CHAPTER III

SWELLING

THE operations which have been dealt with in the preceding chapters have been of the normal character common to all photographic operations, and consist of chemical changes brought about by immersion in suitable baths. The next part of the procedure, which is the kernel of the production of the bromoil print, and might almost be designated bromoil proper, depends upon physico-chemical changes in the differentially tanned matrix. This is where the photographer coming fresh to the process after practice in the silver printing methods needs to re-cast his ideas a little. In silver printing chemical reactions are the basis of the final result, and the crucial factors are rather concentrations of chemical reagents than the conditions of temperature and time under which the reaction takes place, although, naturally, these latter factors are important too. In this section of the bromoiling procedure, the crucial variables are temperatures and times, and it is necessary to measure both factors accurately. Some expert workers of the author's acquaintance make a habit of judging their soaking temperatures by dipping their fingers in the bath. This practice is quite indefensible, and if adopted by the less experienced may well prove a prolific cause of failures. The expert subconsciously compensates for his errors in measuring temperature by variations in inking procedure, but even this is undesirable, and militates against reproducibility of results, and to every serious student no further recommendation need be made to buy a thermometer.

Time as a variable in the swelling of the matrix is much less important than temperature, in that, provided sufficient time at any given temperature is allowed, a maximum of swelling is reached beyond which it is not possible to go.

This maximum usually occurs after about fifteen to twenty minutes soaking, and under ordinary circumstances soaking need not be for longer periods than this. Some workers advocate much longer times, running into hours, or even days. Both Venn and Fred Judge give advice to this effect, but the author is of the opinion that except with freak prints, which refuse to accept the water in normal manner, there is nothing to be gained from the course recommended. In the case of the passage in Sinclair's handbook, in which Judge makes the observation alluded to, it may be that reference is made to papers not specially prepared for bromoil, in which case the remarks are probably quite justified. There is also a further possible reason for prolonged soaking in connection with the difficulty already referred to, of insuring adequate swelling of the deep shadow portions. It is essential that some slight swelling should occur even in the areas which originally had the greatest amount of silver deposit, because the ink does not take so readily on a completely dry gelatine surface. Thus if swelling is slow in those heavily tanned parts, time may work an improvement. If the print has been made in accordance with the recommendations in this book this should never be necessary.

The Soaking Operation. It has previously been said that after the washing following the final fixing operation, the print may be swelled at once for inking, or may be first dried. The latter procedure was advocated as conducive to regularity in final inking. If the print is dry it should first be immersed in tap water at room temperature, and all air-bells carefully removed from both front and back. Immersion is best conducted face downwards, and if the paper shows a tendency to float, which is usual, a few pledgets of cotton wool allowed to rest on its upper surface will suffice to keep it under the water. At the end of about 10 minutes the paper will be thoroughly limp and evenly saturated with water. It may be that the matrix will now be sufficiently swollen to accept the ink in the correct relative proportion, but usually a few minutes' soaking at a slightly raised temperature will be necessary. It is found better to soak at normal temperature first, however, so

that the raised temperature is applied under standard conditions. If the paper is immersed dry, some time will elapse before full absorption of water takes place, and the effect of the raised temperature will not be felt at once.

When the print is thoroughly limp, therefore, another bath of water is prepared at the temperature found desirable, and the print transferred to this. The print must, of course, be kept fully immersed, as otherwise portions rising above the water surface will be subjected to differential swelling other than that produced by the image, and markings will result when inking is attempted. Soaking is allowed to continue for a time if found satisfactory by experiment, and the print is then ready for surface drying and inking up. Times of soaking and temperatures to be employed are frequently given in treatises on Bromoil, but the worker is strongly advised to make experiments with inking under different conditions of swelling as regards both time and temperature, adapting the ink to each print, and thus learning the different æsthetic qualities which can be obtained by using different technical methods. Of this, however, more anon.

Determination of Swelling Temperatures and Times

The question of what degree of swelling to employ in a matrix which is to be inked becomes relatively simple if it is remembered that there is no one degree of swelling which is correct, but that this factor can only be considered in relation to the ink to be used.

The higher the degree of swelling, the softer must be the ink which is to be applied.

