XXV.—*On Sun Pictures, by the Calotype Process. By* Douglas T. Kilburn, Esq. [*Read 4th December,* 1853.]

The publications on the principles and practice of Photography are already numerous, and many of them are written with perspicuity and method, so as to form excellent Vade-mecums for the student, whether he may have prosecuted the art for professional gain, or yielded to its delightful and seducing influence as an amateur. My present purpose is not, therefore, to give a history of Photography, or such an elaborate description of its principles as would involve a consideration of the theory of light and of the laws of optics and of practical chemistry, but only to make public, through the means of the Society, the process which I have myself employed in the production of a few calotype views of Hobart Town, &c., submitted for inspection at a late meeting of the Society. An enthusiast myself in the pursuit of Photography, I am anxiously desirous of leading others into the same delightful path; but I am yet only a beginner, and venture with great diffidence to proceed.

Under the general name of Photography are comprised various subdivisions and modifications of the art; such as Daguerreotype, Calotype, Anthotype, Cyanotype, Ferreotype, &c. Of these, the three following have been successfully prosecuted: the Daguerreotype, discovered in 1839 by M. Daguerre, a Frenchman,—the process now so universally employed for taking likenesses on metal plates; the Calotype, or Talbotype, from Mr. Fox Talbot, by whom it was discovered in the same year,—the process upon paper which, however, is only adapted for copying landscapes or buildings; the third is the process upon glass, by means of albumen or collodion,—it is the most recently discovered, and combining the advantages of each, it seems not unlikely, at no distant day, to supersede them both. I may here observe that collodion is a chemical compound of æther and gun-cotton.

Though tolerably conversant with all the three processes mentioned, it is to the second only (the Calotype) to which I crave attention.

The chemicals which I make use of for the production of views by this process are as follows:—

Iodide of potassium,
Bromide of ditto,
Cyanide of ditto,
Nitrate of silver crystallized
Liquid ammonia,
Hyposulphite of soda,
Acetic acid strong,
Nitric acid,
Gallic acid crystallized,
Muriate of soda, (common salt),
Distilled water.

The following are also required:—

A camera obscura with its lens, slides, and portable stand,
A pressure frame for positive pictures,
A pair of apothecaries' scales and weights, and graduated glass measures,
Four square japanned tin baths a little larger than the sheets of paper to be used,
Two tubs for water,
A small still for distilling water,

Several square boards a little larger than the paper,
And some large camel's hair brushes.

Before I describe the mode of preparing the papers, something may be said about the Camera that I use.

Being desirous of taking views of a rather large size, I felt that unless some means could be contrived for diminishing the size of the Camera, the apparatus would be too bulky to be carried about without the aid of two or three persons. The focal length of my lens was about 21 inches. I therefore, when lately in London, ordered a Camera to be made 24 inches in length, 15 in width, and 13 inches in height, and without a top, which I replaced with a double fold of black calico.

The ends were made to slide into grooves, and the sides to fold with hinges flat upon the bottom, which greatly lessened its bulk, and made it easy of carriage.

The stand for the Camera is of French manufacture, has folding legs, and is light and portable.

My lens, which is by Ross, of Holborn, London, is a compound double achromatic one, of 3¼ inches in diameter; when used for the Daguerreotype, it has a focal distance of about 12 inches, and will cover a plate of about 5 by 4 inches.

To adapt it for the Calotype process, I unscrew the two glasses next to the paper, and substitute for them the glasses from the opposite end, with the convex side next to the paper: it has then a focal distance of about 21 inches. To correct the aberration of the rays of light, I place at about 2½ inches in front of the lens, a diaphragm which has an aperture of only a quarter of an inch. A large quantity of light being thus cut off renders the time of exposure very much longer; but as a compensation, the details of the picture are much sharpened, and the lines at the sides are tolerably straight.

Before leaving this part of the subject I must mention, as a curious fact, that these pictures cannot be taken quite so quickly here under the glorious sunshine, which so dazzles our eyes, as in the apparently unfavourable atmosphere of London,—I speak of the west end of London, not of the city, and of course exclude the real London fog days.

The reason is, that the quality of light here is too yellow for photographic purposes. The more northerly we go, the whiter the light becomes; and the whiter the light, the quicker a photographic picture of any kind can be taken.

It is well known that every beam of the sun's light is composed of a collection of rays, which may easily be separated and shown apart by allowing the beam of light to pass through a common glass prism, by which they are refracted, and may be thrown obliquely upon any white surface.

