

ON May 21st, Mr. F. F. Renwick, F.I.C., F.C.G.I., Hon. F.R.P.S., (of Ilford Ltd.) read before the Royal Photographic Society a paper, and gave a demonstration, which marks the biggest advance for years in the field of printing papers. The new paper, which Ilford are marketing as "Multigrade," has the unique property that by using appropriate filters for the exposing light, its contrast can be made at will anything between Extra-soft and Ultra-contrasty ! Because this paper is so entirely new and also so important, we think it merits more than the usual paragraph describing a new line.

Mr. Renwick's description of how the first idea of the paper arose was most illuminating. In the early autumn of 1936 he "happened to be studying some tests" of an experimental paper which had been colour-sensitised (that would probably be in the course of working out Plastika). There were some curious results, and it occurred to him that perhaps the sensitising had only affected some of the emulsion grains instead of all ; and this proved to be right.

But this is where one sees the difference between the great research man and the merely good one. To the creative imagination these curious results suggested a whole train of new thought. Suppose one deliberately mixed two emulsions, one only colour-sensitised, and then varied the printing light ? What would one get ? Could it be made useful ?

#### FOUR YEARS' WORK

Working out this train of ideas has taken nearly four years, and the result is "Multigrade" paper. Although exact details of manufacture are confidential at present, the general idea is as follows. First, a fast and extra-soft emulsion is made : like all ordinary bromide emulsions, it is sensitive only to blue-violet light. Then a much slower and extra-contrasty emulsion is made, and this is sensitised as an ortho film is sensitised, but with special dyes which sensitise only as far as bluish-green. It is then still very slow to blue-violet light, but quite fast to green light. Then the two are mixed and the paper coated as usual.

If this paper is now exposed to light through a sharp-cutting yellow filter (which, of course, passes green light, but no blue), only the sensitised emulsion is affected, and the print is extra-contrasty. A paler yellow filter lets some blue light through, both emulsions are affected, and their densities added ; and the print is more normal in contrast. A light blue filter, which still cuts green light, allows one to expose only the soft blue-sensitive emulsion, giving an extra-soft print. Unfiltered half-watt light exposes both, giving a soft print, though not so soft as with blue alone.

The choice of the right dye for sensitising must have been quite a problem ! It must raise the speed to bluish-green light very considerably, but not increase the response to violet or blue light : of course, it must "stay put," and not wander about and sensitise the other batch of emulsion when they are mixed ; nor must it make either emulsion at all sensitive to *yellowish-green* light, or there would be trouble in getting a working safe-light. This last problem was successfully solved, for the paper is completely safe to a proper orange light, or to the brownish-yellow Ilford "S" safelight, which we much prefer.

The new paper naturally calls for modifications in our exposing arrangements. For contact printing, Ilfords have produced and patented some very cunning

## A REVOLUTION IN PRINTING PAPERS

*The new Ilford product, "Multigrade," is the biggest advance for years in the field of printing papers. Here is a precis of Mr. F. F. Renwick's talk on it to the R.P.S. recently and the results of our first test.*

printing boxes, in which sliding filters give either blue or yellow light, or any desired mixture of the two : the control lever that slides the filters can actually be calibrated in degree of contrast. For enlarging, one can use any of three systems. First, four different filters are available, which give, roughly, the following five equivalent contrast grades :—

Filter type	Colour	Gradation
M.G.20	Full Yellow	Ultra-contrasty
M.G. 7	Medium Yellow	Contrasty
M.G. 3	Pale Yellow	Vigorous to Normal
—	(No filter)	Soft
M.G.20B	Blue	Extra-soft

Second, the simplest as regards apparatus, one can divide the exposure into two, giving part through the full yellow filter and the rest through the blue (or—except for extreme softness—without filter). By varying the ratio of the two exposures one can get any contrast between the extremes.

Third, and very ingenious : when the lens allows of it, put inside the lens, next to the iris, a full yellow filter with a hole punched in the centre. Stopping down to the size of the hole uses all white light and gives softness. Opening up gives more and more yellow light, and progressively increases contrast.

The actual speed of the paper cannot be given as a single definite figure. For example, with one particular setting of our enlarger, yellow light just blackened the paper in 13 sec, blue-light in 20 sec, so the paper seems about 1½ times as fast to yellow as to blue. But blue light gave a perceptible tint with 1/20 sec, while yellow took 2 sec. for this. So by this test the paper is 40 times as fast to blue as to yellow !

