Gum Bichromate Pigment Printing v.1.03

By Norman Breslow, B.F.A

Preface/Introduction

(What's the difference between a preface, an introduction, a prologue and a forward?)

The material which follows was written in longhand between 1972-1976, and typed in 1977 by me, Norman Breslow *, and discovered by me 40 years later in 2017, in a box of "stuff" I had long forgotten about. I retyped the material in January 2017 using a word processor. I haven't made changes to the original material, but I have added some of the handwritten notes I had made on the original typed pages. And I have corrected some misspellings and some typos, but I've probably introduced others that didn't exist in the original text. Additionally, I have found that the passage of 40 years has made parts of this "how to" guide obsolete, but I haven't changed those parts for two reasons: First, I see this guide as having historical importance, and second, some of the seemingly obsolete parts still have practical value. **Be on notice: Some of this material may be well beyond the ability of today's digital photographers, who never developed a roll of film, to understand.**

The * refers to my name both with and without my middle initial, which is K. I never used that initial until I found that an eminent Professor of Biostatistics was also Norman Breslow, a name I believed was unique to me. After all, neither Norman nor Breslow are common names. However, after discovering that there existed a Norman E. Breslow. who has publications in scientific journals, as I do, I started adding my middle initial to my formal writings, to avoid any possible confusion.

After retyping this tome, the Norman K. Breslow of 2017 started thinking that the Norman Breslow of 1977 was a genius.

Chapter One

The Basics

1) Basics? Well, I guess you have to start explaining things somewhere.

My thoughts exactly, and starting with the basics seems like the most logical place.

2) I think the most basic question I want answered is: What am I going to learn from reading this?

I intend this guide to give you all the information necessary to make black and white and color gum bichromate pigment prints. But I also want to give you a feeling for the process, so this guide is not presented in a typical “how to” manner. There will be much information given that may seem peripheral to the main subject. I will discuss alternate methods and procedures and provide alternate remedies for problems. When you have finished this guide you should have, if anything, too much information. Shall we begin with the basics?

3) Sure, Okay. Could you tell me precisely what gum bichromate pigment printing is?

Gum bichromate pigment printing is a photographic printing technique that was popular in the late 19th and early 20th centuries. With this process a photographer could make both black and white and color prints. The advent of Kodak black and white (b&w) and color films and papers brought about the decline in the use of this process because the Kodak chemistry and materials was more stable and much easier to use.

4) I have heard of gum printing. I assume that this is a short way of saying gum bichromate pigment printing.

No. Gum printing is short for gum bichromate printing. Pigment printing is short for gum bichromate pigment printing. The difference is both simple and great. Gum printing does not involve the use of colored pigments and the resulting print is in shades of brown. Pigment printing makes use of colored pigments and the resulting prints may be black and

white or color.

5) What is gum bichromate?

Gum bichromate is really a combination of two things: gum arabic and potassium or ammonium bichromate.

6) OK, what's gum arabic?

Gum arabic is the sap of the Arabeca tree which grows in some parts of Africa. In its raw form it is a sticky or "gummy" substance that has a semi-hard consistency. In its refined form, it has a slight creme brown color and is a bit sticky to the touch.

7) And the bichromates?

Potassium and ammonium bichromate are light-sensitive salts. They are sometimes referred to as dichromates. The difference between a bichromate and a dichromate may be of interest to a chemist, but has no practical bearing in our work. We may use the terms bichromate and dichromate interchangeably, but I'll probably stick with bichromate.

8) Can potassium and ammonium bichromate be used interchangeably? Are they the same?

While either may be used, they are different. For simplicity's sake, we will use potassium bichromate. After you have reached a point where you feel in control of the process, please experiment with ammonium bichromate. It will give you slightly different results. For now, we just concern ourselves with potassium bichromate.

9) Since I am working with gum arabic and potassium bichromate, I assume the full name of the process would be gum arabic potassium bichromate pigment printing.

Right. To make it even longer, if you were working in full color, you could say *four color gum arabic potassium bichromate pigment printing*. Our forefathers and mothers kept things simple by just saying "bi gum".

10) Could you give me a brief explanation of how the process works?

Yes. For a black and white print, a watercolor paper which has been sized is coated with an emulsion made up of equal parts of gum arabic and potassium bichromate with some

black watercolor added. The paper is dried and then a negative is placed in contact with it, and it is exposed to light. Where the greatest amount of light passes through the negative and strikes the paper, the light sensitive potassium bichromate reacts the greatest and causes the gum arabic harden fully. The hardened gum is insoluble in water and will not dissolve while being developed. This results in the watercolor pigment becoming encapsulated in the gum. Where no or very little light passes through the negative, the bichromate does not react strongly with the gum so that the gum does not harden and become insoluble in water, so it dissolves during the development process causing the black watercolor pigment to wash away. Where a moderate amount of light strikes the paper, the gum partially hardens, so some of the pigment is washed away and some remains. After the development is completed, the paper is dried.

11) What would be done differently to make a color print?

B&W and color pigment printing employ essentially the same technique, but in b&w usually only one negative is used. For full color, color separation negatives are made and 3 or 4 colors are used, one after the other.

12) Why 3 or 4?

Three colors, magenta (red-blue), cyan (blue-green) and yellow are necessary to reproduce color. But these three colors do not combine to make a strong black. The resulting print will be lacking in contrast. While this may produce very nice imagery for some subjects, it may not be suitable for others. To increase the contrast, a fourth “color”, black, is printed. Technically speaking, black is not a color, but most people think of it as one, so we will refer to it as a color in our discussions.

14) Is the process difficult to do, and if so, why?

Yes. Basically, because it is like no other process you have ever worked with. There are many variables. If one step is done wrong, it will effect all the other steps. Many of the possible defects that can develop will look similar, and you will need to learn to determine, first through experimentation and then through experience, which of the probable errors is at fault. You will also be working with procedures and materials that are not typically photographic, such as watercolor pigments, watercolor paper, etc. Processes that are

thought of as photographic sometimes work backwards, such as development. With a contemporary commercial b&w or color process, as you leave exposed paper in a developer longer, the paper becomes darker. In pigment printing, the longer you leave the paper in the developer, the lighter it gets. You will also have to think differently and understand different concepts from those of contemporary commercial processes. Making a standard b&w print using a Kodak type paper and chemicals involves a relationship among the contrast of the negative, the contrast of the paper, and the type of chemicals used...

In making a standard b&w gum pigment print, the amount of pigment used and the amount of light that strikes the paper are the two most important variables. There are other variables that you will need to become familiar with, such as the strength of the bichromate, the changes in the paper when it dries after the emulsion has been coated onto it, the changes in the chemicals over a period of a few hours, etc. It takes time, patience and practice to learn what these new variables are and how to control them. Once these have been learned, however, the process becomes no more difficult than conventional printing, although it is considerably more time consuming.

15) How long does it take to make a pigment print?

The time varies with experience and procedures. It is possible to make a quality b&w print in a few hours, a color print in a day. At first, I wouldn't be surprised if these times were considerably longer. Of course, the length of time it takes to make a print also depends on how particular you are. I've heard Edward Steichen spent a year (on and off) working on a b&w print. This is easy for me to believe. But it must be understood that he did not spend the entire year making just one print. He made many prints of the same negative over the course of a year until he made the one that he felt worked best.

16) To be honest, you don't sound too encouraging.

Well, first, don't forget that I also said that with experience the process would become easier. Riding a bicycle is difficult at first, but after you have learned it becomes rather easy. Secondly, if I told you that there was nothing to the process and then you ran into difficulties, you might lose confidence in yourself, feel the process was beyond you, and abandon your interest in it and your faith in me. I just want you to realize that at first you will have difficulties, but if you are persistent you can master the process.

17) What you're saying is that if I work hard I'll eventually be able to make pigment prints, right?

More accurately, if you are persistent.

18) Could you be a little more specific about the length of time it takes to make a pigment print?

Yes. There is some preparatory time spent making adequate negatives, preparing the watercolor paper and mixing fresh chemicals. After these have been attended to, most of the actual printing time involves waiting for the paper to dry either after the emulsion has been coated onto it or after the paper has been developed. Making a pigment print is like having a part time job. There are times you have to be present, and times when you don't.

19) It's obvious that I know very little about the mechanics of making a pigment print. I have heard that a top-quality pigment pint is superior to any other form of printing. Am I correct about this?

Sorry, but no. You will never be able to get the same detail in a pigment print as you can in a standard b&w or color type C print. Your colors will not be as "true" as in a type C print, either. The amount of detail will depend, among other things, on the roughness or smoothness of the surface of the watercolor paper and the size of the grains of pigment in the watercolor pigment being used. The color of the finished print will also depend on the colors you choose to work with.

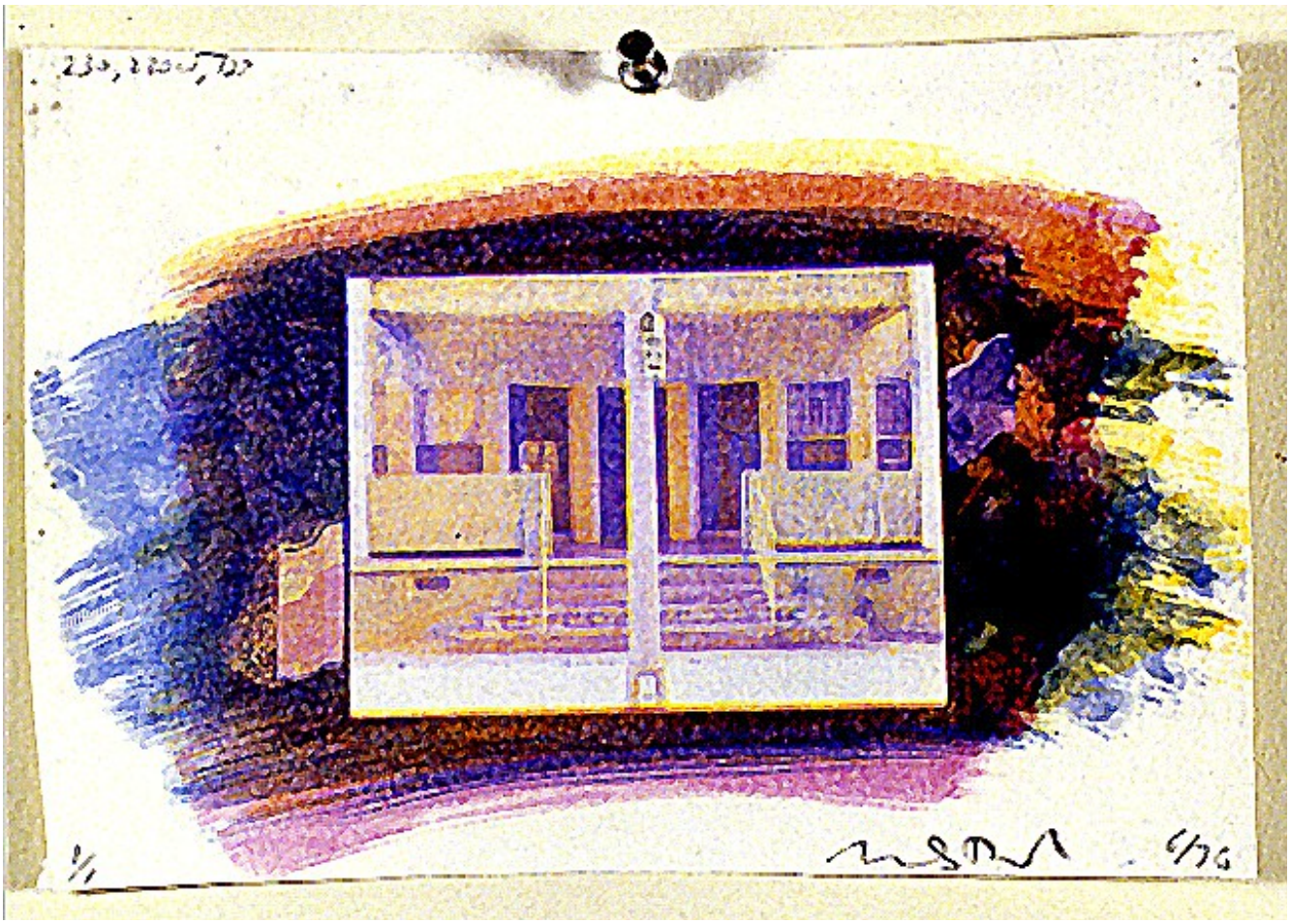
20) You've just about lost me. Are you saying that I will have to struggle to learn a new system so I can spend long hours, even weeks, to make an inferior print?

While it may seem that the pigment printing process will yield inferior results from what I've just said, I have very strong feelings that pigment printing is superior to <u>any</u> other form of photographic printing, and that the initial trouble to learn this technique is well worth it.

21) Why?

Because it gives the photographer total freedom. Freedom in your choice and placement of colors, freedom to use higher or lower intensity colors, or to make a print with some high and some low intensity colors. And to an even greater extent, it gives you the

freedom to experiment with printing techniques and imagery usually associated with or achieved only through lithography or engraving, such as playing with the blues, while leaving the other colors untouched, or making all yellows in a print corresponding shades of gray, while printing the reds and blues as colors. And you can learn to create images that look like nothing made by anyone else. With this process there are umpteen decisions that you will have to make at various times as you create a print, and each decision will effect the others. All or this will enable you to present your imagery in a unique way. In conventional commercial processes, many if not most of these decisions have been made for you at the factory, leaving you with comparatively few options with which to make your print, your statement, "you."



I made this print, using watercolor pigments, in June 1976, during my Anti-Kodak-Look art days while experimenting to see how I could use pigment printing to make unique looking images. I shot the image in 1970, which is of the front of the house in Santa Monica, California, where I rented a room during my starving artist days. The resulting slide was used in 1976 to experiment with, and the resulting pigment print was put on a wall with a pushpin and shot with color film in 2002 and then digitized in 2008. My experiment **succeeded because I've never seen a photo that looks anything like this.**

There is also the overall feel of the print to consider. Since the process uses watercolor pigment and watercolor paper, there is a watercolor quality to the print. Since the print is made from a negative, there is a certain amount of photographic detail present. The finished print therefore takes on some of the qualities of both photography and painting.

This merging of photography and painting is quite important. The average viewer looks at a photograph and reacts as if he were viewing a real object. Psychologically, photography means realism. Even if the photograph is an abstraction, it must be an abstraction of something that really exists. Therefore, a photograph represents an aspect of reality. A painting, on the other hand, generally equates to a "fantasy". Even if it is a painting of a real object, such as a bowl of fruit or a well known landmark, the viewer knows that the painting is a subjective representation of what the painter sees. No matter how "life like" the painter paints, the picture is still seen as the artists interpretation of the event, not as the event itself, while the photographers' abstraction is thought of as a "blur" or "magnification" of reality. By combining the photographic detail with watercolor technique, a unique middle ground is reached.

22) To achieve this unique look, feel and impact, how much equipment and experience do I need?

For b&w, two paint brushes, a darkroom graduate or measuring cup marked in 1/2 oz increments. some glass jars, a spoon, or plastic or wooden coffee stirring sticks; for color, add three Kodak filters. I assume that you already have or have access to an enlarger and other standard darkroom equipment, such as trays, thermometer, timers, etc.

I also assume that you know how to develop b&w film, know how to use a light meter, understand what f stops are as well as other standard photographic terms and procedures.

23) That's all the equipment I need?

That's all you need. You may want to have other equipment. A mortar and pestle for grinding up dry pigment may be useful. An enlarging meter to help in making negatives from slides will be very useful, as will a b&w transmission densitometer which will aid in determining exposures, and a registration easel to aid in keeping your color separation negatives in registration.

While all of these will be useful, it should be noted that you can live, and do pigment printing, without them. After all. people were making gum pigment prints long before many of the above were invented.

24) What is the cost of all this?

An initial investment in materials and supplies of from $15-$25 should be adequate for b&w prints or for brown tone gum prints. Full color printing can cost as little as $20 more. If you should really get interested in the process, you may end up investing a few hundred dollars over a period of time.

