On Collodion Calotype. By THOMAS RODGER jun., St Andrews.*

Agreeably to the desire expressed by the President of this Society at a late meeting, to be furnished with the modes of operation employed by those who practise photography, I now beg leave to submit to the Society the following remarks on calotype :—

In the practice of a new and difficult process, the success of which depends on a number of minute details, which, though they admit of variation, require very nice adjustment, there is much room for ingenuity and improvement. The process of calotype is of this nature, and in the practice of it, many circumstances, of themselves apparently unimportant, frequently occur to prevent success. Hence it is of great importance to simplify the process and render it more certain in its results. These objects I have endeavoured to attain; and, in the following account of the calotype process, my aim will be to detail shortly that process as practised by myself with considerable success and certainty. I shall do so, however, without reference to the modes adopted by others, leaving it to the society to compare the various methods at their convenience.

All the former modes of calotyping have been superseded by the process of collodion on glass plates. The superiority of the latter process will be apparent to every one on a very slight comparison of the results easily procurable by this process, and the most successful results of the old paper process.

Wonderful and beautiful as the pictures by the paper process were considered a short time ago, those by the glass plate process have quite outstripped them, for rapidity of execution, minuteness of detail, for expression, and beauty of finish. It is therefore to this process alone that I confine my remarks.

I need not make particular allusion to the camera, stand,

* Read to the Society February 1854.

and other apparatus necessary, further than to say, that the larger and more perfect the lenses are, the more rapid and certain is our success.

By far the most important and difficult part of this process is the preparation of the chemical materials to be employed, and the nice adjustment of these to one another. In this part of the process there are a great variety of opinions, but most individuals who have practised this art for any length of time, have, after many experiments, adopted certain methods which they have found to be most successful.

In order that there should be a greater certainty of obtaining satisfactory results, it is necessary for the preparation of the various solutions that the chemicals employed should be pure and unadulterated. Great annoyance is often occasioned by using nitrate of silver contaminated with copper or iron;—or again, by using sulphuric ether, adulterated with spirit of wine, or containing sulphuric acid; or, what is infinitely more detrimental, it is often very alkaline, from an excess of alkali having been added to it to neutralize accidental acid in the ether.

As it is my practice to prepare my own collodion I will now describe my method, commencing first with the making of gun-cotton.

Take five and a half ounces nitrate of potash in powder, and add to it in a convenient-sized bowl ten ounces, by weight, of common commercial sulphuric acid. Stir the whole with a glass rod, and introduce as much finely-carded cotton, about two drachms, as will absorb the mixture and be at the same time thoroughly charged with it. Put a cover on the vessel, and allow the action to go on for five minutes. Then remove the cover, and with a glass rod poke and separate the fibre of the cotton. If the action be too intense, which is known by the extreme heat of the surface of the vessel, moderate it by applying a cloth soaked in cold water to its external surface. Then let the cotton be plunged into cold water, and washed so thoroughly that not the slightest trace of acid can be detected. It should then be dried at a very low temperature, and put past in a bottle for use.

The collodion which I have found most tenacious, and

most uniform in its action, is made in the following manner:—

Take of sulphuric ether 12 ounces; add to it half an ounce of iodide of potassium, previously dried and bruised in a mortar, and allow it to become saturated by shaking; then add 6 grains of iodide of silver, shake again to dissolve this, and, after it has become clear, pour it off into another bottle. Next add about 72 grains of soluble or gun cotton, or, what is better, add as much soluble cotton as you consider sufficient to make a solution so thin as to pour freely over a plate of glass.

Then in 12 drams of alcohol dissolve 10 grains of bromide of potassium, and after it is entirely dissolved, add as much iodide of potassium as will saturate the spirit. The whole of this is to be added to the above solution of gun-cotton in sulphuric ether, and well shaken.

It must be understood, that according as the ether employed contains more or less alcohol, so will the proportion of iodized spirit vary, which I have recommended. The proportion here given is suited for ether all but pure.

Should the resulting solution, after being allowed to settle, prove to be too thick, it merely requires the addition of iodized ether, along with the proportion of iodized alcohol. If too thin, the addition of a little gun-cotton is the remedy.

As I have found a minute quantity of free iodine to be useful in collodion, 2 grains of it may be added to the above quantity.

(*N.B.*—The preparation now described is especially adapted for negatives. But for glass positives, it also suits exceedingly well.)

