A NOTE UPON ENAMELS.

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It has long been known that if it is desired that enamels shall be brilliant and transparent, it is essential to wash the enamel after it has been reduced to fine powder, prior to its application to the work, rejecting the lighter portions, which eventually settle from the washing water as a fine mud, and that the coarser the powder the more brilliant the fused enamel will be. But, although the fact is known empirically, its rationale is not well understood, and, indeed, I cannot find that it has ever been carefully investigated, although more or less unsatisfactory explanations have been offered. With a view to ascertaining what really happens I lately undertook a short series of experiments, which seem to throw light upon the question. I first took an ordinary transparent flux, of fairly high fusing point, and applied portions of this after powdering in an agate mortar to a piece of gold, one portion being unwashed, and the other thoroughly washed. The former, the unwashed, fused into a very cloudy film, which, on microscopic examination, was found to owe its opacity entirely to an infinite number of very minute round air bubbles; no solid opaque particles could be found in it, nor was the matrix between the bubbles at all opalescent. The washed sample yielded a perfectly transparent, colorless film, which on being examined was found to contain but few air bubbles, and these of large size. It therefore appears that the dirty cloudy look of an unwashed enamel is due to the dissemination all through it of exceedingly small bubbles, and not to any opacity in the material itself; this agrees with the statement made to me by a very experienced worker in enamels that an unwashed enamel, or the rejected mud from washed enamel, always yields what he termed a "rotten" coating. Several experiments having given precisely the same result it remained to discover the cause of the bubbles. In Mr. Cunynghame's valuable "Art Enameling Upon Metals," 1899, it is suggested that "The reason why the mud becomes opaque when fused upon the metal is, I think, that a portion of the coloring matter is separated, and that the enamel becomes partly decomposed by the action of carbonic acid upon the alkali which it contains. The carbonates of soda or potash thus formed become, on heating, again decomposed by the silica, and minute bubbles of carbonic acid gas are formed."

This explanation from a chemical point of view did not appear to me probable, and it admitted of being readily tested in several different ways. A small portion of very cloudy enamel was rapidly crushed in a few drops of distilled water, passed through a tiny filter, and the filtrate produced no precipitate with lime-water. It was, therefore, pretty certain that the bubbles did not contain free carbonic acid gas. A portion of transparent enamel was powdered, dried and weighed in a very sensitive balance; it was then rubbed up with distilled water for some time and left in the water for four hours; it was then repeatedly washed, being allowed time to settle before pouring off the washing water. After being again dried its weight was found to be unchanged, with the exception of a very trivial loss, accounted for by the opalescence of the first washings.

A further portion was weighed after being coarsely powdered, then rubbed down into very fine powder and thoroughly washed. The residue was thrown upon a weighed filter, washed and dried, and then again weighed. The washings, which had they been allowed to settle would have deposited "mud," were also passed through a weighed filter, dried and weighed again. The sum of the two weights amounted to just that of the original powder with the exception of a very small loss, which was anticipated, as the filtrate after repeated filtration remained slightly opalescent. It is astonishing to find that when a glass is powdered even coarsely some part of it passes almost at once into a powder of such extreme fineness that it passes through a filter, and the longer the powdering is continued the more of this exceedingly fine powder is formed. It is this which is got rid of by washing, and it is this which by its presence causes opacity in the fused enamel.

But it is hardly conceivable that any chemical change can have taken place without alteration of weight; if carbonic acid were taken up, as suggested by Mr. Cunynghame, there would be an increase of weight, while if any soluble material were removed there would be loss. And microscopic examination of the coarser portions and of the mud reveals no difference in the particles except in their size; each alike consists wholly of angular transparent particles. A further portion of powdered enamel was digested for some hours in a saturated aqueous solution of carbonic acid, and on drying and weighing was found to have undergone no change in weight.

In all these cases the filtrates, after being left for some days to settle, so as to get rid of the slight opalescence, and then decanted, yielded no residue on evaporation. It may, therefore, be concluded that no chemical change takes place, but that the inclusion of air in the ultimate fused enamel, when this is opaque, is due to mechanical causes only. Probably what happens is that the very fine particles, especially on the surface, become very thickly agglutinated by the heat of the furnace, entangling between and beneath them an infinity of fine bubbles; but that when coarser particles are fired they run together more slowly, and then the air escapes for the most part, the little which remains forming large bubbles which do not practically interfere with the transparency. No transparent specimen of enamel fused on metal which I have examined was ever quite free from bubbles, while the opaque specimens were virtually consolidated froth.