25) What kind of problems will I have with permanency? I would hate to create an image "Unique unto myself" and have it fade or turn orange or something after a few weeks.

Permanency will depend on the quality of the materials you use. If you buy top quality paper and permanent pigments, and if you develop the print properly, it will far outlast any of today's contemporary photographic processes. If such a print isn't mistreated, it will probably last several centuries.

26) You mean my great-great-great grandchildren will be able to see the original prints I make?

If someone doesn't make a paper airplane out of them first, yes.

27) Where do you suggest we begin?

With paper, its care and feeding, which I discuss in the following chapter.

Chapter Two

Paper and Sizing

28) Ok. What should I know about paper? Will any watercolor paper do?

Yes, but some are better than others. There are also papers made that are similar to watercolor papers that can be used, such as papers made for etching, printmaking, hand lithography, etc. What all these papers have in common is that they can be repeatable soaked in water without damaging the paper. For convenience sake, we will refer to all water "resistant" paper as watercolor paper. Since there are probably as many types of watercolor paper on the market as types of b&w photographic printing papers, it would be impractical to describe the pros and cons of each one, but I can give you some general information.

First, some papers are all (100%) rag, while others are combinations of rag (usually 75%, 50% or 25%) and pulp. The higher the rag content, the higher the quality. Quality, at least for us, concerns the paper's permanency. A 100% rag paper should last almost indefinitely. Chemical reactions in papers with less that 100% rag content will cause the paper to deteriorate (yellow, become brittle, disintegrate) in a relatively short period of time- a few years to a few decades. Archival quality for a Kodak b&w print is 100 years. A 100% rag will far outlast this. 100% rag paper usually costs a bit more than other papers, but in the quantities you will be using, the extra cost will not make much of a difference. For instance, a standard size for watercolor paper is 22" x 30". This can be cut into 6 8x10's with a 6x30 inch strip left over which can be used for various tests or smaller prints, or, 30 4x5's with a 2x30 inch strip left over. Since both sides of the paper can be used, this comes out to 12 8x10's or 60 4x5's. Archers Cover White, a 100% rag paper, costs about $2.50 per 22" x 30" sheet or about 20 cents per 8x10 or 5 cents per 4x5 sheet. This is not very expensive. Since it takes some time to make a print, one 22" x 30" sheet can last a few weeks. So, if you are after permanency, stick to a 100% rag paper. Questions?

29) Not yet. What else should I know?

Different papers have different weights. Almost all papers, whether watercolor or not,

are described by weight. There are 90 pound (lb) papers, 120lb. papers, etc. This means that 500 sheets (one ream) of paper will weigh 90lbs. or 120lbs. respectively, or one sheet will weigh 1/500 of the total weight. Simply put, the higher the designated weight, the heavier the paper. The weight of the paper has little to do with the quality of the paper, since a 100% rag may weight less than a 50% rag, but does present you with one of the umpteen decisions alluded to in #21. You see, the heavier the paper the longer it will take to dry after development, but a heavier paper will not curl, wave or deform as much as a lighter weight paper. This is important when you consider that most b&w and color pigment printing involves making multiple exposures. If the paper curls, waves or deforms, registration become difficult and often impossible. Questions?

30) No.

In addition to the considerations as to quality and weight, you will also have to decide on how rough or smooth a surface you want to print on. The purely aesthetic part of this decision will be left to you. From a technical point of view, some watercolor papers are so smooth that they almost look like conventional photo printing papers. d'Archers 90lb is an example. A paper of this smoothness will give you the best detail since the negative, when placed on the paper for an exposure, will be in more positive contact than with a rougher paper. A rough paper has "hills and valleys"; the negative will only be touching the hills, with the valleys just far enough below to cause a slight loss of detail and sharpness. Some subjects will be helped by this soft focus effect, so rough papers shouldn't be eliminated from your repertoire as unsuitable.

The roughness of a paper also effects the overall luminosity of the print, with a smooth paper having a brighter look and a rougher paper a slightly grayed out appearance. This is also caused by the "hills and valleys".

The weight of a paper and its roughness usually go hand in hand -the heavier the paper, the rougher the surface. To complicate things a bit, all watercolor papers have two surfaces, a front and a back. The front will always be either rougher than the back (such as in Archers Cover White) or have longer fibers (as in Aquarius). Since the back of the paper is smoother than the front, the back of a heavier paper may be smoother than the front of a lighter weight paper. This happy circumstance makes a good compromise between a heavy rough paper that will have a minimum of curl and wave but a longer drying time and a loss of

detail, and a smooth lightweight paper that dries fast and gives good detail and brightness, but also waves and curls a lot, making registration difficult. Now, do you have any questions?

31) I've been saving them up. About a hundred. Let me see if I can get this straight. 100% rag paper will last forever, less than 100% rag paper will die, if I'm lucky, in 10 or 20 years. Heavy paper takes longer to dry than lighter, but won't warp or curl much. Smooth paper will give me better detail than rough paper and have slightly more luminosity, but a rough surfaced paper may be more aesthetically pleasing than smooth for certain subjects. All papers have two surfaces, with the front always being rougher than the back; the back of a heavier paper may be smoother than the front of a lighter paper, which may be a good compromise for the problems inherent in both rough papers and smooth papers. And unless I'm using some exotic paper, the cost factors in deciding which paper to use really isn't important. Right?

32) Right! Even perfect. Where are the hundred questions?

Well, just one. It's all a bit too much for me. I guess I want a paper that will give me good detail and dry fast and that also won't warp or curl. Could you please tell me what paper to start with? Once I get my feet wet I'll be happy to experiment, but for starters, which paper do you recommend?

I'll be happy to recommend a paper. As a matter of fact, I want to. If you use one paper and I give specific instructions on how to use that paper, we will eliminate some potential problems. However, I don't know where you are located. If you live in a small city or town it may be difficult for you to get the paper I would like you to use. So I will recommend three papers. I hope your will be able to get one of them.

33) The best paper to use, at least at first, is Aquarius, made by Strathmore. (Aquarius, by the way, is the exception to the rule that papers are designated by weight. Aquarius isn't.) If necessary, make a super human effort to get it. As a second choice, use Archers Cover White 120lbs, which is a printmaking, not watercolor, paper. As a third choice, use d'Archers White 90lbs. Both are made by Movlin apapier d'Archers (France). The d'Archers white 90lbs. is very light and smooth; the Archers Cover White 120lbs. is moderately heavy and slightly rough.

34) Why Aquarius?

It doesn't shrink, stretch, wave, curl or deform in any way.

35) You already mentioned that papers have a tendency to wave, curl and deform. Now you add to this list shrink and stretch. None of these sound particularly healthy. If these are tendencies of watercolor papers, why doesn't Aquarius behave in these ways?

None of them are healthy, particularly shrinking and stretching. When a painter is going to use a watercolor paper, he just stretches it by wetting and then taping its edges to a wooden drawing board. Otherwise, when the paper is wet with watercolors and then dries, it will shrink, distorting the image as well as waving and curling the paper. This stretching process as just described is impractical as far as our process goes.

When you hang your paper up to dry after developing it in water, the paper will have a tendency to stretch due to the weight of the water in the paper pulling against the side of the paper it is hanging from. Once the paper shrinks or stretches, it is impossible to make further exposures in registration.

Aquarius is perfectly suited for solving these problems because it is part synthetic. It is rag on the front and back, but Fiberglass on the inside. Fiberglass, which is plastic, doesn't shrink or stretch. It doesn't do anything but lie flat. It is so stable that it can be heat dried in a drying cabinet which will reduce your printing time. The front of Aquarius is not rough but made up of long fibers which, I feel, has a pleasing aesthetic effect, but it does cut down a lot on detail.

36) OK, Aquarius has fiberglass in it so it won't stretch, shrink, curl, wave or deform. Why Archers Cover White 120lbs. and d'Archers White 90lbs.?

d'Archers White 90lbs. is the lightest weight and smoothest paper that I've had good results with. Archers Cover White 120lbs. gives excellent results for a heavier paper (and, for what it's worth, is the paper I use most often). There are many other papers to choose from, and since you have already said that you will experiment after you get your feet wet, I am sure in time you will find other papers that you will like as well or better than the ones I've recommended.

37) How do I keep Archers Cover White 120lbs. and Archers Cover White 90lbs. from shrinking, etc.?

I'd rather go into that in a while.

38) Whatever you say. Assuming that I have one of the three papers in front of me, what do I do?

Size it.

39) Whats that?

Coating it so the chemicals and watercolor pigment won't sink in. If this should happen, you will get a stain, not a print.

40) How do I size the paper?

There are a number of different methods. The first way that I don't recommend is to

41) Wait a minute. Why are you about to tell me a way that you don't recommend?

Because I don't like this method and don't think it works all that well, but others I know say it's just dandy. Because as time goes on you will want to experiment and come up with your own ways of doing things, so you should have available to you as much information as possible. Because I would consider it dereliction of duty and couldn't sleep nights if...

42) OK, ok.. Enough. What is the <u>first</u> way that you don't recommend that I use to size paper.

I'm glad you're being reasonable. The first way involves using hard gelatin. This is the method our forefathers used. Hard gelatin can be purchased from chemical supply houses. Up until a few years ago some of the better camera stores carried it, but few do now, apparently due to a lack of demand. It is sold by the ounce or pound, costing somewhere around 50 cents an ounce.

The procedure is as follows. Fill a saucepan with 10 oz. of water and place on a stove. Take 1/2 oz. of gelatin and sprinkle on top of the water. Let the gelatin soak for a minute or two. Turn the heat on low and gently stir with a wooden spoon until the gelatin dissolves. When it does, let the mixture cool to about 120 degrees F and then pour it into an 8x10

darkroom tray. Place your paper, which you have previously cut into 8x10 inch or smaller sheets, into the solution. Agitate by rocking the tray gently and by "re-stacking" the sheets of paper on top of each other for about 15 minutes. If the temperature of the solution drops too much during this time the gelatin will start to gel (naturally enough) and you will have a very big mess on your hands. If the temperature does start to drop, say to 90 degrees F, pour the solution back into the saucepan and rapidly reheat, so the paper, lying in the tray, doesn't have time to stick together. After about 15 minutes of soaking, the paper can be removed and dried.

The easiest way to dry the paper is to take wire clothes hangers, hang them from a bar in a closet or from the edge of a table and attach pincher type clothes pins to each end of the hangers. Clip one piece of paper to each pin and allow to drip dry onto newspapers placed on the floor. Immediately after hanging the paper up to dry, start scrubbing out the saucepan, spoon and tray. Since this technique tends to be messy, I recommend that you size a large number of sheets at one time.

43) Are there any potential problems or is this method foolproof?

Unfortunately, with any of the methods for sizing that I have used, you will be faced with one of three possible situations, only one of which is pleasant. The peasant one is that the paper is sized correctly. The most unpleasant situation is that the paper is over-sized. The other possibility is that the paper is under-sized.

44) But if I follow your instructions the paper should be sized correctly?

Yes and no. The problem is that different papers, due to their weight, rag content and surface, need different amounts of sizing. However, you should have no problem sizing that paper in the future once you have successfully sized it.

The sizing time given in #42 was for Auarius, which needs more sizing than d'Archers White 90lbs., or Archers Cover White 120lbs. I would try 10 minutes in the hard gelatin for these papers.

45) What are the problems of under-sized and over-sized paper?

Under-sized is equivalent to paper that hasn't been sized at all- a stain will occur.

Over-sized paper will not "take" the coating of emulsion well. Imagine painting water onto a sheet of glass. The water will bead up. This is what will happen to varying degrees with over-sized paper.

46) Can I tell by looking at the paper if it is not sized correctly?

No, but you can run a test to help you find out. Take a small piece of sized paper, part of the excess of the 22x30 inch sheet will do nicely, and coat it with the emulsion (discussed in the next chapter) and let it dry. Without exposing to light, place the paper in a tray of water. If the paper develops clear (discussed in Chapter 5), it is not undersized. If it were, the emulsion would have soaked into the paper and not washed off in the water.

This test will also tell you if the paper is over-sized. If the emulsion beads up, like water painted onto a sheet of glass, the paper is over-sized.

47) Is there anything I can do if the paper is under-sized?

Yes, Under-sized paper can be re-sized. However, you take the risk that you will over-size the paper. So, use less hard gelatin the second time around, and pray.

48) Can over-sized paper be saved?

Yes, but unless you are using some super expensive-exotic paper, it's not worth the effort to de-size it and then re-size it. To de-size paper, soak it in hot water for 5 to 10 minutes, change the water and re-soak. Since the sizing has a tendency to effect the paper unevenly, faster in some places then in others, the object is to dissolve all the hard gelatin and then re-size. This soaking in hot water is not great for the paper, which may begin to disintegrate.

If your paper is not very over-sized, that is, if only a slight beading occurs at a corner or along an edge, it is still usable. If it is very over-sized, use the paper to draw on or save it for that picture that eventually will dawn on you that will be perfect with a spotty, uneven look.

49) I'm glad that you don't recommend this method. It seems a bit messy and unreliable. Pardon the glazed look in my eyes.

It is very messy. Once you find the correct time for soaking the paper, the method becomes reliable.

50) What's another method?

The same as I just described, but using soft gelatin, such as Knox unflavored gelatin, which you can get at a supermarket.

51) What's the difference between the two?

If I just said that hard gelatin is hard and soft gelatin is soft, I would be correct but you wouldn't find the answer very useful. Soft gelatin dissolves fairly easily in water, and so a print that is going to take 3 or 4 exposures and developments will usually start staining after the second or third development, because the sizing will dissolve slowly as the print develops. Hard gelatin will last a bit longer, but it is still risky. Don't forget, it does take a while to make a print, and to have it ruined by stains near the end of the process is very frustrating.

52) Do you have any other methods that you don't recommend?

Yes. I have had people swear to me that paper can be sized by spraying it with spray starch. I have tried this method and once, out of about 15 attempts, I got it to work. I would have to rate this method as rather risky, if not totally ineffective. However, since it seems to work for others, I thought I would pass it along.

53) I hope you have a method you can recommend.

I do.

54) Pray tell?

I coat the paper with a plastic base (acrylic) paint. The brand and color I use is Liquitex Titanium White. I suggest you use this paint, at least at first, so we will be working with the same system.

Liquitex Titanium White is available at most art supply stores and comes in both jars and tubes. The chemistry differs between the two. The jar is the correct one to use. It is in liquid form, can be diluted with water and dries to a permanent finish which is impervious to water. This is helpful since the sizing will be permanent, and any number of multiple exposures can be made without fear of staining the print.

55) Is this the only virtue of using Liquitex Titanium White?

No. As mentioned earlier, Aquarius paper has a fiberglass center that helps keep it dimensionally stable. It not only allows heat-assisted drying but also makes registration of negatives for multiple printing more sure and accurate. Other papers have shrinking, stretching etc. problems. If you use Liquitex Titanium White sizing, especially with papers other than Aquarius, you add to their dimensional stability. Papers sized in this fashion can be gently heat dried in a drying cabinet.

56) Anything else?

Yes. The titanium white is whiter than the color of all watercolor papers I have come across. By adding this extra luminosity to the paper, you gain brighter whites and shorter exposure times, sometimes as much as 50% shorter. And, in addition to all this, it is not messy and is easy to use.

57) How easy?

Keeping in mind that there is some trial and error at first with all sizing techniques, very easy. The procedure is as follows: Take a sheet of Aquarius, Archers Cover White 120lb. or Archers White 90lb. paper, and place it on a larger sheet of brown wrapping paper. Don't use newspaper since the ink will transfer to your watercolor paper. Fill a graduate with 2oz. of water. The temperature of the water is not critical. Pour enough titanium white into the graduate to raise the level of the water to the 3oz. mark. If you are sizing more than one sheet of paper at a time, just extend this 2:1 ratio. Use 4 oz. of water and raise the level of the water to 6 oz. etc. If you don't dilute the paint you will put a very nice plastic coating on the surface which will render the paper impossible to use (very over-sized).