This is the fundamental principle which governs all pigmenting technique. By the same token, it is only possible to determine the correct swelling temperature and time with reference to a particular consistency of ink. Commercial inks vary a good deal in their properties, both as regards the particular character which they give to the surface of the finished image and as regards their consistency. There are four principal makes of ink available on the British market, made respectively by Messrs. Sinclair

and Co., Ltd., Lechertier Barbe & Co., Autotype Co., Ltd., and Drem Co. The Lechertier Barbe and Autotype inks are similar in character, and in particular the hard inks are very hard, and are sold in pots from which they are extracted by a spatula or strong palette knife. The soft inks are of a rather fluid nature, and a small quantity must usually be added to ink of hard consistency to make it workable at ordinary room temperatures.

The Sinclair inks are much closer together in consistency, the hard ink being softer than the above two varieties, and the soft ink is less fluid. Only the one colour, a beautiful warm black, is made in two consistencies, the hard being known as "Encre Machine," and the soft as "Encre Taille Douce." The other colours are made of a hard consistency and are used with a medium. The Drem inks are again quite different, and yield prints of a pleasant charcoal-like surface much more "dead" than with the previous makes, all of which tend to give more or less gloss in the shadows, depending on the degree of softening which has taken place.

If we choose Sinclair's Encre Machine undiluted as a starting ink, it will be understood that this is the author's personal preference as an ink suitable for the beginner, and that this does not detract in any way from the merits of the other products, all of which will be discussed on a later page, as regards their special peculiarities and susceptibilities.

Most of the papers on the English market, *made specially for bromoil*, will come into suitable condition for inking at a temperature of 70° F.–75° F., using the Encre Machine as suggested. The Kodak papers seem to work better at 75° F., but the Wellington and Barnet papers are better suited to the lower temperature. The Gevaert product also seldom requires a swelling temperature above 70° F. The Drem paper is supplied with a suggested soaking temperature stamped on the packet. This temperature is presumably adapted to the use of the Drem inks undiluted with medium. The conditions have been found, however, to apply quite well to the Sinclair ink. A start should be made with one or other of the papers mentioned here, the author giving preference (again a merely personal one)

to the Wellington product. A smooth surface will facilitate the beginner's efforts at brush work, as in general the rough papers are distinctly more difficult to handle in the inking operation.

Summer and Winter Soaking

Before proceeding to the determination of the exact time of soaking at the above suggested temperatures we must pause for a while to discuss the swelling conditions as modified by the prevailing temperatures of air and tap water, which naturally vary very considerably with the season of the year. The tendency with most papers specially prepared for bromoil is for the gelatine coating to have a relatively low melting point, with consequent production of adequate swelling and relief at relatively low temperatures. The Drem paper is an exception to this rule, requiring a soaking temperature usually in the neighbourhood of 85° F.

There are a good few reasons to be adduced against the advisability of these low soaking temperatures as will be seen from what follows. If a paper is so manufactured that the gelatine swells to a sufficient degree at a temperature of, say, 65° F., it is frequently the case in summer that the tap water used for the washing operations is above this temperature, and the bleaching and tanning baths, hypo, etc., which have been standing in the room at air temperature will often be even higher up the scale. This being so, it is obvious that the processing of the print itself induces swelling irrespective of the actual soaking operation. This has an important bearing on the standardization of conditions, because soaking times determined under these favourable circumstances will need to be considerably extended when air and tap water temperatures fall.

This uncontrollable factor can be to a large extent cut out by one of two expedients. A high soaking temperature may be adopted, and the ink softened to meet the new conditions, or the manufacturer may choose a harder gelatine so that a higher temperature is required to produce the swelling necessary for hard ink. The adoption of soft ink does not appeal to many bromoilists of to-day,

because it is generally considered bad practice not to use the hardest ink that can be made to take, at any rate as a groundwork. To some extent this is carrying things to an illogical degree, because extremely fine prints can be made without ever using hard ink at all (*vide* the works of Leonard Misonne), but it is quite uncontrovertible on the other hand, that certain types of result can be produced only by the use of hard ink. The worker, therefore, who for æsthetic reasons wishes to use hard ink must either use at the same time one of the present types of low swelling temperature papers, or must confine himself to the very few papers, of which the Drem is one, which require a relatively high swelling temperature.

While discussing this section of the subject, it will be as well to call in question the apparently deliberate policy of most British manufacturers of paper especially for bromoil, of using low melting point gelatines. The only reason which would appear to underlie such a policy would be to enable spectacular demonstrations to be given of prints being brought into condition for pigmenting after next to no soaking in ordinary tap water. This, however, is not a matter which worries the serious worker in the process, and the suggestion is put forward that a paper with a melting point such that adequate swelling for use of medium hard ink (for instance Encre Machine) would not be obtained under about 85° F., should be manufactured. The author is not aware of any formidable difficulties in using such a gelatine, and, at any rate, one or two manufacturers are at present making papers with this type of coating. It will also be seen in a subsequent page that the difficulties of transfer are materially reduced by the employment of such papers.