In one instance only did I meet with a different result. In this case the enamel was an opaque white of very low fusing point. If this was kept, after being powdered, under water for a few days it was found to have gained weight on being dried, and when fired it swelled up and frothed to such an extent as to be absolutely useless, behaving just as a crystal of borax does when heated. A portion of this powdered, steeped

in water for two days, dried at 100 deg. C., and then heated into redness in a hard glass-tube gave off water as it frothed up. In this case therefore it was evident that the fused mass as sold contained some salts which were anhydrous, but which were capable of becoming hydrated by soaking in water. It is a common practice to add borax to a glass in order to lower its fusing point, and it seems probable that this sample contained a large amount of borax or of some borate capable of taking up water of hydration.

But this I have met with only in this one sample; no other has shown any change by being kept under water. Enamels of various colors have been experimented upon, but with no difference of result.

The above experiments appear to prove that water, at all events in short periods of time, exercises no chemical influence upon the enamels; hence, if there really be any advantage in employing a non-aqueous fluid, such as paraffin, during the powdering process, as has been suggested as an improvement, the benefit must be due to causes other than those supposed by its advocates.

When, however, an enamel reduced to impalpable powder is used in a sufficiently thin layer, most of the air is able to escape before the surface glazes, and so a fairly transparent film is obtained.—Journal of the Society of Arts.

THE POCKET STEREOSCOPIC APPARATUS.

SINCE magazine apparatus have been made, the method employed for causing the plate that has been exposed to pass beneath the package of other plates has been modified in various ways, and it appears that all the combinations that permit of reaching such a result have been exhausted.

The system that has met with the greatest success is the Hanau frame, which has been applied to the most widely used models of twin-lens cameras. It may be said that it is universally known. With this kind of magazine, the plate to be changed remains in place when the drawer that contains all the others is pulled out. It then falls to the bottom of the free space left by the drawer, and, when the latter is shoved back, is situated underneath. As it is always

THE "MARSOUIN," A POCKET STEREOSCOPIC APPARATUS.

the top plate that is to receive the impression, the height of the magazine is added to that of the camera, which is proportionate to the focus of the objective. Since the magazines for 12 or 18 plates are always about 2.4 inches in thickness, and since the objectives generally have a focus of from 3 to 4 inches, it results that the minimum dimensions in height that can be given a twin-lens camera is about 5.5 inches.

M. Hanau, by but very slightly modifying his frame, has recently discovered a means of reducing such height in notable proportions, and in a very simple manner. As a camera, he utilizes the space left by the drawer when the latter is pulled out. The plate above, falling to the bottom of this space, is held there by two springs, and is exposed while the drawer is open. This mode of operating offers the advantage of permitting of a reduction of the height of the apparatus to a degree equal to the thickness of the magazine. Besides, there are few chances that two exposures will ever be made of the same plate, since the operator cannot fail to see that the drawer is open and will always think to close it immediately after freeing the shutter.

This principle is evidently applicable to apparatus of all dimensions; but the inventor, in order to show its advantages, has in the first place seen fit to construct a stereoscopic model for 1.8x0.04 inch plates which he calls "Le Marsouin," and in which the camera is completely suppressed and replaced by the magazine which is for 18 plates. The objectives are mounted upon a forepart which is 0.6 of an inch in thickness and contains the shutter, the change of speed and all the parts relating to exposure and instantaneousness. This forepart varies with the objectives employed. When it is removed (and it can be removed very easily, since it is mounted in a slide like the board of an ordinary objective), we have a box 5.5 inches in length and 2 upon all the other sides. The upper part, that which corresponds to the top sensitized plate, is masked by a shutter, which opens when the apparatus is maneuvered, a metallic partition falling automatically in order to limit the two images.

The entire apparatus is of aluminium, and weighs

but about fifteen ounces. At every movement of the drawer a counter automatically inscribes the number of plates exposed.

This apparatus, we think, is the lightest and smallest stereoscopic camera known. The manufacturer will doubtless ere long apply the same principle to apparatus of larger size, always with the result of diminishing the bulk to a degree equal to the thickness of the magazine.—La Nature.

