CHAPTER FOUR

Developing the Negative

THE development of miniature negatives should be carried out in the specially designed tanks available for this purpose as the time and temperature method used with tank development is both the simplest and best method of developing the tiny images. The tray method with the consequent seesawing of the roll film back and forth, is a tedious process and increases the chances of harm coming to the emulsion which is extremely delicate when wet. Visual inspection by means of safe-lights is difficult at best because of the small size of the negatives and, in the case of panchromatic and super-sensitive panchromatic films, is impossible because of the abnormal sensitivity of these films to even the relatively weak green lights.

Once a film has been tanked, it is free from all harm, the developer works uniformly on all portions of the roll film, and it need not be touched until it is completely fixed and washed and is ready to be hung up to dry. The big advantage of the tank is the ease with which the development can be attended to, for all processes, even, in some cases to loading the tank, (which normally requires either a dark room or a changing bag), may be carried on in full daylight as the tanks are absolutely light-proof.

There are numerous types of tanks obtainable, designed for both 35mm. film and also for roll film of vest pocket size and larger. Perhaps one of the more popular tanks is the Correx, several models of which are offered, some for cine film and others for roll film. In this tank the exposed film is wound on to a spool between an indented and permanent strip of clear celluloid. The exposed film to be developed is really sandwiched between the indented strip and in this way the developer passes around the entire film during development.

After each roll of film is developed the celluloid "apron" should be wiped dry before another strip of film to be developed is wound on the spool. The Reelo developing tank, similar in size to the Correx, differs in that the film, instead of being sandwiched between layers of celluloid, is wound on to the reel by means of spiral grooves which hold it upright and in a separated condition, permitting the solution to have free access to all parts of the film. The tanks mentioned here do not exhaust the models obtainable, for other tanks are available of various types. A small thermometer which can be kept inserted in the tank during development will keep an accurate check on the temperature of the solution, permitting the time of development to be accurately plotted.

Regardless of the tank used, a fine grain developer is essential if negatives are to be produced which will stand enlarging up to 11x14 inches or more. Whether to use developers which come prepared in powder or liquid form, requiring but to be dissolved in a stated amount of water, or whether to compound your own formulas is relatively immaterial for the results obtainable in either case will be equally satisfactory. The use of prepared developers is quicker, cleaner, and less troublesome than mixing one's own. On the other hand, it is undoubtedly more economical in the long run to compound your own developers. A further advantage is the control that can be exercised over the composition of the developer as some formulas permit of varying the degree of contrast or softness obtainable in the negative by that developer.

Of the prepared developers there are many which are well known and are compounded especially for use with miniature negatives. There are the Perutz Fine Grain Developer, Hauff's Mikrol, Glycin Tubes, Rytol, Rodinal, Glycinol, Boratol, Nograin, Agfa Fine Grain Developer, Supersoup, M. P. G. and a host of others. Most of the foregoing may be used several times until exhausted and many will keep for a month or more, provided they are kept in well stoppered bottles. Allowance must necessarily be made for the weakening of the developer each time it is used, and thus, as the solution ages, the developing time should be increased somewhat. With some developers care should be taken not to prolong the developing time unduly for fear of introducing Dichroic fog, (a veiling or fogging of the negative produced by the developer). When the time of development has to be so prolonged to produce proper density that Dichroic fog creeps in, the solution should be discarded as it has outlived its normal life span and the negatives produced will be all but worthless.

A few of the better known formulas which have excellent fine grain characteristics are presented for those who prefer to prepare their own solutions.

Fine-Grain Borax Developer (Eastman D-76)

	"A"	"B"
Elon	30 grains	40 grains
Sodium Sulphite	3½ ounces	3½ ounces
Hydroquinone	75 grains	40 grains
Borax	30 grains	30 grains
Water	32 ounces	32 ounces

Developing time: 9 to 12 minutes at 65° F.

"A" will give a little more snap in quality (higher contrast gamma) than "B" which will give a softer quality negative.

DuPont Borax Formula

Rhodol (Metol, Elon, etc.)	2.5 grams
Sodium Sulphite, Anhydrous	75.0 grams
Hydroquinone	3.0 grams
Borax	5.0 grams
Water	1.0 liter

Developing time: 5 to 7 minutes at 68° F.

