CHAPTER III

THE INKING-UP

THE PRODUCTION OF THE DIFFERENTIAL SWELLING. — In the chapter on the bleaching we fully explained the processes which take place in the gelatine film under the action of the bleaching solution, and that the most important result of the bleaching process, aside from the disappearance of the silver image, is the formation of different degrees of swelling corresponding to the primary image, which in their totality form the tanned image produced in place of the photochemical image by the bleaching.

For the success of the bromoil print, it is now of the utmost importance that the different capabilities of swelling, now latent in the gelatine film, should be satisfactorily utilized. It is obviously possible to produce this swelling in very different degrees. The colder the water used for the swelling, the smaller the difference between the lights and shadows, while the warmer the water the more this difference is accentuated. If, for example, a print prepared for the bromoil process is placed in *cold water* and allowed to swell for some minutes, the existing capacity for swelling will only be excited to a slight degree. The high lights of the invisible image only take up a little water, and when dry are differentiated from the shadows under oblique visual examination by a very delicate gloss or not at all. If

this picture is now worked-up with greasy ink, a print is obtained with *a short scale of gradation, and its tone values are usually less satisfactory than those of the original bromide print.* If, on the other hand, the print is placed in *very warm water,* the swelling of the gelatine reaches a maximum. The high lights are very much swollen, even the half-tones are somewhat raised, and the shadows, which do not absorb water, appear sunken. The result of the swelling in such warm water in this case is the formation of a very pronounced relief, that is not only visible, but is almost perceptible to the touch. If such a picture is inked up, a bromoil print is obtained, *the contrasts of which are much stronger than those of the original bromide print.* Between these two extremes there is obviously a whole series of intermediate stages, the suitable employment of which permits of the most varied gradations.

As already mentioned, the capacity for swelling of the different makes of bromide papers is not the same in baths of the same temperature. This fact, however, argues neither for nor against the usefulness of the various bromide papers. It makes necessary, to be sure, a certain care in the use of a paper, the qualities of which are unknown. If one has to deal with such a paper, the prepared print should first be soaked in quite cold water; it should then be removed from the water, placed on a support, dried in the manner to be later described, and examined by oblique illumination as to whether the high lights show by a slight gloss that they have absorbed water. This will be the case if the image shows well swollen high lights; if they are not present, it will hardly be possible to find distinctly glossy places. In any case one may begin with the inking-up, prepared,

as will be explained later, to increase the swelling if necessary during the inking-up by immersion in warm water. If on the other hand, the print, when taken from the cold water, distinctly shows places where differences of swelling are shown by a gloss or even a delicate relief in the film, the work may be proceeded with, without further trouble.

Under any circumstance one should be careful at first in the production of the differential swelling. *There should rather be no relief than too pronounced a one;* for differences of swelling that are too small can be easily and satisfactorily increased during the work; on the other hand it is scarcely possible again to reduce too strong a relief. While learning, or when using an unfamiliar brand of paper, it is therefore advisable to allow the sheet to swell first in cold water and to carefully begin the inking-up. Only if this is not satisfactory, should a warmer bath be used and the inking again tried. This method is, however, dealt with more fully in the section of Chapter III, entitled "Different Methods of Working" (page 85).

THE PROPERTIES OF THE RELIEF AND ITS INFLUENCE ON THE CHARACTER OF THE PICTURE. — In order that the following explanations may be understood, an important property of the prepared and dried gelatine film must be mentioned.

The film of the prepared print, in which the differences of swelling necessary for the formation of the bromoil print are latent, develops variations of relief when it is placed in water. Then the untanned high lights absorb water, as already described, while the hardened shadows do not absorb it. The result of this process is the formation of those swellings, which, when they

have attained a certain degree, are characterized by the formation of a relief.

A definite degree of swelling corresponds to a definite temperature of water. This swelling disappears again if the film is dried. *The gelatine has, however, acquired the property of again attaining the same degree of swelling when immersed in water at any time after drying, even if the temperature of this water be a good deal lower.* A print, for example, on which a certain relief has been produced in water at 35° C. (95° F.) and which has given up this water again because of drying, again attains the same relief if immersed in ordinary tap water at 10° C. (50° F.). If, however, this print after drying is immersed in water at 40° C. (104° F.), that is in hotter water than that first used, a still higher relief is obtained, and again in a similar manner, after drying, it will attain this higher relief when immersed in water at any lower temperature.

The degree of swelling that is once attained can, therefore, so far as the resistance of the gelatine film will permit, be increased, but it cannot be reduced, if the print as a whole is not subjected to a tanning, as with formaldehyde, a process that is not easily controllable. This peculiarity of gelatine makes it necessary to go to work carefully in the formation of the relief, so as not to carry the latter too far. If the work is begun on a too low relief this can be easily increased to the necessary height, as will be shown later, absolutely without any regard to any inking up that may have been done. *On the other hand, if the formation of the relief has once been carried too far, as a rule the print can not be used,* although reduction of the excessive swelling by a tanning agent may be attempted.

The property of the gelatine film, just described, offers a further convenience for the bromoil worker; for he can bring the bleached and dried print to the necessary degree of relief in water of suitable temperature, and, if he does not wish to work it up at once, it can be dried and laid aside until needed. In working-up such prints he is then, as a rule, relieved of the necessity of obtaining warm water.

The question how far the swelling of the film has to go or in other words what kind of a relief should exist, if any, in order to obtain a harmoniously graduated bromoil print, is extremely difficult to answer. A few practical trials quickly give the ability to judge this correctly. If a well-modulated negative is used, one in which the differences of gradation between the high lights and the shadows are not too great, the swollen gelatine film after drying should show a very delicate but still noticeable relief; yet the high lights of the print should scarcely be raised above the shadows, and should not show too marked a gloss.

The visibility of the relief is essentially determined by the character of the print. The more contrasty the bromide print was, the more easily are the different degrees of swelling made apparent by the formation of a visible relief. A picture with sharp outlines and great contrasts, such as an architectural study, easily gives a distinct relief visible in all its details. Pictures with softer gradation, as, for instance, delicate portraits, behave differently. One can not expect a striking relief in such prints. If this should be forced by warming the water, the bromoil print may easily attain an undesirable harshness. With portraits, one should therefore be satisfied when the outline of the profile against

the background, the contours of the eyes and the mouth, are raised to a barely visible extent from the gelatine base. At the same time very dense parts, like a white collar, a lady's light dress, lace, etc., may show a very distinct relief, even when the sharper lines of the face scarcely stand out in relief. Yet even in such cases the features can be recognized by the different gloss of the high lights and shadows under oblique observation. Naturally some attention must be paid here to the particular views of the operator. If strong contrasts are desired, greater differences of swelling must be used; if, on the other hand, softly modulated effects are sought, distinct relief must be avoided. In any case it is advisable not to attain this at once, but to get it as needed during the working-up by the use of water gradually increasing in temperature.

It must be laid down as an axiom that the efficiency of a relief should never be judged by the eye alone, but should always be carefully tested out by inking-up with the brush. The degree of swelling is correctly estimated at the first attempt when, in inking-up, the picture appears quite clearly after a little hopping, and this may happen if the character of the image is right, even though no relief could be seen.

The stronger the relief formed by warming the water, the more contrasty the bromoil print will be. Nevertheless there is a certain limit which should not be overstepped. If the print is warmed in the water bath so much that an excessive relief, which can almost be felt with the finger, is formed, in which deeply cut lines alternate with highly glazed places in relief, then the high lights are so saturated with water that under no circumstances will they take ink; even the softest inks

will not adhere to them. Thus we obtain harsh high-lights without details, while the deeply sunken shadows literally fill up with ink and become sooty. If the formation of the relief has been driven so far, it is not advisable to treat the print with ink.

The forcing of the relief to the extreme possible limit is only justified when working with a flat negative, in order to obtain as rich a gradation as possible from a flat print. Also, this should not be done all at once before the commencement of the inking-up, but effected gradually during the work. Working in this way, extraordinarily successful results can be obtained and the contrast of the bromoil print can be made far more rich than that of the original bromide print. The limit lies only in the resisting power of the gelatine film and the flatter the bromide print was the sooner this is reached.

The upper limit of temperature permissible for the water can hardly be defined; it depends entirely on the hardness of the gelatine film. It may happen that it is necessary gradually to go almost to the boiling point. Films that are hardened right through will withstand even boiling water without forming a relief.

If, in warming the print, the melting point of the gelatine is approached, those parts which are but slightly tanned, such as the high lights, and especially any unexposed edges, begin to show a granular structure, and finally, when the heating is carried further, to melt.

In the development of the relief great care should be taken that no part of the print remains dry, and, if the film is placed face down, air bubbles should be avoided. If the print is placed face up in the dish, no part of it should project above the water, as it will then not ab-

sorb enough water; if the swelling has already taken place and a part of the film projects above the water (and this frequently happens, as the print, which at first lies on the bottom of the dish, after some time rises to the surface), the relief of the exposed parts goes down after some time, since the water evaporates from them into the air. Such insufficiently swollen parts, or those which have dried out, behave exactly as though they had been tanned more than the other parts of the surface. They have been able to absorb little or no water, or have lost the absorbed water by evaporation. They therefore take the ink, like the tanned shadows, far more readily than they would if they had retained the right amount of water, and far more ink adheres to them than should be the case and than adheres to the correctly swollen parts of the film. Thus patches of different form and size are formed at these places by the stronger adherence of the ink. Yet by renewed soaking of the print in the water these neglected places may be easily brought anew to the correct degree of swelling, and as far as concerns small spots caused by air bells, can be easily corrected. If larger patches of the film are insufficiently swollen, after the application of the ink they are usually much darker than the rest of the surface, and in such cases it is not always easy to obtain again the necessary evenness of the ink; it is then often necessary to ink up the whole print much more strongly than was originally planned, or to remove the whole film of ink.

Besides the warm water bath there is also another means at our command to produce the differences of swelling. This is the use of *ammonia*. A. & L. Lumière and Seyewetz, in a treatise published in 1913, on the

resistance of gelatine to alkalis, found that cold solutions of ammonia did not attack gelatine but caused it to swell more.