BORSIG ELECTRIC PLOW.

THE A. Borsig Company, of Berlin, one of Germany's large manufacturing concerns of steam and electrical machinery, has introduced an electrical plowing system which seems to have met with favor, especially among the large-estate owners of Germany and the beet-sugar producers, says The Western Electrician. Germany, as is well known, is the greatest beet-root sugar-producing country in the world. Most of the great sugar-mill proprietors own at the same time extensive estates on which they cultivate their own beet roots, and the Borsig company is especially pushing its trade in electric plows among the sugar mills in Germany, Austria-Hungary and Russia. Agencies have been established in all the principal sugar-producing centers of these countries.

The cost of such an electrical plowing outfit for an average sugar-mill estate is given by the Borsig company as \$44,250. A steam engine of 250 horse power is needed to operate five electric plows. This engine may be worked condensing before and after the season, but during the season the exhaust steam may well be used in the evaporating apparatus. The estimated items of cost are as follows:

Engine	\$7,500
Electric generating station.....	5,000
Line construction and transformers...	10,000
Five electric plows and sundries.....	21,250
Miscellaneous	500
Total	\$44,250

At this cost the capital to be invested amounts to about \$8,850 per plow, thus being about 40 per cent. less than that required for the two-machine steam plow. With such a plant, the Borsig company further states, 2,500 hectares, or about 7,200 acres, can be plowed over at a depth of 14 inches, or an area twice as large as that which could be worked by the two-machine steam plow.

The electric plow works by means of two wire cables, which run in a parallel direction over the field, about three feet from each other. At one end an anchor carriage is used, which is so constructed that the carriage body itself is never influenced by the working plow, as the anchoring device is fixed to a kind of portable crane attached to the frame of the carriage. Thus the carriage frame itself can never get out of its original direction. As soon as the plow returns to the motor the anchor is lifted out of the soil by means of the motion of the idle plow cable, and this exactly for the distance which is required for the anchor setting in again.

In most cases, where the electric plow is used at present, the current is derived from a central station, from which it is transmitted to the field by means of overhead wires. From this overhead wire a flexible, isolated cable is, at a given point, connected to the motor car. The latter is placed on one end of the field to be plowed, and the anchor carriage at the opposite end of the field. The plow then travels between the motor car and the anchor carriage. As soon as one furrow is completed, motor and anchor cars advance exactly one furrow's space, when the work starts again.

The Borsig company asserts that the anchor carriages with disk wheels leave very much to be desired as to their practical use. The Borsigs therefore adopted for their system a multiple strong earth anchor, which, by the tractive power of the plow cable, fastens itself in the earth by self-action. A short chain connects the anchor with a rope pulley, the latter serving as a guiding device for the plow. Two horses are required for the transportation of the anchor carriage from field to field.

With regard to the use of the electric plows in sugar-mill estates, the company states that a special advantage lies in the fact that already existing stationary steam powers can be used for the generation of electricity, and that at the same time a number of individual plants may be supplied from such a central station. This is of the greatest importance, as in sugar factories the whole machinery lies idle during nine months of the year.

LAYING CABLES IN ARCTIC WATERS.

In the accounts printed at the time regarding the difficulties of laying the first Alaskan cable last summer, and the accident to the "Orizaba," there were many errors, and a good deal of misunderstanding has occurred in regard to the work. George F. Porter in The Electrical Review, in clearing up the situation, says that the order which was given by the United States government contemplated the making, laying, and equipping of 187 miles of cable divided into two sections, one of which, 55 miles long, connected Unalaklik with St. Michael, while the other, 132 miles long, crossed Norton Sound to Safety Harbor at Cape Nome. For the purpose of laying the cable the steamer "Orizaba" was chartered, and her hold was made ready for the 187 miles of cable which was taken on board at San Francisco.

The steamship sailed from San Francisco and Nome City was reached in twelve days. Gen. A. W. Greely was taken aboard, and then the vessel went over to St. Michael to lay the cable from that point to Cape Nome. The day was fair and calm, and the cable-layers decided to waste no time, as the weather in that latitude is most uncertain. The shore end was towed ashore and connected with the cable hut, taking one hour and twenty minutes. Then the "Orizaba" was started on her way to Cape Nome at a rate of four and a half knots. Everything was moving smoothly until