#### SPEED AND CONTRAST

In fact, when comparing papers of different contrast grades, speed is meaningless unless one specifies "speed for equal black" or for "equal high-lights," or some such qualification. Very roughly, the speed for "Normal" gradation seems to us to be, say, half or a quarter that of ordinary Ilford Normal bromide ; or of the same order as that of Plastika : and equal total exposure, however split between yellow and blue light, tends towards equal depths in the shadows. If one wants equal high-lights with different contrast, every second of blue light must replace about 20 sec. of yellow light.

Processing is stated to be quite normal. Different colour of printing light makes no difference to image colour, which is a typical bromide black. The "maximum black" is very deep and rich, even when one is only using one half of the emulsion : and Ilfords state that it gives excellent sulphide tones. They recommend their standard Bromide developer, I.D.20, the formula for which is given in their instructions sent with the paper.

Unfortunately, it just happened that Mr. Renwick's

lecture, and the arrival of the samples, both came to pass on the eve of M.C.W.'s press day, so that time for testing has been very limited. It has, in fact, been totally inadequate for what we call a *real* test; for it must be remembered that the one and only grade of "Multigrade" is more than the equivalent of a complete series of contrast grades of an ordinary paper. So the notes that follow must be regarded as an "interim report" only.

#### FIRST TESTS

Our first tests were made through a wedge, and developed in an M-Q developer very similar to I.D.20, tests being made with the blue and full yellow filters. The results fully justified the claims made. The negative density range from just "off black" to just "off white" was 2.3 for blue light, 0.7 for yellow. Ilford's own figures for their standard bromide papers are 1.8 for soft and 0.9 for ultra-contrast; so that Multigrade covers a wider range than the whole bromide series of six grades.

If one considers a "normal" subject of 30 to 1 range, this means that errors in development giving any gamma between 0.6 and 1.5 could be compensated for: or to put it another way, at constant gamma of 0.8, either a flat subject of only 8 to 1 constant range, or any more contrasty one up to the freak range of 800 to 1, could still be made just to fill the black-to-white range of the paper.

Our next test was with the Latitude developer, and here we must record a great disappointment: "Lat." does not work with this paper. It *develops* it all right, and gives its usual magnificent blacks. But it does not give latitude. With blue light and full to slightly excessive exposure there is just a little latitude. But longer development, though making up to some extent for shorter exposure, also gives softer gradation altogether. One is faced with the necessity of correct exposure within, say, 50 per cent. up or down, either with M-Q or Lat. With yellow light there is even less latitude, as one would expect, for with an ultra-contrasty grade, of course, the slightest change of exposure has much greater effect.

The actual contrast with yellow light was almost identical with both developers. With blue light, Lat. gave more contrast—which, of course, is just what one does not want.

#### CONFESSION

So here we must confess with regret our first failure with Lat. The actual M-Q which we used for the rest of the tests was a mixture of Lat. with the soft-working developer already recommended by Mr. Turner; i.e., Lat. with the addition of ½ part Metol to every 1 part Quinol. We have both of these stock solutions handy, so mixed equal parts of them to make a developer with a total ratio of 1 part Metol to 4 parts Quinol, like I.D.20. This mixture was diluted 1 in 16 for use: properly-exposed prints showed first signs of image at 20-30 sec, and were completely developed in 2 mins.

Lastly, we tested various picture negatives, with mixed exposures—part through the full yellow filter, part through the blue. The tests were quite rough, being simply judged by appearance, as this was all that time permitted.

It seemed that a slight admixture of yellow to a mostly blue exposure made less difference than a short blue exposure to one mostly yellow. Very roughly, and simply as a general rule, we estimate that equal "jumps" in apparent contrast would be given by: All blue; 2/3 blue to 1/3 yellow; 2/3 yellow to

1/3 blue; 4/5 yellow to 1/5 blue; 9/10 yellow to 1/10 blue; and all yellow.

As stated above, equal total exposure gives very much the same shadow density, however it is divided between blue and yellow. But when yellow is mixed with a "no filter" exposure instead of with blue (as it can be except when extra-soft results are desired) then one should first divide up the total time to give the desired contrast, and then halve the "blue" exposure if one actually makes it with no filter.