If a bleached print is immersed in an aqueous one per cent solution of ammonia, the film attains in a very short time *the highest degree of swelling of which it is capable,* without the gelatine in the high lights being softened or damaged. The estimation of the height of the relief, which is so important for the successful carrying out of the inking, is scarcely possible with the ammonia bath, as it is extremely difficult to gauge its action. Therefore, it should only be used in those cases in which the highest swelling is absolutely necessary, as for instance, when using papers which have been strongly hardened in the manufacture, or with prints with very poor contrasts. A further application is with the transfer process, in which on the one hand it permits of the use of very soft inks and on the other hand enables one to keep the gelatine very resistant. Full details on the transfer of bromoil prints will be found in a later chapter. In very extreme cases, one may try to combine the action of the warm water and the ammonia bath, and use a warm ammonia bath. The $\frac{1}{2}$ to 3 per cent solution of sodium carbonate recommended by E. Guttmann acts even more energetically than the ammonia solution.

As is obvious from the foregoing remarks, it will be as well to work usually with water baths and leave the ammonia bath for a last resource, the more so as in the swelling of prints in this bath certain troublesome phenomena may appear, which do not occur when using the water baths. Sometimes the bleached image reappears in the ammonia bath in a brown color; some-

times small white spots appear on the prints which will not take the ink and which, as can be determined by examining them by transmitted light, also exist in the substance of the paper; finally the gelatine film sometimes swells all over, so that the ink is not taken up anywhere. Prints which are failures in consequence of the use of the ammonia bath, should be dried and can be again treated in a warm water bath.

THE UTENSILS. — For the application of the ink the following are required:

Brushes. — A best quality oil-printing brush with very elastic hairs cut on the slant, the so-called stag's-foot brush, should be used. To apply the ink, a brush should be used with a working surface of from $1\frac{1}{2}$ to $2\frac{1}{2}$ cm ($\frac{5}{8}$ to $1\frac{1}{4}$ in.) diameter; by diameter is meant the length of the longer axis of the elliptical surface produced by the slanting cut of the brush. For working-up very small surfaces or for placing accents of color, a brush of about $\frac{1}{2}$ cm ($\frac{3}{16}$ in.) measurement should be used. In certain cases still smaller brushes may be useful. Such brushes are only used for working up details; they are only aids for special work. For the application of the ink generally, only the larger brushes should be used. It is far more difficult to apply the ink evenly with small brushes than with the larger ones, so that their use may cause needless discouragement.

The application of the ink is effected by placing the whole working surface of the brush charged with ink on the print, and then slowly lifting it up; this results in a deposition of ink corresponding to the working surface of the brush used. The smaller the brush the more often it must be applied, and therefore, the greater the probability of irregular inking, especially in those

parts where the brush marks overlap. Also small brushes are handled less conveniently than larger ones and smear easily. The first thing to do in inking a bromoil is to obtain a good, even, thin film over the whole surface, to get a general impression of the whole effect. Only then is one in a position to judge how the tone values should be varied. The use of too small a brush unduly protracts this first operation and makes it difficult.

The brushes should be elastic but not too soft. Too soft brushes smear, that is to say, they deposit the ink in a thicker layer at their edges than in the middle and produce elliptical rings of ink, which must always be evened out by hopping.

In determining the size of the brush, the size of the bromoil print must be taken into account. Generally it is easier to work with brushes of from $1\frac{1}{2}$ to $2\frac{1}{2}$ cm ($\frac{5}{8}$ to $1\frac{1}{4}$ in.) in diameter. For large sizes up to 30 x 40 cm (12 x 16 in.) brushes of even 4 or 5 cm ($1\frac{1}{2}$ or 2 in.) may be used. Such brushes are not cheap, but are practically indestructible, if they are properly cleaned every time after use. The brushes are sold in tubular paper cases; these latter should be preserved and the brushes, after cleaning, put back into them, so that they are covered and the hairs do not get ruffled.

In order to preserve the brushes and keep them in good working order, they must be cleaned as soon as the work is finished, otherwise the ink left in them sets and makes the hairs brittle.

Brushes of long swine bristles with cut ends may also be used; with these especially, clean prints are quickly attained. They are superior to hair brushes of poor grade.

The cleaning of the brushes is best effected as follows: Pour into a deep dish a *readily volatile* fat solvent, such as benzol, trichlorethylene, carbon tetrachloride (carbona), etc.; but not turpentine, for if this be used the brushes cannot be used sometimes for days. Dip the brush into the liquid and press out the solvent on the edges of the dish, and stroke the brush vigorously on a piece of lintless linen, which should be used for this purpose only. The solvent can be used, ignoring the opacity which it soon assumes, as long as it will dissolve the ink. Only the hairs of the brush should be dipped in the solvent, but not the binding, as in some cases the cement with which they are fastened may be attacked.

The Inks. — Theoretically, any ink prepared with a fatty medium is suitable for bromoil printing. In order to give satisfactory results, the inks must satisfy two conditions: they must have the correct consistency and their medium must be soluble in benzol. As regards the consistency of the ink it should be noted that the prepared film in its swollen condition, that is when the lights are saturated with water, absolutely repels greasy inks only when this swelling attains the highest possible degree; a case which one seldom needs and which will usually have to be avoided. If this swelling is not carried to the limit, the high lights, in spite of the water they hold, will take up the greasy ink, yet usually only when the ink is very soft. *The swollen high lights thus repel ink of thicker consistency, while they take the softer inks more easily in proportion as they become thinner.* That the tanned shadows also take hard ink is natural, for they do not contain, or contain only to a very small extent, the water which repels the ink.

From these considerations it follows that in many cases satisfactory results cannot be obtained by using ink of only one consistency.

The hard or heavy ink should have about the consistency of table butter, and it should be possible to spread it into an even smooth film on a glass plate with light pressure. *The soft or light ink* should have about the thickness of honey and should spread under the knife without noticeable pressure.

Collotype or copper-plate printing inks of various makes are frequently usable. As a rule, however, they must be tested as to their usefulness for our process; their consistency is frequently too hard, and sometimes they are not taken up by the film or cannot be distributed well, even when they are considerable diluted with linseed oil varnish, in spite of an apparently correct consistency.

The nature of the ink is not only influenced by the greasy substance used as a medium, but also by the material of the coloring matter itself. This is why many inks, in spite of their apparent softness, work tenaciously or "short," while sometimes inks of hard consistency smear.

If occasionally the dilution of an ink of too hard consistency appears necessary, this is best effected with linseed oil varnish, which, however, should not contain any driers. If the work has been begun with a stiff ink of a certain shade and it is desired to retain this tone to the end, it is advisable not to use a thin ink for dilution, but to thin down the stiff ink with varnish.

Inks of too hard nature are not practicable. Such were necessary in the oil-printing process. In the bromoil process, which is much less sensitive to the con-

sistency of the ink, their use merely means a needless loss of time. An ink of correct consistency is easily taken up and produces quick drawing without smearing, while too hard inks are difficult to apply and soon refuse to take if they are not diluted.

It is extremely simple and advantageous to prepare the inks oneself, as outlined by E. Guttmann in Chapter VIII, p. 177. The process recommended by him is to place the powdered colors on a matt glass plate and rub up with varnish by means of a muller or pestle. This procedure is considerably facilitated, if, according to my suggestion, a few drops of a readily volatile oil-solvent be added. The ink is thus immediately liquefied and can be quickly and perfectly rubbed up. The solvent evaporates during the grinding, which is much easier than in the old way, and the ink again acquires the desired character without suffering in any way.

As a palette for the ink the best thing is a piece of waxed or parchment paper, fastened on a white support, such as a card. Such a palette has the advantage that after use it can be discarded without cleaning. Moreover the color value of the ink can be fairly easily determined on it. If necessary old negatives, or other glass, may be used as a palette, and their use also makes cleaning unnecessary, which is an unpleasant and messy job.

A small quantity of ink should be taken and distributed as thinly and evenly as possible on the palette. A thick layer is not convenient, as then the brush takes up too much ink and too much is deposited at a time on the bromoil print. The film of ink should show as smooth and uniform a surface as possible; thicker ridges should be avoided, because the brush is thus more

strongly inked in spots and therefore transfers the ink unevenly to the print. The distributed ink should be perfectly homogeneous and flexible. A thin layer of ink sets to a skin on its surface after a short time and then cannot be used.

This setting also takes place in the body of the ink and becomes evident by the formation of a delicate skin or hard crumbly particles on the surface of the ink. These must always be removed; such hardened inks can only with difficulty be distributed on the palette. Finally it should be mentioned that hard inks may be slightly softened by warming.

THE SUPPORT. — A stout glass plate or drawing board should be used as a support, and inclined at an angle of about 30 degrees by propping up at the top; *a damp and elastic pad* must be placed on the glass or board. *This pad is not for the purpose of keeping the print damp during the working-up, as is usually stated;* on the one hand this is superfluous in view of the possibility of repeated soaking, which is to be described later, and on the other hand it would not produce the desired result. It is erroneous to suppose that the water which passes from the damp support to the paper side can equalize the loss of water which the film suffers by evaporation from its surface. The pad should, therefore, only be so damp that the bromoil print adheres firmly to it, when under the brush. The pad should absorb and hold moisture; but this should not be imparted to the brush when it touches the pad in working-up the edges, otherwise water will be carried on to the print and cause spots. *For this reason damp blotting paper or filter papers should be absolutely rejected for the pad.* If such papers are used for the

damp pad, the brush, which in working the edges must inevitably touch them, will not only take up water but also the paper fibers and, transferring them to the print, cause trouble. Moreover, sheets of paper in a damp state are difficult to lay smooth and are scarcely usable.

The best material for the pad is the *copying sheets* used for copying books, which consist of two layers of linen with an intermediate film of rubber. Such sheets have the advantage that when damp they always remain flat and smooth. A damp piece of linen, doubled and smoothed out, is also simple and certain. The pad must lie absolutely flat, because any ridges become most unpleasantly visible in inking-up, particularly with thin papers, as the brush always slips from the highest parts of the ridges and causes inequalities in the print.

Removal of the Water from the Surface of the Print. — After the prepared print is removed from the water and laid on the pad, the water adherent to its surface must be removed. This is best effected in the following way: Take a large, absorbent, lintless cloth, spread it smoothly over the print, and press it gently with the flat of the hand. By repeating this, the water is easily removed without endangering the film; whether the drying is complete can be judged by *examining it obliquely. The freedom of the cloth, used for drying the print, from fluff and lint is of great importance.* If the cloth gives up fibers to the surface of the print, these cannot be seen at first. In inking-up, innumerable minute dark spots and lines appear on the film, as the deposited fibers take the ink very strongly and thus suddenly become visible. It is frequently erroneously assumed that such troublesome defects come from the brush. This is seldom the case; on close examination

these fibers will be seen to be particles of the textile material. When possible, linen that has been frequently washed should be used for the drying.