When the correct level has been reached, pour the water and paint out of the graduate into a glass jar or dish. With a small stiff bristled brush (a #3 will do nicely) remove the Liquitex that remains on the bottom and sides of the graduate and put it into the glass jar or bowl. Stir the mixture for a few seconds and then wash out the graduate and brush in soapy warm water. If you delay too long, the paint will dry and coat the graduate and the brush with plastic.

Take a soft wide brush, one with bristles at least 2" long and 2" wide and paint the paper, first making horizontal strokes from top to bottom and then by brushing vertically from

left to right. This cross-hatching motion will help insure that you don't leave any spot un-sized.

There should be just a bit of paint left over after covering one side of the paper. As a general rule, you should always mix up slightly more than you need or think you'll need so you won't be caught short. Wash the brush and bowl out and wait for the paint on the paper to dry.

Aquarius will take two coats on each surface. Archers Cover White 120 lbs. and Archers white 90 lbs. usually only one coat but sometimes two. Except with Aquarius, both sides of the paper must be coated, or the desired structural stability of the paper will not be achieved. I recommend that Aquarius be sized on both sides since this will enable you to use both sides of the paper to print on. But Aquarius does not need sizing on both sides for dimensional stability, because of the stable fiberglass interior.

After the paper has been sized and dried, cut off a small piece from a corner (a 1" square is fine) and run the test described in #46. If the paper stains, re-size it, but this time add 25%-50% more water to the paint and proceed as described above.

58) How long does it take to size the paper this way?

About 5 minutes to mix the paint and coat the paper, anywhere from 30 minutes to 2 hours to dry the paper per coating, depending on atmospheric conditions.

59) It has occurred to me that if I use the titanium white diluted as you suggest, and if I use Archers white 90 lbs. which you say usually takes only one coat, then there should be no variables. But you say "usually" take only one coat. Why the disclaimer?

Because I don't know how heavy or light a coat you are applying. And because the way your brush the paper one day may be different on another day. It is both a question of experience and of mood. Are you being particularly meticulous today or a bit sloppy?

60) OK. Any special tips?

Yes. You will find that when you coat the paper your paint brush may go off the edges of the paper. This is why the wrapping paper is used. What often happens is that the paint seeps underneath the watercolor paper and dries, causing the watercolor and wrapping

papers to stick together. If this happens you have just ruined part of one of your two surfaces. To avoid this, periodically lift the edges of the watercolor paper from the wrapping paper as it dries.

61) Anything else?

Yes. You may notice that when your paper is dry it has a slight wave to it.. This is because the paper dried unevenly. Don't worry. After you cut the paper into smaller pieces and lay them flat for a while, the wave will disappear.

62) Does the fiberglass in the Aquarius make it difficult to cut?

No. But when you cut the Aquarius paper, you will release small amounts of fiberglass into the air. Some people react negatively to this- that is, they scratch themselves a lot. If this happens to you, either don't use Aquarius or make only big prints that don't necessitate the cutting of the paper.

63) Anything else?

No, not for now. Just take a break and let everything you've read so far sink in.

Chapter Three

Emulsion and Pigments

64) So that I know exactly what we are talking about, could you define "emulsion"?

Glad to. The emulsion is the light-sensitive coating that is placed on the fully sized paper. In gum printing, the emulsion would consist of gum arabic and potassium or ammonium bichromate. In pigment printing, the emulsion consists of these two elements plus a watercolor pigment.

As I mentioned before, there is a slight difference between potassium and ammonium bichromate, and we will only concern ourselves with the former.

65) OK. Since I know nothing about potassium bichromate, I'm just wondering where I get it. At photo stores?

Yes. Kodak makes a photographic quality potassium bichromate that comes in a 1 lb. size that is available at some photo stores. If your favorite store doesn't stock it, it can be ordered for you. It can also be purchased from chemical supply houses, "science centers", some hobby shops, etc. At present, it costs about $3 for a 1 pound jar.

66) Since you mention one pound, I assume it comes in dry form.

Yes. It comes in a granular form and looks similar to potassium ferricynaide, a chemical most photographers are familiar with.

67) How is it diluted?

Well, the way which is usually recommended is to dissolve the potassium bichromate in a proportion of .5 dry ounces (16 grams) to 5 oz. of water at 100 degrees F. The bichromate dissolves easily and will look bright yellow-orange.

68) I get the feeling that you have a different way of doing it.

I do. I don't recommend the above method because it is time consuming, can be somewhat messy, and will necessitate the purchase of an accurate scale if you don't already have one. In addition, unless you mix each batch of bichromate exactly the same way, the strength you mix one batch will vary from the next, which could cause a major change in exposure time. This can be a bit maddening and result in a waste of both time and paper and other supplies. It is difficult enough, at least at first, to zero in on the correct exposure time. It's horrendous to be part way through making a print, run out of chemicals, mix up a fresh batch and find out that your exposures are now totally off. This would amount to starting all over again.

69) What is the method that you recommend?

Take a one gallon jug, fill it half way with 100ºF water, pour one pound of potassium bichromate into the jug a little at a time while shaking the jug gently. When all the bichromate is in the jug, cover and shake well. Then add some water and cover and shake again. Finally, add enough water to make one gallon. This will yield a supersaturated solution. The 5 to 5 oz. method will make a saturated solution. In the super-saturated solution, not all the granules will be dissolved. This will not interfere with the process, however, since the "extra" granules will settle to the bottom of the jug, and only become a potential problem when you use up most of the gallon. When you finally get to the bottom of the jug, (a gallon can last more than six months when used 1/2 or 1 oz. at a time) you will notice some undissolved granules in your emulsion. At this point just dump the remaining solution and mix up a fresh batch. This new batch will have the same characteristics as the old one. Or, pour the contents of the freshly mixed bichromate into another jug, straining the solution as you pour. You will now have a gallon without any residue.

70) I still don't quite see why using a super-saturated solution is preferable to using a saturated one?

From my experience, the super-saturated solution will not vary from one batch to another. The same amount will dissolve and the same amount will settle to the bottom from batch to batch. This will eliminate the possibility of one batch being stronger or weaker than another. However, the first method will work, so if you feel more comfortable measuring out the chemical, feel free to do so.

71) Is the bichromate light sensitive? Do I have to mix it up in total darkness?

It is light sensitive, but in its powered and liquid form, only slightly. You can mix it under any lighting conditions.

72) Now that I have one gallon of potassium bichromate, what do I do?

Make sure that you also have gum arabic, since you have to mix the two together to make your emulsion.

73) Is the gum arabic also light sensitive?

In the sense that everything is light sensitive to some degree, yes, but for our purposes, no.

74) If the bichromate is light sensitive, what is the purpose of the gum arabic?

As described in #10, the gum arabic is hardened by a chemical reaction when light strikes the bichromate, and this hardening of the gum encapsulates the water color pigment.

75) Oh yeah, sorry, I forgot.

That's Ok.

76) Where do I get gum arabic?

From lithographic supply houses, or possibly from a friendly lithographer or engraver.

77) How does it come?

Usually in liquid, in quart and gallon sizes. There are different gum arabics used for different lithographic processes. You need 14º Baume gum arabic. The 14º Baum refers to the gum arabic's specific gravity. There are a number of different companies that make gum arabic, among them 3M and Hurst. Gum arabic also comes in natural and synthetic forms.

78) Do you have a preference for a particular type of gum arabic? Which do you use?

I use Hurst #325 14º Baume gum arabic. I started by using 3M, chosen because it was a brand name that I recognized. Then came an embargo on natural gum arabic due to some

type of political/economic dispute between the gum arabic exporting countries and the U.S, With the unavailability of natural gum, synthetic gum was developed. The synthetic gum was generally thought to be inferior to the natural. I happened to find some natural gum made by Hurst and decided to switch brands rather than use the synthetic 3M. I found that there was a slight difference between the two, rapidly got used to the difference and decided to stay with the Hurst, even though natural 3M is again available.

(A shorter answer would have been "I use Hurst #325 14º Baume gum arabic." The more lengthy answer was given to help make a point. There are times when you are forced to experiment. If you are used to using one type of film, paper or chemical, etc., and find that you must switch to another for circumstances beyond your control, don't panic. The best procedure is to use the material just as if it were the old, taking into consideration any information the manufacturer may indicate, such as ASA numbers, etc. Run a test with a negative or slide you have had good results with in the past, and see what the differences, if any, are. You may be pleasantly surprised.)

79) Thanks for the advice. When I get the gum arabic, must I do anything to it before it is ready to use?

No, you use it straight from the bottle.

80) How is it combined with the potassium bichromate? In a one to one ratio?

If you are making 8x10s, 1/2 oz. of each (total 1 oz.) will give you enough to coat a few pieces of paper. Chemically, it seems to make no difference if you mix the gum into the bichromate or the bichromate into the gum. You can use a glass jar and pour the bichromate and gum in and stir with a small brush for about 30 seconds until the chemicals are thoroughly mixed together.

81) After they are mixed, I add the pigment, right?

When making b&w prints, you can. I usually prefer to use a slightly different method. I pour the gum arabic into the jar, then add the pigment, and finally the potassium bichromate. You see, the bichromate has a strong yellow-orange color, and this color will interfere with your visual evaluation of the color and strength of the pigment.

82) OK. I don't mix my potassium bichromate and gum arabic together, although I can if I want to. I measure, say 1/2 oz. of gum into a jar, add watercolor pigment, and then add an equal amount (1/2 oz.) of bichromate. Right?

Yes, but only with tube or liquid pigments. With dry pigments, there is a slightly different procedure.

83) Dry pigments?

Yes.

84) I can see that I need some information about pigments. What should I know?

Well, pigments can be placed into a number of different categories. First, there are watercolors, gouaches, temperas and poster colors. Second, there are pigments that are mixed with a binder (often gum arabic) and come in tubes and jars, and pigments that come in dry, powered or granular form. Third, there are pigments that are permanent and others which are not (fugitive).

Any of the above pigments will do, as long as it is water re-wetable. There are acrylic based paints which can be diluted with water but which dry to a plastic finish. Liquitex titanium white, recommended for sizing the watercolor paper, is just such a paint. These acrylic based paints cannot be used. Only water re-wetable watercolor, gouache, tempera of poster colors can be used. Also, oil based paints, such as oil colors, cannot be used.

85) Why must water re-wetable colors be used?

Because after the emulsion is coated onto the paper, it is allowed to dry. Then the exposure is made and the print is developed in water. If the pigment is not water re-wetable, there will be no development action. Do you understand?

86) Yes. What are the differences among watercolors, gouaches, temperas and poster-colors?

For our purposes, the differences lie in the opacity of the pigments. Watercolors are the most transparent, poster and temperas the most opaque, and a gouaches opacity lies between these.

87) Throughout you have been mentioning watercolors. Now you add gouaches, tempera and poster-colors. You also say that as long as they are water re-wetable (not acrylics), any can be used. What is your recommendation?

For b&w I use either gouaches or watercolors. For full color prints I usually use watercolors, rarely gouaches. For nonobjective or abstracts, any or all of them.

Just as in selecting a paper, there are many considerations to evaluate. To help you decide which typed of pigment to use, it is best if we discuss what these different considerations are at this time.

88) Sounds reasonable. What's first?

Opacity. I have mentioned before, and we will discuss in detail later, that most pigment printing involves making multiple exposures. If you use a pigment that is too opaque, you will cover up detail as you make one exposure on top of another exposure. This is self defeating. Therefore, for most forms of pigment printing, a watercolor, which has the least opacity of any pigment, will work best. Depending on what type of printing procedure you wish to follow (see the following two chapters), you may find that for for b&w or one-color and white, a gouache will work best because its level of opacity will eliminate some or all of the multiple exposures. Put another way, with a gouache it is often possible to make a b&w print with only one exposure, reducing printing time, registration problems, etc.

For full color printing, it is necessary to use a transparent pigment, since the colors must blend together to give the full color effect. Questions?

89) Yes. I've been wondering: If I make one exposure on top of another, won't the first exposure be ruined when the second emulsion is coated over it?

No. After your print has been developed and dried, it becomes permanent. You can take the print into the shower with you and it won't wash off. But during the development process and while the print is drying after development, the image is frail and can be damaged or ruined easily. Take care not to touch the emulsion during these times. Questions?

90) No. What else?

All pigments do not have the same fineness of ground. Different organic pigments, for instance, will have different grain sizes due to their nature. Some are capable of being more finely ground than others and different companies make different qualities of paints, so Chromium Yellow light from one manufactures may have different pigment sizes than those from a different manufacturer.

91) Is a finely ground pigment best to use?

Not necessarily. I am sure that you have found that sometimes grain adds to a picture and sometimes it detracts. It depends on the subject matter and the statement you are trying to make.

92) What about permanency?

Pigments that are permanent are usually "earth colors", that is, ones that are refined from ores or earth, such as cobolts or umbers. Pigments that are made from synthetics often are not permanent. Non-permanent pigments are called fugitive and will change color and fade with age.

93) So if I use permanent pigments my colors will not change with age, but remain "true".

Yes, but only if all the potassium bichromate is washed from the print during development. If any remains, it will eventually cause the colors to change. Also, proper care must be taken with the print. Direct exposure to sunlight will cause any pigment, permanent or not, to fade and change color.

94) Are there any differences between dry and tube pigments as far as quality, grain and ease of use go?

What differences do exist as far as quality and grain size go are usually due to different manufacturing procedures among companies. Tube and liquid pigments are a bit easier to use since there is no need to dissolve them before adding them to the gum arabic. Dry pigments must first be dissolved before they can be added to your gum.

95) Do permanent pigments come in tubes, dry pigments or liquids?

All.

96) Why can't dry pigments just be added to the gum, as tube pigments can?

They won't dissolve. Later I will give detailed instructions for this procedure, but for now just remember that tube or liquid pigments can be added to the gum directly but dry pigments can't. Questions?

97) Are dry pigments better than tube pigments?

No. Just different.

98) Then why would dry pigments be used instead of tube pigments, if dry pigments involve additional steps?

Because in addition to opacity, permanency and grain size, you should consider the aesthetic differences and qualities in the looks of pigments.

The aesthetic considerations as far as we will concern ourselves here come down to hue, value and chroma (intensity). Hue is just another word for color. Value indicates how light or dark a particular hue is. (A dark red or a light red). Chroma indicates the hues' brightness or dullness (a dark dull red or a dark shiny red). You may find that the value and chroma of a particular dry pigment is better suited for your needs than the same hue in a tube or liquid pigment.

99) OK. And while we're on the subject, I've noticed that there are some very pretty inks and dyes made. You haven't mentioned using them. Why?

Because they won't work. There is even a product called *Dr Ph. Martin's radiant water colors* which come in liquid form and could be very easily and accurately measured into the emulsion by using an eyedropper. But this product, as with all inks and dyes, just won't work in our process.

100) Why?

Think of the gum arabic as a fish net. Watercolor pigments, gouaches etc. are big fish. During development they get caught in the net and can't escape. Dyes and inks are little fish, and during development they pass through the net and escape. It is a pity, since many of these colors are exquisite.

101) Then I'll stick with the four types of pigments you mentioned earlier. I believe I noticed another magic word. Measure?

Yes. If you are making a print that requires more than one exposure, it is helpful to use the same amount of pigment each time. It is necessary to use precise amounts of pigment when making full color prints to get the correct color balance and to make sure that you don't use too much or too little, which may lead to problems.

102) What sort of problems?

Too much pigment will give a result similar to that which occurs when the paper is over-sized: pieces of emulsion will flake off during development, giving a spotty, uneven look.

103) And too little pigment?

The resulting print will look too light; it will be lacking in contrast and look "washed out". So far I have tried to avoid giving hard and fast rules. I envision this process as being very free, and rules tend to inhibit creativity. The time has come, however, to give you a "big rule". A print can never be darker than the darkest pigment or combination of pigments used. The difference between the darkest part of the print and the lightest area determines the contrast of the print. Unlike contemporary commercial process, the length of exposure plays only a minor role in creating the darkness of a print.

