Section of Photography and Microscopy.

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ON THE USE OF SENSITIVE PAPER IN X-RAY WORK

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The use of so-called "bromide papers" in X-ray work is, of course, not new or original. Roentgen himself, in his early publications on the subject of the X-rays, intimated that he had used sensitive photographic paper in the course of his investigations and experiments, and many if not all X-ray operators have from time to time made use of this variety of photographic material in their experimental work. The objections that most experimentors have had to contend with in the ordinary commercial brands of paper is the fact that the surface of even the so-called smooth paper is a decided matt. This matt surface gives the resulting picture the appearance of being buried in the texture or pores of the paper, with a consequent loss of much of the necessary detail. The finish or surface of this matt-surface paper is of such a nature that squeegeeing on glass or ferrotype plate does not materially improve the surface or appearance of the picture.

Of late years, several manufacturers have put upon the market a glossy variety of developing-paper as a substitute for, or to compete with, the well-known varieties of printing-out papers. This glossy variety of developing-paper has the advantage of keeping the image on the surface, and for this reason is well adapted for the reproduction of more detail in the picture.

It should be remembered that the developing-papers now on the market vary greatly in speed, or the amount of exposure that is necessary to produce the latent image, and it is obvious that the slow varieties now so extensively used, especially by amateurs, and in which the sensitive silver salt is composed largely, if not entirely of a chloride, are not

at all suited for X-ray work. We must confine ourselves therefore to the older and comparatively rapid bromide papers.

The particular paper that I myself have been most successful with is a comparatively new German brand of bromide paper now being introduced into this country. It is made by the "Neue Photographische Gesellschaft" in Berlin, Germany, and is marketed in different grades of smooth, glossy and rough; it is coated on what appears to be a very excellent quality of paper stock.

The glossy variety is one that is best adapted for X-ray work, on account of the smooth finish and fine texture of its surface. How well it is adapted to this particular purpose may be determined by an inspection of the samples shown here.

The question naturally arises, What possible advantages are to be derived from the use of sensitive paper instead of glass plates? The possible advantages are many, and it is my purpose now to call attention to some of the more evident points of vantage as they have occurred to us while experimenting with the various brands of bromide paper available at the present time.

First, the matter of price: in this the use of paper would result in a saving of from forty to sixty per cent. of the cost of dry plates. Other things being equal, this one feature alone would be of sufficient importance to insure the very wide use of a sensitive paper that could be relied on to give satisfactory results under all conditions and at all times.

Another advantage is the saving in possible breakage. Every X-ray operator has had experience in this line. The breaking of a glass plate usually occurs towards the end of an exposure, and always in a case that has necessitated a considerable amount of care in the preparing for and patience in making the exposure. The ominous click that accompanies the accident not only means the loss of a rather expensive plate, but also a waste of the time and energy that has been expended in preparing for and in making the exposure. Nothing of this kind is at all likely to

occur with paper, so that the exercise of ordinary precaution would insure us against any possible danger of wasted exposures.

The facility with which the resulting pictures may be stored will, of course, appeal to all, as the difference in bulk and weight is self-evident. One feature of considerable importance in this connection is the fact that the name of the patient and all the necessary data relating to the case or the making of the exposure may be written on the back of the exposed sheet before development, in this way obviating any possible chance of making a mistake by confusing two or more of the resulting pictures.

Many physicians who are not familiar with, nor in the habit of looking at photographic negatives, cannot see detail in a transparent plate, and, consequently, prefer to have a print. This opens up another possible field for sensitive paper. Not only would the use of this paper obviate the necessity of making positive prints, but we may, if we choose, utilize the paper in combination with glass plates for the same purpose. By exposing a piece of paper and a glass plate at the same time, and developing them in the same solutions, we not only make the paper print and the glass negative at the same time, but we also, in addition to this, have a more or less valuable means of control; for by comparing our results a possible flaw in the plate could not possibly be mistaken for a pathological condition of the part of the patient radiographed.

If for any reason we desire to have two or more prints of the same subject, we can readily obtain them by exposing the required number of sheets of paper at the same time. The paper itself offers little or no resistance to the rays, so that we can expose a dozen sheets as readily as we could one.

Probably the greatest advantage is the rapidity with which we can obtain the desired information. Those of you who have had any experience in this line well know how anxious the doctor usually is to see the result of the exposure; you also know that a plate in the process of development is not always the most reliable source of infor-

mation, so that, under ordinary circumstances, we are obliged to wait until the plate is sufficiently fixed to be transparent. This extra wait for the fixing bath can be avoided by using paper, as, after proper development and a thorough rinsing in water, the resulting picture may be examined in broad daylight without any appreciable damage by fog or other change of the residual silver salts. The necessary fixing in hypo may be done later.

These are but a few of the possible points of superiority that have presented themselves to us while experimenting, or in the regular routine use of the X-rays.