When the water is to be removed from a print that has already been inked and again soaked, care should be taken that the cloth is freed from any folds by damping and subsequent drying, for such folds can, when pressed on the print, damage the film of ink. Although this is not of material importance, as such faults can be easily evened out by hopping, yet these small precautions avoid unnecessary trouble. Sidewise or wiping movements of the cloth should be carefully avoided, especially if the print has already been inked, because the ink is unnecessarily smeared by the wiping. After removal of the cloth one should make sure by examining the print obliquely that the water has been completely removed from the surface.

It is advisable to keep several cloths ready for drying off the film, for this will have to be done fairly frequently during the work. *Care should be taken to remove most carefully every trace of water; water which is picked up by the brush causes spots,* for the drops of water in the brush keep the ink away from the points of contact. In such cases it will be seen that white spots make their appearance in different parts of the print, continuously shifting their position during the work. By perfect drying off, these phenomena, which are in any case not necessarily important as regards the final result, can be avoided. In drying off a print already inked-up, the cloth will as a rule remove some ink from the surface; such cloths should not be used again until they have been washed, because they may transfer ink to a place where it is not wanted.

THE BRUSH WORK. — The prepared print, lying flat on the pad, and with its surface freed from adherent water, should now be inked up.

Before beginning the application of the ink a little stiff ink, at least as large as the working surface of the brush, should be placed in a corner of the palette. This should be spread out flat, thin and free from ridges; then the knife should be wiped and a little soft ink spread in another place.

The brush should now be pressed down on the *hard ink* already distributed on the glass plate, and the ink dabbed very carefully from the brush on a clean place of the palette. *One should never go with the brush direct from the ink itself to the print, as this will form a spot which it is difficult to work out. It is of the greatest importance always to work with a brush that has been well dabbed out and in which the ink is evenly distributed.* If the brush has not been sufficiently dabbed out it leaves on the print a quantity of small, much darker and usually linear particles of ink, which cannot be distributed or are only removable with difficulty. Such spots must then as a rule be removed by the method described on page 72.

The whole brush technique is based on the following principle: if the brush charged with ink is placed on the print and allowed to remain there for a moment, and then *slowly* lifted up, the ink remains on the image. If it is set down sharply and *quickly* lifted (the so-called "hopping"), it removes ink. In the first inking-up of a print, the swelling of which has been correctly carried out, the application of the ink may be effected by a gentle dabbing. A very thin film of ink is thus produced and almost simultaneously correctly distributed.

The brush should always be held by the extreme end between two fingers, never by the middle or near the hairs. *The more lightly and more delicately the brush is managed the better it works.*

It is best to begin the work at some characteristic place of the picture, which is well known to the worker; the ink should first be spread as delicately and evenly as possible on a small spot, avoiding, as far as possible, going over the same place twice with fresh ink. When the place selected has been covered with a light film of ink, the surface should be hopped over with light movements, when, with correct preparation of the print, the outlines will soon appear. *A bromoil print correctly prepared,* and with swelling suitable to the ink used, *is easily recognizable by the fact that the image appears delicately but distinctly under the very first strokes of the brush.* If this does not happen even after some time, either the degree of swelling of the print is too low or there is some fault in the preparation of the print, such as, for instance, unsuitable paper, a poor bromide print, errors in bleaching, etc. The longer the hopping continues, the more distinct the details should become. Then the application of the ink should be continued in places adjacent to those already worked up, until finally the whole surface of the print has been evenly gone over with ink and the image is visible in all its details, although still very thin and delicate. It is advisable to use a rough print from the negative as a guide.

Beginners usually make the mistake of jumping from one spot to another without filling up the intervening parts. This makes the work more difficult. Inking up should be carried out continuously by passing from those

places already worked on to those not inked up. If it is noticed that the places which were first inked up appear too pale compared to their surroundings, since they have still too little ink, they should be inked up more strongly. Too dark spots should be evened out with the brush by removing the excess of ink and depositing it on the less inked parts. The amount of ink used on the print is very small; that which is first taken up by the brush lasts for a long time. It is not necessary to have frequent recourse to the ink spread on the palette by the knife, but is much better to take up, as long as possible, fresh ink from the spot on the palette on which the brush was dabbed.

On the other hand, however, every application of the brush to the print should actually deposit some ink on the print. If those parts touched by the brush do not increase in intensity, *it must be determined whether the dark places on the palette from which ink is supposed to be taken, are actually giving up ink;* for if the film of ink remaining on the palette is too thin, fresh ink must be deposited and distributed on it by the brush.

Care should be taken not to overload the brush with ink, for then the hairs stick together, distribute the ink badly on the print and, moreover, frequently leave large coherent particles of ink on the film, thus causing spots. As the brush is cut on the slant, it may happen that in dabbing out the brush on the palette and in the application of the ink to the print, the front and longer part of the brush is used more strongly. Then the ink collects at the back edge of the brush and causes spots when the brush is used more vigorously.

In many cases it is possible to complete the print with the hard ink alone. *If it is noticed that the hard*

ink does not take well on the print and is removed again in lifting the brush, its consistency is too stiff for the work. One should not then continue to use it, but should *soften the ink* in the following manner: First place the brush in the hard ink and dab it out well in another place on the palette. Now dip the ends of the brush hairs carefully and very lightly into the soft ink and dab out the very small quantity of the soft ink taken up by the brush on the same spot, on which the hard ink has been previously distributed. There is thus formed on the palette as well as in the brush a mixture of the two inks. Now try carefully whether the now softened ink adheres well to the print, by placing the brush lightly on a light place of the print. If it leaves behind a *light* trace of ink without any trouble, the consistency is correct; but if this does not happen, the ink must be diluted again in the same way with the soft ink. If on the other hand the brush leaves behind a *strong* trace of ink from a light touch, the ink is too soft and requires the addition of some hard ink. *It is not advisable to mix the soft and hard inks on the palette with the knife, as it is very difficult to strike the right consistency in this way.*

This applies to all mixtures and dilutions of the ink which may be necessary in the course of the work, as in strengthening a colored ink with black, or in the preparation of any desired tint by admixture of different inks, and finally in softening inks with varnish. In all these cases mixing of the inks on the palette with the knife puts too much ink into use; also, as long as the ink is on the palette, one cannot estimate with the necessary exactitude either the tint or the consistency. The correct procedure is rather first to go

with the brush to the first color and distribute this on a clean place, then set the same brush in the second color and make the mixture on the palette by dabbing. Then the mixture thus obtained should be tested as to its shade of consistency by gentle application to the print, and more of one or the other ink added in the same way with the brush. It should be noted that inks of a soft consistency go a very long way; the whole surface of the brush should never be dipped into such inks, but only the point of the brush. Softening of the inks with varnish should be effected in the same way.

When the first inking up is finished, the addition of ink of the same consistency is continued until the print is completed or will no longer take ink, which, as has already been pointed out, is known by the fact that the newly applied ink no longer adheres, but that the brush removes it from the print. Then one proceeds to a further dilution of the ink by taking more soft ink with the brush and adding it to that already mixed, and continues the work. The use of the unmixed soft ink is not even necessary in many cases. If, however, it proves to be necessary, it should be used, but with care, for a brush stroke which puts too much soft ink on any part of the print, especially in the shadows, causes a patch. *The beginner will work most easily and successfully if he always keeps the applications of ink as delicate as possible and obtains depth only by a repeated and even coating of ink, fully distributed every time.* If a place should still turn out to be too dark, one can try removing the excess of ink, if it be a hard one, with a clean brush. If a dark patch is formed by too vigorous application of a mixed or even a soft ink, another brush should be dipped into the hard ink,

dabbed out, and the spot removed with this brush. Moreover, such places can as a rule be easily rectified after the second soaking of the print, which will be described presently. If the fault cannot be removed in this way, the ink must be partially or entirely removed, according to the instructions in Chapter III, page 73, and the work begun anew. This should be done without hesitation by the learner if the application of the ink does not succeed as he desires; the prepared print can be used for practice like a school slate by washing it off after each attempt with a solvent of the greasy medium.

For the application and the hopping off of the ink for large areas of the print one should *always use the whole working surface of the brush.* Smaller surfaces or outlines should be worked up with the front edge of the slantingly-cut brush; in laying on the ink one should never continue with the point, because this bends and gives unpleasantly sharply defined ink edges. *In order to cover a place with ink very thoroughly, one should hold the brush firmly, give it a slight twist and then raise it up straight and slowly.* If it is desired to coat a whole print evenly with ink, it should be applied in stripes over the whole print, the brush being pushed forward and not necessarily completely lifted up from the surface. The brush is pressed down firmly, the pressure relaxed a little, the brush moved forward half its width, then pressed again, and so on. In this way with a little experience there may be produced perfectly even ink stripes which bring out the outlines of the image and which are made close together until the whole print has been gone over, when one begins with the hopping. With papers with marked structure these stripes are

best made in the direction of the structure and not at right angles. *Especial care should always be taken that the shadows of the print, which take the ink most easily, are not too strongly inked up, and one should try by light hopping to bring out all the desired details at the very first application of the ink.* When the shadows have once taken too much ink, it is not easy to clear them up by brush work alone. The inking up of large deep shadows must always, therefore, be very carefully done. Such parts of the picture are the most strongly tanned and therefore take the ink very readily and hold it very tenaciously. They should therefore never be touched with a brush freshly charged with ink, but one should work on the heavier shadows only when the brush has given up the greater part of its ink to the less sensitive parts of the image. Even then it always contains enough ink for the darker parts of the print. The first application of ink in the shadows, especially, ought never to be heavy and cannot be kept too delicate. When the desired details in the shadows appear to be well defined, they should then be strengthened. But even this should not be effected by a single thick coating of ink, but by successive additions of thin ink films and hopping after each.

Especial emphasis must be laid on the statement that *all details*, which it is desired to have in the finished print, *must be brought out by the first application of the ink.* If parts of the image are strongly inked up before the desired details have appeared, it is difficult to develop these later. On the other hand, detail, which has been brought out in the first inking, cannot be suppressed by any further skilful application of ink, but only strengthened.

These phenomena can on the other hand be successfully used to prevent the appearance of undesirable details in the picture. If for artistic reasons one desires to suppress detail and work flatly, the parts in question should be inked up from the start more strongly and evenly, and the hopping be either entirely omitted or stopped before the details which are to be omitted are brought out.

For beginners especially, it is useful in applying the ink, as well as in hopping, to lift the brush after every few strokes and examine the results obtained, so as to decide on further procedure.