104) When I'm making a standard Kodak b&w print, the length of exposure determines how dark the print gets. What you're saying is that pigment determines how dark the pigment print gets.

Exactly. Commercial printing paper is made up of microscopic bits of silver. Each silver grain is capable of becoming black. If you give a long enough exposure through any negative, you cause all the silver to be fully exposed and hence darken during development.

Since pigment printing does not rely on silver to darken during development, but on the pigment itself, the print cannot be darker than the darkest pigment used, or combination of pigments used.

105) You say that exposure plays only a minor role. Can you elaborate?

Yes, although I will go deeper into this in chapter five. If you do not give a long enough exposure (underexpose) then the pigment, or not enough of it, will not remain on the paper, but develop off. Therefore, the exposure only causes a given amount of pigment to remain on the paper.

If the darkest pigment is gray and not black, the proper exposure will only insure that the gray pigment will stay on the paper in proportion to the amount of light that passed through the negative, resulting in a gray and white print, not a black and white one. There will, however, be detail in the grays.

106) I think I understand, but I'll ask anyway. What does too little pigment have to do with gray pigment?

I'm sure you understand too, but while I have this opportunity, let me verbalize if for you. If you take some black watercolor pigment from a tube and paint it on some paper, you will have black. If you take black watercolor pigment and water it down and then paint it onto paper, you will have gray. You have simply diluted the pigment which changed its value. In its diluted form, it is not opaque enough to appear black. It still is black pigment, but light passes through it, bounces off the white paper and passes back through the paint. This makes the paint appear gray. Therefore, saying that you have used too little pigment is the same thing as saying that you have diluted it too much.

107) Thank you.

You're welcome.

108) Okay. Too much pigment will cause the pigment to flake off during processing and too little pigment will not give me a good black. Is this important in color printing?

Too much pigment, yes. Too little pigment, not necessarily. In b&w printing we depend on the proper contrast to assure us that we are seeing accurate representations of the colors in the original subject. But more importantly, we need proper contrast to give the illusion of depth and to separate one object from another. In color photography, differences in color help us determine both depth and separation of one object from another.

The eye can look at a pastel photograph, which is what a photograph with watered

down (non-saturated) colors would be, see that the colors are not saturated, but not rebel. The eye, seeing a "flat" b&w photograph, does have a tendency to fight this "unnatural" image. It is possible, therefore, to make a color photograph with weak or non-saturated colors work, but it is just about impossible to make a b&w photograph with weak blacks work.

109) So it is important for me to have the correct amount of pigment in a b&w print, but not as important in a color print.

Correct, as long as you don't have too much pigment, which will cause flaking of emulsion. And I have a feeling that you will be happiest with your results, at least at first, if you use the correct amount of pigment in both your b&w and color prints.

110) And the correct amount of pigment is what?

It would be nice if I could give you a simple foolproof method to get just the right consistency of pigment on the first try. Unfortunately, I can't. If it will make you feel any better, let me assure you that only a minimal amount of experimenting will be necessary for you to lock in on the correct amount of pigment to use.

Realizing full well that I am repeating myself, if your emulsion flakes off during development, and if you have determined that your paper has been properly sized (#46), you are using too much pigment. If your finished print is lacking a good black or, if color, is generally weak in color saturation, you are not using enough pigment. Therefore you need an amount of pigment that falls in between these extremes. Once you have determined the amount of pigment to use, you can easily standardize this part of the process. This is where measuring comes in.

111) How do I go about measuring?

Measuring pigment for a full color print is different from that for a b&w print: Using tube pigment is different from dry pigment. I suggest that we cover these separately.

112) Fine. How do I measure tube pigment for a b&w print?

For black tube pigments, I suggest that you use a plastic or wooden coffee stirring stick. Put a line, either with pencil or with a piece of masking tape, about 1 inch from one end. Squeeze out the tube pigment so that it covers the one inch distance in an even line. Uneven

pressure will case the pigment to be thicker at one point of the line than at another, which will give you varying amounts of color from one batch of emulsion to another. Try to avoid this.

When the pigment is on the stick, dip it into a glass jar containing 1/2 oz. of gum arabic. With a small paint brush, scrape the pigment off the stick, remove the stick from the jar, and stir the pigment into the gum with the brush for about 30 seconds until the pigment is evenly distributed. Add to this solution of gum arabic and pigment 1/2 oz. of potassium bichromate and stir for another 30 seconds. You now have a light-sensitive pigment emulsion with approximately the correct amount of pigment.

116) Again, if I want to make a blue and white print using dry pigments, I would follow the same directions.

Yes.

117) Since I envision starting off making b&w prints at first, lets stick with this for a while. I take it that you are not guaranteeing that the amounts of pigment you recommend will yield prints with the correct amount of pigment because you stressed "approximately".

That's correct.

118) I kind of thought so. Why?

Because I don't know what type of pigments you are using.

119) Then could you recommend one?

Try Windsor and Newton ivory black or lamp black watercolor or gouache for tube paints, and Permanent Pigments (That's the brand name) lamp black or ivory black for dry pigments. But I still don't know how thick or thin a line you are squeezing or how big or deep your teaspoon is at the tip. I will, however, guarantee that you are somewhere near the correct amount.

120) How do I find out for sure?

Make a test print. If the emulsion flakes off during processing, use 1/2 the amount of recommended pigment and repeat. But if the print looks weak, double the amount of recommended. With some watercolors, you will find that doubling the amount of pigment to

correct for a weak black will cause flaking. If this happens, switch to a gouache which is more opaque or use the multiple printing method described in chapter 5.

121) How do the procedures for mixing b&w pigment differ from mixing pigment for a full color print?

If you are just making a b&w print, all you need is a pigment dark enough to give you a good black so you will obtain a print of normal contrast. If you are making a green and white print, all you need is a pretty (or ugly, if that's the effect you want) green that doesn't cause the emulsion to flake off during processing. But for full color, you need three or four (see Chapter 5) colors that mix together to make a black.

The 3 watercolors used are those that closest resemble the inks used in offset lithography: magenta (red-blue), cyan (blue-green) and yellow. These colors, when mixed together, will yield a neutral gray-black. The names of the colors made in both tube and dry pigments that closest approximate printers inks are Alizeran Crimson (for the magenta), Pthylocyanne blue (pronounced thalo-cyan) and Chromium yellow light (for the yellow).

122) Are these pigments mixed in the same manner as when mixing pigment for b&w printing?

You go through the same motions but the proportions are different. You will probably find that you have to use about 4 times as much cyan as magenta, and about twice as much yellow as magenta. Or, put another way, 1 full measure of cyan, 1/2 measure of yellow and 1/4 measure of magenta. You do not mix the pigments into the same jar, since you must keep them separate for separate color exposures.

Set up 3 jars. add 1/2 oz. of gum into each and then mix one color into each jar, unless, of course, you are using dry pigments, in which case you would first mix the pigment with water and then add the gum. Be sure to thoroughly wash the measuring stick or spoon or eyedropper or other measuring device before going from one color to the next, or you will contaminate them. It's not a bad idea to use separate measuring devices for each color. And it is very important to just mix the pigment and the gum. Do not add the bichromate.

123) I assume I shouldn't add the bichromate because it is yellow-orange in color, which will make my blue-green look very green. I really don't see what difference this makes but you

mentioned before that it would.

It does. Also, the addition of the bichromate will start the aging process in the emulsion, which should be avoided. This, however, will be covered later. Let's stick with the color change.

124) OK. Why will the yellow-orange color of the potassium bichromate cause problems?

When you have your 3 jars of colors mixed, all you have is 3 pretty colors. Even if you used the proportions given in #122, you cannot be certain that the 3 colors, when eventually combined, will yield black. (Technically, if the proportions of each color were correct, a black would occur if the three colors were combined. In practice, a dark neutral gray results- #12.) The object, however, is to get a dark neutral gray, which we will refer to from now on as a black. This black will assure us that when we make a print we will not be using too much or too little of one color, hence causing a color shift. To see if the 3 colors mix to make a black, we must run a test to see what color results when the 3 colors are combined. The yellow-orange cast of the bichromate will make a color test impossible to make.

125) How is the test made?

Take an eyedropper and put 3 drops of each color into a fourth jar. Be sure to rinse the eyedropper before going from one color to the next to avoid contamination. When you have 3 drops of each color in the jar, mix them thoroughly with a brush and then paint some of the color onto a piece of sized watercolor paper and allow to dry. When the paint is dry you will be able to see what the color shift is, if any; whether the color is a reddish gray, a greenish gray, etc. If the color is too red, it is lacking in both cyan and yellow. If it is cyan (blue-green) it is lacking in magenta, etc. As you can see, if you have added the bichromate, all the colors would have yellow-orange mixed in with them, so it would be impossible to tell what the color shift is and how to correct for it.

126) If I have a shift that is too green, all I have to do is add some magenta pigment to the magenta I've already mixed, and repeat the test to see if I have corrected enough or if I have over corrected.

Right. You want to add the complementary color to neutralize the color shift.

127) I suppose that adding additional pigment to gum arabic is easiest to do with tube pigments, since it is difficult to add dry pigments to a of liquid?

Yes. But you can mix up a small amount of dry pigment in a dry jar and pour the contents of the previously mixed color into it.

128) Good thinking. In # 123 you mentioned something about an aging process.

Yes. Emulsion is not particularly light-sensitive when it is in liquid form, but there is a negative chemical reaction that does take place when the gum and bichromate are mixed together. The emulsion slowly changes character and becomes faster, i.,e., more light-sensitive. This would be fine, since it would make exposures shorter, but it is unpredictable and therefore a bit dangerous. The safe working time of fully mixed emulsion is about 3-4 hours. After that you are taking chances.

129) But you have also mentioned that it could take a day or a week to make a full color print. What do I do? My balanced emulsions won't last that long.

In Chapter 5 we will discuss fully the making of full color prints. For now, remember that the key lies in careful preparation. If this has been done thoroughly, it is possible to make a full color print in 6-8 hours. Happily, the solution of gum arabic and pigment will safely last about 10-12 hours. By adding the bichromate only when the color is to be used, the magenta, cyan and yellow colors that have been previously balanced may be used.

There is also a back-up system that can be employed. After mixing your 3 colors, take 10 drops of each color and put into separate jars. Since these colors are just for reference, it doesn't matter if they are stored for a few days. When you need to mix up a fresh cyan, for instance, you can use a few drops of stored magenta and yellow to mix with it.

130) OK. Now that I have my emulsions, what do I do?

Coat the paper.

131) Do I follow the same procedures I used to size the paper?

Yes. Use a soft wide brush. Dip the brush into the glass jar, let it soak up some emulsion, then wipe the side of the brush against the jar to remove excess chemical. Paint

the emulsion on the paper, trying to make as even a coating as possible, although some unevenness may be tolerated. If you notice "bubbles", areas where the emulsion doesn't adhere to the paper, the paper may be over-sized or you may be using too much emulsion. Try letting the emulsion sit on the paper for 20-30 seconds and recoat, this time using a very dry brush. A perfectly even coating is very difficult to achieve and not all that necessary. What is necessary is to get a minimum coating over the entire paper, that is, with no white areas of paper showing. Areas that build up with emulsion will probably not cause problems, although sometimes this is the case. Heavier coated areas of the paper almost always develop off the paper, so a uniform print results.

132) Can the coating of emulsion be done in room light?

Yes. Since this goes against what most photographers have held as a self evident truth, that is, that light sensitive material must be handled in the dark or under a safelight, you may feel a bit insecure coating your paper in a well-lighted room. If this the case, try using a bug light or red safelight. But room light is perfectly safe. Avoid direct sunlight, however.

133) Are there recommended ways to dry the paper after it has been coated?

The best way is to hang it up. A coat hanger with clothes pins will do nicely. However, I usually use a push pin or thumb tack and pin the paper to the edge of a wooden work table or to a wooden wall. You can just leave the paper lying flat on the table, but the drying time is longer this way and the emulsion has a tendency to form "puddles".

134) Then I just wait for the paper to dry and I am ready to use it?

No. The length of time the paper dries is critical. As the emulsion dries it increases in light sensitivity. A paper that dries for 1/2 hour will need more exposure time than one that dries for 1 hour, but less than a paper that dries for only 15 minutes.

135) Do you have a recommended drying time?

This is a difficult question to answer. You must consider the atmospheric conditions in the room used to dry the paper. The drying time in a cold damp room will be longer than in a warm, dry one. Choose a room or closet that is convenient for drying paper and run some tests to determine how long it takes for the paper to dry. The drying time in the room I use is

about 15-20 minutes. To make sure that the paper is thoroughly dry, I have standardized my drying time to 1/2 hour.

136) Can room lights be left on during the drying process?

They can, but at this point I draw the line. I dry my paper with the room lights off.

137) Can the paper be forced dry with heat?

I don't recommend it. The rapid drying may cause the paper to dry unevenly, causing some areas to become more light-sensitive than others.

138) I'm trying to visualize the paper drying by hanging by one corner. Won't the emulsion run off the paper?

Some running might occur, but the worst you should get is a slight build-up at one edge. If the dried paper looks very uneven, with only a little pigment at the top and a greater amount in the middle and bottom, you have used too much emulsion. Next time use less. Any questions?

139) None offhand.

Then take a break and then move on to Chapter 4.

Chapter Four

The Negative

140) Negatives. What if I told you that I don't know how to develop film?

Then I would suggest that you get a book on the subject.

141) I was only kidding. Where's your sense of humor?

I'm glad you were only kidding. But being able to develop film is the only photographic skill necessary for making pigment prints. If you don't know how to make a contemporary photographic print, if you don't even know what a polycontrast filter is, you would not be handicapped. After all, pigment printing existed before these did. If you don't know how to develop film, however, you will have to learn, and since there are numerous books on the subject, I won't devote time here for these fundamentals.

142) OK. But I can develop film. Now what?

Take out your densitometer.

143) I don't have one.

I had a feeling you didn't. We will be discussing densitometers throughout this chapter because I feel the information to be of great importance. I do not recommend that you run out an buy one, though, since they are expensive and there are other methods that can be substituted in place of using one, one of which will be described in this chapter. As I mentioned in #23, though, it would be helpful to have a densitometer. I never used one until I got involved with pigment printing, and have since found that the gadget has saved me many hours and a good deal of money in wasted supplies in both conventional and pigment printing processes.

Briefly, a densitometer is a machine that enables you to read the density (degree of opacity) of a given area of a negative, positive or print. By subtracting the shadow density reading (which is always the lowest reading in negatives) from the highlight density reading,

(which is always the highest reading in negatives), you determine the gamma (contrast) index of the negative, positive or print. Questions?

144) Are there different types of densitometers?

Yes. A densitometer that reads negatives or positives is called a transmission densitometer because light is transmitted through the negative or positive. A densitometer that reads prints is called a reflection densitometer because light is reflected off the surface of the paper. Densitometers that do both are called transmission-reflection densitometers.

Physically, some densitometers work electronically while others are operated manually. The latter type is usually much less accurate but is also much less expensive.

Lastly, some densitometers come with color filters that aid when reading color films, transparencies and prints, and some do not. The first is called a color/b&w densitometer and the later just a b&w densitometer.

For our kind of work, a manual b&w transmission densitometer is all that's needed. Kodak made one that is also a reflection densitometer that costs about $125 new (it might be possible to find one used).

145) How does the Kodak model work?

Manual densitometers have a continuously graded piece of transparent material (that gets less transparent as you adjust it and reach one extreme) that is accurately calibrated. It allows continuous readings in fractions of an f stop by matching the opacity of the negative to the opacity of the graded scale. The total range is calibrated from 0.0 to 3.0. Each **.**1 graduation, which is read on a dial, equals 1/3 of an f stop.

146) Why does **.**1 equal 1/3 of an f stop. It would seem more logical if **.**1 equals 1 f stop or 1/10 f stop.

1/3 f stop was chosen as the major gradation because ± 1/3 f stop is considered the standard photographic tolerance.

147) Why?