If, as the result of what has been said, it is desired to attempt the use of soft inks in conjunction with higher degrees of swelling on the normal type paper, a temperature of swelling of about 85° F. to 90° F., with Sinclair Taille Douce used alone, will be found about correct. The gelatine when swollen to this degree requires moderately delicate handling, as it is soft, and easily abraded. About fifteen to twenty minutes' immersion will usually provide the maximum relief obtainable at the particular temperature.

Experimental Method for Determining Soaking Times

Temperatures for soaking have already been put forward to suit typical papers. It now remains to determine the most suitable times. As stated previously, time is a minor variable compared with temperature, but nevertheless it should be controlled and standardized. Many of the modern low soaking temperature papers can be brought into condition in very short times. Prints can, for instance, be inked up after only three to five minutes' swelling in tap water, if all conditions have been favourable in the preliminary processes. These very short times have serious drawbacks in many ways, in that the full degree of swelling at the temperatures employed has not in most cases been reached, and hence it is necessary for reproducible results, to judge the soaking conditions with considerable exactitude, which is difficult to do, outside a scientific laboratory. To get fully swollen matrices time periods of the order of twenty minutes and upwards are found from experience to be necessary, and in general the best results are only to be obtained if times of this order are allowed.

In order to find out exactly how long soaking should continue it is best to work with a trial print, cutting this up into moderate sized fragments. It is necessary to have sufficient image on each piece to allow of a judgment being passed on the rendering of detail and gradation. About three inches square would be a suitable size. Three or four of these pieces may be immersed at the same time in water of the selected temperature and any air-bells removed with a clean finger tip lightly applied. The temperature of the water may be maintained for the first ten minutes, but after this it may be allowed to fall gradually to room temperature. At the end of twenty minutes the first portion may be removed, excess water dabbed off with a wad of fluffless linen, and the hard ink applied. Successive pieces are then removed every five or ten minutes, up to about forty minutes, and inked similarly. To begin with, if the first time has been slightly insufficient the ink will take, but with a coarse, unpleasant granularity. This will

gradually disappear with increased soaking, until, finally, the ink may begin to refuse to go on so easily. It should not be difficult to choose an intermediate point where the ink takes easily with full shadow gradation. The later stages, where the ink does not go on with such readiness, may be useful if the print is intended for transfer, as an almost over-soaked condition is ideal in this case.

Provided that the temperature has been suitably chosen to fit the ink employed no actual oversoaking is likely, and if the stage is reached where the ink actually refuses to take, it is a sure indication that the temperature is too high, and a fresh batch of trial pieces should be put in at a temperature 5° F. to 10° F. lower, according to the apparent over-swelling. At each particular temperature there is, for practical purposes, a degree of swelling which cannot be exceeded with normal increases of soaking time. Actually, a very slight increase in water absorption probably goes on, but it is of minor extent only. The higher the temperature the more rapidly is this pseudo-maximum of swelling reached, so that whereas twenty minutes may be required at 70° F., ten minutes will be sufficient at 80° F.

An old maxim for judging if the print is in the correct condition was to feel it with the ball of the finger or thumb. It should feel swollen and slimy in the highlights and sunken and rough in the shadows. This rule usually leads to the production of a degree of swelling which necessitates softer ink, as most modern low melting point papers give very little perceptible relief when they are in condition to accept medium hard ink. In fact, the degree of apparent relief varies so much with the paper employed that the rule is of little use, unless found by experience to work with the particular paper being used.

Air Temperature and Ink Consistency. We have discussed one way in which the prevailing atmospheric temperature may influence the behaviour of a bromoil in inking, i.e. the papers so made that they come into the correct condition for inking at relatively low temperatures may actually be exposed to higher temperatures in the baths and washing waters than are necessary in the swelling operation. There is another and quite different way in

which inking procedure is altered by the atmospheric temperature in the room in which the inking is carried out.