One should accustom oneself to examine the print *from time to time at a certain distance,* while it is being worked on; for the correct impression as to whether the tonal values are correctly chosen, can be gained only at a greater distance; it is then seen more easily and clearly whether or not individual parts of the print carry too much or too little ink.

Particular parts of the print, which one wishes to have *more contrasty,* should be gone over after the hopping with *a wiping motion of the brush;* the ink is thus removed from the raised parts of the relief. If one goes too far in this, the inking can be done over again in the usual way.

If it is desired to free a brush from the soft ink, it should be dipped into hard ink specially spread on the palette for this purpose, and dabbed out well on a clean place, and this operation repeated two or three times, using each time another part of the palette. At the end of this manipulation the brush will practically no longer contain anything but hard ink.

When one has once learnt the initial steps of brush

technique, in the course of time one fails to notice the difference between the laying on and the hopping off of the ink. *The hand in time acquires an instinctive handling of the brush, which takes care at once of both the application and the distribution of the ink;* if the proper relation between the consistency of the ink and the degree of swelling of the gelatine has been hit upon, a simplified handling of the brush comes of itself, because then the application of the ink is especially easy.

When, with papers of rough surface, the grain of the paper remains white in the shadows, in spite of hopping, such places should be treated by going over them with the inked brush with light pressure *with a rotary motion.*

Practice teaches that there is always a definite consistency of ink which corresponds to a definite degree of swelling and with this the print may be executed from start to finish. If the operator has learnt by experience what ink consistency corresponds to the existing swelling of the film, he will prepare his ink of the suitable consistency, and is then in a position to carry out the work uninterruptedly without any new mixing of the ink.

It is a little difficult for the tyro to answer the question as to *when the application of the ink should be stopped,* that is to say, when the print may be looked upon as finished. There is frequently a temptation to consider the print finished when it is very delicate yet completely visible in all its details. The beginner often lacks the courage to apply more ink at this stage; he usually believes also that the print will take no more ink, because, as has been mentioned above, the part of the palette from which he has hitherto taken the ink, gives up no more. Such prints, which recall sketchy

pencil drawings, deceive one during the work, but only satisfy later if this particular technique is suited to the character of the picture, which is certainly not always the case. One must therefore carefully consider during the work whether one should actually stop.

The second danger lies in the opposite direction, and is due to the fact that, led on by the constantly increasing vigor of the image, *one cannot rightly decide when to stop.* The danger here is that one is tempted by the vigor of some part of the picture to make the other parts also as strong in color, until by such continued action the print is immersed in the deepest gloom, which becomes still more gloomy after defatting the finished print. Such excess must be avoided as a rule. Experience and taste soon teach one to hit the happy mean.

The first, delicate and general application of ink, which may be considered as a guide print, is in many cases somewhat wearisome, especially when the picture has large areas of rich, deep shadows. With correct preliminary treatment of the print there are no real difficulties in the preparation of such a guide print. Yet the work, especially with large sizes, is really time-consuming and also offers, when considered from the artistic standpoint, but little interest, since the actual creative work of the operator only begins after the guide print is finished; only then is he in a position to actually give expression to his artistic feelings by suitable inking of the different parts.

Since, therefore, the work in the preparation of the guide print is actually quite mechanical, it is natural to make use of any means which enables one to facilitate and hasten this work.

For this there may be used, but only by the expert worker, a method based on the following considerations:

If an ink of suitable consistency is dissolved in a suitable solvent, such as benzol, carbon tetrachloride, trichlorethylene, etc., the pigment is very evenly disseminated in this solvent. If the latter again evaporates, the ink deposits in an even coating, unchanged in its nature.

It is therefore, possible, in the first application of the ink, to use such a solvent on the print and by its aid the wearisome mechanical work of the first inking may be rapidly and easily carried out.

In practice the method of procedure is as follows: there is first produced, on the print which is to be worked up, a relief which is vigorous enough to sufficiently develop all the detail in the shadows. An ink which is fairly stiff for this degree of swelling is chosen; the brush is first dipped in the solvent and then into the ink, which has been thinly spread on the palette. After a few dabbings on the palette the ink solution with which the brush is charged is spread on the print with a hopping motion and distributed with the same brush as evenly as possible. If the distribution becomes difficult in consequence of evaporation of the solvent, the brush should be again dipped in the solvent, and then the distribution can be easily completed. The film of ink thus obtained should be fairly thin, but must not be quite even.

After the complete evaporation of the solvent, the ink is worked up with a clean brush, with which the guide print can be finished without trouble and in the briefest time.

There are also other variations of this method of

the application of dissolved inks. For instance, one may first apply some ink with the brush to the print and then distribute it with a second brush dipped in the solvent; one may also prepare a solution of the ink in a dish and paint it on the picture, or bathe the whole print in a solution of the ink. All these variants, especially the last two, have, however, certain disadvantages, so that the procedure first outlined is to be preferred.

After the guide print is prepared in this way, the further application of the ink is carried out in the normal manner.

The solvent is most conveniently chosen so that it is not too volatile, as for instance heavy benzol. But it ought not to contain any oil. When placed on the surface of the hand, it should evaporate fairly slowly, but without leaving any trace of grease.

Certain failures, which sometimes appear in this process, must be mentioned. If the film of ink is too thin, it can be repeated without further trouble in the same way, with rather more ink. If, on the other hand, too much ink is applied, a complete image is immediately formed without any possibility of the shadows being worked up. In this case the ink must be again removed by the solvent. If individual parts of the picture are too dark, from too much ink, it is sufficient to go over these parts with a brush dipped in the solvent, in order to clear them up.

If, after evaporation of the solvent, great irregularities in the distribution of the ink are seen, as for instance, spots and streaks which cannot be easily worked out, the print should again be placed in water; after drying off, the evening-up may be carried out without difficulty.

If in hopping with the second clean brush the image does not appear at once without trouble, either the relief was too low, or the ink too soft, or the solvent contained oil.

The ink can obviously be placed on the bromoil print not only with the brush but with any other suitable ink carrier, such as *rollers*. Yet by this the process is rendered *more mechanical* and deprived of all those great advantages, which distinguish it from all other printing methods. *Especially, the possibility of local treatment is mostly lost;* the unlimited command of the tonal values and the structure of the ink can only be guaranteed by the use of the brush. The only offset to this loss is a gain in speed. Agility, however, is not sought after in artistic labors. If one wants to prepare a lot of prints quickly, it is better to use the bromide process, which is especially suitable for such a task, and thus save the trouble of the bleaching and the other processes necessary in making bromoil prints.

RESOAKING OF THE PRINT DURING THE WORKING-UP. — *Resoaking the print during the inking up, without regard to the existent film of ink, is one of the most important aids in the bromoil process.*

This procedure is based on the following considerations: It has already been pointed out that the prepared gelatine film possesses the property of again assuming after drying the same degree of relief which was imparted to it by the warm water bath. When a swollen print is taken out of the water and placed on the pad for working up, evaporation immediately begins at the surface of the film; the gelatine, therefore, continuously gives up water to the surrounding air during the work, and more quickly in proportion as the air is drier and

warmer. As has already been mentioned, the damp pad does not alter this, since the supply of water from the pad through the paper is not sufficient to restore the water content of the film. Therefore, while one inks up one part of the print, all other parts gradually lose their water; and since it is this water which renders the gelatine, after its tanning, capable of repelling or taking the greasy ink, the work gradually becomes more and more difficult. The gelatine film, which feels smooth when the film is removed from the water, especially in the high lights and any exposed margins, becomes gradually leathery. It may still take ink, but the distribution of this, and especially the development of the drawing and the details, become more and more difficult.

If, however, the print, which is partly or entirely inked up, is again placed in water and this time in cold water, the gelatine film very rapidly absorbs this and again attains the same degree of relief that it had at first. Sometimes it appears as though a marked clearing up of the image takes place in the water; the high lights become cleaner, and many details appear in the shadows which were not visible during the working-up. On the other hand, with some inks the picture appears to become weaker under the water. This, however, is only an illusion and is of no importance, as in drying, or in again going over the picture with the brush, the image again attains the previous depth and color and still greater clearness.

Here also, one must take care that the print is *completely immersed* and that no air bells adhere to the film, since those places to which the water does not have access do not reswell, and on further work may give rise to spots. In removing the print from the water

the inked-up surface should not be touched with the fingers, or finger prints will remain in the ink. The print should therefore be taken hold of by the edges.

While the print is soaking in the water, the bringing out of the details, especially in the shadows, may be facilitated by stroking those parts with the tip of the finger or a swab of absorbent cotton. In the same way dirt which has collected on the surface during the work may be removed. In the latter case one may also use more vigorous friction, even though the ink film is thus removed, since the removal of the troublesome particles is more important than saving the thin film of ink, which can be easily renewed.

The print is then removed from the water, placed on the pad, and dried as previously by spreading over and pressing down a lintless cloth, although because of the film of ink any wiping action should be avoided. Then when the brush work is resumed, it can be completed in an extraordinarily easy manner.

It should be specially noted that the print must be *worked up after this second soaking with the same brush as before, which need not be recharged with ink.* Only after the print has been hopped in this way, should fresh ink be applied.

During the work, the bromoil print, as a rule, will scarcely retain the necessary degree of dampness longer than a quarter of an hour, and not this long in dry and warm weather.

The resoaking of the print should be undertaken without hesitation as often as any difficulty in the distribution of the ink is met with; for this saves a great part of the brush work, and almost automatically brings out contrasts and details. Especially while learning the

process and later with more difficult prints, the work is most conveniently divided as follows: first application of the ink and distribution by hopping, as long as it is easy; resoaking the print; drying off and hopping anew with the brush not freshly charged with ink; second application of the ink and hopping of the ink now applied; another soaking, and so on. The operation may be repeated as often as desired without the film taking any harm.

Because of the possibility of always bringing the print to the correct degree of relief during the brush work by means of resoaking, *there is absolutely no limit to the size of the bromoil print.* One can simply finish a part of a print of any desired size and then, after another soaking, go on to the next part and so on until the whole print is inked.

If the relief of the film corresponds to the desires of the operator, the bromoil print may be finished completely in this way. *If it is seen that the relief is not sufficient to give the desired modeling and contrast, the resoaking may be effected with warmer water than was used at first.* Yet, until the worker has completely mastered the process, this should be done carefully and the temperature of the water gradually raised by adding hot water, in steps of not more than five degrees, until the requisite relief is attained. The use of a *thermometer* is here absolutely essential, for the estimation of the temperature of the water by the hand is quite unreliable and may lead to the greatest errors. This applies to all water baths used in the bromoil process. At this point it should be noted that a print, which on account of its characteristics has to be placed at the beginning in very hot water to attain the necessary re-

lief, is usually covered with very tiny air bells, which can easily be overlooked; they must be removed by wiping under water so as to avoid troublesome spots.