Because 1/3 f stop is the tolerance of the human eye. To be more accurate, 1/3 f stop

is the tolerance of the trained unaided human eye. Differences of less than 1/3 f stop can only be guessed at, no matter how highly trained the unaided human viewer is. With the Kodak densitometer mentioned earlier, differences of up to 1/12-1/24 of an f stop can be determined accurately- with practice, or course.

148) Please give me examples of how one is used.

With gradations of 1/3 f stop marked in .1 gradations, .3 indicated 1 f stop (1/3+1/3+1/3=1), .6 indicated 2 f stops, 1.5=1.5/.3=5 f stops from 0.0 (we divide by .3 because .3 equals 1 f stop. A highlight reading on a negative of 1.7 and a shadow reading of .5 would equal a 4 f stop range, that is, 1.7-.5 = 1.2, and 1.2/.3 = 4. If you really know how to develop film, then you probably know that a 4 stop range in a b&w negative between highlight detail and shadow detail is considered normal: it will print on a #2 Kodak paper.

149) So with a densitometer I can read my highlight detail and my shadow detail and determine if I have a normal negative.

Yes. It will also tell you how flat or contrasty your negative is if it isn't a normal negative, and so indicate what grade of contemporary printing paper to use. But what's just as important as knowing what the contrast of our negative(s) are is that it can also indicate what our printing exposure should be.

150) How?

Well, if a 4 stop range is considered normal for a contemporary b&w negative, there should be no difference between a negative with highlight and shadow readings respectively of 1.7 and .5 and another negative with readings of 2.2 and 1.0. They both have a 4 stop range (1.7 - .5 = 1.2 / .3 = 4. But there is a big difference. The negative that reads 2.2 and 1.0 is overall more dense than the negative that reads 1.7 and .5. A .5 reading in the shadows is 1 and 2/3 stops less dense than a 1.0 reading in the shadows. (1.0 - .5 = .5. And .5/.3 = 1 and 2/3 stops.) The thinner negative will need a much shorter exposure time that the denser one.

151) How does all this apply to pigment printing?

The importance of understanding this information will become clear in a while. If you

have a densitometer you will be able to accurately determine the contrast of the negatives you will be printing which will help insure that you will realize prints of correct contrast of the negatives and hence correct detail and you will also be able to correctly determine the printing exposure necessary to give you an optimum print.

152) I realize that you have told me all this for a reason which makes me feel a bit uneasy because I don't have a densitometer.

All is not lost. Later I will give you a method to help you accurately guess the overall contrast of your negatives and the shadow density to determine printing time.

153) Do we get to make negatives now?

No. We still have some preparatory information to go through first.

154) Such as?

Well, there are two general types of pigment printing, regardless of whether we are making a b&w or color picture. The first I call the contemporary method because it is the way people make pigment prints today. These people are misled in their thinking that they are printing in the traditional method, i.e., the way our foreparents did about 100 years ago. The second method of printing is the traditional method, but slightly modified.

155) Why slightly modified?

Actually, the printing procedure isn't modified, but because films have changed in the past 100 years, we must make our negatives correspond to the negatives of the past. This is the modification.

156) Is one way easier and do they both give the same results?

The modified-traditional method is by far easier and gives superior results.

157) And the preparatory information you mentioned?

Well, with either method, the ability to register negatives, whether for b&w or color, is necessary. One form of registration is rather simple and involves no preparation. The other is a bit more complex and does involve building a registration easel.

158) Which method do you recommend?

Neither. They both will give satisfactory results. The difference is really one of aesthetics. Your prints will look completely different, depending on how you chose to register your negatives. The aesthetic considerations will be discussed in the following chapter.

159) I'm not really handy with tools and I don't have many. How difficult is it to make a registration easel?

Not very. Go to a lumber yard and have them cut you a piece of 1/2 or 3/4 inch thick plywood finished (smooth) on both sides. The piece of wood should be flat, not warped. The dimensions of the wood really depend on how large you plan to make prints. A 12x12 inch piece should do. At the same time buy a 1/4 inch wooden dowel. You will only need a few inches. They usually come a few feet long, but are very inexpensive. The total cost of all this, including the cutting of the plywood, should be under $5.

Then go to a stationery supply store and buy a standard 1/4 inch 3 hole punch. Get the type that has one fixed center punch and two movable punches. This may cost about $15. Questions?

160? No. Now what?

I recommend that you begin printing small, say using 4x5 inch negatives. As you gain experience and confidence, move up in size. Adjust the 3 inch hole punch so that one adjustable punch is about 1 and 3/4 inches from the center, and the other about 1 1/2 inches from the center. With this setup, you can punch 4x5 inch film.

161) Why not make them both the same distance?

If they were both the same distance it is possible, if your mind wanders, to place a negative on the easel upside down or flipped left to right. I know, because it has happened to me. If the holes are unsymmetrical, this becomes impossible.

162) Okay.

Punch a piece of paper and place it on the easel so that the holes are running parallel about 1" from one edge. Draw a pencil line around the inside of the punched holes and then

drill three 1/4 inch holes about 3/8 inches deep in the outlined positions. Cut 3 one inch pieces of dowel and place them in the holes, but do not glue them in place.

163) Why not glue them in place?

Because in time you will want to use larger film and permanently placed dowels may be in the way.

164) Why can't I use the same hole positions for larger pieces of film?

You can, but it's best to have the holes spaced as far apart as possible. This will help insure steady, accurate registration.

165) What is the procedure for using the easel?

The easel is used both to make a negative or negatives by enlargement of a transparency onto film, and for placing the negative(s) on the printing paper in exactly the same position for repeated printing exposures.

166) Not to change the subject, but why make negatives by projecting a transparency onto film? If I want to make a b&w print, why can't I just shoot a negative in a normal way?

You can, but it's not practical. For one thing, unless you have a 4x5 or larger camera, you prints are going to be very small. Don't forget, the negatives are printed by contact.

Another reason is that if is very difficult to make color separation negatives in a camera, and for this type of negative your subject matter would be limited to objects that didn't move. (See the photo at the end of this chapter.)

167) But if I just wanted to make a b&w print, why couldn't I shoot a 4x5 or larger negative in a camera?

It's still not practical. Negatives for the modified - traditional method of printing. which is by far the easiest way of printing and the way I feel gives superior results, needs a special type of processing. Until you get the hang of it, you may need to make 3 or 4 negatives in order to get one usable one.

If your subject doesn't move, you can shoot your film directly in the camera. If the

resulting negative is not correct, you can go back and reshoot and reprocess. If your subject does move, you may end up with one good negative out of 4 exposures, but the composition of the good negative, or the expression on the model's face, may not be worth printing.

Another point is that if you shoot slides, you have the option of making a b&w or color print, or both. and in various sizes. Questions?

168) No.

Okay. Then I want to make it clear to you that you do have an option. You don't have to use the modified-traditional method of printing. You can use the contemporary method. There are people who do use it. (They have a lot of trouble, and I personally think that they are crazy, but they do use it.) To use the modified-traditional method, you may have to spend extra time in the darkroom. This extra time spent in the darkroom processing negatives will save you days or even weeks of printing. But you do have the option of shooting a normal negative in a camera and processing the film in a normal manner.

169) I understand. Somehow I get the message that I am going to be printing in the modified-traditional method, starting with a slide. I like the options of being able to decide "after the fact" whether I will make a b&w or color print, and its size.

It is handy.

170) How do the negatives for the contemporary pigment printing method differ from the negatives for the modified-traditional method?

Assuming that you take a b&w negative of a "normal" scene, say a landscape on a sunny day, and process you film according to the manufactures recommendations, you will, naturally enough, end up with a normal negative, As I mentioned before in #148, a normal negative is one that has a 4 stop range between its highlight detail and its shadow detail. **This 4 stop range is too great for pigment printing**.

The range you need is 2 stops, because the emulsion used in pigment printing has about a 2 stop range. Think of a line that is 2 inches long with another line above it that is 4 inches long. The 2 inch line represents our paper and the 4 inch line a "normal negative". If you place both lines in contact, you can see that 2 inches of the 4 inch line will not touch the

shorter line. If the 2 inch line represents our film, then you can see that we are loosing 2 inches, or stops, of detail. Those who use the contemporary pigment printing method try to manipulate their printing procedures to get the 4 inch line to fit onto the 2 inch line. We just make the negative compatible with our paper. We manipulate the negative, not the printing.

Ordinarily, to do this you would overexpose and under-develop. This is not recommended because it will yield a negative with a fairly high shadow density which will result in a rather lengthy printing exposure.

What we must do if we want to print with the modified-traditional printing method is to expose our film normally but under-develop it. This will yield a negative that is compatible with our paper and thin by contemporary standards, which will be perfect for our modified-traditional printing process.

171) So the object is to get a negative that has a 2 stop range that is also on the thin side.

Correct.

172) And we do this by normally exposing and under developing.

Correct.

173) And this procedure is the modification in the modified-traditional printing process.

Yes. All we are doing is modifying our negatives so that they are compatible with the emulsion. The negatives used about 100 years ago were, the ones we use today are not.

174) What is the procedure for making a modified-traditional negative from a color slide for b&w printing?

Simply put, place a slide or transparency into an enlarger, magnify it so that it covers your film, place the film under your enlarger and expose it to light- exactly the same as when making a regular b&w print, only we are using film instead of paper to print on.

175) For a b&w pigment print, how many negatives do I need?

Only one.

176) Putting aesthetics aside, is their any reason for me to use the registration easel?

Putting aesthetics aside, no.

177) I'm about to make a b&w negative from a slide placed in my enlarger. I may or may not be using a registration easel. I've never done this before. What type of film should I use? Developer? How do I determine my exposure.

One at a time. For film, I recommend Kodak Plus X.

178) Why?

Because it is slow enough to project onto and its easily available in many sizes.

179) And the developer?

Kodak DK-50.

180) Why?

Besides the fact that Kodak recommends it for many similar applications, it just happened to be the developer I was using when I worked out the exposure and development times needed to yield a negative with a 2 stop range and low shadow density. Feel free to experiment with other developers if you wish.

181) How do I determine my exposure?

Do you have a light meter and an exposure meter?

182) No. I mean I have a light meter in my camera. I don't have an enlarging meter. In the beginning you said that I didn't need all kinds of equipment.

You don't. Honest. Relax. But having some equipment does make things a bit easier. Borrow and incident-type light meter from a friend. I really suggest that you get an inexpensive enlarging meter, if not a good one. If you happen to have a color analyzer, you can use the white light scale as your enlarging meter.

183) Why do I need them?

The incident light meter so you can establish a base exposure. The enlarging meter to help establish new exposures when the enlarger is moved farther or closer to the film to make bigger or smaller negatives or when cropping out unwanted areas of a slide.

184) Assuming that I have an incident light meter, what do I do?

Set up your enlarger in a normal manner. If you shoot 35mm slides, put a 50mm lens on the enlarger and set the condensers, if any, for that focal length lens..

185) Check. And then?

Set the lens at f 5.6. Set the exposure meter at ASA 100. Shut off all safelights and turn the enlarger on. Place the exposure meter so that the hemisphere is touching the lens. Take a reading.

At this point we start running into variables. You see, the information I am about to give you is based on my exposure meter and my lens and my condensers and my enlarging bulb. The chance that your equipment and mine will match exactly are slim. I have checked my equipment against others', and so I feel that, unless your equipment is very different from mine, the following information should put you in the ball park.

The light meter reading I get is 1/30 second at f 8.

186) What if my reading is off?

Simply adjust your lens until you get a reading of 1/30 second at f 8 with ASA 100.

187) What if my reading is so far off that I have to open my lens farther than it will go, say to f 2, if I have a maximum aperture of f 2.8?

The reason I chose f 5.6 as the lens setting was to make the probability of this happening about nil. For this to happen the differences between my light meter reading and yours would have to be 3 stops, which seems to me to be unlikely. If it should happen that you have to open your lens more than it will go, just remember that you are deficient that amount of light. Use the amount you are deficient to modify the instructions I will give you in a bit. But I really don't think that you will have to worry about this happening.

188) I hope not. At this point, let's say that my lens reading is f 5.6, just like yours, and my

exposure meter reads 1/30 second at f 8 at ASA 100. What does all this mean?

Nothing by itself. Your exposure not only depends on the amount of light leaving your lens, but also on the distance from the lens to the film. The closer the distance the shorter the exposure necessary; the further, the longer.

189) To establish an exposure time, how far should the lens be from the film?

Do the following. Put a 35mm carrier in the enlarger without a slide, and enlarge the white light projected to a 6x10 inch area onto a piece of white paper you have punched and inserted on the registration easel, If you are not going to use the registration easel, place a piece of white paper on the baseboard of the enlarger. When you have the enlarger set at the 6x10 inch projection size, your exposure will be 1 second at f 22, with the following exceptions: (A) If your lens read differently than f 5.6 (#187), say f 4, you close down 4 stops. With this example, your exposure would be 1 second at f 16. (B) If you are deficient in stops (#187), you must also open your lens up the appropriate amount of stops. For example, if you were deficient 2/3 of a stop, open up 2/3 of a stop from whatever your lens comes to by closing down 4 stops because you lens was not a f 5.6 when it should have been. I'm sure this is all perfectly clear.

190) Huh?

You sound like you have some questions.

191) A few. Actually, I'm a bit confused.

Look, all we are trying to do is establish a base exposure. I have already established a base exposure with my equipment. I did this by the trial and error route. As President Lyndon Johnson used to say, "Let us reason together." Now I happen to know that with my set-up, an exposure at the 6x10 inch magnification with a 50mm lens for making a b&w negative on Plus X film is 1 second at f 22. Now, if I just told you to make an exposure at 1 second at f 22, the chances are great that it wouldn't do you much good. There are too many variables. So the problem as I see it is to take the information that I have and break it down in such a way that you can use it to zero in on the correct exposure regardless of variables, or: leave you to your devices. When I first started trying to make separation negatives I checked a number of different references. They all gave very different instructions. One reference book had two

different sections dealing with separation negatives, and the information in one section had nothing to do with the other section. The purpose of this book is to help you to learn to make pigment prints, not to say "exposure is determined by experimentation", as I have read elsewhere. I have discovered though, that because there are so many variables, giving hard factual instructions is not always possible. From a philosophical point of view, it may not even be desirable. After all, if the process was totally systematic, there would very little difference between it and a contemporary commercial process. While the information is contained in #189, we will now go through the process in a slightly different manner. OK?

192) OK. Let me tell you what I am sure of and what I don't fully understand. I put a 50mm lens on an enlarger and check to see that the condensers are in the correct position. I set an incident light meter at ASA 100. I set the enlarging lens at f 5.6, Why do I set the enlarging lens at f 5.6? Since you know that the lens will eventually end up at about f 22, why not set the lens at f 22?

A fair question. The amount of light coming trough an enlarging lens at f 22 is quite low. Most light meters are not very accurate at very low light levels. To help avoid a misleading exposure reading, I arbitrarily chose f 5.6.

193) Now, your light meter gave a reading of the light coming through your lens at f 5.6 at 1/30 second with your meter set at ASA 100. If my meter should read the same, everything is fine. The amount of light coming through my equipment is the same as the amount of light coming through your equipment. Right?

Right.

194) But if I get a different reading with my meter, it means that a different amount of light is coming out of my enlarger from that coming out of yours. I therefore have to compensate for this difference. Right?

Right.

195) Now there are 4 stops difference between f 5.6 and f 22 (8, 11, 16, 22). Lets say that when I get a reading of 1/30 second at f 8 on my light meter, my lens is at f 4. All I do is close down 4 stops, which would be f 16, right?

Right.

196) Lets say that more light is coming out of my lens than out of yours. If my meter indicated 1/30 second at f 8 but my enlarging lens is set a f 8 instead of f 5.6. I still close down 4 stops. Right?

Right.

197) That would be f 32, right?

Right.

198) What do I do if my enlarging lens only closes down to f 22?

Get a 1 stop (.3) neutral density filter and put it under your lens.

