THE FUTURE OF PHOTOGRAPHY: AN EARLY PROPHECY BY ARAGO.

At the present time almost everyone makes photographs. Photography is a universal pastime, but it is also a scientific process of marvelous power, and it can be said without exaggeration that it has transformed many of the sciences heretofore dependent upon observation, and introduced into them an almost automatic precision otherwise impossible. This French discovery, the artistic applications of which were at first the most prominent, now appears in its true light as one of the important achievements of the last century, which has seen so many. This seems all the more true as one considers the great field opened to it by the Roentgen rays, etc., and the extensive part that it still plays among things unexplained and unknown. Scientifically the multitude of problems which it asks without answering offers to the physicists of the future one of the most interesting domains to be explored—one of those where they will make, without doubt, the most curious and decisive observations on the inmost essence of matter and of force; practically, we lack only photography in colors, in the development of which we are, at present, at the period corresponding to that of the daguerreotype in monochrome photography. Under these conditions there is considerable interest attached to the predictions made concerning photography at its beginning, some sixty years ago, by one of the most brilliant scientific spirits of the past century—the great Arago.

The report of 1839, an abstract of which we are about to give, is entitled "Report made to the Chamber of Deputies on the Daguerreotype, a process invented by M. Daguerre for producing the images of nature obtained in the camera obscura." This scientific report was addressed to the Chamber, so that it would pass a law according a national recompense to Daguerre. In this report, where Daguerre's process was for the first time made public, Arago recalls at first the camera obscura, the invention of the Neapolitan Giovanni Porta, and the desire aroused immediately in all those who had observed the reproduction of objects in this camera to see a means discovered of perpetuating it. "In the eyes of all," adds he, "this was a dream destined for a place among the extravagant conceptions of a Wilkins or a Cyrano de Bergerac. The dream, nevertheless, has just been realized."

Taking up then the history of the subject, he recounts the first results obtained by Niepce in 1827, results that seemed adapted only "to the photographic copying of engravings." Niepce, who, as we know, allowed light to act on the bitumen of Judea, was obliged to make sun-exposures ten or twelve hours. This rendered impossible the reproduction of even inanimate objects, as the shadows, in this interval of time, would pass from one side to the other. The daguerreotype, the principle of which it is useless to recall, but the two principal instruments of which we reproduce from the drawings of Arago, had just realized an enormous progress.

The apparatus consisted of the sensitizing and developing boxes shown in Figs. 1 and 2 respectively. The silvered copper plate was placed face downward on the supports, *h h*, Fig. 1, and sensitized by fumes from pieces of iodine placed in the cup, *e*, which formed a coating of iodide of silver on it. The exposure was then made and the plate developed by placing it in another box, Fig. 2, where it was exposed to the fumes of mercury at a temperature of 120 deg. to 130 deg. F. The mercury was placed in the bottom of the box, *P*, and heated by the alcohol lamp, *U*. The development was watched through the window, *S*. The plate was afterward fixed in a hyposulphite of soda solution.

"The rapidity of the method," says Arago, "is perhaps what will most astonish the public. In fact, scarcely ten or twelve minutes are needed in the dark days of winter to complete an exposure of a monument or a street scene. In summer, with bright sunlight, this time can be reduced one-half." What would he have said at the one one-hundredth of a second exposures of to-day? But the remark that follows is of still greater interest at the present moment: "The making of a daguerreotype does not include a single operation that cannot be learned by anybody. It does not require any knowledge of drawing or any manual dexterity. By conforming point by point to certain very simple directions there is no one who cannot succeed as certainly as M. Daguerre himself."

In the following note is also to be found a scientific truth that is truly remarkable: "People will perhaps have made thousands of beautiful daguerreotypes before its mode of action will have been completely analyzed." Not thousands, but millions of photographs have already been made, and the essential principle of the process has not yet been determined, viz., the modification undergone by the iodide, the chloride, or the bromide of silver under the action of light—a modification that only becomes visible under the action of the developer.

Arago thought immediately of the reproduction of monuments in foreign lands, of exact copies that the Egyptian expedition could make of hieroglyphics afterward destroyed. He indicates, along with Paul Delaroche, the advantage that painters will have from photography (an advantage which of all the primitive hopes is the one the least realized, since it has brought us only those make-believe photo-chromos against which the true artists have reacted by impressionism);

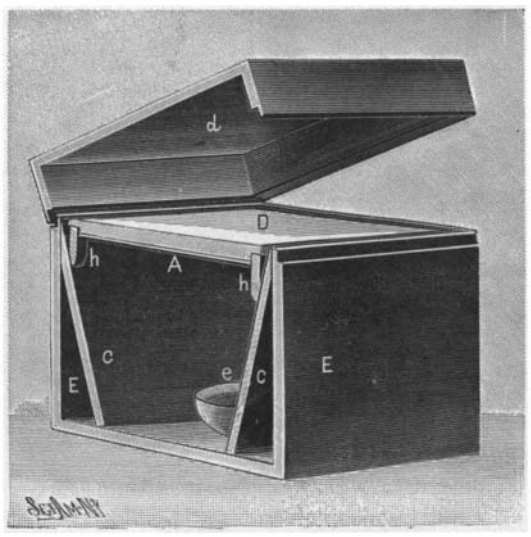

Fig. 1.—SENSITIZING THE DAGUERREOTYPE PLATE.

he asks but two principal questions (which make us smile to-day)—whether photographic methods will become common, and whether they can be applied to portraiture.