If the relief of the whole print is satisfactory, but, because of the character of the negative, a few places in the deep shadows do not show the necessary details, the desired shadow detail might possibly be attained by increasing the whole relief, yet at the same time the relief in the rest of the image would be carried too far. In such cases, the places which should be relatively more swollen can be separately more highly swollen while the rest of the surface of the print retains the original relief, by pressing on them a cloth soaked in warm water or a suitably formed swab of absorbent cotton. A still stronger effect is obtained when such places are painted with a water-color brush charged with a one per cent solution of ammonia, either on the film or, after previously marking the outlines, on the back.

When the relief of the gelatine has been increased by soaking in water which is warmer than that used for the first bath, certain precautions must be observed in removing it from the water. It frequently happens, when using certain inks, that *the water which runs from the film causes streaks and spots*, and that evening these out is at least troublesome and frequently very difficult. This action, which does not occur when resoaking in a bath of the same or a lower temperature, is explained by the fact that the greasy medium of the ink is liquefied by the high temperature of the water, and runs down irregularly or mixes with the water and is carried off by it. There are thus formed on the film of ink marks which show the form of the streams of water which have run off. Such troubles may be avoided by bring-

ing the support close to the dish in which the print is soaked, lifting the print out of the water as far as possible in a horizontal position and placing it in the same position on the support, and immediately spreading the previously dried cloth over it and carefully drying. By observing this precaution, the running off of the water from the film, which is the cause of this difficulty, is prevented. Any traces left by the cloth, used for drying off, can be easily evened out again by the brush.

By making use of this soaking of the print during the work, the bromoil printer *is absolutely unlimited in the time used for his work and is not driven by any necessity for haste.* He can continue his work in peace and without hurry, and devote himself to any particular part of his picture at will, without being afraid that other parts will meanwhile lose their capacity for being worked up.

THE REMOVAL OF THE INK FROM THE SURFACE. — If, in the application of the ink, a fault occurs, which for any reason cannot be corrected with the brush, or if one sees in the course of the work that the ink film is not satisfactory in tonal values or shading, the print would have to be discarded, if it were not possible to remove the ink without damage to the film. This is feasible, however, without any special difficulty; one need not, therefore, throw away such a print, but after removal of the ink can again ink it up, but this time with avoidance of the previous fault.

If there are only small faulty places, the ink may be removed from the print as it lies on the pad, as follows:

Cut a small piece of transparent, waxed paper, or, lacking this, of thin smooth white paper of approximately the shape of the over-inked spot, but slightly

larger, and place it on the faulty spot, turning up a little corner so as to be able to lift the paper again. Then rub with the finger tip carefully and pull off. The ink is thus removed from the bromoil print and transferred to the paper. If the removal is not complete, the operation is repeated with a second piece of waxed paper. If very small places, as, for instance, the eyes of a portrait, have to be dealt with, the rubbing should be done with a round stick, such as a penholder.

By inking again, the part that has been thus removed may be replaced without any trace of a correction.

If the whole film of ink is to be removed from a bromoil print, *a soft dry cloth or better still a swab of absorbent cotton should be soaked in benzol or other solvent, and the picture washed with it.* The medium of the ink is dissolved by the benzol and the ink taken up by the wiping cloth.

Every stroke must be made with a clean portion of the swab, which must frequently be soaked again with benzol, otherwise the ink dissolved by the benzol and taken up by the swab will be again put down on the paper. If, after washing with benzol some traces of ink still remain on the film, the print should be *immersed in water, but only after the benzol has completely evaporated not only from the film but also from the fibers of the paper,* and it should then be gently wiped with the finger. Even if the film still shows a slight tint after this, the working-up may be begun again successfully, since the traces of the previous inking disappear under the new application of ink.

This complete removal of the ink with benzol may also be repeatedly effected. *Beginners can, therefore, use any prepared print several times for experiments.*

But experts should not think of washing an unsatisfactory print with benzol. Those who possess a transfer machine can remove the film of ink mechanically in the simplest way by transfer.

If it is desired to remove the ink from very small portions of the print, this is most easily effected by repeated use of *art-gum,* which should be sharpened to a point. After every application of the art-gum, a fresh surface of the gum must be used, so that the ink is not again transferred to the picture. It should be noted, however, that repeated use of the gum on the same spot may cause blisters.

FAILURES. — To assist the beginner, some possible failures will be here described.

It may happen that during the inking *the print becomes covered with fibers and small hairs of the most different shapes.* This phenomenon may sometimes become so troublesome that a successful print appears problematical. It is frequently *incorrectly assumed* that these impurities are *caused entirely by the brush.* Hairs that have fallen from the brush are always recognizable as such, for they are straight, relatively thick, lie entirely on the surface of the film, and can be easily removed. When there is an excessive appearance of *fibers,* they are due to the use of an unsuitable cloth for drying. The fibers are of the most different shapes, from dots to recurved and entangled lines.

From the fact that they always appear most strongly and frequently during the inking up, it is frequently erroneously assumed that they are caused by the brush used for the inking, or that dust is deposited from the air; this is not so. A dirty brush may be to blame; mostly, however, they are fibers of very different shapes,

which are brought on to the damp and somewhat tacky gelatine film by the pressure of an unsuitable cloth, which is not free from lint, and they are held fast by the gelatine and torn from the cloth as this is lifted. At first these thin and almost transparent fibers are not visible. But they take the ink, and thus it happens that they seem to appear in ever increasing numbers during the inking. If *individual* fibers (which may come from an otherwise suitable cloth), or brush hairs that have fallen out, have to be removed, this is readily effected by *art-gum,* worked to a point with the fingers. With such a point long fibers can be very easily lifted from the film, while the tiny cloth fibers cling very firmly to the film. A small white spot, where the gum point has touched, remains, as this removed the ink also from the gelatine. Such points can be completely closed up by repeatedly going over them with the brush.

Single hairs or fibers lying on the surface may be allowed to remain, when they occur in places where for any reason one must not destroy the ink film; they can be very easily removed from the film with a sharp instrument in the after treatment of the finished print; usually they leave scarcely any mark.

If, on the other hand, the fibers have appeared in large numbers, the print should be immersed in water and one should try to remove them by gentle friction with the tip of the finger, which is generally successful, even if the film of ink is also removed at the same time. If, however, the fibers adhere so firmly that they cannot be removed in this way, which is particularly likely to happen in the shadows, the whole coating of ink must be removed in the manner outlined in the previous section, page 73.

The only safeguard against the appearance of this difficulty is the use of a material as free from lint as possible for drying the film.

It may happen that *the print takes the first hard ink instantly and very readily,* but that even with long hopping clearness of the details is not obtained; the picture indeed shows up well, but remains muddy, as even the high lights retain the ink and become darker with further application of the ink. Then, as a rule, the requisite relief has not yet been attained, and the print must be placed in warmer water. If all the instructions for the development of the bromide print, the bleaching and the swelling have been adhered to, and success is still wanting, then the fault lies in the paper, which was hardened too much in manufacture. The bromoil process is based on the fact that the shadows are tanned more than the high lights, and that then the tanned places take up more ink than the untanned. If the whole film was completely hardened from the start, there cannot be more tanning added by the bleaching, and the ink will take everywhere, in the lights and in the shadows.

If the high lights of the picture completely repel any grade of ink, while this adheres thickly in the shadows, then the formation of the relief has been forced too far.

If the print *takes the ink neither in the high lights nor the shadows,* there is either a fault in the preliminary preparation, as, for instance, bleaching in too warm a solution, or one too strongly acidified, or the print has been acted on too energetically by the ammonia bath. In the last case the print may be dried and again swollen in water.

If large or small irregular spots which take the ink

more strongly than the surrounding parts, *are formed during the inking*, the reason is either that the prints have lain one on top of the other in the preliminary baths, or the film has been prevented from swelling by air bubbles, or by having risen out of the water. Thus certain places are less well prepared or are not swollen, and therefore behave as though they had been more strongly tanned, that is to say, they take even the first ink strongly and stand out from their surroundings as spots and streaks. Sometimes such spots are improved by putting more ink on the print; if they are not of large area and are in the less important parts of the picture, they may be ignored, as they can be removed from the finished print without special trouble, as will be explained later. If, however, the spots have a large area, or occur in an important part of the picture, for instance, in the eyes of a portrait, it is preferable to stop further work. As a matter of fact, all such blemishes may be removed by after treatment of the print, but the trouble entailed by the correction of large faults is greater than the work of preparing a new print.

Sometimes darker spots or streaks of irregular outline show themselves during the work, which from their shape cannot be ascribed either to air bubbles or to partial sinking of the relief. Then there are probably irregularities in the gelatine coating, for which the preliminary treatment of the bromide print is not responsible.

If the print shows a satisfactory relief, but still takes the ink badly or not at all, the reason is in the incorrect composition of the bleaching solution, or the *omission of the intermediate drying* after bleaching.

Finally it may happen that the image *appears* almost *as a negative* during inking-up, since the high lights

take the ink quicker than the shadows. This phenomenon appears when the intermediate drying after bleaching has been omitted, or if *the work has been begun with too soft an ink.* In such cases, if too much ink has not been applied, the fault can be corrected by further working-up with a hard ink. If this is of no use, all the ink must be removed from the faulty places in the manner already described.

If during the inking-up *small irregular white spots in groups* show themselves and shift their places, then there are drops of water in the brush or on the print. The print should be dried, the brush also, and the spots hopped dry and worked over.

Yellow or brown spots and patches, which often appear during the work, increasing in number and continually enlarging, or even penetrating through the film into the fiber of the paper, are to be ascribed to the fact that particles of amidol were deposited on the film before the soaking of the print. When these particles dissolve in water they cause the trouble just described. If there are merely scattered spots of this kind which have not penetrated the paper, they may be scraped out of the finished print and then retouched. The real remedy, however, is in keeping the amidol carefully closed and as far as possible not in the same room as the prepared prints.

Ink streaks, which a print treated with a soft ink shows when it is taken out of the warm water, only appear when the print is placed in a slanting or vertical position; they can be avoided by taking the print from the water and immediately bringing it into a horizontal position on the support and rapidly drying, so that the water cannot run off.

The failures caused by the use of the ammonia bath were described on page 46.