199) Now if my light meter reads 1/30 second at f 5.6 when my enlarging lens is all the way open, I have one stop less light coming out of my lens than I need to have but there is nothing I can do about it.

But you do know that you have one stop less light than you need (you're deficient one stop) and you do know that you ordinarily close you lens down 4 stops. So all you have to do is add one stop of light by only closing down 3 stops instead of 4.

200) Fine. Now after I make any adjustments that may be called for, I insert a 35mm carrier without a slide in it and magnify the light coming through it to 6x10 inches. At this distance with my lens zeroed in I have an exposure time of 1 second. Correct?

Correct.

201) Wow, I never thought I'd make it. Why enlarge the light to a 6x10 inch size. I'm projecting onto 4x5 inch film, remember?

Yes. And I also remember that you don't have an enlarging meter. I have found that most slides I make into negatives need some cropping, and so I have established a size that takes this into consideration.

202) And if I need to enlarge the slide even more or reduce it down, as you pointed out in

#183, I'll have to make adjustments in my exposure. How?

You can check with your photo store and see if they have any tables that indicate the amount of exposure change necessary when making various size prints from the same negative. Or you can get an inexpensive enlarging meter.

203) I can see that I'll eventually get an enlarging meter. Before asking about them, I do have another question.

Shoot.

204) Is the exposure time of 1 second at f 22 (or whatever it comes out for me) standard for all film sizes. You gave instructions for 35mm film with a 50mm lens. I also shoot 2 1/4 and 4x5.

Unfortunately, I can't say for sure. Although f stops are standard from one lens to another, they have nothing to do with the amount of light that passes through a lens. f 8 on a 50mm lens is the same as f 8 on a 135mm lens, that is, it designates mathematically how much light is capable of going into a lens at a given setting. Regardless of this fact, the amount of light that passes through and out of a lens will differ from lens to lens. This is due to the physical make-up of the lens: the amount of glass used, the type of glass used, the coatings on the glass, the cement used to join the elements together, etc. Most lenses used in cinematography are marked in T stops. Think of a T stop as a "true" f stop. It indicates the amount of light that passes out of a lens. Since enlarging lenses are not marked in T stops but in f stops, you have no way of knowing if your 50mm lens at any given f stop is projecting the same amount if light as another lens would be projecting. You must add to this the problem of light change when condensers, focusing bellows, etc. are moved for different lenses.

You can solve this problem by first zeroing in with your 50mm lens as we just discussed and then take a light meter reading. Then set your enlarger up for your 75mm lens and adjust the lens until you get the same light meter reading as with the 50mm lens. Repeat this procedure for a 135mm or 150mm lens.

205) Thanks. I'm seriously considering getting an enlarging meter. Will it really make things easier?

Much easier. It will enable you to change magnification sizes and lenses at will, in a matter of seconds.

206) What is the procedure for zeroing in with an enlarging meter?

You must be zeroed in before you can program your enlarging meter. I can't tell you exactly how to program your meter since different meters are programmed in different ways. With some meters you place the light sensitive probe under the light coming from the enlarger and push button. In any event, programming an enlarging meter is a simple thing to do.

Usually meters are programmed for the shadow detail or shadow areas of a negative or the highlight detail or highlighting areas of a slide. I suggest that you program your meter for the projected white light coming through the carrier without a slide in it.

207) Why?

The white light is directly equivalent to using an incident meter- that is, it gives you an average reading. It is by far the simplest way to determine correct exposure. Any other questions?

207a) Yes. Are we now ready to make b&w negatives?

Yes. Place your slide in the enlarger and magnify it to the 6x10 size (or whatever you want as long as you have a method to determine the change in exposure) using the registration easel with a white piece of paper on it to focus on. If you don't use the registration easel, remove the inner box that that comes with your film and use it as an easel. Cut a piece of white paper to 4x5 inches and place it inside the box you are using as an easel to focus on, but be sure to remove ithe white paper before making your exposure.

If you are using an enlarging meter, remove the slide and adjust your f stop. Replace the slide and shut of <u>all</u> lights. Any questions?

208) No. Now what?

If you are not familiar with sheet film, you will have to know how to tell the emulsion from the base. Almost all sheet films have code a notch, which is like Braille, used to tell one type of film from another and to determine the emulsion side of the film in the dark. Near the

corner of one of the two short sides of the film (the 4 inch side of 4x5, the 8 inch side of 8x10, etc.) is the code notch side, which can be found by running you finger along the edge of the film. When the code notch is positioned on the upper right hand side of the film, the emulsion is facing you.

209) OK.

If you are going to use the registration easel, you may want to punch holes along the side of the film that contains the code notches so the holes won't show on the finished print. This is an aesthetic choice. Do as you wish. Place the film into the punch and make the holes. Then place the film onto the registration easel, making sure that the emulsion is facing up. If you are not using the easel, place the film in the inner box, again being sure that the emulsion is facing up.

If you use the inner box from your film, use some masking tape to secure the box in position on the baseboard of your enlarger. You will notice that the piece of film is a bit smaller than the box, so place the film along two edges of the box, say the side closest to you and the left side. This is especially important to do when making color separation negatives which must be in registration. Questions?

210) No.

All your safelights are off, I hope.

211) Yes.

Make a 1 second exposure.

212) And now we develop the film.

And now we develop the film.

213) And I assume that I need film hangers and a couple of deep tanks.

No. We are going to develop the film in trays.

214) Great. That saves me some money. But why? Isn't sheet film usually processed in tanks?

Basically to save money. Although you're starting with 4x5, eventually you may be using 8x10 or 11x14 inch film. 11x14 hangers and tanks get expensive, and 11x14 trays are inexpensive.

215) Then what do I need?

Two or three darkroom trays large enough for the film you are processing, depending on whether you use a stop bath or not, and a thermometer.

216) And the procedure?

Mix up one gallon of Kodak DK-50 developer as per directions on the can. Dilute 1 part developer of 1 part water (1:1) and bring to 68ºF. Now, you may have noticed that I was a bit sloppy about using a stop bath. I really don't care if you do or not. But I am not being sloppy about the temperature of the developer, 68ºF exactly.

217) Exactly?

Okay. ± 1/2°F. But I prefer exactly.

218) And?

Develop the film by inserting it in the developer, turning it over and rocking the tray gently but continuously for 2 and 3/4 minutes. This is a rather short development time but it should give you a thin negative (low shadow density) and a two stop range. Questions?

219) Well, I do feel a bit uncomfortable by "...it <u>should</u> give you a thin negative...:

We do have a problem that does seem unsolvable, or, to put it another way, you're going to have to do more work on your own, or to put it still another way, we still haven't finished zeroing in on our exposures. As I mentioned in #185 and implied in #'s 193-194, the chances that my light meter and the one that your are going to borrow will give the same readings really depends on a fluke. Therefore, all the preparations you have done to set up your enlarger to put out a specific amount of light is no guarantee that that amount of light matches the amount of light which comes out of my enlarger.

220) Then how do I know if my negatives are of the correct contrast and density?

Take a deep breath. If you have a densitometer you can read the shadow area of the processed negative to see if it has a .2 density. You can also read the highlights to see if you have a 2 stop range.

221) I don't have a densitometer!

I know, I know. Please don't hold your pencil that way. It frightens me. It looks sharp.

222) It is.

Believe me, everything is going to be all right. But we are going to talk about densitometers again for a minute. Trust me. Now, if you have been observant, you will have noticed a few things. For one, I have said that we need a 2 stop range. This ordinarily means, and does in this case, that we want a 2 stop range between the highlight detail and shadow detail. I have also said that we want a .2 reading in the shadows. I find it easier to forget about shadow detail and highlight detail and just work with shadows and highlights, areas of the slide that have no detail. We want the shadows to go black and the highlights to go white. So, if we read the shadows and the highlights, and if these areas are slightly more than 2 stops, and if the printing exposure is correct (see Chapter 5), you will end up with a print that has black shadows and white highlights. By slightly more than a 2 stop range, I mean 2 and 1/3 stops (.7).

223) I'm not exactly sure I'm following you.

I have chosen a .2 shadow density to give a good black in the shadows and a reasonable exposure time during printing. If you first check to establish that you have a .2 reading in your shadows, and then choose your first white beyond your your highlight detail, and if that white has a .9 reading, then you have a proper negative that will give you a black, shadow detail, grays, highlight detail, and whites. (The math is .9 highlight detail - .2 shadow = .7/.3 = 2 and 1/3 stops difference.

224) OK, but it's all academic, since I don't have a densitometer.

I know. Now, if you read the shadows and find that you have a .3 or .1 reading, you should not try to manipulate development but instead make another negative and give a slightly shorter or longer exposure. For a .1 reading, try opening up 1/3 stop. For a .3

reading, try closing your lens down 1/3 of a stop. As a general rule, exposure will determine the shadow density.

If you find that the contrast between the highlight and the shadow is greater than 2 and 1/3 stops (.7) do not adjust exposure but manipulate your development. To increase contrast, extend development, to decrease contrast, shorten development time. As a general rule, **changes in development time effect contrast**.

225) Won't increasing or decreasing my development time effect my shadow density?

Very little. If you have followed the instructions for determining your exposure time and f stop, you should be somewhere in the ballpark. If your development time is 2 minutes and 45 seconds and you find that you must increase or decrease development time slightly to correct your contrast, the highlight area will be the area most effected.

226) How much should I increase or decrease development time to correct for contrast problems?

If you are 1/3 (.1) stop to contrasty, I suggest that you decrease development time by about 10% to 2 minutes and 30 seconds. If you are 1/3 stop too flat, I suggest you increase development time by about 10% to 3 minutes. Questions?

227) Well, it's not that I'm contused, it's just that I haven't learned anything.

What?

228) I mean, I've learned how to set up my enlarger to make b&w negatives, and that I'm going after a 2 and 1/3 stop range between my highlight and shadow areas, and that I need a .2 density in my shadows, and that manipulating development time most effects my contrast and that manipulating exposure most effects my density, but I really don't feel that I've learned anything because I don't have a densitometer, so I have no way of checking to see if I have the proper shadow density or contrast range. Do you see my dilemma?

Yes, but I will now give you a method to accurately guess the shadow density and the contrast range of your negative, so all is not lost.

229) Thanks.

All you have to do is buy a Kodak projection printing scale which costs about $4. It is intended for use in determining the correct printing time when making conventional b&w prints. It is a piece of processed film with instructions printed on it. For our purposes, forget the instructions.

The printing scale is a circle divided into 9 sections, each section having a different density. The section that is marked 48 has a density of .1, the section marked 32 has a density of .25. Now, .25 is 1/16 f stop more dense than .2, and so within tolerances (tolerances are 1/3 f stop, remember?) The section marked 6 is 2 1/2 stops more dense than the section marked 32, which is 1/6 f stop to contrasty, again within tolerances. Therefore, you can visually check the shadow area of your negative and see if its approximately the same density as the section marked 32 and you can visually check the highlight area of your negative and see if it matches (or is just a bit less than) the density of the section marked 6. At first you may just be guessing, but in time your guesses will become highly accurate.

230) **Why couldn't you have told me this before?!**

Abuse me if you want, but some day you will thank me for having showed you the correct way to determine the density and contrast of your negatives, that is, with a densitometer.

231) You have made a point about the .2 shadow density. You have said that this is to give a reasonable printing time for pigment printing. What if I come up with a b&w negative of .7 contrast but with a .3 or .4 or .1 shadow density. Must I remake the negative?

No. You can still get a good print. But if you try to stay at .2 shadow density, you will run into fewer problems while printing. I know some people who try to print with a .8 shadow density. Because their light set-ups are different from the one I will describe later (Chapter 5), and because their negatives are 2 stops denser than I recommend, their printing times range from 15-30 minutes. Your printing time will be much shorter.

232) How much shorter?

Later,

233) And if I decide that making negatives with a .2 shadow density and a .9 highlight density

is too much of a hassle, I can expose the negative in the manner described, develop and use it even if some adjustment is indicated.

Yes. You can print by the contemporary printing process which I will describe later. When you learn the complexities of this method, I am sure you will decide that a little extra time in the darkroom is well worth it to save a few days or weeks of printing.

234) How does making b&w negatives for the modified-traditional method differ from making negatives for full color printing?

For full color printing we need 3 color separation negatives, each one matching, within tolerances, the contrast and, to a lesser degree, the shadow density of the others. It amounts to making 3 b&w negatives that match each other.

235) I hate to show my ignorance, but I've heard the terms color separations and color separation negatives before, but I'm not quite sure what they mean.

Color film has three emulsions, a blue, a green and a red. Without going further into the complexities of color films, lets just say that each emulsion records particular colors of the original scene. By using filters, it is possible to isolate each emulsion from the other two and record the information on it on a piece of b&w film. The color separation negatives are b&w pictures of the information recorded by the individual light sensitive emulsions in the film. Got that?

236) Yes. What type of filters do I use?

Kodak Wratten gelatin filters, either 2" or 3", numbers 29 (red), 47b (blue) and 60 (green).

237) I have a #25 red filter. Can I use that?

Yes, along with a 47b and a 60 or a 61. Use as a group 29, 47b and 60, **or** 25, 47b and 61. And you can use a 58 (green) instead of a 60 or 61 filter.

238) What do these filters cost?

About $2.50 each. They'll last a long time if you don't get them dirty.

239) Do the filters all have the same filter factors? Can I make the exposures in any order regardless of which filter I am using?

No, but the differences are slight when it comes to making color separations, so think of them as all being the same.

240) Then how do I proceed?

Basically, the same as with the way you made the b&w negative from the color slide. Put a slide into your enlarger and enlarge it to the size you want. Remove the slide and take a white light reading with the enlarging meter you are going to buy. Now, adjust your enlarging lens so that it is two stops open from where it would be for making a b&w negative, because the filters you will be using will cut down the amount of light hitting your film.

I haven't mentioned this before, but not all darkroom enlarging timers are accurate. Some may give a true 1 second exposure, and another may give a 1.3 second exposure when set for 1 second.

It's just something you'll have to compensate for if you find that your negatives aren't coming out as good as they should. If they look a bit overexposed (dark), then give the exposure(s) a bit less time.

244) [My numbering system got messed up] Is the development time for the color separation negatives the same as for b&w negatives?

No, Try a 3 minute development instead of the 2:45 for the b&w.

245) Why?

The negatives made with the filters seem to need a bit more development to raise their contrast a hair.

246) Any other instructions?

Yes. Process all 3 negatives at the same time in the same tray using fresh developer. Don't make one exposure, process it, then make the second, etc.

247) Why not?

The chances of getting 3 negatives that match within tolerances are greatest if they are all developed in the same developer for the same time with the same agitation at the same temperature.

248) OK

249) I'm sure that it will become necessary to be able to tell which b&w negative was made with which filter. If so, how do I tell?

An excellent question. There are two methods which can be used to distinguish one filtered negative from another. The first method of involves looking at the negative and determining visually which is which. This is quite simple to do once you learn what to look for and is the method most people will end up using. Briefly, a filter will lighten any color that is the same or similar to its own color, and darken any color that is opposite (complementary) to it. A blue filter will lighten blues and blue-greens but darken yellows and reds. A red filter will lighten reds, yellow, pinks, oranges and magenta's but darken blues, greens, violets etc, On a negative, something that is light in the slide is dark (dense) and something that is dark in the slide is light (transparent). So if you have a slide that contains a red, all you have to do is look for a negative that represents that red area as opaque to identify the negative that was made with the red filter. The same will hold true with blue and green. After making and looking at separation negatives for a while, it will become easy to visually identify which negative was made with which filter. At first, though, you may have some difficulty.

The second method is the one that most people will find easiest and safest to use at first. This method involves physically coding each negative. For instance, a single hole paper punch or scissors can be used to make a mark at the edge or corner of the film. One hole could be used to identify the green-filtered negative, two could stand for the red, and three for the blue.

250) Is that it for my education about negatives for gum pigment printing?