This spectrum (as it is called) will then be found to consist of nine rays (formerly believed to be only seven), of the following colours, and placed in the following order:—

1 .... Lavender
2 .... Violet
3 .... Indigo
4 .... Blue
5 .... Green
6 .... Yellow
7 .... Orange
8 .... Red
9 .... Crimson.

It is likewise known that each collective beam or ray which proceeds from the sun possesses three distinct properties—namely, the property of heat, of light, and of actinism, or chemical power.

By experiment we can determine to which portion of the coloured spectrum each of these three properties belongs;

for instance—the maximum strength of the heating ray is found to lie between the colours red and crimson; that of the lighting ray between the yellow and orange colours; whilst the greatest power of the chemical ray is between the violet and indigo. Curious as it may appear, it is nevertheless true, that neither the light which we see, nor the heat which we feel, have any thing to do with the production of pictures by the sun; it is to the actinic, or chemical and invisible ray, that we are indebted for the wonderful power of so minutely delineating Nature's works and copying the master-pieces of art.

The photographist can easily prove the above facts to be correct by the following experiments:—Let him prepare a piece of photographic paper in the usual most simple manner, namely, by a wash of ammonio-nitrate of silver. This paper, if exposed to the sunlight in Hobart Town, at this season of the year, ought to become quite black in less than ten minutes. By preparing a second piece of paper in the same manner, and submitting it to the sun's rays, with a piece of yellow glass placed over it, the paper will be found nearly insusceptible of change; but if the same prepared paper be similarly exposed, with a piece of blue glass, of a colour so deep as apparently to obstruct all light, placed over it, the paper will blacken nearly as fast as if it were exposed to the unveiled sunlight. The knowledge of this fact enables me to prepare the papers (in that part of the process which would suffer from daylight) without the aid of a lighted candle, by the substitution of a medium of yellow calico, which thus cuts off the actinic rays, while it allows those of light to pass through freely. The following experiment shows conclusively the different degrees of actinic power which belong to the various portions of the spectrum. The rays being thrown by means of the prism upon a sheet of paper, photographically prepared as before, the paper will be found to be very unequally darkened;—at the chemical rays, represented by the colours blue, indigo, violet, lavender, and beyond that shade, the paper will be found to have the intensest black; at the lighting rays, shown by the colours yellow and orange, the paper will retain its primitive whiteness; and lastly, at the heating rays, to which the crimson belongs, the paper will be but slightly affected: the actinic power therefore seems also to belong, though in a minor degree, to the red and the crimson, representing heat—a circumstance which has not yet been satisfactorily explained. The light in Australia, therefore, is too yellow for the production of very *quick* pictures by any of the photographic processes; but it is only a question of time, not of *distinctness*, upon that account.

It is stated that the nearer we approach the equator, the more feeble become the chemical rays; and consequently the more difficult are the pictures to be obtained.

But, besides the chemical power being stronger or weaker in different latitudes, it is also found to be affected by the seasons and by the different times of the day; thus the Spring and Autumn, and the early morning, are found to be the most favourable periods for the production of *quick* pictures. I shall now proceed to describe my method of preparing the papers.

Preparation of the Negative Paper.—Choice of Paper.

Whatman's English paper is very good, but rather too thick for negative pictures, and hardly sufficiently well sized for positives.

Turner's paper is good, but too expensive.

Canson-fre-res, a French paper, is very well sized, but a little too thin for negatives, and more so for positives.

The above, however, are the best papers with which I am acquainted.

1st *Operation—Iodising.*

Take 20 grains nitrate of silver, and dissolve in ½ an ounce of distilled water in a small glass-stoppered bottle. Take also 4 drachms of iodide of potassium, 4 grains of bromide of ditto, and dissolve in ½ an ounce of distilled water in another glass bottle.

These mixtures will not spoil by keeping, but ought not to be exposed to daylight.

When wanted for use, drop say 50 drops of the first mixture into a glass vessel, then add so many drops of the second solution, until the white precipitate which forms is re-dissolved, and the compound mixture becomes clear like water. Take a sheet of paper, and having marked with pencil one side, that you may know it again, pin it by one or two of the corners on to a deal board a little larger than the paper; then holding the board inclined, dip a clean large camel's-hair brush into the compound solution just described, and brush the paper smoothly and evenly across the sheet, and afterwards from the top to the bottom; the greatest care being taken that no part of the paper is omitted in brushing it over.

