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PHOTOGRAPHY

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This invention relates to photography in general and in particular to a method of making prints in natural color.

Many methods of producing prints in natural color are known, for example, wash-off relief imbibition, Chromatone, carbon, carbro, and others. This invention relates particularly to an improved method of making carbon prints in natural color.

In general, the carbon process consists in exposing to bright light, under a negative, a dry, pigmented gelatin sheet, supported on a paper backing, which gelatin has been sensitized to light by immersion in a solution of a soluble bichromate or chromate, and dried. The time of exposure is usually determined by test. The action of the light is to render the gelatin which receives light insoluble in hot water, so that, after exposure, the gelatin unacted upon by the light can be washed away by hot water, leaving a positive image of insoluble, tanned, pigmented gelatin.

The pigment in the gelatin sheet can be any color desired. To produce prints in natural colors, images are prepared in cyan, magenta, and yellow, then superimposed in register with one another.

It is quite generally accepted that carbon printing must be done with dried, sensitized pigment paper. Wall and Jordan, Photographic Facts and Formulas, page 235, 1940 edition, state that sensitizing can be done in full light, but the tissue must be dried in the dark, as it becomes sensitive while drying, and on page 215 that when wet the sensitized paper is not sensitive to light, but it becomes so on drying. Neblette, Photographic Principles and Practice, 4th edition, page 27, states that carbon tissue is sensitized with bichromate, dried, and exposed; page 662, that before use, it has to be sensitized in a solution of potassium bichromate and then dried in the dark; page 767, that if such a gelatin film is bathed in a solution of a dichromate and dried in the dark, it becomes light sensitive. Wheeler, Photographic Printing Processes, page 104, 1930 edition, states that it is important to remember that, while the tissue remains insensitive as long as it is wet, and that, consequently, sensitizing may be carried out in daylight, sensitiveness comes with drying.

A distinct disadvantage of dried, bichromate-sensitized pigment paper in making trichrome prints is the varying sensitiveness of the sensitized, dried pigment paper with age. The sensitivity to light varies with the rapidity of drying. After drying, the sensitivity first rises, then falls, over a period of hours. While this can be tolerated in monochrome work, it cannot be tolerated in tricolor work, where accurate color rendering is essential.

Contrary to the above authorities, I have found that wet, bichromate or chromate-sensitized carbon pigment actually is sensitive to light to a degree very satisfactory for making carbon prints in natural colors. As an example, I sensitized a pigmented gelatin sheet by immersing it for 3 minutes in a 4% aqueous solution of ammonium bichromate, without draining placed it on a waxed Celluloid, firmly squeegeed the wet sheet to the Celluloid to remove air bubbles and make it adhere to the Celluloid, and placed the combination immediately in a printing frame in such manner that the dry side of the Celluloid was against the negative.

With a No. 1 Fotoflood lamp in a reflector, and with the print frame 16 inches from the tip of the lamp, I exposed from 2 to 6 minutes, depending upon the density of the negative used. To prevent the heat from the lamp melting the wet gelatin sheet, I directed the blast from a fan against the printing frame, or I exposed by 1 minute intervals, followed by 1 minute cooling periods. I then removed the Celluloid plus adhering gelatin pigment plus backing paper, placed the combination in warm water until the gelatin began to melt, removed the backing paper, washed away surplus pigmented gelatin, and obtained a satisfactory pigmented gelatin image on the Celluloid sheet.

It will be noted that the pigmented gelatin image was produced by printing through the Celluloid support, and not by printing upon the exposed surface of a dried, sensitized, pigmented gelatin sheet, as in the old process using dried gelatin sheets. In the old process it was necessary, after exposure, to soak the exposed gelatin sheet in water, roll it against a waxed Celluloid, leave it there for a time under pressure to cause it to adhere to the Celluloid, then immerse Celluloid and adhering pigmented gelatin in hot water and develop as described. This was because, in the old method described, the latent image was on the top, or exposed, surface of the gelatin, with soluble, unexposed gelatin beneath the latent image, so that the latter was not attached to the Celluloid and would float away in hot water development. In my improved process, the latent image is formed while in contact with the Celluloid, and by exposure through the Celluloid, and adheres to the Celluloid without more.

While, in the above example, I used as sensitizer ammonium bichromate, other, water-soluble bichromates or chromates may also be used, such as potassium, sodium, or other bichromates, or potassium, sodium, or ammonium chromates. Where, in the appended claims, the term water-soluble bichromate is used, I mean to include as equivalents the above-stated equivalents.

It will be noted that in my improved process, no period of varying sensitivity after drying the sensitized, pigmented gelatin sheet can occur, for the reason that the gelatin sheet is printed immediately after the removal from the sensitizing bath.

I have determined that the sensitivity of wet, sensitized, pigmented gelatin is not of a different order of magnitude than that of similar, dried sheets. For example, where, in the above example, a dried gelatin sheet is used, a 100 watt lamp (instead of the No. 1 Fotoflood, 250 watt) for like periods of time gave similar images.