ALTERATION OF THE CHARACTER OF THE PICTURE BY THE INKING. — If the inking is carried out exactly according to the previous instructions, which have been given chiefly for the benefit of beginners, the result will be a picture which, as regards gradation, will be like the original bromide print before it was bleached. The finished bromoil print, produced by a perfectly even application of ink over the whole picture by means of successive additions, each thoroughly worked over with the brush, differs from the original bromide print in coloration, structure, more extended gradation, and change in the character of its surface. As the worker is at liberty to stop at any desired stage of the work, he can obtain from the original bromide print, according to his taste, a delicate light-toned bromoil or a very rich and highly modulated print, or any intermediate stage between these two extremes.

Yet these possibilities by themselves alone would not justify the conversion of the original bromide print into a bromoil. The substitution of a new photographic positive process for an old one is only justified if the new process accomplishes something essentially different and above all something better. But absolutely uniform working over of the bleached bromide print with greasy inks does not completely fulfil this postulate. Mere changes of gradation of the whole picture or of its color can certainly be attained by simpler photographic methods. The extraordinary advantages of the bromoil process lie in other directions.

Bromoil printing, for instance, permits us to ink any individual part of the print more or less, or even not

at all, at will; it is possible to give enormous brilliance and aerial perspective to the high lights; they may show when finished every tonal value represented in the negative; it is also possible to darken them to an extraordinary extent by the application of more or softer ink. On the other hand, the shadows may be kept perfectly light by omitting to ink them or by very delicate treatment, or, by successive applications of the ink, they may be strengthened to very great intensity and yet retain all their details.

The worker has wide opportunity for control in the local treatment of his prints. His dependence on the negative is limited to the drawing, while in the treatment of the tonal values he is absolute master. Most of the other positive processes are dependent on the negative for their extremes of depth and of delicacy; the bromoil process does not know this dependence. If it is desired to obtain a delicate picture from any negative, one uses only a little ink, and hops it off thoroughly; then there may be obtained from even *the most contrasty negative a delicate print, but one thoroughly worked out in all its details.* On the other hand, there is practically no limit to the continued application of ink; the film is still capable of taking up more ink, long after the limits of artistic pictorial effect have been passed. The result is that in the bromoil process *vigor and depth of the shadows can be produced in any desired intensity.* The most striking advantage of the process lies, however, in the possibility of changing the tonal values of any individual portion of the print at will.

If for example, a negative was used in making the original bromide print which had been taken without

any attention to the requirements for getting correct tones, by suitable treatment in making the bromoil one can obtain an approximately correct print without special trouble, since one can, for instance, convert an absolutely clogged-up sky, which is pure white in the bromide print, to a suitable grey tone by the use of soft ink, and at the same time lighten foliage which is too dark; a flat print, wanting in plasticity, may be improved by making objects in the foreground more vigorous, and accentuating appropriate parts of the middle distance. It is easily possible to supply the lacking aerial perspective of certain kinds of prints. In portrait work in the bromoil process, skilful workmanship renders one absolutely independent of the nature of the background. A light background can be made dark, a dark one light. In portraits taken out of doors, the small details of the background that are out of focus or obtrusive may be omitted, toned down or completely remodeled. Unpleasing details of the clothing or the hair can be omitted or so far softened down that they are no longer disturbing. We are able to accentuate certain parts of the picture to make them dominant, while other parts of the image may be treated very sketchily; in short, the possibilities of control which this process offers are almost inexhaustible.

I will now try to outline the methods of carrying out some of these modifications, as far as is possible without practical demonstration.

The beginner is first of all recommended to use a proof print from the negative as a check, so that he may have a clear idea as to what changes he needs to make, and so that further, in carrying out his ideas, he does not change neighboring parts of the print which

should remain unchanged. The simplest example of control is the *lightening of the shadows.* This is done by very careful application of the ink, which is stopped before the shadow parts become too dark. One should avoid touching such parts later with the brush, when it is charged with soft ink.

If light portions are to be made darker, the procedure depends upon the size of the parts involved. Extensive parts of the picture in high relief, as for instance the sky, should be gone over as evenly as possible with a suitable soft ink, and with this, simultaneously, by going lightly over the lighter places and applying it more heavily here and there, clouds may be put in. The evenness of the inking is of the greatest importance here, as it cannot later be hopped off very much; frequently in such cases the ink only lies on the surface, without adhering firmly; if left untouched, it combines intimately with the surface when the print is dry, but is easily removed by hopping. It is possible to change the outlines of neighboring parts of the image; if too dark edges are formed, they can be easily softened by after treatment of the finished print. In some cases it may be necessary to add considerable quantities of varnish or linseed oil to dilute the ink. The darkening of too light places may be also effected by dabbing ink with the brush on the finished dried print, which the print then naturally takes all over.

If tiny light patches are to be made darker, the point of the large brush, or if necessary of a very small brush should be used, avoiding any disturbance of surrounding parts, as far as possible. Such changes are difficult only when the bright spots that are to be worked out are in immediate contact with very dark parts. The process

is much simpler when parts of the print of medium tones, which are surrounded by lighter parts, are to be darkened. If, for instance, the eyes of a portrait are to be darkened, ink should be applied to the whole of the eye with a small brush, and then hopped off. A tree trunk, which must be brought out in relief, should be covered throughout its whole length with soft ink, and the ink should then be worked over, by hopping it from the lighter toward the darker parts. In practice, the bringing together of neighboring tones, which differ considerably in value, can be easily effected by *hopping off the ink from the darker parts* with a brush that has not been freshly charged with ink, *and depositing it on the lighter parts*. The lightening of too dark places can also be attained by going over them with a perfectly clean brush that has not been dipped in the ink. Isolated high lights can be accentuated by touching them with a pointed water-color brush, dipped in water; then the film swells and repels the ink. *Stained high lights or too dark middle tones* may be lightened by wetting a brush of proper size by means of a wet cloth and then lightly hopping with this the places which are to be corrected. The brush picks up the color, but must be immediately cleaned by rubbing it on a clean portion of the palette, after which it may be again wet and used again. Clouds can be worked into dark parts of the sky in this way.

THE STRUCTURE OF THE INK. — Independently of the surface of the paper on which the work is done, *the structure of the coating of ink can be influenced by the nature of the brush work*. If a brush well charged with ink has its full surface placed firmly on the gelatine film and then slowly lifted up, an impression of the

surface of the brush remains; the individual hairs or groups of hairs of the brush have each deposited a part of the ink that they had taken up, and a very coarse-grained spot of ink is produced. If we now hop, that is, dab with quick light blows of the brush, the ink begins to be distributed, since it is taken away from the lighter parts and taken up by the shadows. The drawing of the picture *thus appears under the brush, at first with a very coarse grain and without many details.* The longer one hops and thus distributes the ink, the finer becomes the grain, and it especially becomes much finer on the addition of softer ink. *The bromoil printer hence has it completely within his power to limit the division of the ink to any desired coarseness of grain,* assuming, of course, that he has suited the consistency of the ink to the degree of relief, and is therefore able to completely finish the print with the original ink without adding any softer. Prints may thus be prepared, which because of their coarse structure, resemble certain graphic methods. But, when this is intended, the application of the ink must be carried on as evenly as possible from the beginning, so that it needs very little hopping off, for any considerable amount of hopping unavoidably produces a finer grain. Even if the use of softer inks is necessary, a coarse structure can be obtained by suitable brush work. *The longer, however, the ink is distributed by hopping, the finer becomes the structure of the ink film* and the smoother the surface.

The most perfect smoothness is also attainable, if it is desired for any reason. For this a not too volatile solvent should be used, such as heavy benzol. The method of using this is as follows: when the print has been fully inked and is complete, though still somewhat

coarse-grained, a cloth should be wet with the benzol, and the brush lightly pressed thereon and then passed quickly over the desired parts of the picture. At first a smeared spot is formed on the surface of the print; by continued gentle hopping the spot is gradually worked out, and by continued working we get a fineness of detail, equal to that of printing-out paper. It is true that even the highest lights acquire a delicate film of ink, so that a print treated in this way is somewhat low in key. If the hopping with the brush charged with benzol is not continued until the finest possible grain is attained, a misty effect may be produced, with some suppression of the finest details; a method which is frequently useful in the production of landscapes.

By suitable ink and brush technique the effect of any other known photographic printing process may be attained in bromoil printing, from the rich-in-detail gloss of collodio-chloride paper to the characteristic effects of gum-bichromate. Yet the far-reaching possibilities which bromoil places at our command really only begin where most of the other processes end.

Different Methods of Working. — In the following pages some of the different methods of technique, which the bromoil process permits, will be briefly sketched. Obviously, however, the description of these methods cannot be made complete without practical demonstration. Nor can all conceivable methods of working be mentioned, as individual treatment of the process can be varied in many ways.

We will first describe the method of working which is most suitable *for the beginner,* because it offers tolerable certainty to those who have not yet mastered the process.

The beginner, in order to obtain good results, must start with a bromide print as clean and well-modeled as possible, and its high lights should not be fogged in the least. He should place the print, bleached and prepared exactly according to the methods detailed in this book, in water at about 18° C. (65° F.), leave it there for a few minutes, dry its surface, and begin the application of the ink with the stiffer ink, which should be thinly applied and then worked over until the hopping brings out no further detail. If the drawing of the image does not quickly appear upon hopping the print, and the result is only a detailless patch of ink, the original temperature of the soaking bath must be increased. Then the print should be again immersed in the water, left for two minutes, and again dried. The work of hopping is now continued with the same brush with which the print was originally treated, *and without its having been again put into the ink.* As a rule the mere placing of the print in water again will have increased the contrasts, and new details will have appeared, which can be considerably accentuated by now going over with the brush. Only when the print has been again worked over, should fresh ink be carefully applied with the brush; this should then be distributed by hopping, and the print again soaked in water. The procedure thus outlined: application of the ink, hopping, soaking, going over it with the empty brush, fresh ink application, hopping, soaking, and so on, is continued as long as the print gains in strength and depth, without becoming dull or muddy. If, however, this point is reached, the inked print should be immersed in water at a rather higher temperature and left in it for some minutes. The print is then further

treated with the brush, without fresh inking, and will soon become much clearer in the high lights. If the clearing thus obtained is not sufficient, the temperature of the water bath should be increased by a few degrees, but not more than 5° C. (9° F.) at a time. As the high lights become clearer it may happen that the stiff ink will no longer be taken up. Then it is necessary to soften it a little. This method of working will guarantee to the beginner the attainment of good results with tolerable certainty.