Yes. But I want to emphasize that most of the above is information not needed if you want to use gum printing to free yourself from the constraints of the Kodak Look. If that's what you want to do, it doesn't matter if your separation negatives match, or were made with the right combination of filters, etc. Just experiment. I've included the

above information to educate you, but not to limit you and your artistic expression. The reproduction of one of my gum prints near the beginning of this book (#21) is an example of freedom from the Kodak Look. You may or may not like the look, but I'm happy it doesn't look anything like a Kodak picture.

Above is a tricolor photo I shot on film in 1968 using the three color separation filters 29, 47b and 60. Where the Alka-Seltzer bubbles moved between the three exposures of the film, they became colorful. This gives you an idea of what the three color emulsions do to make a regular full color picture, as seen in the Alka-Seltzer package on the right, which didn't move. You too can shoot pictures on film using the color separation tri-color filters discussed above, but that's a subject for a different book. This one is about gum pigment printing.

Chapter Five

Making the Print

(Note: Numbers 241, 242, 243, 251, 252, and 253 have been unintentionally omitted.)

254) Now that I have my negatives, paper and emulsion almost under control, I guess I'm ready to make a print. What's the first step?

Your light source. Eliminating variables has been a concern of ours from the beginning. Eliminating variables in the printing process is essential, and fortunately, easy to do. Some considerations to various light sources should be discussed first, however, since there are a number of different ways to proceed.

255) What are my options?

Well, there is sunlight and incandescents (artificial lights).

256) How about sunlight. It's free and easily accessible.

It is free, but if you want to make prints at night or if you live in an area where it rains often or has overcast skies, you will find working with sunlight a disadvantage.

On the plus side, sunlight yields very short exposure times, doesn't take up space in your darkroom and you don't have to worry about bubs burning out.

257) What about incandescents?

Well, the advantage of incandescents is that you can work at night or when it is raining. The disadvantages are that exposure could get quite long, you can overload your wiring and blow fuses, and unless the bulbs are arranged correctly, you could get hot spots on your prints.

As for the type of incandescent bulbs to use, I recommend blue photofloods (5000K), although clear (3200-3400K) will also work. The emulsion we are using is most sensitive to

ultraviolet light, and the blue bulbs are slightly richer in this radiation.

258 How long are "quite long" exposures?

Up to half an hour. Don't panic. With a proper light set-up, exposures are only about 90 seconds to 6 minutes.

259) What about special bulbs that are rich in ultraviolet radiation?

I know a fellow who bought a UV bulb that must have been a foot in diameter, and a special transformer to power it, and his exposures, with his paper about 5 inches from the bulb, were about 15 minutes. A few 250 Watt photoflood bulbs at a distance of 5 inches from the paper (much too close, actually) would give an exposure of 20 to 30 seconds. It should be understood that the emulsion is most sensitive to UV light, but it is sensitive to light in general. I recommend bright incandescents to dim special purpose UV bubs.

260) Which do you recommend, incandescents of sunlight?

Since they are both valid, I can't recommend one or the other. Since I like to work when the mood strikes me, which often is a night, I usually use incandescents. For the sake of consistency, I will assume that you will also use incandescents, although I will also give information on exposing with sunlight.

261) If I use a 250 Watt incandescent bulb in a reflector, will I get satisfactory results?

Not really. The biggest problem will be long exposures, of the 15-30 minute variety.

262) Then what do you recommend?

Five 250 Watt bulbs, arranged in a square with one in the center. With the exception of the center one, the bulbs should be spaced about 6-8 inches apart. The bulb in the middle should be centered so that it is equally distant from the four outside bulbs.

263) Is each bulb in a reflector?

No. If you get some porcelain light sockets at a hardware store and attach them to a piece of wood that can be suspended from a ceiling, you will have a satisfactory light set-up.

264) But if the light isn't being directed to the paper by reflectors, isn't a lot of light being wasted?

Yes, but if the lights are enclosed in one large reflector, a lot of heat will be built up. To avoid this problem, a blower system would have to be installed to cool the bulbs. And the large reflector itself would have to be constructed out of heat-resistant material. The problem with enclosing each bulb in its own reflector is that hot spots have a tendency to occur.

265) Why suspend the lights from a ceiling? Why not attach them to a wall?

Basically, to take advantage of gravity. It's a lot easier to place your paper and negative on a table and then place a piece of glass over them to keep the negative in positive contact with the paper than putting them in a contact frame and standing it so it faces the bulbs attached to the wall. This is impossible to do if you are using the registration easel.

266) Why five 250 watt bulbs? Why not two 500 watt bulbs or one 1000 watt bulb? Surely the difference of 250 watts won't make that much difference. Or if it does, how about two 500 watts and one 250?

The five 250 watt bulbs arranged as I recommended in #262 will help eliminate hot spots and will easily cover an 8x10 negative. Three, two or one bulb will not give as even illumination.

267) How about five 500 watt bulbs?

You're not going to give up, are you? Five 500 watt bulbs will build up a lot of heat, and possibly overload your electrical circuit.

268) OK. You mention hanging the lights from the ceiling. How far should they be from the paper?

This is determined by using a light meter. I don't recommend using the bulbs closer than 12 inches to the paper. The closer they are to the paper, the greater the chances of hot spots. Also, the heat from the bulbs will cause the negatives to deform.

269) How do I determine the correct distance between the bulbs and the paper by using a light meter?

Set your incident meter at ASA 150. Move the meter closer or farther from the bulbs until a reading of 1/60 second at f 16 is reached. This is the distance that the bulbs should be from the paper.

270) I hate to sound paranoid, but what if with my set-up I get a reading of 1/60 at f 16 at less than 12 inches, say 8 inches?

Then move the light meter back to 12 inches and take a reading to see how much less light is falling on the paper. If you get a difference of, say, 1 stop, then increase your base exposure by 1 stop.

271) What base exposure?

Well, if you have faithfully followed through on all of my recommendations, and if your lights are standardized at 1/60 second at f 16 at ASA 150 at a 12 inch distance, your base exposure time with a negative with a shadow density of **.**2 will be 180 seconds.

272) Is that a promise?

Kind of. Since we have already discussed the problems of differing equipment and set-ups, all I can say is that you will be in the ball park, and at most some minor adjustments will have to be made.

If your resulting prints are underexposed, you will have to increase your base exposure of 180 seconds by trial and error to determine your new base exposure time. Similarly, if your prints are overexposed, you will have to determine your new base exposure time by shortening your exposure.

273) But once I have determined my base exposure time (if it isn't the 180 seconds you feel it will be), and if I always use a negative with a **.**2 shadow density, I can always use the same exposure time-I'll be zeroed in.

Yes, if you use modified-traditional negatives.

274) That's one of your qualified yeses. Could you elaborate?

In a bit we will discuss the different procedures for printing with contemporary and modified-traditional negatives. Since we are now discussing light set-ups, it's a good time to

describe the procedure for exposing with sunlight.

275) Fine. How?

It's very simple. Take a reading of the sunlight with your incident meter set at ASA 150. Count the stops difference from 1/60 second at f 16 and adjust your exposure time accordingly (we will refer to this as your modified sunlight base exposure). For example, if you get a reading of 1/125 second at f 16, the sunlight is one stop brighter than the base reading of the incandescent set-up of 1/60 at f 16 at 12 inches. So, instead of using a base exposure of 180 seconds, use a base exposure of 1 stop less, or 90 seconds. This modification will be in the ball park, but some minor zeroing in will be necessary.

276) Why?

Because sunlight emits a lot more UV radiation than incandescent bulbs do, your base exposure for sunlight may be around 35-40 seconds.

277) Now what?

We have mentioned before that there were two different ways of registering negatives, and that these different ways had different aesthetic effects. I feel that this is a good time to discuss this as well as registration in general.

278) Well, you have already described making negatives using the registration easel in the last chapter. If I have the negatives, with holes punched in them and an easel that has pegs that fit through the holes, I assume that all I have to do is punch holes in my paper. I could then place the paper on the easel, place the negative over it, and then put a piece of glass over both to keep them in firm contact.

That's correct. But I also described making negatives by placing the film in the inner cardboard box that comes with the film. Printing these negatives in registration is slightly more difficult.

279) How is it done?

If you are making a b&w print, place the negative on the paper and attach it with small pieces of masking tape. Take a pencil or pen and draw a line around each corner and around

the code notch. If you eliminate problems of shrinking and stretching, you will always be able to replace the negative in the same place.

280) What about color negatives?

For prints that require more than one negative, there are a few different ways to go. One method is to place all the negatives over each other on a light box or window. Align all the negatives so that only one image appears, i.e., so that they are in registration. Tape the negatives to each other so they will not separate or shift position and then transfer them to the paper. Draw lines around the corners of each piece of film. The problem with this method is that, more times than not, the corner of one piece of film will lie slightly inside the area of another, so that it will be impossible to draw a line around it.

One way to get around this problem is to draw lines wherever possible and then remove the negatives, untape them from each other, and replace them, one at a time and draw lines around the corners that were obscured or blocked before.

A second problem arises out of confusion. You may have 12 corners marked and it's sometimes difficult to remember which negative goes where. This problem can be eliminated by coding the corner pencil lines. For instance, with the negative that you are going to print with magenta emulsion, you can put an "m" next to the pencil drawn code notch.

281) What's another way?

It's a variation of the method just mentioned. Make a print with one of the 3 color separation negatives just as if you were going to make a b&w print. Follow the procedures in #279. While the print is drying after development, place the second negative to be printed over the first negative and tape in registration. When the print is dry, place the negatives on the paper, using the pencil lines and the first negative to insure proper placement. Tape the second negative to the paper and then remove the first negative. Now draw lines around the second negative. Repeat this procedure for the third negative.

282) OK, I can visualize what's happening and it's not all that difficult. But how do I get rid of the pencil lines and what do I do about the pieces of tape on the negatives and prints?

(1) You don't. (2) Nothing.

283) But you can't have pencil lines and photograms of the tape on the print.

Who says?

284) But they will make the print look- well, maybe not ugly, but unclean. It's just not done.

If this look bothers you, you can use the registration easel.

285) At the onset, if I don't want to purchase a paper punch and make a registration easel, isn't there some way I can make a print that won't show pencil lines and tape photograms?

Yes. If you are making 4x5's, you can use 5x7 film , WITH A 4X5 IMAGE PRINTED in the center of the of the larger piece of film, you can draw lines and use tape, and when you have finished printing you can cut away the offending areas that are on the paper.

286) Out of curiosity, which method do you use?

I let my pencil lines and tape show. Look at the picture in #21 where you can see my tape photograms.

287) Why?

For purely philosophical reasons. When you look at a photograph you see magic. Photographs seem to appear out of nothingness, like subatomic hadrons. I am not particularly interested in process art (art that places more emphasis on the process of creating the piece than in the results of the process itself), but I see nothing wrong with showing that my photographs are not born of nothing but instead evolve through a number of steps that culminate in a finished whole. However, if I should be working on a piece that I feel should not benefit from the registrations and tape showing, I would use a method that avoided these marks. So far, however, I haven't worked with any imagery that I didn't feel would be helped by this rather straight forward approach. If you feel that these marks will detract from your statement, then eliminate them.

288) Then you don't use a registration easel.

No, although I have two. If I used the registration easel, I would not get the effect I want, which I feel is important to my imagery. It's just an aesthetic option and has nothing to do with one method being better to use than another.

289) I'm curious as to why you suggest drawing lines around the code notch. Aren't lines around each corner enough for registration purposes?

They are. But you eliminate the possibility of placing a negative on the paper backwards or upside down if you also draw the code notch.

290) Anything else on registration?

No.

291) Well, now that we have registration out of the way, and I have my light set-up, the negatives made and the paper sized, I'm wondering if we have finally reached to point of making a print?

Yes.

292) Really!

Yes, really. But what type of a print?

293) A black and white.

OK. But we have mentioned making negatives for the contemporary method and for the modified-traditional method of printing. And so we will discuss both of these procedures. We will first discuss b&w and color printing by the contemporary pigment printing method. This method is rather difficult and not recommended. I really don't want you to print this way, but I do want you to fully understand the procedure.

294) Why?

For two reasons. First, you may find applications for certain parts of this procedure and second, you will appreciate the ease of the modified-traditional method all the more.

295) OK, you're the boss. How do I go about making a print in the contemporary method?

As I am sure your remember from the last chapter, a b&w negative of normal contrast today is one that has a 4 stop range between its highlight detail and its shadow detail. 100 years ago normal negatives had a 2 stop range. The emulsion of your b&w paper has a 2

stop range, and so the negative of yesterday was compatible with the paper. Today's b&w film has too long a range for the paper, or if you prefer, the paper has too short a range for the film. Most people working with pigment printing today have either lost sight of the incompatibility of today's negatives and yesterday's paper or never knew that negatives of the past were normal at a 2 stop range. Therefore, they try to print "contrasty" negatives on "flat" paper. This is quite difficult to do and leads to all kinda of problems.

296) How are negatives with a 4 stop range printed on paper with an emulsion that has a 2 stop range?

By making at least 3 exposures. The first exposure is made for the highlights, It really amounts to overexposure. What you want to do is pass a lot of light through the densest part of the negative, so the detail in the highlight area of the negative will be printed.

The second exposure is for middle-tone areas. Think of this as the normal or base exposure.

The third exposure is for shadow detail. This exposure is equivalent to underexposure.

297) But this doesn't make sense. The overexposure for the highlights will ruin the detail in the middle-tones and shadows. The middle-tones and shadows will be too dark.

You've stopped thinking of pigment printing and you're back to commercial processes. You've forgotten the rule that states that the darkness or lightness of a print is dependent on the darkest pigment or combinations of pigments used, and that exposure plays only a minor role in the overall darkness of the print.

298) I still don't fully understand.

You must pass light through the darkest part of the negative to get detail in the highlights. This "overexposure" will only result in a dark print if a dark pigment is used.

Now, since the highlights in a b&w print are, by definition, light, a light gray pigment can be used for this exposure and so detail will be lost, but there will be good detail in the highlights. You would have a print at this point that looked very light., with very light detail in the shadows and middle-tones, but proper detail in the highlights.

The second or base exposure is made with a medium gray pigment. Since the exposure is too short to allow light to pass through the highlight areas of the negative, the highlights that have been previously printed will not be disturbed; there will be no further pigment or detail added. This exposure will print the correct amount of pigment and detail in the middltones, with the darker gray pigment covering the light gray pigment from the "overexposed' highlight exposure. This exposure will again overexpose the shadows, however.

The third exposure is for the shadows, and really amounts to underexposure. As in the second or base exposure, the highlights won't be effected, and in this case the middle-tones won't be effected either. But this exposure is just right for the shadows, and since a black pigment is used, you end up with a print which has a full range of grays, from black to white.

299) So the overexposure in the highlight exposure doesn't effect the final print because darker pigments are printed over the overexposed areas.

Correct.

300) And so three exposures are needed.

Yes, although 5 exposures can be made by inserting one between the highlight and middle-tone exposures using a gray that falls between these two, and one between the middle-tone and shadow exposures, again using a pigment that falls between the pigments that are used for these two exposures. I really don't feel that this makes a better print, but you can try it and decide for yourself.

301) To make this type of print, what exactly would be the procedure?

If you are not using the punched hole registration system, tape your negative to the sized paper and draw lines around it (#279). If you are using the punch hole system, place the negative over the paper to determine how much of the paper should be covered with emulsion. In either case, remove your negative and coat on your emulsion (#112, 115), making sure that the entire area that the negative covers will be coated. You can coat the entire piece of paper if you want, but this usually isn't necessary.

The emulsion should contain only 1/3 the amount of pigment recommended in (#112,

115). Follow the same procedure used to size the paper. Try to get as even a coating as possible, but some tonal differences may be tolerated (#131). Use a fairly dry brush so as not to get the paper so wet as to inhibit the drying time. Try this: place the brush into the jar containing the emulsion and let if soak for a bit. Remove the brush and wipe the bristles against the inside of the jar two or three times on each side, and then coat the paper. Repeat if more emulsion is needed. Questions?

302) No.

