Section of Photography and Microscopy.

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Teachings and Practice of the Lumiere Starch Grain Process.

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THE PRINCIPLE OF THE PROCESS.

If on the surface of a sheet of glass, and in the form of a single film, a collection of microscopic elements, transparent, and colored reddish orange, green, and violet are spread, we shall find, if the spectral absorption of these elements is correct, and if they are *in correct* proportions, that the film thus obtained, when examined by transmitted light, will not appear colored; this film will only absorb a fraction of the transmitted light.

The luminous rays traversing the fundamental screens, orange, green, and violet, are reconstructed, and from white light if the sum of their surfaces for each color, and the intensity of the coloration of the constituent elements exist in proper proportions. The thin trichromatic film thus formed is subsequently coated with a panchromatic emulsion.

If now such a plate be submitted to the action of a colored image, taking the precaution to expose it through the back, the light rays traversing the fundamental screens, will, according to their color and the color of the screens they encounter, suffer a variable absorption. Thus we realize a selection by the microscopic elements which enables us, after development and fixation, to obtain colored images; the colors being complementary to those of the original.

HOW THE COMPLEMENTARY (NEGATIVE) IMAGE IS FORMED.

If we take, for example, a part of the image colored red, the red rays will be absorbed by the green elements of the film, whilst the violet and orange elements will transmit them. The panchromatic film, therefore, will be acted upon under the orange and violet elements, and the green elements will appear, after the fixation, because the panchromatic film has not been acted upon under the green elements.

Development will reduce the silver bromide of the films and

mask the orange and violet elements, and the green elements will appear, because the silver bromide has not been reduced under them. We have, then, in this case, a residue colored green, which is complementary to the red rays we have been considering. The same phenomena will occur with the other color; that is to say, with green light, green elements will be masked, and the film appear red. In the case of yellow, the violet image will appear, and so on. It will be seen that a negative in these complementary colors ought to give, with a plate prepared in the same way, positives which would be complementary to the negative; that is to say, positives which would produce the colors of the original.

One might also, after development of the negative image, omit the fixation, and reverse the image by one of the well-known methods so as to obtain a positive direct, which would present all of the colors of the original object.

The difficulties which we have encountered in the application of this method are numerous and considerable; but, after laborious researches we have surmounted them, and the Lumiere Company is prepared to supply such plates.

It will be sufficient to briefly indicate some of the most important conditions which had to be fulfilled to prove how delicate the problem was.

TECHNICAL PROBLEMS OF THE PROCESS.

We have first to find the film formed of microscopic filters, orange, green, and violet. It was necessary that this film should adhere to its support, be very thin, and that the coloration of the elements of which it would be composed should be rigidly determined as regards intensity and exactness of color, and as regards the number of elements to a given area. The colors must be stable, they must not run, and there must be no superposition of the colored filters, and no interspaces. Finally, the film has to be covered with varnish having the same index of refraction as the grains.

It was essential that the sensitive film should be orthochromatized—so that there should be no false rendering of colors—and that this orthochromatizm should be in a relation to the nature of the emulsion and the color of the elementary filters. The film of the emulsion should be of a special nature to prevent

diffusion, and the manipulations, development and exposure should be appropriate to these preparations.

The simple enumeration of one of the conditions will serve to show how much care and method is necessary. First, potato starch had to be separated by instruments specially devised for the work, for the grains have a diameter of from 15 to 20 thousandths of a millimetre. These grains were divided into three lots, which were respectively stained reddish-orange, green, and violet, by the aid of special coloring matters.

The colored powders thus obtained were mixed, after complete desiccation, in such proportions that the mixture did not show any residual color. The resultant powder was then brushed on to a sheet of glass, covered with a sticky substratum. With suitable precautions, we shall obtain a single film of grains, which touch each other without any superposition.

The interspaces had to be filled by a similar process of powdering so that no white light was transmitted. This obscuration is effected by means of an extremely fine, black powder of wood charcoal, for example.

We have thus formed a screen on every square millimetre of surface, of which there are eight to nine thousand of small elementary screens, orange, green, and violet. The surface thus prepared is protected by a varnish having about the same refractive index as that of the starch grains, a varnish as impermeable as possible, on which finally a thin film of sensitive panchromatic emulsion of silver bromide is coated.

The exposure is made in the ordinary way in any camera, but in every case taking the precaution to reverse the plate so that the rays from the lens traverse first the colored particles before reaching the sensitive film. It is also necessary to interpose a special yellow screen to compensate for the excessive activity of the violet and blue rays. The absorption due to the interposition of the colored elements, although a very sensitive emulsion is used, necessitates a somewhat longer exposure than usual. Still, it is possible to obtain results in sunshine in one-fifth of a second, with a lens working at f/3.

Development is effected as in an ordinary photograph, and if one is content to fix the image, the result will be, as we have already pointed out, a negative presenting by transmitted light the colors complementary to those of the object photographed. But

it is preferable to re-establish the order of the colors, on the same plate, by chemical reversal of the image. For this, the silver reduced by the developer is dissolved by a suitable bath, and then the remaining silver bromide is developed, producing a black image, which is complementary to the negative obtained by the first development.

It will thus be seen that the manipulations are simple and only slightly different from those of ordinary photography.

PETROLEUM IN ITALY.

As early as 1893 a French company obtained a concession from the Italian Government to explore a certain tract in the Apennines, near Piacenza, and to export any deposits of petroleum found there. The success of this company was sufficient to cause the formation of another French syndicate four years ago, and last July these two were absorbed by a Genoese company, with a capital of $3,000,000. The wells already bored are some 95 in number, of which 70 are practically exhausted. The remaining 25 produced about 40,000 barrels of crude oil in 1905, and with the eight wells now boring it is expected that the total production for 1906 will have reached over 65,000 barrels. The concession of the new company comprises about 11,000 acres.

The wells, none of which are gushers, reach a minimum depth of 1300 feet and the engineers in charge say that those which are exhausted may be made to yield again by deepening. This has not as yet been undertaken, perhaps because by the terms of the grant it is necessary to bore new wells in order to maintain control of the territory. A central motor is used to operate, by cables, the pumps of the various wells.—*Eng. and Min. Jour.*

OLD AGE PENSIONS for workingmen will be made the chief object of the labor members of the British Parliament at the present session. The Parliamentary Committee of the Trades Union Congress, in its public manifesto urging this legislation, says that commissions and committees have sat long enough and that the time has come for action. It states that "half a million of old people over sixty-five years of age are dependent upon charity or Bumbledom for the ordinary necessaries of life; the pressure of workshop life is such that old people find increasing difficulty in getting employment, and the workhouse is, in too many instances, the only refuge after a life of labor." It is added that about 200,000 persons are now in receipt of over £9,000,000 a year in pensions from the exchequer, most of whom were well paid in the public service. The plea is that the "soldier of labor" be now put on the list.—*Iron Age.*