

because many of its compounds possess the curious property of fluorescence, or rendering visible the chemical rays of light, by converting them into rays of a less refrangibility. Its properties in this respect have been well investigated by Professor G. G. Stokes. A beautiful transparent yellow glass, with a green tinge, is frequently met with in commerce, being largely used for ornamental purposes. If this glass be examined by candle-light, it will be seen to be perfectly transparent, and to have no green tinge, but if looked at in daylight, especially if the sun shines on it, it will become almost opaque, reflecting back a strong greenish-blue light. On concentrating a beam of sunlight on to a thick piece of this glass by means of a lens of one or two inches focus, the cone of light will be traced out through the glass by a strong luminosity, appearing as if the particles of the glass were in some degree opaque to the light. This effect is caused by the invisible chemical rays present in the incident light being lowered in refrangibility, and thereby converted into luminous rays by the action of the uranium compound in the glass. This effect may perhaps be better understood by some of our readers, if we consider the uranium glass to have phosphorescent properties, and to be excited into luminosity by the chemical rays of light.

If a slab of uranium glass be employed as a screen for receiving an image of the solar spectrum, especially if the latter be pure enough to show the fixed lines, the appearance is very striking. Where the visible spectrum falls no particular effect is produced, but as the eye travels along the band of colours up into the blue and indigo end, the lines in these parts, difficultly visible under ordinary circumstances, shine out with unaccustomed brilliancy. The line H, barely detected by the unaided eye, is remarkably prominent, and beyond, far into the regions of darkness, are seen groups of lines, some as fine as spider threads, some like great black bands stretched across, cutting almost through the slab of glass, which glows through its whole body with an indescribable phosphorescent light, except where the jet-black lines intersect it. If the prismatic apparatus be of quartz, and a fine summer's day be selected for the experiment, the length of the solar spectrum will be apparently increased four or five fold. Starting from H, near the limit of the visible spectrum, but almost the commencement of the invisible part, we see the broad band *k*, the curious group of four nearly equidistant lines, *m*, the somewhat allied band *n*, and then a host of other lines to which physicists have given letters, until the alphabet itself proves too humble for its requirements, and other lines and groups are detected faintly following *x*, *y*, and *z*. Professor Stokes, who has thoroughly investigated the action of uranium compounds upon the higher rays of the spectrum, considers that for some purposes a slab of uranium glass is not the most convenient for purposes of observation. Glass must be viewed in one particular position, in order to see the lines with the best effect, and in many cases it would be more convenient to have a screen prepared by means of a highly fluorescent powder applied like a water-colour on paper, which could be viewed in all directions indifferently. The professor states that he has long regarded it as a desideratum to obtain by precipitation an insoluble or sparingly soluble salt of sesquioxide of uranium, which should be as fluorescent as the best salts of that base, and which might be treated as a water-colour. He has recently succeeded in preparing such a salt, though not by direct precipitation. The ordinary phosphate obtained by precipitation is only slightly fluorescent. If, however, this salt, with as much water as remains when it is washed by decantation, be put into a saucer, a little free phosphoric or sulphuric acid added, and then crystals of phosphate of soda, phosphate of ammonia or borax be added in excess, the original salt is gradually changed into one which is powerfully fluorescent. The change seems to take place most rapidly with borax, but as an excess of this salt is liable to decompose the fluorescent salt first formed, it is better to

employ a phosphate. The quantity of acid should be sufficient to leave a decided acid reaction when the liquid is fully saturated by the alkaline phosphate employed. The change may be watched by observing, from time to time, the fluorescence of the salt by daylight, with the aid of absorbing media. It is complete in a few days at furthest, when the salt is ready to be collected. This requires precaution, as the salt is quickly decomposed by dilute acids (and, accordingly, by its own mother-liquor, if diluted), and even, though more slowly, by pure water, with the formation apparently of the original phosphate. It is also decomposed,—at least, in time—by alkaline carbonates, with the formation of a beautiful yellow non-fluorescent salt, resembling the precipitate given by alkaline carbonates in salts of sesquioxide of uranium. The salt may be collected by adding at once, instead of water, a saturated solution of borax, in quantity at least sufficient to destroy the acid reaction. The salt is then poured off in suspension from any undissolved crystals of the alkaline phosphate employed and collected on a filter. A pressed cake of this salt, or a porous tile, upon which the salt is spread, having been moistened with a solution of borax, forms an admirable screen. It shows, of course, the visible as well as the invisible rays—the former by ordinary scattering, the latter by fluorescence.

Hitherto the only uranium salt used in photography has been the nitrate. This seems to be rather an inappropriate salt; for since the action of light upon it is to reduce a higher to a lower state of oxidation, it is clearly inadvisable to employ as the sensitive surface a salt containing so much oxygen as the nitrate. Analogy with other photographically sensitive compounds would lead us to propose that some organic compound of uranium should be used, as, for instance, the acetate, which is likely to be far more acted upon by light than the nitrate. Acetate of uranic oxide is prepared in the following way:—Nitrate of uranium is placed in a porcelain dish and gently heated with a spirit lamp. It fuses at first in its water of crystallisation, and at a higher temperature decomposes, oxygen going off. If the source of heat is removed when it begins to evolve oxygen a yellowish-red mass is obtained which still contains nitric acid. This is heated with glacial acetic acid, when it entirely dissolves. The solution, upon being evaporated to the crystallising point, deposits acetate of uranium, the surplus nitrate of uranium remaining in the mother liquor.

When the acetate separates from a very acid solution by a slight reduction of temperature it forms yellow oblique rhombic prisms, which dissolve in water with slight decomposition and crystallize out on evaporating the solution. They contain two atoms of water of crystallization. When a saturated solution of this salt, at the ordinary temperature, is cooled to a lower degree, square based octohedra separate, which are the same acetate of uranic oxide, but with only one atom of water. If carbonate of ammonia be added to a hot solution of uranic acetate till a precipitate begins to separate, and acetic acid be then added, a solution of a double acetate of uranium and ammonium is formed. Upon allowing this to crystallize it separates in thin yellow silky needles, readily soluble in water and slightly acid to test paper. They are not decomposed by water even when boiling. In a similar manner double acetates can be prepared containing uranium and potash, soda, ammonia, &c. As these are in every respect stable salts it is more than probable that really valuable photographic compounds may be obtained from them.

ON DEVELOPING THE PHOTOGRAPHIC NEGATIVE.*

BY M. AUG. TESTELIN.

When a negative developed with pyrogallie acid is nearly completed, there forms a yellow deposit on the surface, or rather a sort of fatty film so adherent that a stream of water will not detach it. This deposit arises from the decomposi-

* Continued from p. 167.