After the paper has been coated and allowed to dry for a standard time (#134), place the negative on the paper (if you are not using the punched hole system, also tape into position) and cover with a piece of glass to hold the negative firmly to the paper. Give the base exposure of 180 seconds plus one stop (total of 360 seconds) for the highlight exposure. Keep in mind that the base exposure is based on a negative with a .2 shadow density and a 30 minute drying time. If the paper dries for more or less than 30 minutes, a modification in the base exposure time will be necessary (#134). If the shadow density is greater than .2, a longer exposure will be necessary; if lower, a shorter exposure will be needed.

Assuming that your paper has dried for 30 minutes and that your negative has a .2 shadow density, an exposure of 360 seconds should be in the ball park, if the incandescent light set-up as described in #262 is used, or 1 stop more than your modified sunlight base exposure if sunlight is used. Questions?

303) No.

After the exposure is completed, remove the negative and place the paper in a tray of water that is about 80-90ºF. The paper should float on the surface of the water. When you first insert the paper in the water developer, you must make sure that the entire piece of paper is wet or the print will not develop evenly. To make certain of uniform development, remove the paper after it has been in the water for about 5 seconds, allow it to drain for only a second or two and then reinsert it in the water. At this point, you should notice a yellow substance washing out of the print. This is the potassium bichromate, which like inks and dyes, will not be trapped by the gum (#100). After a minute, remove and then reinsert the paper and then walk away. Allow 5 minutes (at least) before removing the paper to check on the progress of the development of the print. After the development is completed, which usually takes

between 30 minutes and 1 hour, hang the paper to dry just as you did after coating on the emulsion (133). When it is thoroughly dry, recoat with an emulsion that contains 2/3 of the amount of pigment recommended in #'s 112 and 115 and give an exposure of base minus 1 stop or around 90 seconds with the incandescent light set-up or a stop less than the modified sunlight base exposure if sunlight is used. Questions?

304) Yes, a few, the most important of which is how do I know when the print is fully developed? By inspection?

No. It is very difficult and not recommended (at least at first) to determine development visually, nor to try to manipulate development. This process develops to completion- that is, development action will stop when the development action is completed. (Possibly more accurately, the development action slows down at this point. If you left the print in the water for half a day, it would be further developed than after an hour, although the additional 11 hours development would total less than the first hour's development.) The only manipulation open to you is to under-develop the print, that is, remove the print from the water before the development is completed.

Now, this form of development differs from commercial process in that it works backwards (#14), and so gets lighter the longer it develops. Underdevelopment in pigment printing equates to over-development in commercial process.

The object is to know when the print is fully developed. This is best done by removing the print from the water and observing the clarity of the water as it drips off the paper. I allow the water to drip onto the lip of the white plastic developing tray I use. If any pigment remains in the drops, the process is not complete.

Because the water in the tray contains a lot of pigment that has developed off the print, you can get a false reading because the water dripping off the print contains pigment from the water; you may not be seeing pigment that is still coming out of the print. To avoid this, remove the print from the water about every 10 minutes, dump the water and replace with fresh.

305) You say that I shouldn't try to manipulate development. But what happens if the print looks great but the water drops contain pigment? Further development will make the image

lighter and ruin the print. Why couldn't I just dry the print at this point?

If you hang the print up to dry at this point, the excess water will run off the paper, carrying pigment into areas of the print where pigment shouldn't be, and so degrading the image and ruining the contrast.

306) What if I lay the paper down instead of hanging it up to dry?

The pigmented water on the surface of the print will still run into areas where it shouldn't.

307) If the print develops to completion and is too light, how do I know if the problem is that I used too little pigment or if I have given too little exposure?

There are a series of tests you can run to determine the correct amount of pigment to use and to establish the base exposure. Generally speaking though, if you have good detail but your image is light, you have used too little pigment. If you don't have good detail, the problem is one of exposure.

308) Another thought. If I just print the highlight areas, I'll have no blacks or middle-tones, so my image will look kind of weird.

Not only weird, but almost nonexistent. After all, the print will only contain whites and very light grays at this point, and without blacks it's almost like looking at a white piece of paper.

309) Then I'll have no way of knowing if the exposure is a good one until I print the middle-tones and blacks.

With experience you can tell, but at first, you're right.

310) Wouldn't it make more sense to print the blacks first, then the middle-tones and finally the whites? That way I could see the image better and be able to judge how the print if progressing.

It makes perfect sense, and not only for those reasons. If you started off with an emulsion of black, instead of dumping the highlight emulsion and mixing up the middle-tone emulsion, all you would have to do is add about 50% more gum bichromate, to dilute the

black emulsion to a middle-tone gray emulsion.

The problem with working this way is that you add lighter pigment over darker pigment, which has a tendency to lighten and degrade the blacks. If you are not going after a "dynamite" perfect print, you can work this way, since it will yield a print.

311) You said "instead of dumping the highlight emulsion and mixing up the middle-tone emulsion." Why can't I just add more pigment to the existing emulsion?

Actually, you can, at least in b&w. It's just that I don't. Because of the yellow-orange color of the bichromate, it becomes difficult to judge the amount of pigment in the emulsion visually. As you gain experience in printing, you may find that you can tell by looking if the emulsion is "right", I find that a visual check on my measured amount of pigment is helpful. And it only takes a few seconds to mix up new emulsion.

312) What else should I know?

Only that with this process, or any process, the color in the jar of emulsion, even if the bichromate has not been added, will be different from the color in the print. The color in the liquid emulsion will be darker and richer than on the print, since there is more pigment in the jar and the thin coating of transparent emulsion looks lighter on the paper.

313) Then if I feel that a particular color isn't dark enough or rich enough on the print, I should add more pigment to the emulsion.

Not always, since too much pigment will cause flaking of the emulsion during development (#102).

314) Then how do I go about making a color darker or richer?

Usually by printing the shadows, middle-tones and highlights twice each.

315) This could take forever.

Literally, since each time you make an exposure you run the chance that the exposure will be out of registration due either to poor placement of the negative, maybe due to shrinking or stretching of the paper.

316) I noticed that in #314 you started out with the word "usually". Is there a way out?

You might try printing with a more opaque pigment, such as a gouache instead of a watercolor (#88). This often works well with b&w or one color and white if you are not getting the darkness or richness in color you want with watercolors. But it doesn't work well with multiple color printing since a lot of transparency is needed to show one color through another printed over it.

317) I'm afraid to ask, but I will. How is a color print made with this method? I assume that it amounts to the above, but multiplied by a factor of 3, for the magenta, cyan and yellow layers.

Yes, which means that you would have to make anywhere from 9 to 20 exposures.

318) Between 9 and 20?

Well, 9 if you make a highlight, middle-tone and shadow exposure for the magenta layer (total of 3 exposures), triple that if you must print each layer twice (6+6+6). Now, if you decide to add a fourth color (black), and if you have printed the highlights, middle-tones and shadows twice each for the magenta, cyan and yellow, you will probably make two black exposures for the shadows (6+6+6+2 = 20).

319) And with each of these exposures I run the chance of poor registration or just plain making a mistake.

Yip.

320) Ugh! Anything else I should know?

Yes. Whether you print with the contemporary method of the modified-traditional method, you should know which negatives to print with each color. If you remember, we discussed making code punches on the separation negatives (#252). When printing for full color, you must use the color pigment that is complementary to the color of the filter used to make the negative.

To make this simple, just remember: print the magenta emulsion with the green-filtered negative, print the cyan emulsion with the red-filtered negative, print the yellow emulsion with the blue-filtered negative.

321) Why?

Image a slide that has a large area of red. When you make separation negatives, the one made with the red filter will show the red in the slide as opaque in the negative (#252). If you were to make a print using magenta emulsion with the red filtered negative, that area would print as white. Not only that, but the color red in the slide is not magenta, which is one of our printing colors. Magenta is red-blue. But when magenta and yellow are mixed together, you get the color red.

Now, the red on the slide will be clear or almost clear on the green-filtered negative and also clear or almost clear of the blue-filtered negative (#252). If you print the green filtered negative with magenta emulsion, and the blue filtered negative with the yellow emulsion, you will get magenta and yellow, which yields red.

We could delve deeper into the mysteries of light and filters, but I'd rather not. If you are interested, there are many books and publications that cover this material.

322) OK. Is there anything else I should know?

Yes. To make a color print by either method, you must know how to balance your three color emulsions. We covered this material in #125, but I'd like to give a quick review. If you were to take equal parts of Alizerian Crimson, Pythlocyanne Blue and Chromium Yellow Light, you would not get a black. You would not even get a gray. You would get a reddish gray. This equates to a color shift. If you can't get a neutral gray-black, then you can't get a print that accurately represents the colors in the original scene. So your first task is to mix the 3 colors in a proportion that will yield a gray-black.

323) In chapter three we discussed balancing magenta, cyan and yellow. As a mini-quiz, how is it done?

Well, I take 3 jars and pour 1/2 oz. of gum arabic into each. With my measuring device (#'s112 and 115) I put 1/2 measure of magenta, about 1/2 measure of yellow and 1 measure of cyan into the separate jars. With an eyedropper I take 3 drops of each and combine them into a 4th jar. I must rinse the eyedropper out before going from one color to the next to avoid contamination. I mix the pigments in the fourth jar together with a small brush and then paint some onto a piece of sized paper and allow it to dry. If the dried color is a neutral gray-black,

fine, but if there is a color shift I have to alter one or two of the colors. For example, if the shift is magenta, I should add the complement, green. Green is made up of yellow and blue, so I need to add yellow to the yellow and cyan (blue-green) to the cyan. I keep repeating this process until the color is a dark gray-black.

Fine. By this time you should see the horrendous problem you face when you try to print full color with the contemporary process.

324) Well I now have all my colors mixed and balanced. True, I don't have my bichromate mixed in yet because the yellow-orange color would make color balancing impossible. Assuming that the colors are the strength for my shadow detail exposures, I will have to lighten them. This could be done by adding more gum arabic and an equal amount of bichromate. After I make my highlight exposure for one of the colors, say the yellow which is printed with the blue filtered negative, I will have to mix up a darker color of yellow for the middle-tone base exposure. The problem as I see it is how do I make sure that the yellow middle-tone emulsion will balance against the magenta and cyan middle-tone emulsions? I have nothing to make an eyedropper test against unless I mix up magenta and cyan middle-tone emulsions. I suppose I could keep some of the original emulsions aside for the shadow exposures, but I can see that things are getting out of hand. Even if I were to mix up 9 different emulsions, 3 magentas, 3 cyans and 3 yellows at the beginning, and made sure all the colors balanced against each other, the problem of the emulsions becoming unstable exists. I don't see a horrendous problem, I see an impossible one.

It is, just about.

325) Do you have any suggestions as to how I can get out of this impossible situation you've gotten me into?

Well, as far as the chemicals becoming unstable, if you don't add the bichromate until you are just about the use the emulsion, the safe life is extended from 3-4 hours to 10-12. Remember? (#128).

326) I really don't see how that helps very much.

It doesn't. For the record, though, I would like to point out that if you are very patient, work hard and are ingenious, this process can work.

327) Now I remember. You put me through this so I would fully appreciate the modified-traditional method.

Yes, but also because the above information may be useful to you later. We are now ready to proceed with a discussion of the modified-traditional method for b&w printing.

328) Please proceed.

For b&w, mix up your emulsion as if it were for the contemporary process shadow exposure (#'s 112, 115). Use whatever registration system your prefer and give a base exposure of 180 seconds for incandescents or a modified sunlight base exposure for sunlight and develop. If you want or need richer or darker pigment, repeat or use a more opaque pigment (#88).

329) That's all?

That's all.

330) What about color?

Mix up and color balance your 3 colors for a shadow exposure. Add potassium bichromate to one color, give the base exposure and process, then repeat with the second color and then repeat again with the third. If richer colors are needed, repeat the entire process. The use of more opaque pigments than watercolors for this procedure is not recommended.

331) Are you kidding?! What about the emulsion going bad?

It would be a good idea to set some of each color aside to match against the possibility that your printing will be interrupted or that you run into problems (registration, or instance) and must start over.

332) I notice that you suggest printing each color once and then, if needed, reprinting each color a second time. Why shouldn't I print, say, the yellow twice, then the magenta twice, and finally the cyan twice?

You can, but it would make more sense to first ascertain whether your print needs two exposures of each color. This is best done by printing each color once and evaluating the

print. If you feel that richer colors are called for, then you can either add more color to the existing print by exposing each layer again,or by starting over and exposing each layer twice in a row on a second print. You should also understand that you are not limited to just two exposures of each layer, but can print any number of layers, say 3 or 4 of each.

333) Could you discuss the addition of black? From what you've told me, I should end up with a color balanced print that has weak blacks.

If you determine that black should be added to increase the contrast of the print, there are at least two ways to proceed. If you find that you often add black, a b&w negative can be made at the time you make your separation negatives. After you have finished with your color emulsions, print a black emulsion just as if you were making a modified-traditional b&w print, but give a base minus 1 stop exposure.

334) Why a base minus 1 stop?

Because you only want to strengthen the blacks, that is, the shadow areas. If you give a base exposure you will place middle-tones and highlight grays over colors which will degrade them (unless, of course, you like the effect, in which case use a base exposure. The object is to underexpose to allow only the shadows to print.

335) And the second method?

If you haven't made a b&w negative, you can sandwich the 3 separation negatives together in registration and give a base plus 1/3 stop exposure with black pigment.

336) Why a base plus 1/3 stop exposure this time?

To compensate for the additional density caused by the two extra negatives. Questions?

337) Yes, but not on this. When I make my color printing exposures, does it matter in what order the colors are printed?

In offset lithography and other mechanical printing processes, the colors are put down in the following order: yellow, magenta, cyan and black. This order gives the best results in these processes. But for pigment printing, I suggest magenta, yellow, cyan and black.

338) Why?

Because in pigment printing it is (almost) impossible to see what the yellow printer layer looks like. The yellow doesn't have much contrast against the white paper, so you can't see any detail. You can see the detail in the magenta layer, and when the yellow is added you will be able to see detail in it, too. Questions?

339) No.

Then I would like to say that you shouldn't panic when you look at your print after you have put on the magenta and yellow layers. (I always do, and I should know better.) At this point the print looks awful. There is very little detail and the color is a dull red-orange-pink. But when you get the cyan layer on, it looks completely different. This is also a good point to mention some things that I haven't talked about yet, but should.

340)Talk.

A black or color can be lightened by diluting the emulsion with equal parts of gum and bichromate (#106). But there is another way. You can add a bit of white pigment. If the emulsion is at the point where the addition of more pigment will cause the emulsion to flake off during development, this procedure is inappropriate. If the is this is the case, a new emulsion of white and black or white and a color can be mixed. Some companies sell gray watercolors and gouache. This is an advantage because the same gray can always be used, but slightly more on an advantage for the contemporary pigment process than for the modified-traditional process.

341) Thanks, but I'm not going near the contemporary printing process, so I'm not going to worry about graying out pigments.

True, if you plan to stay with the standardized modified-traditional process, you should have no use for this information. But if you are creative, you can put this information to valuable use. For instance, for pasteling out colors to make a pastel print.

342) But what is the difference between diluting a full-strength emulsion or adding white pigment?

The two emulsions will yield prints that look different aesthetically. Some time ago I

mentioned that the advantage of using the pigment printing process is that it frees the photographer from decisions made for him at the factory. I said that there were umpteen decisions that the artist would have to make, and that each decision will be a creative decision.

As soon as you have gained a bit of knowledge, you are placed in a position of making a creative decision. It is important for you to understand that all decisions are ultimately of a creative nature, and choosing whether to exercise a particular option is a decision, a creative decision, in itself.

This is one reason I insisted on talking about densitometers, the contemporary printing process, about sizing paper with hard and soft gelatin, about dry pigments, etc. It has been the purpose of our discussion to show you how to make a pigment print, but has also been a concern of mine to help you develop your creativity.

We have come to the end of this ebook. While you have all the information you need to eventually make pigment prints, I realize that you will have much pain learning to apply the information I've given you. But if you are persistent, you will eventually be rewarded.