Since the effective light in carbon printing is blue, and since blue light penetrates blue and cyan pigment paper more deeply than it does magenta or yellow pigment paper, with perfectly balanced separation negatives the exposure of blue or cyan pigment papers need be less. I have determined that the exposure ratio for cyan, magenta, yellow is, for a certain brand of pigment papers, 1:1.4:1.4. Other brands of pigment paper may vary somewhat from this ratio. The above ratio was determined by printing a gray scale only.

If the separation negatives are not wholly balanced, as evident from density determinations of the gray scales thereon, adjustments of exposure times must be made with the three-colored pigment papers, as is usual in any color printing process.

As an example of the carrying out of my improved process, starting with balanced separation negatives of the object, I immerse a cyan, a magenta, and a yellow pigmented gelatin sheet in an aqueous ammonium bichromate solution of about 4% concentration, for a period of 3 minutes, without draining I remove them from said bath and squeegee each such gelatin sheet to a waxed Celluloid, place each in a printing frame carrying the corresponding separation negative, Celluloid side against the negative, close the printing frames, and expose them to the No. 1 Fotoflood lamp at a distance of 16 inches for a period of 4 minutes for the cyan, 5.6 minutes for the magneta and yellow. I then remove the Celluloids plus adhering pigment sheets from the print frames and place them in water at about 100–110° F. When the gelatin starts to melt I remove the paper backings and wash until all soluble gelatin has washed away, leaving on the Celluloids a colored, tanned image, a positive of the respective separation negative used.

I then dry these colored images on the Celluloids. When dry, I again soak the cyan image in cold water, soak a sheet of paper coated with meltable, so-called soluble, clear gelatin, adhere the two together and allow them to dry. The gelatin sheet falls off the Celluloid and takes with it the cyan image.

I then wash the surface of the cyan image on the paper with turpentine, to remove any wax taken from the waxed Celluloid, then soak the paper plus cyan image in cold water, soak the magneta image on its Celluloid in cold water, adhere the two together in register, and allow them to dry. When dry, the paper will fall off the Celluloid and take with it the magenta image, now resting on top of the cyan image.

I proceed similarly with the yellow image, so that I obtain, on the soluble gelatin paper, three superimposed, colored images, yellow on top, magenta in the middle, and cyan at the bottom. Since the yellow image is opaque and obscures the other images, I reverse their sequence as follows. I soak in warm water a paper coated with an insoluble, tanned gelatin. I remove the wax from the above combined image by turpentine. I soak in cold water the combined image. I combine the insoluble-coated gelatin paper with the soluble gelatin-coated paper carrying the combined images, adhere the two together and allow them to dry for a time between blotters under pressure. I then place the adhering papers in water at about 100° F., whereupon the soluble gelatin upon which the combined images rests melts, the paper backing comes away, leaving the combined images embedded in the insoluble, tanned gelatin of the other paper, with the yellow image at the bottom, the magenta image in the middle, and the cyan image on top. This, after drying, constitutes the final color print.

In another form of carrying out my invention, which I prefer when using separation negatives made from color transparencies, such as Kodachrome, Dufay, Finlay, etc., I use an automatic masking and simultaneously simplify the steps in the process. As an example thereof, I may proceed as follows.

With the red record negative and with my above-described process, I print a cyan image on a waxed Celluloid and dry it on the Celluloid. I then soak the cyan image on the Celluloid in cold water. I sensitize a magenta pigment sheet in the said ammonium bichromate solution and, without draining, press it firmly against the wet cyan image on its Celluloid. I then register, on the Celluloid side, the green record negative with the cyan image and retain it in position by transparent tape. I then place the assembly in a printing frame in such a manner that the printing light passes first through the green record negative, then through the cyan image, to reach the wet, sensitized magenta pigment paper. I then expose the whole to light, but increase the printing time about 1.3 times, to compensate for passage through the cyan image. I remove, then, the Celluloid and adhering pigment paper from the print frame and, after removing the negative therefrom, place the Celluloid and adhering pigment paper in warm water. When the gelatin begins to melt, I remove the paper backing and wash until all surplus gelatin and pigment has been removed, leaving the magenta image superimposed on the previous cyan image and perfectly registered therewith, for the reason that it was printed therethrough. I then dry on the Celluloid the combined images.

It will be noted that not only is the magenta image absolutely registered with the cyan image (and it could not be otherwise) but also that the magenta image has been masked in printing by the cyan image, thus purifying the reds and correcting for overlap of colors. Also, all necessity of registering a magenta and a cyan image, in transfer to soluble support paper, has been avoided. Only one celluloid support is used, and no soluble support paper.