Glycin Developer

Sodium Sulphite, Anhydrous	45 grains
Glycin	15 grains
Sodium Carbonate	45 grains
Water	16 ounces

Developing time: 30 to 40 minutes at 65° F.

Developers utilizing the agent Paraphenylene-Diamine, partake, somewhat, of the characteristics of physical development, in which the metallic silver comprising the negative image is deposited on the film from the developer. There are several ways of using developers in which paraphenylene-Diamine is a constituent; one is to give the film normal exposure and develop in formula No. 1 while the other is to give the film twice normal exposure and develop in formula No. 2. The very finest grain is obtained by the second method, even when using a relatively coarse grained film, though at a cost of film speed and a slight sacrifice of shadow detail.

Paraphenylene-Diamine Formula No. 1

(For **Normally** Exposed Negatives)

Paraphenylene-Diamine	90 grains
Sodium Sulphite	450 grains
Borax	255 grains
Tri-Basic Sodium Phosphate	210 grains
Water	16 ounces

Developing time: 35 minutes at 68° F.

Paraphenylene-Diamine Formula No 2

(For Negatives Given **Twice** Normal Exposure)

Paraphenylene-Diamine	72 grains
Sodium Sulphite	420 grains
Water	16 ounces

Developing time: 30 minutes at 68° F.

Parker No. 76

(For Negatives Given **Normal** Exposure)

Paraphenylene-Diamine Hydrochloride	110 grains
Glycin	45 grains
Sodium Sulphite, Anhydrous	450 grains
Tri-Basic Sodium Sulphite	410 grains
Water	16 ounces

Developing time: 14 to 16 minutes at 70° F.

Paraphenylene-Diamine should be dissolved in hot water about 180° F. and when in solution the Sulphite is added. The Borax and Tri-Basic Phosphate may be added after the Sulphite is thoroughly dissolved. For those subject to skin poisoning, rubber gloves are recommended for handling the solutions.

When preparing any of the foregoing developers, the chemicals should be dissolved exactly in the order given. To aid in their solution they should be made up in a small quantity of hot water and when all chemicals have been dissolved, cold water should be added to bring the solution to the proper strength. If, after adding the cold water, the temperature of the developer is still too high, packing the graduate in cracked ice will cool the solution or it may be placed in a refrigerator for several hours.

Pre-aging of formulas containing Paraphenylene-Diamine Hydrochloride vastly improves their developing qualities, especially in those portions of the negative comprising shadow detail. The pre-aging may be done by mixing the dry chemicals and allowing them to stand in tightly sealed glass containers for about two weeks, or by permitting the liquid developer to stand in corked glass containers for a period of a month. Permitting a fogged length of film to stand in the freshly prepared developer over night approximates somewhat the effect of pre-aging.

Once the film is in the tank, it should be soaked in pure water for a minute or so. This not only prevents the formation of air bells, but also moistens the film and produces a more uniform chemical action when the developer is poured in. As even a temperature as possible should be maintained in the various solutions; 65° F. being considered normal for all photographic solutions. Extremes of temperatures between the developer, fixing bath, and wash water may distort the film, produce reticulation (a leather-like graininess brought about by the emulsion warping from the celluloid support) or may cause actual breaks in the fine grain emulsion.

After the development is complete, the film should again be washed for several minutes under running water, thus clearing away all the alkali of the developer and preventing the acid of the fixing bath from reacting with the alkali and producing pin holes in the emulsion. Upon completion of the fixing (10 to 15 min.) the film should be washed in running water for 20 to 30 minutes, removing all traces of the Hypo fixing bath and putting the film in as good a physical condition as possible for continued and future use. A partially washed film will, after several months, discolor and begin to deteriorate because of the crystallization of the minute particles of hypo in the film.

When the film is hung up to dry, both sides should be wiped free of excess water by means of a wet viscose sponge. The sponge should then be rinsed in water, squeezed dry, and the back or celluloid side of the film wiped several times. Wiping the film in this manner causes it to dry more rapidly (producing a finer grain than does prolonged drying) prevents water marks on the emulsion, and removes foreign matter that may be clinging to the film.