HARD INK TECHNIQUE (*Coarse-grain Prints*). — If it is desired to prepare a bromoil print of *rough surface and coarser character,* the worker must be able to finish the print exclusively with a relatively hard ink. For this it is necessary to determine by trial the temperature of the water bath at which the film of the print acquires a relief which is absolutely suitable for the stiff ink. When this degree of relief has been found, the print should be inked up strongly but evenly from the very start, so that one is not compelled to go over individual places several times with the brush. Thus the coarse structure of the ink is obtained. The use of hog's bristle brushes is also efficacious in coarse-grained work.

SOFT INK TECHNIQUE. — This method of working is used on the one hand for the preparation of low-toned misty effects, on the other hand to obtain fully and richly modeled prints. In the first case the bromide print should be correctly exposed, but not completely developed; while in the second case it should be thoroughly developed. The print is then, according to the choice of the operator, either brought at once to a fairly high relief, or only gradually raised to the same relief

during the application of the ink. Then, in the course of inking, a point is soon reached at which the stiffer ink is repelled by the high lights and perhaps also by the lighter half-tones, and during the hopping is again taken up by the brush. Then the ink should be carefully softened with linseed oil or varnish, and the whole print gone over with the softer ink. Prints which are executed in the soft ink technique are characterized by a specially fine velvety surface after defatting.

SKETCH TECHNIQUE. — If one proposes to completely work up certain parts of a print and leave the rest treated in a sketchy manner, and possibly to omit some parts altogether, one should begin by working up the part which should stand out. Thus, in a portrait, the head should be first worked up; then proceed systematically, with the ink remaining in the brush, to sketch in the clothing and the background, and perhaps leave unimportant parts of the print completely untouched. To facilitate the work, disturbing details or a too prominent background may be removed or reduced on the bromide print, before bleaching, with dilute Farmer's reducer. If, when the work is finished, the parts that have not been inked are visible through their relief and glossiness, these traces of the uninked picture completely disappear in drying, if the original bromide print was not developed too vigorously. If one contemplates producing a vignette, it is absolutely unnecessary to obtain this by the use of masks or vignetters when making the bromide print. The effects which result from the suitable treatment of the bromoil print are far more free and beautiful.

If certain parts of the picture are to be accentuated and all the rest is to be rendered visible, even if only

sketchily, one may also work in the reverse way. The whole picture should be given a thin coating of ink, as even as possible, which should be hopped only just enough to barely bring out the drawing. Then work out those parts, to which attention is to be directed, keeping as closely as possible to the outlines. When these, the most important parts of the print, are finished, it is frequently seen that the rest of the picture is too delicate. This should then be gone over again with the ink as at first, without completely working it up, until the correct tonal value is attained. Then the necessary harmony is obtained by going over the outlines with the brush.

Large Heads. — The far-reaching possibilities of the bromoil process offer special advantages for the free modification of tones in portraits. It is advisable to take the portraits with a neutral or dark background. The only exception is when a head is to be done in red chalk, when a white background is preferable. Starting from such a negative in bromoil printing the background may be kept, according to choice, either light or very dark, or be shaded. One precaution should, however, be observed in every case; before starting on the head itself, the background should be worked in lightly from the margins toward the head, so that no dark line may be formed when working on the outlines of the portrait. If this shows during the work, it must be worked down to harmony with the background at once before it gets too dark. One can, therefore, from a given negative, produce at will either a fully worked-up head against a dark ground, or a light, sketchy image on the light background of the paper, or any intermediate stage.

If, as previously suggested, parts of the picture are

to be treated sketchily, while others are to be fully worked up, the parts which should appear sketchy are allowed to remain coarse-grained, while the structure gradually becomes finer in passing into the worked-up portions. No portion, however, should be made perfectly structureless. Bromoil prints thus worked up are much more artistic than those pictures which are known by the name of photo-sketches. The latter usually show a head, printed with all the gradation and fullness of detail given by printing-out paper. The tone becomes gradually lighter toward the edges, where we find some strong lines, imitating the character of a line drawing, all surrounded by a perfectly white background. To the trained eye the technique of such photo-sketches is abominable, for the contrast between the inimitable detail of the head and the perfectly blank background is so great that it cannot be bridged over by the effort to imitate the manner of an etching. On the other hand, such problems can be solved in an artistic way with our process, for the head may always be produced in a rather coarse grain, so that it dovetails harmoniously into the sketchily treated surroundings.

Oil-Painting Style. — If it is desired to prepare portraits which resemble reproductions of oil paintings, one should proceed as follows: the head should be first inked in considerably deeper than it should appear in the final print; then, if the head is on a light background, it will appear vigorous, even if not much ink is used. If, however, the background is dark and heavy, the inked-up head will appear considerably lighter because of the contrast. For this style of work it is best to select a warm dark brown ink. When the head is finished, some very soft ink of the same shade should

be placed very thickly in the corners and margins of the picture, and this should be worked from all sides towards the head, which naturally must not be touched with the soft ink. Finally the blending of the head with the background should be very carefully done. In the lower part of the portrait the clothing should blend into the background in a similar manner; only one must take care in making the negative that no light pieces of drapery or accessories are used, because they cannot be easily completely covered. Any lighter accents, which may be desired in the background, should be made by removing the ink with a clean brush. One may thus make the head stand out in a dark oval, or attain similar painting effects. Prints prepared in this way ought not to be defatted, as they then lose their similarity to oil paintings. They must be left to dry for several days, in a place free from dust, until the thickly-applied ink has hardened.

NIGHT PICTURES. — Twilight and night effects can be easily obtained from ordinary negatives by carefully swelling the bleached print so that the differences of relief existent in the print are only slightly brought out. Then the capacity of the lights and shadows for taking the ink is not so very different, and the gradation is shorter. A second possibility of obtaining the same effect is offered by using mainly soft ink, which, as is well known, adheres to a certain extent even in the high lights of the print; only the soft ink must be applied very carefully and thinly in the shadows, so that these do not become choked up with ink.

In this way one may make night pictures from day-light exposures, accurately corresponding in tone values to night exposures. Previous practice has been to use

either underexposed negatives or overexposed prints for such effects; in both cases the night effects were gloomy, but false in tone values, and usually without details in the shadows. In bromoil printing the gradation can be shortened as described, without loss of drawing, and one can simulate perfectly the short scale and mysterious gloom of night. If the too dense sky of the negative cannot be sufficiently darkened by the use of soft ink, its inking should be postponed till the print is dry.

PRINTS WITH WHITE MARGINS. — If it is desired to obtain bromoil prints with *margins of the natural paper*, the negative should be masked with clean-cut black safe-edges of lantern slide binding strips, or one may use a mask, and print or enlarge on a sheet of bromide paper large enough to leave unexposed margins of the desired width. In making enlargements the mask, cut out of rather thin card, should be pinned on the enlarging screen over the sheet of bromide paper. After bleaching such a print the tanned image will appear slightly depressed within a strongly swollen, white frame of less tanned gelatine. The inking is done without any attention being paid to this unprinted edge. In consequence of its strong relief this gelatine does not take any ink from the brush, or, at most, a mere trace. When the print is finished, the ink is easily wiped from the white margins by means of a damp cloth, which removes this ink with the greatest ease. The finished and dried print is enhanced in effect if a plate mark is impressed in this wide white margin.

THE SWELLED-GRAIN IMAGE. — Coarse-grain printing in bromoil has previously depended on a very carefully determined relation between the degree of relief of the film and the consistency of the ink, which had to be so

chosen that the ink was not very easily taken up by the film. If inking was then skilfully done, the structure of the face of the brush was visible to a certain extent all over the print and gave the effect of a more or less coarse and irregular-grained image. It was obviously necessary for the success of a print of this type that no portion of the image should be gone over several times with the brush, for, if this was done, the structure was obliterated and the spot in question became smooth. Since, also, the requirement that the degree of relief must be rather high for the chosen consistency of the ink could never be fulfilled by the shadows, since these always take the color easily, we often obtained an undesired smoothness of effect in the shadows. For this reason typical coarse-grain prints could not always be produced with certainty.

I therefore endeavored to improve the technique of bromoil in this respect and to work out a grain method which could be depended upon with certainty in every case. The basic thought was that *the fundamental basis for making a coarse grain print should be a part of the film itself*, and I endeavored to prepare the latter so that a grain structure could be produced which should equally underlie all parts of the image.

Such a grain structure can theoretically be obtained in the following way: if we allow a properly prepared uninked bromoil print, which has been brought to the proper degree of relief, to dry off a little and then spray it by means of an atomizer with extremely fine liquid drops, the film will again swell up under every drop, but only under these; and when we ink up, we obtain a definite grain effect which, however, only persists if the inking is completed before the sprayed-on water

grain again dries out. Such a relief grain is not permanent, because the subsequently swollen portions of the film cannot retain the difference in swelling. This process, therefore, has only experimental interest and practically can be used but rarely.

To make the swelled grain useful, the secondarily swollen points of the film must permanently retain the difference in swelling which has been imparted to them.

To attain this end, I start from the fact that portions of the gelatine which are treated with alkaline solution will swell much more in a bath of warm water than spots which have not been thus handled. If, therefore, the desired grain can be applied to the film by means of an alkaline solution, all the elements of the grain will swell up more strongly in the water bath than their surroundings, and will therefore protrude above the rest of the film and thus attain and retain a better degree of swelling than the latent tanned image.

The next step was obviously a practical treatment of the film by spraying it as evenly as possible with extremely fine drops of an alkaline solution. It soon appeared that the greatest attention must be paid to the type of apparatus with which the spraying was to be done. Any atomizer whose spray combines fine and coarse drops is useless. Any atomizer which is worked by blowing with the mouth or by intermittent blasts of a pump is unsuitable, for at the instant when the stream of air is interrupted, a certain quantity of liquid remains in the mouthpiece and is thrown out by the next blast of air in the form of coarse drops. Therefore, only continuously functioning atomizers can be used, preferably those types which are actuated by double rubber bellows. Only with such atomizers is it possible

to count with a fair degree of certainty on the production of a system of uniformly fine drops. Ammonia, which has previously been generally used in bromoil printing as a swelling agent, cannot be used to produce such a grain, because the ammonia gas volatilizes in great part in its passage through the air. A five per cent solution of potassium carbonate has been found to be most satisfactory.

The next question is at what stage of the process the swelled grain should be produced. Making it on the dry print is not permissible, because the droplets are taken up too greedily by the dry film and diffuse quickly and irregularly. The safest method of working is to place the bleached and dried print in cold water until it becomes limp, then blot it off until quite dry on the surface, and then treat it.