I then soak the combined, registered, cyan-magenta images on the Celluloid in cold water and press them against a wet, bicromate-sensitized, yellow pigment paper, register on the Cel-

luloid side the blue record negative with the combined images, and expose to the same light as before for a period 1.5 times as great as that used in exposing the cyan image, to compensate for the light passing through both cyan and magenta images before reaching the yellow pigment gelatin. I then remove from the print frame the Celluloid carrying both combined cyan and magenta images, remove the negative therefrom, and immerse the Celluloid and adhering yellow pigment paper in hot water, as previously, to develop the yellow image on and adhering to the other two combined images, the yellow image also being automatically in register therewith.

It will be noted that the yellow image has been purified as to color and color overlap, because of the masking by the cyan and magenta images, through which it was printed. Also, there is no question but that the yellow image is in perfect register with the already-registered cyan and magenta images.

Since the yellow image is on top, and is rather opaque, the color photograph must be viewed from the Celluloid side. I may leave the combined images on the Celluloid and adhere the image side to white backing paper, thus obtaining a glossy color print. If such be intended, no waxing of the Celluloid before use will be necessary.

Alternately, I may thoroughly swell the tanned gelatin of a gelatin-coated backing paper, adhere the same to the combined images on the Celluloid and allow to dry, whereupon the backing paper will crack off the Celluloid, bearing the combined images with it, yellow image underneath, cyan on top, and magenta in between, as desired. It will be noted that, on account of the production of the colored images one over another on the Celluloid, no intermediate transfer is necessary and that only a single transfer may be used.

To my surprise, I have found that, in practicing my invention, no mask or border is necessary to prevent frilling of the gelatin image from the Celluloid during the hot water treatment. In the usual method of working with dry, sensitized carbon pigment sheets, and also to an even greater extent in the carbro process, unless a colorless border is left around the image, the heavy, thick edge of the gelatin image almost invariably lifts off the Celluloid and this lifting spreads to the rest of the image, causing the latter to float off the Celluloid support. For some reason that I am unable to explain, no such action takes place with carbon images printed by my wet process. A dense border of an image, caused by the pigment paper extending beyond the negative, which would certainly lift off the Celluloid in the old process, shows no tendency to lift off in the wet pigment process. This lack of frilling in hot water development overcomes one of the biggest troubles with carbon and carbro processes. Heretofore, extraordinary precautions against frilling were often necessary, such as coating the waxed Celluloid with alum-tanned albumen, operating at low temperatures before the hot water development, etc.

What I claim is:

1. A process of producing a photographic print which includes exposing to light under a negative a pigmented gelatin sheet saturated with an aqueous solution of an alkali bichromate, until a latent image forms in said gelatin sheet, and developing the said gelatin sheet in hot water to remove the unexposed, pigmented gelatin.

2. A process of producing a photographic print which includes adhering, to a transparent sheet, a cyan-pigmented gelatin sheet saturated with an aqueous solution of an alkali bichromate, exposing to light under a negative said cyan-pigmented gelatin sheet until a latent image forms therein, developing said gelatin sheet in hot water to remove unexposed, pigmented gelatin, drying the cyan image so produced, adhering to said cyan image a magenta-pigmented gelatin sheet saturated with an aqueous solution of an alkali bichromate, exposing to light under a negative and through said cyan image said magenta-pigmented gelatin sheet until a latent image forms therein, developing said magenta-pigmented gelatin in hot water to remove unexposed pigmented gelatin, drying the combined cyan and magenta images so produced, adhering to said combined and registered images a yellow-pigmented gelatin sheet saturated with an aqueous solution of an alkali bichromate, exposing to light under a negative and through said combined images said yellow-pigmented gelatin sheet until a latent image forms therein, developing said yellow-pigmented gelatin in hot water until unexposed, pigmented gelatin is removed, and drying the combined cyan-magenta-yellow images so produced.

3. A process of producing a photographic print which includes adhering, to a transparent support, a pigmented gelatin sheet saturated with an alkali bichromate aqueous solution, exposing to light under a negative said pigmented gelatin sheet until a latent image forms therein, developing said gelatin sheet in hot water to remove unexposed, pigmented gelatin, drying the pigmented image so produced, adhering to said pigmented image a pigmented gelatin sheet, of a color other than the first-used gelatin sheet, which second sheet has been saturated with an aqueous solution of an alkali bichromate, exposing to light under a negative and through the first-mentioned pigmented image said second pigmented gelatin sheet until a latent image forms therein, developing said second pigmented gelatin in hot water to remove unexposed, pigmented gelatin, drying the combined, pigmented images of different colors so produced, adhering to said combined and differently-colored images a pigmented gelatin sheet of a third color, which latter gelatin sheet has been saturated with an aqueous solution of an alkali bichromate, exposing to light under a negative and through the combined, pigmented images said third color gelatin sheet until a latent image forms therein, developing said third pigmented gelatin sheet in hot water to remove unexposed, pigmented gelatin, and drying the triple, pigmented images of different colors so produced.

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