Replying to the first he remarks that the plate used by Daguerre is a trifle cumbersome, and that it might be preferable to have sensitive paper, as Daguerre had thought of at first. In connection with this, we know what have been the successive steps surmounted in obtaining a proper support for the sensitive surface; plates of copper coated with silver, waxed paper, glass, and, finally, celluloid film. The numerous defects of this last substance as it is manufactured to-day, the constant failures that it occasions by its rapid decomposition, by the difficulty of handling it, etc. and the fatigue that it causes when developing it, make it much to be hoped that some one will soon discover the photographic paper dreamed of at first by Daguerre.

The price of daguerreotype plates is equally curious to recall; it ranged from 60 to 80 cents per plate. Here, too, is another amusing passage: "They delude themselves—those who, but recently, when about to set out on a journey, declare they wish to make use of the different times when the stage is ascending hills to take pictures of the surrounding country. A person is no less deceived when, struck by the curious results obtained in reproducing pages and engravings from very old works, he dreams of the reproduction and multiplication of photographs by lithographic methods." What would Arago have thought if he could have been transported into Switzerland in 1901, in the midst of the army of hand cameras, which operate

Fig. 2.—DEVELOPING A DAGUERREOTYPE WITH MERCURY FUMES.

even on trains in motion (it is true that the movement of Swiss trains is majestic), in the midst of misses and fräuleins who send home souvenirs on postal cards illustrated by photographs? The following reflection, however, counteracts the disappointment that this future causes him: "But it should be remembered that when observers apply a new instrument to the study of nature, what they hope to obtain is relatively small, compared to the succession of discoveries of which it becomes the origin. For this reason it is on the unforeseen that one must especially count."

As for portrait photography, this is what Arago said of it: "In general, we are scarcely disposed to admit that one will ever be able to use the same instrument to make portraits. The problem contains, in fact, two problems apparently irreconcilable. In order that the image may be obtained quickly, that is, within the four or five minutes that the person posing must remain immovable, it is necessary that this person sit in bright sunlight. But such a bright light causes the most impassive person to wink and squint involuntarily." And he then tells how Daguerre in some measure got around this difficulty by interposing a blue screen.

The scientific side of the question naturally appealed to Arago. He mentions immediately the possibility of making photographs of the moon, of studying the rays of the spectrum, etc.; but what he says about photography in colors is particularly interesting, since in that lies for us the problem of the future.

"The question has been asked," he says, "whether we will ever be able to reproduce colors by the daguerreotype. . . . This problem will be solved the day some one discovers a substance that the red rays color red, the yellow rays yellow, the blue rays blue, etc. M. Niepce has already described effects of this nature where, in my opinion, the phenomenon of light interference in thin films plays a certain rôle [this is the principle of the great discovery of M. Lippman]. Perhaps he has accomplished the same with red and violet as Seebeck obtained simultaneously on chloride of silver, at two ends of the spectrum. M. Quetelet has just sent me a letter in which Sir John Herschel announces that his sensitive paper, after having been exposed to a very brilliant spectrum, showed all the prismatic colors with the exception of red. In the face of these facts it would be hazardous to affirm that the natural colors of objects will never be reproduced in the photographic image."

We have with us to-day, sixty years after, the same problem. We can produce, by a prolonged exposure, veritable colored and fixed daguerreotypes, but the color can be seen only by holding them at a certain angle and the plates are not susceptible to the obtaining of multiple prints. This is about the point to which photography had advanced in 1839. Perhaps the next half century will give us real photography in colors; that is, the direct and complete fixing of the colored image as it is seen on the ground glass of the camera.—La Nature.

Hydraulic Plant at Vizzola, Italy.

The hydraulic plant of Vizzola, which already distributes more than 15,000 horse power for lighting, traction and electrolytic industries is the most important installation which has been made in Italy up to the present time. The abundant waters of the Tessin, from the point where it leaves the Lago Maggiore to its confluence with the Po, were long used for irrigation, but until recently no attempt had been made to utilize their fall, which is considerable, for the production of light and power. A project had been set on foot as early as 1889 in connection with the Villoresi irrigation canal which provided for utilizing about 40,000 horse power, and in 1896 the Italian company obtained an authorization from the government which would allow of the development of this project and give them a fall of 75 to 90 feet. In the winter of 1898 the work upon the hydraulic installation was begun by the Lombard company and their great undertaking was brought to a successful end after more than a year's work. The mechanical and electrical parts of the plant have also been well carried out. The machinery building, which is erected near Vizzola, contains a plant which will produce 23,000 horse power when working at full load. There are 10 generating groups, all alike, each being made up of a horizontal turbine directly connected to a dynamo; each group has a capacity of 2,200 horse power. There are also a number of smaller turbine groups for use as exciters, etc. The large turbines have been built by an Italian firm, Riva, Monneret & Co., of Milan, and the electric outfit has been installed by the Schuckert company. The triphase current leaves the station at a tension of 11,000 volts, and is carried by 24 main feeders to the distribution circuits for lighting and power, which have a total developed length of 90 miles. These circuits supply all the neighboring region. The present distribution of energy from the Vizzola plant has reached 15,000 horse power, and is continually on the increase. It is estimated that by using hydraulic power this plant makes a yearly saving of $500,000.

A Moth's Knife.

The Entomologist describes a peculiar instrument by means of which the silk-producing moths of the Australian genus Antheræa cut their way out of their hard cocoons. The instrument "is a short, hard, black, and curved thorn, situated in the thick joints at the base of the forewings, one on each side. In a rubbed specimen the thorn is easily discernible; but in a good one it is concealed among the dense scales."