The practical method of producing the swelled grain is as follows: the print, which has been swelled in cold water and thoroughly dried off, is placed on a horizontal support and the atomizer set in action; as soon as it works with complete uniformity, it is passed back and forth across the print as evenly as possible under continuous observation, until the whole print is uniformly covered with a layer of extremely fine drops. The most important precaution is the continuous observation of the print while the spraying is being done, and this is best done by having the light fall on the print at as small an angle as possible. The practical way to do this is as follows: the print is laid on a table near the window. The operator sits in front of the window and gets both his eye and the atomizer very slightly above and in front of the print. Under these conditions there is a reflection of light in every single drop, which

makes the observation of the distribution of the drops very easy. At the instant when the whole film seems to be uniformly covered with dew, the atomizer is quickly turned away from the print.

It is necessary to be thoroughly familiar with the action of the atomizer which is being used; with most atomizers the finest drops, on account of their lightness, fall downwards not very far from the mouthpiece, while others project their finest drops to a greater distance. The sprayed print, which naturally cannot be touched on the film side, must be left undisturbed for a certain period, which must be determined by experiment, for it depends, among other things, on the temperature of the room and the peculiarities of the paper which is used. An approximate idea may be had by considering these points: the longer the potassium carbonate solution lies on the print, the more the finest drops evaporate, while somewhat larger drops continue their action, so that the grain becomes coarser through longer action. A coarse grain can also be obtained by the use of coarse drops. If the drops are allowed to dry completely, the diffusion produced during this longer time results in an extra swelling of the whole film, without any grain effect.

After a sufficient time has elapsed, the potassium carbonate solution is removed from the film by rinsing or blotting off, and the print is swollen to the necessary degree. It is obvious that much lower temperatures must be used for this than if the print had not been treated with the graining solution, for the drops of the potassium carbonate solution cover a considerable fraction of the surface of the print. The fact that the greater portion of the surface of the print has been affected by

the spray makes it apparent that the alkaline solution cannot be replaced by a tanning solution, for the greater portion of the film would become less capable of swelling if such a solution were used, and therefore the latent tanned image would be destroyed. When the print is blotted off after swelling, it should show a scarcely visible relief when looked at by light falling from the side. The actual effect of the grain cannot be perceived until after the inking has been done.

The prints obtained in this way have, if the treatment has been successful, a very beautiful grained structure which extends over the lights and shadows quite evenly. It is possible to work on such a print quite normally without having to harmonize the degree of relief and the consistency of the ink with great accuracy. Especially is it possible to work up any given part of the print as long as desired with the brush without endangering the structure; on the contrary, it is improved by this treatment. For bromoil transfer, there are the following special advantages: every new transfer has exactly the same coarseness of grain, if this is imparted to the film once for all. In combination transfer, the grain persists in spite of the fact that several impressions are made on the same paper, because the swelled-grain elements are re-impressed in the same spots, if the registration is accurate.

Finally, it might be well to mention a few causes of failure which frequently occur in the first experiments. If the print appears to be covered with many small white spots at a certain distance apart but not in contact, the grain is too heavy and therefore does not take up enough ink. In this case, after rinsing, the print may be sprayed once more, carefully and not too heavily.

Larger white spots on the print show that when the grain was made large drops were produced by the atomizer. If such drops are noticed while spraying, the print should be immediately placed in water, dried off and sprayed again. If the print shows spots of rather large area which do not take ink and only show irregular ink spots here and there, it has been sprayed too long, that is, too much potash solution was applied, and the print is then useless as it cannot be corrected. In addition, such a print may be easily recognized after swelling, for a coarse grain pattern will be clearly visible on the film.

This swelled-grain process permits of very beautiful and characteristic results, yet, like all variations, it assumes a solid knowledge of the bromoil process, and must be practically used over and over again before it can be applied with certainty.

MIXING THE INKS. — As has already been mentioned, we have at our command for bromoil not only black and brown, but any other color of ink in various shades.

As a rule, however, colored inks are somewhat too bright to be used pure; moreover, as a rule they can only be had commercially in a fairly soft consistency. This is actually no disadvantage, as one is often forced by the consistency of the ink to do what is counselled by good taste, that is to tone down the colored ink with hard black ink. It is not practicable to make a mixture of hard black ink with the colored with the knife on the palette, because it is difficult to hit the exact shade with certainty in this way. It is better when using green, blue or any other colored ink *to mix the inks with the brush on the bromoil print itself.* First one should go over the whole print very delicately with hard black

ink and almost complete the drawing by hopping. Then the work should be continued as would be done if we were mixing hard and soft ink, merely replacing the soft black ink by the colored one. Then the work should be continued with the mixed ink; if the exact shade has not been hit, more or less of one or the other color is taken up by the brush until the desired color effect is obtained.

It is immaterial that those parts of the print on which one has tested the mixture show a little too bright or too dark a tone. By going over these again with the final correct color these places, though perhaps only after resoaking, will reach the proper tone, as the ink in the brush and that already on the print quickly mix to a uniform value.

If, in the course of the work, it appears that the mixture of this and the colored ink, the color tone adhere properly, it is not advisable to attempt further softening by the addition of soft black ink. By the mixture of this and the colored ink, the color tone already decided on will be altered. In such a case varnish or linseed oil must be used to soften the mixed ink.

Polychrome Bromoils. — Prints of two or more colors have previously been made, aside from the three-color process printed from three-color separation negatives, chiefly by the gum-bichromate process, by coating the print successively in different colors. After each coating the negative was printed, usually with masks, and the unnecessary parts of each colored coating were washed away during development. The preparation of a polychrome gum print is extremely tedious and uncertain. Not the least of the difficulties is the fact that in

consequence of the addition of the chromate the color effect cannot be determined with accuracy until the print is finished and the chromium salts are removed. Moreover, as a rule the color layers are perfectly distinct and the color mixtures formed by their juxtaposition must be accepted as they happen to come. A correction of the colors during the work is not easily effected.

The bromoil process, on the other hand, is in its very essence preëminently suitable for work in several colors, and offers all the possibilities which have previously been lacking. Without any special preliminary preparation the worker can apply any number of different colors to one and the same print at one sitting; he can harmonize them to each other during the progress of the work, combine neighboring colors by working them into each other on the print and easily correct any error that may occur.

It is true that the execution of a bromoil print in polychrome requires complete mastery of the process; an indispensable condition is a perfect command of the handling of brush and ink. Therefore, experiments in polychrome bromoil printing can only be recommended to those who have the monochrome process absolutely at their fingers' tips.

If a negative is to be printed in several colors, the worker must first be absolutely clear as to his artistic scheme and know exactly in what color each individual part of the print must be executed; he must further be sure that the chosen colors harmonize with each other. He will not always be satisfied with the colors to be found in commerce, but must prepare the necessary inks for himself.

At first pictures should be chosen which contain large areas of uniform coloration, and as few colors as possible should be used. If you are not perfectly familiar with the print, it is necessary to have a proof as a guide, so as not to overstep the outlines of the different parts of the image which are to be individually colored.

The best way of setting to work is as follows: first select the color necessary for one or more of the larger areas of the picture, for instance green for the foliage, and work up these areas completely, until they have acquired the requisite vigor and detail. Such parts of the outlines as are adjacent to lighter, and hence more strongly swollen parts of the print, need be given no special attention, for color that does not belong on them may easily be removed again with the damp cloth, as previously mentioned. On the other hand it is well to work carefully with every outline which lies next to a darker part of the picture which is finally to be of another color. Here it is best not to apply the ink right up to the boundary, but to complete the inking with a small brush only after the adjacent parts are coated with their own color. If, however, such outlines are overstepped and the adjacent parts are colored with an ink that should not be applied to them, this should be removed with a very wet cloth, twisted to a fine point, by gentle rubbing. During this the print should remain on the pad. If the incorrectly inked portions are small in area the ink may be removed with art-gum.

When the first large areas are finished, the print should be again soaked in water, as it will probably have dried somewhat, then dried off, and another part of the picture dealt with, with a fresh color. If the adjacent

colors are properly chosen, the result, with objects which have no sharp outlines but merge into one another, will be that the adjacent parts will spontaneously blend into a harmonious transition of color. Parts of the picture which have the same basic color must not be done throughout in one and the same shade; thus large stretches of vegetation, which extend into the distance, should be executed in front in a yellowish green, and should be shaded back into a bluish green and insensibly into blue in the distance; such transitions can be effected without difficulty. If in the shadows there are small parts which require another color, they should be inked with a very bright color, which is then reduced by going over the whole surface at one time.

If it is found that a mistake has been made in any color, that part of the print may be cleared of ink as described on page 72, and the work repeated. If it should finally appear that individual colors are too glaring or that the whole color scheme is too harsh, it is possible to go over individual parts or the whole print with some suitable color, so that the colors already applied are improved by a slight admixture of this covering color.

Such a procedure shows most emphatically what advantages there are in the possibility of mixing and toning down the colors on the print itself. As a rule, to tone down too bright colors, these portions or even the whole print are gone over with black ink, but if necessary other colors may be used for the same purpose.

Thus, for instance, a picture in which there are brown roofs, yellowish-green foliage, a sky of a pronounced blue shade and water of another blue, can be made harmonious by going over the whole print very lightly

with the blue of the sky. Thus the vegetation will lose some of its yellowish tone, and all other colors, without losing their own characteristics, will acquire a certain unity. If the sky parts of a picture are swollen too much, their uniform inking is not easy. Then it is advisable to ink up the sky only on the dry print, as is suggested on page 112.

Because the tonality of any color, which has already been applied, can be altered with the brush, polychrome bromoil printing affords very great possibilities. Obviously good taste and a sound color sense are indispensable requisites, for without them there is danger of producing the undesirable effects characteristic of certain colored postcards. It may also be remarked that the colors, after defatting, have a somewhat less pronounced brilliancy, as they lose their gloss.

In polychrome bromoil printing, the choice of too small sizes is not to be recommended. The larger the picture is, the larger also are the areas which may be uniformly treated and, therefore, the easier it is to keep within the outlines.

Within the limits of this chapter, it is not possible to teach polychrome bromoil printing, only to outline its fundamentals. The unlimited freedom which it offers will certainly in the course of time produce many excesses in color. For this, however, we should condemn, not the process itself, but those who have abused it. In general it will be as well not to approach too closely the actual colors of the objects represented, but to work for the attainment of artistic effects. We must, however, in any case avoid even the most remote imitation of the painter; we cannot arrive at the solution of the problem of natural colors on paper by the polychrome bromoil process.