During the development of the film a more uniform chemical action will be produced if the tank is agitated several times each minute. This will prevent streaks of density due to the stagnation of the developer. The agitation may be done by hand or by means of devices obtainable for that purpose.

The foregoing has been descriptive of chemical development wherein the silver salts of the emulsion are converted into metallic silver by the action of the developer. In physical development the silver composing the image is deposited on the film from the developing solution.

Physical development has several characteristics which make it almost ideal for developing miniature negatives. For one thing, it produces a fine-ness of grain and it has a fidelity to original detail and delicate nuance of tone and contrast unrivalled by any method of chemical development. For the general run of negatives it will be found most excellent, though for portraits it is probably unsuitable because of its almost embarrassing fidelity to original detail.

One of the orginal drawbacks of this method of development, so far as developing miniature negatives is concerned, was the fact that it was thought that special equipment was necessary for proper processing. However, by using precautions no more arduous than normal, the following method is applicable to development in the Correx tank or in any tank of non-metallic construction. In the case of the Correx tank it should be observed that all metal parts, such as the film clip on the spindle, the reverse of the rivets in the core of the spindle, and the clip on the end of the celluloid apron, should either be painted with chemical resistant laquer or covered with water-proof adhesive tape so that the metal cannot come in contact with the developing solution.

Dr. Odell Simplified Formula

Iodide Fore-bath

Potassium Iodide	80 grains
Sodium Sulphite	½ ounce
Water	16 ounces

This solution is employed at full strength and can be used several times before becoming exhausted.

Silver Bath (Stock Solution):

Sodium Sulphite	1 ounce
Silver Nitrate, Crystals	120 grains
Sodium Thiosulphate (hypo)	2 2/3 ounces
Water	16 ounces

The stock solution should be carefully and exactly prepared as follows: The sodium sulphite should be separately mixed in about 5 ounces of water and the silver nitrate separately mixed in about 2 ounces of water. When both substances are in solution the silver nitrate solution should be poured into the sulphite solution and the whole stirred vigorously until the white precipitate has dissolved. In order to aid in the solubility of the hypo it is advisable to bring the whole solution up to about 12 or 14 ounces and after the hypo is dissolved add whatever water is necessary to make 16 ounces. This stock solution is relatively stable to light and keeps indefinitely if stored in a dark colored bottle.

FOR USE take 1 part of the above stock solution and 4 parts of water. To each five ounces of diluted solution add 4 grains of Amidol, stirring until it is completely dissolved. **The Amidol should be added to the solution only a few minutes before placing the negative into the developing solution.**

The following steps should be followed for normally exposed negatives: First soak the film in clear water for a minute or so. Then, after the water has been removed from the tank, pour in the Iodide Fore-bath for no more than 30 seconds. Again rinse the film in clear water and pour in the Silver-Amidol bath, about 65° to 70° F. Development will be complete in one hour. Remove the developer, rinse in clear water for several minutes, and fix in a fresh Acid Hypo bath. Fixation will be complete in from 20 to 60 minutes, depending upon the temperature and the freshness of the bath. Washing and drying are as usual. It should be noted that during the development the tank should be kept constantly agitated.*

Miniature negatives have a habit of accumulating with startling rapidity and some method must be found to safely store them so that they can be protected and handy for future use. Cutting the individual negatives apart makes it difficult to properly store them and to handle during printing and en-enlarging. A better plan is to cut the roll into strips containing three or four negatives which can then be kept in the special film index books and filing albums made for this purpose. The film can also be kept in the roll and stored in cases subdivided into numerous small compartments. An undeniable advantage of this method is the ability to store a great number of negatives in a small space. By all means save your negatives and studying them carefully, for a study of the exposures and the actions of the various developers is a valuable and rapid means of improving one's technique. And don't forget, it is technique and attention to many little details which count in miniature camera work.

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* For a complete treatise on physical development see, "Physical Development," by Allan F. Odell, M.Sc., Ph.D., New Photo Miniature Series, No. 2.