The paper is so extremely interesting that we have laid down for ourselves—and Mr. Turner—quite a programme of test work—actually making curves for various "mixes"; seeing how the curves are for "straightness"; finding whether the contrasty exposures are best suited to under-exposed or under-developed negatives, and so forth. We hope later onto publish a detailed article by him on the subject. Also, what an opportunity for the control enthusiast now, when by shading with a cut piece of filter he can vary the contrast over the subject, as well as the depth!

At present there is just the following additional information: Surfaces available at the moment are Glossy and Velvet, single-weight; Silika white and cream and Cream Matt, double-weight. A leaflet dealing with "Multigrade Paper" will be available by the time this appears. Filters are available either bound up in glass like safelights, for contact printing boxes, or as gelatine or cemented in "A" glass as lens filters. At the time of going to press we have no news of the prices of paper and filters, but the former will, we understand, be about the same as those of bromide.

#### SILIKA

Ilford Ltd., have produced a new surface in their series of "Lustre" bromides. It is not unlike the "Rough Lustre" already well known. But it is just a little less rough, and at the same time the sheen is more pronounced. Whereas in the other papers of the series the sheen is most pronounced in the shadows, leaving light half-tones almost matt, in "Silika" the whole print has this sheen lying over the fairly rough base. The effect is wholly delightful, and the emulsion has, of course, all the usual good points of the series as regards colour and gradation.

It is produced with white or cream base, and in grades 2, 3 and 5, i.e., soft, normal and contrasty.

# MORE ABOUT MULTIGRADE

WHEN I had got over the first novelty of making good prints from negatives long put aside as hopeless, I began to make some serious tests on Multigrade. In doing so, I found that there were certain curious features about its curves, and that started me on to a general investigation of the relations between Transmission and Reflection Densities, which, I understand, the Editor will be able to publish in this issue.

This is one of the reasons why this report has been rather delayed. However, now for the results.

Fig. 1 shows a whole series of curves for Multigrade, for mixed exposures through the blue (M.G.20b) and deep yellow (M.G.20) filters. Each curve is marked with the ratio of exposures. It is particularly to be noted that the curves have been displaced sideways to be clear of one another, so that their positions give no idea of relative speeds; they are intended simply to show the contrast and the shapes of the curves; relative speeds are given by Fig. 3 below.

One sees that some of the curves, especially the medium-to-contrasty ones, have rather a marked "toe." It was this point especially that led me to my "general investigation," of which one result was to show that this is an almost necessary result of the constitution of Multigrade, i.e., a mixture of two emulsions of widely different contrast.

The practical result is to indicate that if one wants to use Multigrade as a standard paper, one should make one's negatives suitable for a normal to softish paper when they are fully exposed (develop to, say,

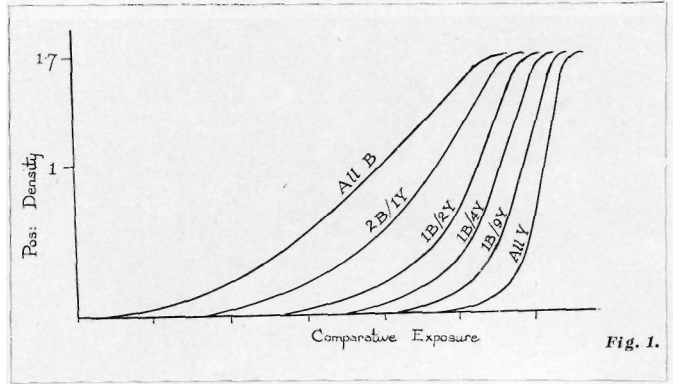


Fig. 1.

gamma of 0.9 or a little more). Then any under-exposed ones will be more or less automatically corrected for by the increasing "toe" of the paper as one gives more yellow light to make up for the softer negatives due to under-exposure.

As regards actual "speed," one must remember that one cannot make a definite speed comparison between papers of different contrast, unless one specifies a speed for equal high-lights or equal shadows. So before dealing with speed, I will give in a compact form the data as to contrast range which follow from the curves of Fig. 1.