There are, of course, drawbacks and defects in paper at the present time. One of them is the comparative slowness of the emulsions used on ordinary bromide papers. This, to some extent, has been overcome by this same German company, in what they call their negative paper, the emulsion on which is much richer, and, consequently, more rapid than that used on their regular grades of paper. This negative paper is very thin, and is intended to replace celluloid films, and also the various kinds of stripping films that are at present being reintroduced and used quite extensively, especially in Germany. This thinness or transparency of the paper would also tend to do away with another rather serious objection to heavy bromide paper—the tendency for an image, especially of the heavier portions of the body, to veil over or fog; a perfectly transparent paper would give us all the possible advantages of a glass plate in this respect. There remains but one more serious question, and that is the keeping-quality of paper coated with a very sensitive emulsion of silver salts; and, while this may possibly be a serious, or rather a difficult problem, there appears to be no positive reason why manufacturers cannot obtain a paper that will not affect the sensitive salts in the emulsion.

In addition to its use as a substitute for glass plates in taking the impression direct, glossy bromide paper can, of course, be used to advantage for reproduction, or the making positive prints from X-ray negatives. For this purpose the German brand of paper also has some points of supe-

riority; for, in addition to its being a very rapid paper, so far as the time necessary for exposure is concerned, it has the added advantage of being a slow or rather steady developer, so that we have considerable latitude in this step of the process, and can modify the resulting picture to a considerable extent by either accelerating or retarding the same in the course of its development.

Those of you who are in touch with or consult German photographic or X-ray journals will probably recall the really beautiful reproductions on bromide paper that these journals occasionally contain. This so-called method of "light printing," while it appears to have originated in this country, does not seem to have been developed or followed to any considerable extent. In Germany, on the other hand, it has evidently been developed into a distinct branch of the printer's or, rather, the photographer's art. The printing and developing of these pictures is done automatically, by means of specially constructed machines, and it would appear that there was a possibility of developing this same method of photographic printing in this country so as to make it available for illustrating books and periodicals in cases where the presentation of detail is considered of sufficient importance to assume a possible slight increase in cost.

ELECTROCHEMICAL WORKS AT NIAGARA.

The *Electro-Chemist* gives the following interesting data :

The present total output of electricity at Niagara is about 50,000 H.P.; of this no less than 23,200 H.P. is consumed in electrolytic and electric smelting operations. This power is distributed as follows :

	H.P.
Electrical Lead Reduction Company	500
Acheson International Graphite Company	1,000
Pittsburgh Reduction Company	5,000
Carborundum Company	2,000
Matthieson Alkali Works	2,400
Niagara Electrochemical Company	500
Ampère Electrochemical Company	300
Union Carbide Company	10,000
Oldbury Electrochemical Company	1,000
Roberts Chemical Company	500
Total	23,200

Cassier's Magazine for May gives some interesting statistics in connection with these works.

The Electrical Lead Reduction Company reduce lead from its sulphide in the form of sponge, principally for the manufacture of litharge. The original alternating current at 2,200 volts is used for induction motors, which in turn drive direct-current dynamos which generate current at 100 volts. (See *Electro-Chemist and Metallurgist*, i. p. 32.)

The Acheson International Graphite Company convert anthracite into graphite in the electric furnace. The current is used at 80 volts pressure. (See *Electro-Chemist and Metallurgist*, i. p. 89.)

The Pittsburgh Reduction Company, it is needless to say, extract aluminium from bauxite by the Hall process. (See *Electro-Chemist and Metallurgist*, i. pp. 2, 10.) The two-phase alternating current, which enters the works at 2,200 volts, is converted first to 130 volts and then by rotary converters, each of 600 kilowatt capacity, to direct current at 160 volts.

The Carborundum Company produce silicon carbide in 110-volt alternating-current electric furnaces.

The Matthieson Alkali Works transfer the 2,200 volts two-phase current into direct current at 230 volts. They produce chloride of lime and caustic soda by the Castner process.

The Niagara Electrochemical Company convert their current into direct at 165 volts for the production of sodium and sodium peroxide from caustic soda.

The Union Carbide Company work their electric furnaces (200 H.P. each) at 110 volts and 25 alternations. According to *Cassier*, this company probably uses more electric power than any other one factory in the world.

The Roberts Chemical Company use direct current at low voltage for the production of caustic potash, etc

GLASS COLORING BY PENETRATION.

M. Léon Lémal proposes to color glass, not throughout the mass nor in enamel fashion, but by what he calls penetration. A little silver salt is put on the surface of the glass, which is then heated to 500° or 550° C. The excess of salt having been removed, the surface appears yellow, the color penetrating to a depth of 0.17 millimeters when the baking has lasted for about five minutes. After an hour, a layer of double that thickness would be colored; after eighteen hours the color would have penetrated through a glass plate 1.6 millimetres in thickness. In reflected light this yellow displays a beautiful greenish or blueish fluorescence. The intensity of the coloration depends, of course, upon the quantity of salt applied. But very minute quantities suffice. To transfer a lace pattern on glass, it is only necessary to dip the lace in a 0.001 solution of silver nitrate and then into potassium sulphide. According to *La Nature*, colored monograms can easily be obtained in this way, and what is still more interesting, ordinary collodion negatives can be printed on glass in various colors. Silver and copper give a red; gold and iron salts have also been used. When the baking is continued for a long period, the coloring matter is renewed from time to time, say every six hours. The observation has a scientific interest as well. The rate of penetration would probably depend upon the nature of the glass, and upon the atomic volume of the metal.

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