Dry by hanging the paper up by one corner; half-a-dozen papers may thus be coated at once. When quite dry place the papers with the coated face downwards in a large tub of clean water, and let them soak in it for twenty-four hours or so, according to the heat of the atmosphere; when taken out and dried, by hanging up by the corner, they will be found to be tinted on the prepared side of a delicate straw colour. They will keep for any length of time without being affected by the light, care being taken never to touch the prepared surface with the fingers.

2nd Operation—The Sensitive Solution.

The following process must be performed by the light of a candle, or if by daylight it must be passed through a yellow medium, and the chemicals must be carefully guarded from the sun-light.

Take 25 grains nitrate of silver, $1\frac{1}{4}$ drachms acetic acid, $\frac{1}{2}$ an ounce of distilled water, mix in a glass bottle, then make a saturated solution of Gallic acid with distilled water in another bottle; when required for use mix 15 drops of the aceto-nitrate solution, with 30 drops of saturated Gallic acid, in 6 drachms of distilled water. Brush this into the prepared side of the paper, fastened on a board as before, with a clean brush, and let it remain for about a minute, the board being inclined. Then place the paper between folds of blotting-paper until nearly dry. It is now fit to be placed in the camera; and it is better to use it as soon as possible after the above preparation:—this last solution will not keep above a day.

3rd Operation—In the Camera.

Place the paper prepared as above, and carefully secured from the daylight, with its face to the glass of the frame of the camera; then slide the frame into the camera.

The focus of the object must previously have been carefully adjusted on the ground glass of the camera. The time of exposure can only be learned by practice; it will vary with the intensity of the chemical light on the day or season of the operation; also with the degree of care devoted to the preparation of the paper.

4th Operation—The Development of the Picture.

The paper upon its removal from the camera rarely exhibits any trace of a picture. It must still more than ever be kept from the daylight.

Mix 1 part of aceto-nitrate solution with 3 parts of saturated solution of Gallic acid, as described in the 2nd operation. Take a clean brush and lay this on for a quarter of an hour, or until the picture is thoroughly developed: when the Gallic acid is used the brushes must be frequently changed, or soaked in a strong solution of nitric acid.

5th Operation—The Fixing.

Mix 1 part of saturated solution of hyposulphite of soda with 6 parts of clean water. This should be poured into a vessel sufficiently large to contain the paper lying flat. When the picture is considered to be sufficiently developed, it is to be plunged into this solution with the face downwards, and kept there until the yellow colour produced by the iodide of silver has entirely disappeared, which would be in about an hour. The solution will serve for a number of pictures if fresh hyposulphite is added occasionally, and the dirt extracted, by its being filtered through blotting-paper.

6th Operation—Removal of Hyposulphite.

I soak the picture for some time in two vessels of water, then dry by hanging it up by the corner. This finishes the production of the negative picture, the most difficult of the two. In a perfect negative, nature is as it were reversed: the sky and bright lights should be quite black, and the trees and shadows ought to be nearly as white as the colour of the paper.

The picture, if carefully fixed according to the above directions, will be quite unalterable by daylight. Care should be taken to keep the back free from spots and blots, as they would cause white blotches in the positive pictures, now to be described.

7th Operation—The Positive Paper, or Printing Process.

Dissolve 8 grains muriate of soda (common salt), in 1 ounce of distilled water. Take a clean sheet of paper, and having, as before, marked one side, fix it on to a board and sponge it quickly and evenly over with this solution. Dry it, and keep it for use.

8th Operation—Sensitive, for Positive Paper.

Dissolve 50 grains of nitrate of silver in 1 ounce of distilled water. Drop into this solution as many drops of liquid ammonia as will cause the white precipitate which then forms nearly to clear—then stop; add to it 4 or 6 drops of acetic acid, and shake up the mixture, which will keep without change if closely shaded from daylight. Brush this into the positive paper prepared in the above-mentioned manner; then dry it thoroughly (by candle-light only), and the paper will keep for twelve hours or so.

9th Operation—In the Pressure Frame.

Place the prepared paper and a negative picture face to face, and then put them into the pressure frame, with the back of the negative picture next the glass; so that when placed directly opposite the sun, its rays may pass through the negative picture to the positive paper placed beneath. The improved pressure frames will permit half of the picture to be examined without disturbing it, which will enable the operator to watch the process. When sufficiently darkened, it should be removed and fixed as follows.

10*th Operation—Fixing the Positive.*

Take 2 ounces of hyposulphite of soda, 1 quart of clean water. Make of these a bath in a tin vessel. Plunge the positive picture into the bath, and keep it in for an hour or two. The impression will appear to fade whilst in this bath, but when dried it will be found to have regained its tone.