Fig. 2 shows this. The base-line gives percentages of blue light above and yellow light below, from 100% yellow on the left to 100% blue on the right. The curve gives the density range of the paper on the left-hand vertical scale, and contrast range on the right; it will be seen that the latter varies from a 7 to 1 range with the full yellow filter to 180 to 1 with the blue. I have also marked on the curve itself the values given when the whole exposure is made with the medium (M.G.7) and pale yellow (M.G.3) filters, and with unfiltered half-watt light. Further, I have shown on the left the contrast ranges quoted by Messrs. Ilford for their grades of ordinary bromide paper, as a guide for those who are not in the habit of thinking in terms of numerical contrast or density ranges.

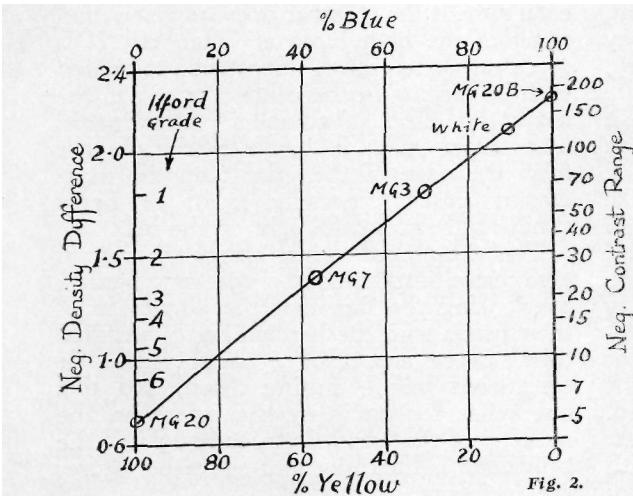


Fig. 2.

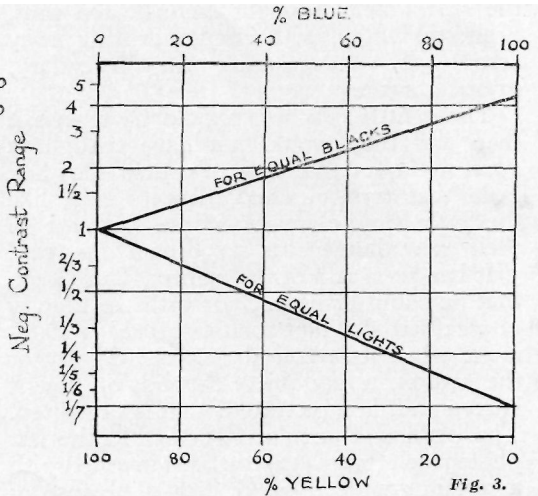


Fig. 3.

"STEWED PRUNES"  
 Rolleicord, 1/5th sec.  
 at f/5.6, Selo H.P.2,  
 Photoflood lighting.  
 Photograph by G. E.  
 Foden, Specially Com-  
 mended, Class B,  
 August Competition.



Lastly, in Fig. 3, I give the comparative exposures required for equal blacks and for equal whites on the same sort of base-line as in Fig. 2. In each case I have taken the exposure of 100% yellow light as unity.

Rather a lot of information is packed into Fig. 2, but I think it is fairly clear. It shows up the fact that by simply exposing part time through each of the two filters, one can get any effect from considerably softer than Grade 1 to much more contrasty than Grade 6.

Fig. 3 emphasises the difficulty of assessing "speed" when the contrast grade varies. When one thinks of it, since blue light makes the paper work as a very soft one, it must call for a very wide exposure range between black and white—in other words, the paper

with blue light is faster as regards the lights and at the same time slower in the shadows.

Fig. 3 should be used thus : suppose one has made a print with 50-50 yellow and blue light. One finds, say, that the high-lights are right, but the shadows not deep enough—the paper is too soft. So one decides on another shot, with exposure two parts yellow to one part blue. Now as the high-lights are right, we use the line " for equal lights." 50-50 calls for about 1/3 the standard exposure ; 67Y-33B (i.e. 2 to 1) calls for 1/2 the standard. So we must give this new print 3/2 times the exposure of the first one, to get equal lights.

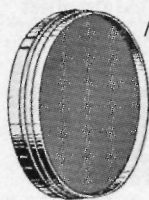
P.K.T.