It is common knowledge that the lubricating oil in a motor-car sump is more viscous, and more slow-flowing in cold weather, and more liquid in hot weather. This is a general property of all oils and greasy substances, and applies equally well to bromoil ink. The inks softened by heat behave in exactly the same way as those thinned with medium, i.e. they demand a higher degree of swelling in the gelatine matrix. Thus, if a given time and temperature for swelling are employed, more medium will be necessary in the ink according as the room temperature is lower, and the hard ink more solid. Provided that a really hard ink is used, such as the Lechertier Barbe or Autotype hard varieties, it is merely a question of adding more or less thin ink until the correct consistency is reached. If, however, a medium hard ink, like the Sinclair Encre Machine, is used, this may in very warm weather develop into a medium soft consistency and actually necessitate a higher swelling temperature. In the examples previously given where a temperature of 70° F. is suggested this would be correct with the room atmosphere at 65° – 70°F. during inking. If, however, the room temperature were 75° F. or above, it might be necessary to swell at 75° F. or even at 80° F.

In a recent article on Bromoil by C. J. Symes (*Amateur Photographer*, 1929, p. 538) this aspect of the swelling question has been worked out in great detail, and the following practical procedure evolved. The soaking *temperature* is chosen to correspond to the room temperature; the soaking *time* is varied to correspond with a given consistency of ink. The following two tables are quoted from the article, and refer to a paper with gelatine of melting point 120° F. (this would be similar to that used in the Wellington and Barnet papers).

TABLE I

Room Temperature	*Soaking Temperature*
55° F.	65° F.
60° F.	70° F.
65° F.	75° F.

TABLE II

Soaking Time	*Pigment*	
	Encre Machine	*Encre Taille Douce*
45 mins.	50%	50%
30 mins.	66%	33%
20 mins.	80%	20%

This question of the influence of room temperature on inking is not usually considered in works on the subject of Bromoil, and, indeed, may not become of any great importance unless the temperature conditions are extreme. However, in attempting to pigment prints at very low or very high temperatures, say below 50° F. or above 70° F. the importance of the effect on the ink itself is very great. The above described working method is very sound.

Before leaving the subject of swelling, there is another method of working which deserves mention as being practised in one form or another by several workers of experience. The print may be raised to a relatively high temperature immediately following tanning and fixing, and may then be dried and re-soaked in cold water prior to inking, or may even be plunged direct in cold water and inked without intermediate drying. One worker uses an ordinary bromide paper made with a high melting point gelatine (Illingworth papers are apparently suitable), and plunges it into a bath at not less than 130° F. directly after the final fixing and washing. The print is then dried, and when inking is to be put in hand it is immersed in water at 65°–70° F. for two or three minutes and inking commenced. Another experienced and skilful worker known to the writer warms his final fixing bath up to 80° F. or so, with a low melting point paper, washes, dries and re-soaks, or alternatively inks right away, after washing,

With experience such methods unquestionably work well, but the author does not counsel their employment,

because, as a general rule, the complete original degree of swelling is not acquired before inking, and consequently it is impossible to resoak the print during inking without an increase in relief being produced, usually with unfortunate results to the ink already deposited. As repeated soaking during inking is an important aid in securing spontaneity of ink deposition, this is a drawback not to be underestimated.

Other methods of inducing relief in the swelling process include the use of swelling agents, such as dilute acids and alkalis. Ammonia has been recommended to this end by Underberg (*British Journal of Photography*, Vol. 73, p. 479), who suggests a 5% solution, presumably of the ·880 liquid ammonia, in water. These ammoniacal baths, however, unless in extremely great dilution produce too much relief with the low melting point gelatines, although working well with the harder varieties of emulsion gelatines. Another procedure which has been put forward is to soak the bleached and fixed print in formalin, and then, when hardened, to take the temperature up to 150° F. or more. This procedure is claimed to be very effective for transfer purposes, but the author has found that the hardening with formalin is difficult to standardise, and the final amount of relief obtained shows wide irregularities. There might be an opening here for someone with the time and opportunity to experiment.

Matters of Importance from Chapter III

(1) In soaking, temperature is the important variable—time should, however, also be standardised.

(2) Swelling can only be considered in relation to the consistency of ink to be employed.

(3) The higher the temperature of swelling and the greater the degree of relief, the softer must be the ink.

(4) Most papers made specially for bromoil have low melting point gelatines, and suitable time and temperature conditions for use with medium hard ink (Encre Machine) are: 20 mins. at 70° F.

(5) Summer and winter tap water and air temperatures influence necessary soaking conditions and also alter the consistency of the ink. Methods for making allowance are suggested.

(6) The disadvantages of the present type of low melting point bromoil papers are emphasised.

(7) Experimental determination of soaking times and temperatures is advised and described.