The colour or tone may to a certain extent be modified by the length of time that the picture is kept in the hyposulphite bath. This solution will serve for several impressions, and will improve by use.

11*th Operation—And Last Process.*

Remove the picture from the above bath and pass it through two waters successively to cleanse it from the hyposulphite. It should remain in the last water for an hour or so. Then dry it as before directed, and it is finished. A hot smoothing-iron passed over it will deepen the tone considerably. The positive pictures never arrive at the sharpness and minuteness of detail which the negatives possess. The latter are made more transparent by saturating with white or virgin wax, and by this means the positives are rendered more distinct. The process of waxing, however, is very troublesome. Stains on the fingers may be removed by a strong solution of cyanide of potassium.

I have thus succinctly described my *modus operandi*, which differs considerably from that patented by Mr. Fox Talbot.

I have tried others, but I find this method the easiest and most certain.

Some calotypists use successive washes or baths of nitrate of silver, and solution of iodide of potassium, &c. Some wash first with the iodide solution, and then brush on the nitrate washes. Others again use the iodide bromide solution alone, &c.: but it would take volumes to contain all the processes and fancied improvements.

Without wishing to exalt the Calotype process above its great rival the Daguerreotype, I think that it possesses the following advantages:—Paper, the material upon which it is taken, is less costly and cumbersome than the metal plates of the Daguerreotype; the artist is not so much at the mercy of his subjects, as landscapes and buildings are not so troublesome to copy as nervous or fidgetty sitters for portraits; and lastly, the power of producing an infinity of copies from one matrix is not the least of its attractions.

On the other hand, the extreme minuteness of detail and sharpness of outline which the Daguerreotype gives is not to be obtained by the Calotype process. The time of exposure in the latter is fully five times as long as in the former, which renders its application to portraits impracticable.

It will readily be comprehended that the extreme uncertainty of success in this process, even after the greatest care and attention has been bestowed upon the preparation of the papers, renders the amusement highly exciting. At the moment that the paper is removed from exposure in the camera, there is no indication whether the operation may or may not have failed. Until the Gallic acid solution is applied the paper is generally white, or rather straw-coloured, as at the commencement of the operation. After, however, a few minutes application of the Gallic acid, a slight change comes over the paper, the line of the sky is clearly marked and begins to darken, and the trees which cut it remain white—the buildings begin to appear: the operator watches them attentively as they seem to grow out of the paper. What is that?—a large part of the picture still retains its original whiteness. He cannot make it out; he applies more Gallic acid without any improvement, the white blot still remains; and the disappointed operator is at last obliged to acknowledge with regret that his negative is a failure. The most frequent cause of these disagreeable failures is, I think, the presence of organic matter in the water used in the first operation, which cannot always be obtained quite pure. Newly-caught rain water or spring water, not too hard, are the best.

Other causes of failure are the following. The paper may not be evenly or well made, the size upon it may not be pure, the paper may have been touched by dirty fingers; the chemicals may have been spoilt by the voyage from England, may not be pure, or may not be evenly spread upon the paper.

Many trials and the greatest care are requisite to produce even moderately good impressions. When, however, really good negatives of interesting subjects are obtained, they are truly valuable; as with care an unlimited number of copies may be procured from them, each slightly varying in tint from a rich brown to jet black.

If successful, the enthusiastic photographist feels that his labour is repaid, since he possesses the power of making copies from nature which in tint rival sketches produced in sepia and Indian ink, and surpass them in accuracy and minuteness. The labour of several days must be applied to the production of sketches by the hand such as would compete in finish with the pictures produced by the sun in a few minutes.

The value of the Calotype pictures to the artist, as subjects to copy from, is very great. By their aid he is enabled to correct his perspective; to carry into his studio the designs from which he can work up his drawings to the highest degree of finish; to give to each object in his picture its exact size and value,—as it often happens in drawings that more than a proper degree of importance is given to objects which in nature are small and insignificant; and lastly, to use the calotypes as a study for the correct mode of throwing the shadows,—for nature itself, being its own artist, cannot err on these points.

I fear that I have but imperfectly described this most interesting process. There is so much to be said upon the subject that the difficulty has been to compress my communication within the limits of an ordinary paper. But if in any part of my description I have not made myself sufficiently intelligible, it will give me pleasure to assist personally any members of the Society who may desire to practise the delightful and amusing art.