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PACKET  
of

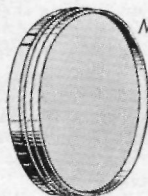


# MULTIGRADE

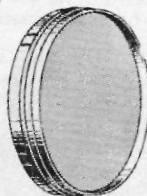
THE NEW ILFORD PRINTING PAPER



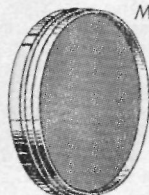
M.G. 20 B.



M.G. 3



M.G. 7



M.G. 20

*and*

# 4

# FILTERS

you can make good prints  
from all printable negatives!

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# A MULTIGRADE EXPOSURE CALCULATOR

*The scales reproduced on the opposite page should be pasted on stout card and, when dry, cut out with knife or razor blade. If desired, a neat slide-rule can be constructed, as in Fig. 1., the instructions being pasted to the back card.*

E. J. HART and H. d'A-FONSECA

WHEN one acquires a packet of Multigrade paper and the necessary printing filters, it is only natural that one's first desire should be to test its capabilities with extreme types of negatives. The file is combed for negatives which have been proved impossible to print on ordinary bromide—either all "soot and whitewash" or underdeveloped and flat—and, using all blue or all yellow printing light, one is astonished to find that these unprintable negatives can be made to give amazingly good prints.

With the four filters supplied by Ilford's (MG.20B, MG3, MG7 and MG20) the technique is as simple as when using ordinary bromide of five different contrasts, with the difference that the two extremes obtainable with Multigrade are far outside those of ordinary bromide. In this case, the advantage of Multigrade lies in the fact that one need stock only one grade of paper, and one decides—either by trial or by previous experience—that the negative requires soft, medium or hard paper, selects the appropriate filter, and the rest is merely a matter of test-strip and final print.

However, to extract the utmost from this remarkable paper, the two-filter technique must be employed (MG20B and MG20), and this is far from simple. The reward, nevertheless, is well worth the extra trouble, because the range of the paper can be adjusted exactly to suit the negative and the type of print desired.

Now, at first sight, this appears easy, for if a trial print shows that a more contrasty grade of paper is needed, one just increases the yellow exposure and reduces the blue. Unfortunately, the amount deducted from the one is not added to the other, and for each new proportion a different

total printing time is necessary. In fact, the longer one tries to produce prints by this method, the more one realises the extreme difficulty of working with two variables simultaneously unless these two can be interconnected.

Fortunately this connection has already been worked out by Mr. P. K. Turner, who, in his article on the subject in last September's *M.C. W.*, presented an extremely valuable graph showing the relationship between the percentage blue and yellow light and relative printing time for equal blacks and equal lights. In this graph he uses as his reference standard the printing time with 100 per cent, yellow light, and he describes a method of working which makes use of the line for equal lights to find the correct printing times for any selected ratio of blue to yellow light.

No use whatever is made of the line for equal blacks, and it occurred to the authors that a simple calculator of the slide-rule type might be constructed from information taken from both the "lights" line and the "blacks" line, which, employing a modified technique, would enable the correct proportions of blue and yellow to be selected with a minimum amount of preliminary testing, saving both time and paper.

Instead of guessing, more or less blindly, at the proportions, and making several test prints before the correct ratio is found, the authors advocate a method sometimes used for determining the correct paper grade with ordinary bromide. In this case, since Mr. Turner's graph is based on the printing time with 100 per cent, yellow, the preliminary tests are made through the yellow filter.

First a test-strip is made from that part of the negative from which the print is being taken, using the densest or "high-light" portion, the exposure times used being pencilled on the back before development—say, 10, 20, 40 and 80 seconds. A second test-strip is made, but this time using the thinnest or "shadow" portion of the negative, the exposures being again recorded on the back, say, 5, 10, 15 and 20 seconds. These two test-strips are developed together for the full time (the writers recommend  $1\frac{3}{4}$  minutes at 65 deg. F. in I.D.20) and then placed for a few seconds in acid hypo so that they may be examined in white light. It is common practice for experienced workers to judge their test-strips in the normal light of the dark-room,

but for this technique such a light is inadequate, a bright white light being essential.

Let us examine the high-light test first. The problem is to select from it the exposure that gives a tone which is slightly off-white, the exact degree of off-white depending on the whole print. For example, if the brightest highlight in the picture is a flesh tone, a deeper tone will be selected than if a white collar holds that position. The careful choice of this tone is very important, as the quality of the final print depends largely upon it.