The next proceeding is to clean a plate of glass thoroughly, finishing it with a piece of chamois skin or silk, and then to cover one side of it with the prepared collodion, which I do in the following way:—

I fasten a cylindrical piece of gutta percha to the under side of the glass as a handle; and, holding by this the plate in my left hand in a level position, I pour on the collodion from a small phial, in a steady and uninterrupted stream, upon the near right-hand corner of the plate, at the same

time altering its level so as to cause the collodion to traverse the whole surface, and then allow the superfluity to run back into the bottle from the farther right-hand corner of the plate. Next, I immediately give the plate a rotatory motion, by means of the gutta percha handle, to render the coating equal, and, after the expiry of from ten to fifteen seconds, according to the temperature, I immerse the plate slantingly in a bath of nitrate of silver, of the strength of 35 grains of the crystallized nitrate, to 1 ounce of pure water. I suspend it in this bath for forty seconds without lifting it, and then raise and re-immerse it three or four times at short intervals, or, until the solution flows freely over the surface and the coating is free from the streaky or greasy appearance, which it has at first. The prepared plate requires now to be dripped for a short time, and then exposed to the image in the camera.

The window of the room in which the plate is rendered sensitive by the bath, and in which the picture is afterwards to be developed, &c., requires to be covered by a double layer of yellow calico.

The lenses with which the accompanying pictures have been taken are German, whole plate size, and ten inches focus.

With a diaphragm of two inches diameter, the plate requires to be exposed from eight to ten seconds, for a negative in summer.

For portraiture I invariably use a shady place, so chosen that the main light shall fall on one side of the subject. An awning or roof is placed about three or four feet above the sitter, to prevent too much light striking directly on the head.

After the plate has been exposed in the camera for the requisite time, it is carried back to the operating room to undergo the process of development.

The solution for this purpose is made as follows:—

Take sulphate of protoxide of iron, 480 grains.
Glacial acetic acid, 1 oz. (fluid).
Water (common) 8 ounces. Dissolve.

This should be poured expertly over the plate beginning at an unimportant part of the picture, and the plate should be agitated until the image appears sufficiently distinct, and intense to copy from, if a negative is wanted.

If a positive on glass is desired, the plate should only be exposed for a third part of the time in the camera, and should be developed with this solution.

Sulphate of protoxide of iron, 96 grains.
Water (common), 8 ounces.
Nitric acid, 16 drops.

The development being now completed, the picture must be thoroughly washed, by pouring a stream of water over it; and then it must be secured from the further action of light and rendered more fit for transferring if a negative, by removing the yellow iodide of silver from the blanks and shadows of the picture. For this purpose I use

Cyanide of potassium (crude cakes), 120 grains.
Water (common) 8 ounces. Dissolve.

After allowing this solution to remove the whole of the spare iodide of silver, the picture is again submitted to a thorough washing, and allowed to dry spontaneously, or by a gentle heat. The picture is now ready for the copying process.

As the collodion is liable to be scratched by the paper or otherwise in copying, it is better to be coated with varnish to prevent this, especially if it is to be frequently copied. The varnish used for this purpose is composed of—

Gum damar, 1½ or 2 drams.
Mineral naphtha, 4 ounces.

Before detailing the method of transferring or copying, I may here state, that when a negative appears to be scarcely intense enough to give a clear, bold, and satisfactory copy, I intensify it by the following process:—

After the picture has been fixed, and CAREFULLY washed, from cyanide of potassium, I pour over it a quantity of the negative developing solution, diluted with an equal bulk of water. Upon this is poured a quantity of a solution of nitrate of silver, in the proportion of 15 grains to 1 ounce of water, and I continue to keep the plate in motion for a time. If the image is made strong enough by this single application, it is well; but if not, a little more nitrate solution and developing liquid should be applied till the desired pitch is obtained. After this, the plate must be well washed, and

again submitted for an instant to the cyanide of potassium, and finally washed thoroughly. I have found that this mode of strengthening a negative, though somewhat tedious, possesses the property, more than other methods, of increasing the intensity of the half tints in the same ratio as the brighter parts of the picture.

(*N.B.*—The operation of intensifying ought to be conducted in the least lighted part of the operating room.)

We will now go on to the process of transferring to paper impressions from negative pictures, which, although decidedly more simple and more easily conducted than the previous process, is, nevertheless, often attended with very unsatisfactory results.

