving it."
>
> — *Syd Mead, American artist and illustrator*

So as I build the cameras, I remind myself to become increasingly aware that I really should concentrate on exploiting the inherent qualities of pinhole functionality. I would encourage you to do the same. These include primarily

- infinite depth of field
- extreme wide angle (of most designs)
- long time exposures

Regarding the third quality, I initially considered these long exposures as a problem to overcome, but now I want to use them to my advantage. I have a friend with a copy of a famous photograph by Eugène Atget hanging on his wall. Taken in the early years of the 20th century, it shows what should be a busy intersection in Paris. But there are no vehicles and no pedestrians in the photograph. The streets appear eerily empty, allowing the viewer to concentrate on the curiously shaped building in the center of the picture.

Of course, you've realized the truth by now. Although most people believe the streets to be empty, they were not when the picture was taken. Looking at it carefully, you can see slightly darker smudges where people had briefly hesitated while walking, perhaps to gawk at the camera. Vehicles were moving just a bit too quickly to register on the film.

This kind of thing comes naturally to a pinhole camera, but would be difficult with a modern camera without extra accessories like neutral density filters.

Just as the form of these cameras has been established by their function, I believe their function should in some way affect the aesthetics of their photographs.

— *Bryan Dahlberg*