Having decided on the correct high-light exposure in the test-strip, we next examine the shadow strip in the same way. The shadow detail is not usually so critical as the high-light, but it is still important enough not to be treated lightly.

When the correct test exposures have been selected, the difficult part of the process is over, the remainder being a matter of a few seconds' manipulation of the calculator. Suppose that the selected high-light exposure is 33 seconds, and that for the

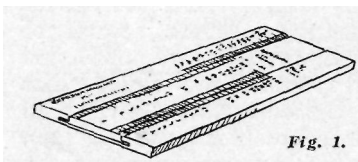
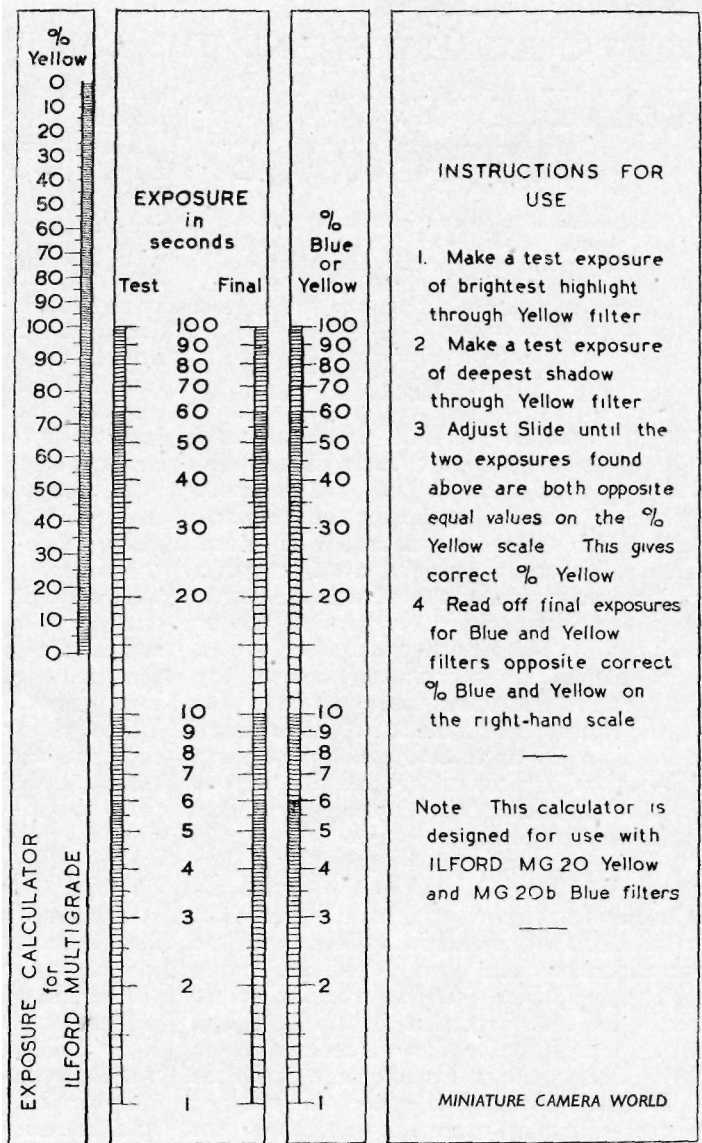


Fig. 1.



*These scales should be pasted on stout card, and, when dry, cut out cleanly with sharp knife or razor blade.*

shadows, 12 seconds. These two figures are noted on the Test Exposure scale of the calculator slide, which is adjusted until the figures 12 and 33 are opposite equal values each side of the 100 per cent. mark on the Yellow scale. This is found to be 70 per cent. and gives the correct proportion of yellow for the final print. The corresponding amount of blue is, of course, obtained by subtracting this figure from 100 per cent., giving 30 per cent. blue.

With the same setting of the slide the

actual exposure times for the blue and yellow filters are obtained on the "Final Exposure" scale opposite 30 and 70 per cent. respectively on the right-hand fixed scale. In this case exposures are 6½ secs, blue and 15 secs, yellow.

The setting of the enlarger—magnification and lens aperture—for final print must be the same as for the test-strips, or the exposure above will not be correct. Temperature of developer also should be unchanged.

When assembling the calculator it is important that all "100" marks be in line.