Various kinds of paper are suitable for obtaining copies—of these some are better adapted than others. I use several kinds, but at present almost exclusively a paper manufactured by Pirie and Sons. One of the specimens, marked No. 3, is on a cream-coloured wove paper, made by Cowan of Edinburgh; and No. 1 is on Turner's photographic paper, procured from W. and J. Milne, Hanover Street, Edinburgh.

Having got a paper fit for the purpose, the first thing to be done, before applying the blackening agent, is to imbue it with some of the metallic chlorides. A solution of one salt may be used, or a combination of two or more. I use a mixture of two chlorides—viz., terchloride of gold and chloride of sodium, of the following strength:—

Chloride of sodium, 50 grains.
Solution terchloride of gold, 30 drops.
Rain water (pure), 20 ounces.

The strength of the solution of terchloride of gold is 15 grains of the crystallized chloride to 4 drams of distilled water.

This solution being put into a shallow dish of a size suitable for the sheets of paper, they are taken one at a time by two adjacent corners, and are slowly drawn through the solution, first one way and then the other. They are then pinned by one corner on a wooden screen to dry.

To render this paper sensitive to light, I pursue the following method:—Taking a piece of the paper, and driving

off any dampness it may have contracted by slightly warming it, I then proceed, with a glass rod or a *pellet of cotton*, to coat its surface with ammonio-nitrate of silver as evenly as possible, and then dry it quickly, by holding it to the fire, or by pinning it up in a dry, darkish place. Dampness, either before or after the sheet is coated, is very apt to cause blotches, and hence it is advisable to use the sheet as soon as possible after it has been prepared.

The pressure frame I use is of the simplest construction. It consists merely of a cross-headed flat board, to which is attached by hinges a frame containing a square of plate glass; the pressure being given by a pinching screw.

The ammonio-nitrate of silver is made as follows:—

Nitrate of silver (crystallized), 110 grains.
Rain water (pure), 3 ounces.

Shake till all the crystals are dissolved, and then add liquor ammoniæ (fortissimus) in small quantities till the precipitate at first formed is almost entirely redissolved. Should too much ammonia be added, a few crystals of nitrate of silver will bring back the turbidity, in which condition I find it most suitable.

When the negative and sensitive sheet of paper underneath have been exposed to the action of the sun's rays long enough to make the copy a shade or two darker than it is intended to be when finished, the copy should be immersed as soon as possible into a bath of hyposulphite of soda to prevent the light from exerting any further influence upon it, or, as it is termed, to fix it. This bath is made thus:—

Hyposulphite of soda, 2 ounces.
Water (common), 16 ounces.

To render this bath from the first capable of giving tints equal to an old bath, there should be added a dram or half a dram of chloride of silver, and 40 drops of chloride of gold solution, of the strength already mentioned. Those pictures, which were from the first rather faint, will be fixed after ten minutes' immersion; and darker ones may be allowed to remain as many hours, or until they assume the desired gradation of light and shadow. The pictures must then be

subjected to a thorough washing, so as to remove completely all traces of the hyposulphite of soda bath, which will otherwise be pernicious to the permanence of the colours of the photograph. The copies are then dried; and pressed, or polished on the back.

I have thus endeavoured shortly to describe the manner in which I practise the calotype process, and which I can confidently recommend for certainty and success. I have only given an account of one process, although several others might have been mentioned, being anxious not to confuse or render the description unnecessarily complicated.

The adjustment of the chemical materials to each other is of such importance, that the greatest accuracy is required in their preparation. All the manipulations of the process also require the greatest care.

In conclusion, I trust that my description is sufficiently clear to be understood, and that it may be of use in forwarding the progress of this art, and that it will be followed by accounts of the experience of others.

An Enquiry into the Principles which regulate the Action of Sails and Rudders, with some Practical Suggestions.

By Rev. James Brodie, Monimail, Fife.*

While the practical skill of the British seaman secures for him the foremost rank in his hazardous profession, and while the superior attainments of many of our navigators entitle them to a distinguished place among the cultivators of science, there are not a few questions connected with sailing vessels that have as yet received no fully satisfactory solution. Among these there is none more important than that which forms the subject of our present inquiry; and the author of the following remarks indulges the hope that its importance will plead his excuse for bringing it before the notice of the Society:—

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