PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

NOTE ON A SIMPLE APPARATUS FOR APPROXIMATELY ESTIMATING THE COLOURS OF WATERS.

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(Read at the Meeting, March 5, 1902.)

SEVERAL instruments capable of being used as colour meters for waters have been described, but have not come into general use, probably owing to the initial cost of the apparatus. I have found the inexpensive arrangement described below very convenient, and probably it may be of service to others, who, like myself, have occasion to make systematic examinations of water-supplies.

The water to be observed is contained in a horizontal 2-foot tube A (see figure) by the side of a similar tube B, containing distilled water; light, reflected from an inclined white card C, passes through both tubes, and a mirror D, fixed at an angle of 45° , reflects it upwards, so that the tints of the waters may be seen and compared by the observer's eye at O, about 10 inches above D. The ends of the 2-foot tubes rest against a mask M (having two circular holes 19 millimetres diameter), which screens off all light from the mirror except that passing through the tubes. Above the mirror D is a little platform P, provided with two circular openings, 19 millimetres diameter, and supporting two short cylindrical glasses E and F, 70 millimetres high and 40 millimetres diameter. A few c.c.'s of distilled water are placed in the cylinder F (through which the water under examination is observed), and a standard brown solution is run into the other cylinder E (above the distilled water 2-foot tube) until the colour of the water in A is matched. The depth of brown solution necessary is recorded in millimetres, read off either from a scale on the side of the cylinder E, or by immersing a small transparent glass or celluloid millimetre rule in the brown solution itself.

To facilitate the comparison, the mirror D is divided transversely, and the two halves slightly tilted and adjusted so that the images from both tubes may be observed simultaneously, without moving the eye, at O; and in making the final adjustment with the standard brown solution the cylinders are covered with a cardboard box screen S, provided with two viewing holes in the top.

The standard brown solution which I have found most convenient and generally applicable is the same as that now used in the colour meter originally described by Crookes, Odling, and Tidy (*Chem. News*, 1881), and consists of a solution containing 1 gramme of pure crystallized cobalt sulphate and 0.05 gramme of potassium bichromate in 1 litre. Occasionally the tints of waters are better matched by a somewhat browner solution containing 1.5 grammes of the cobalt sulphate and 0.05 gramme of potassium bichromate to the litre. The solutions keep well, but should be checked occasionally.

The 2-foot tubes are of stout glass, about 26 millimetres external diameter; on one end a disc of nearly colourless glass is cemented; round the other end a strip of

thin celluloid (10 millimetres wide, and in length 10 millimetres less than the circumference of the tube) is tightly bound by wire, so that the strip projects about

1 millimetre beyond the tube. To fill, the tube is held vertically, and completely filled with the water; a disc of thin glass placed on the open end is held in position

by the celluloid and surface tension, and after wiping the outside of the tube it may be placed on its side, or even inverted, without any risk of leaking. Possibly small tubes of similar construction will be found useful for polarimeters. All the glass discs for the long tubes, and also the discs for the bottoms of the glass cylinders E and F, should preferably be cut from the same thin sheet of colourless glass.

As in the case of all colour meters for water, turbidity, even if present in the slightest degree, introduces a disturbing element, and all water samples should, therefore, be examined in a large flask in a good light, and any opalescence noted.

DISCUSSION.

The PRESIDENT said that, while comparison tests of the colour of water samples probably could not be utilized to any very great extent by the ordinary water analyst who had to deal with a large number of samples of different origin, such tests would be of considerable value to those who were dealing with one kind of water which did not alter very much in colour, and which might be taken as a standard or compared with a standard from time to time. It was important, however, to consider not merely the colour itself, but its probable cause. The cause might be an entirely harmless one—such, for instance, as peat—or, on the other hand, it might be due to sewage pollution. In isolated cases, therefore, too much stress must not be laid upon the colour itself without careful consideration as to its cause.

Mr. RICHMOND said that his own experience led him to believe that there was often a very distinct difference in colour between water polluted with animal matter and water coloured, for instance, by peat or decaying vegetable matter. One improvement which he thought might be worked out in the case of the apparatus that had been described was the use, instead of a standard solution, say, of potassium chromate and cobalt sulphate, of solutions of the three primary colours. The preparation of such solutions had been recently described in connection with a process of colour photography, and their use would afford a valuable means of estimating colour and expressing it in terms of the three primary colours. Accurate colour estimations would be found useful in other directions. For instance, in the determination of the end-points of titrations extremely accurate results could be obtained by means of a colour estimation. Of course, it was imperative that the solution should be quite clear. Sometimes, when turbidity occurred, colour effects were obtained in the case of solutions which had absolutely no colour. In order rapidly to remove turbidity in water by settling, it was necessary that the distance the particles had to travel should be as small as possible, and therefore it was an advantage to let the water stand in as thin a layer as possible; if the water were put into the tube and allowed to stand, the turbidity would settle down in a much shorter time than would be the case in a bottle.

Mr. ALLEN inquired whether the author had any experience of the use of coloured glasses such as were employed in Lovibond's tintometer. He would also like to hear what Mr. Richmond understood by the three primary colours—whether red, yellow, and blue, or red, green, and violet—and how he would propose that they should be obtained.

Mr. RICHMOND said that the primary colours he referred to were red, green, and violet, or blue-violet—*i.e.*, the three colours which, when they were made into screens and the light was passed through the screens separately and then combined, yielded a white or neutral gray light.

Mr. ALLEN inquired how the purity of the colours would be insured.

Mr. RICHMOND said that, as a matter of fact, the colours could be obtained absolutely pure if necessary, and colours which, though not absolutely pure, served satisfactorily as primary colours, could be obtained without much trouble. In a recent paper on the Lumière process of colour photography (abstracted in the *Journal of the Society of Chemical Industry*, 1902, page 275) were given the compositions of solutions by which the three primary colours could be prepared.

Dr. RIDEAL said that it was perfectly true that the estimation of the colour of water had most value when a comparison was being made between different samples from the same source; but, after all, that was frequently the kind of problem that had to be dealt with. Whether or not a water was good depended upon whether it remained constantly in the same condition, and whether it was similar to other waters in the same neighbourhood, so that variations of colour might be expected to throw some light upon the problem under investigation. In one case recently which he had had to deal with the colour of the water was certainly an important factor. In that case it had to be decided whether a peaty water, itself initially coloured, was contaminated with colliery water or with sewage or farmyard drainage. In addition to the colour imparted by the peat, the black colour from the coal, that due to urine from the men in the colliery, and from the farmyard contamination, all influenced the final colour of the waters. All of these colours were distinct, and although they all appeared to be more or less brown-yellow, the amount of each could be fairly accurately gauged by a Lovibond tintometer with varying tube-lengths. The brown-yellow colour of waters contaminated by any of these four different colours might be of approximately the same intensity in a tube 2 feet long, but if instead of using a tube of constant length one estimated the colours in tubes of different lengths, such as were used in polarimetric work, the fraction of absorption of the different colours would be different for each of the different colouring matters, and a very good differentiation could be arrived at by such means, even in cases where the colours were apparently the same when observed in a tube of fixed length.

Dr. MUNRO said that he had had occasion once to examine a spa water with a view to ascertaining whether the water was contaminated by the water of either of two small rivers which ran in front of the pump room only twenty or thirty yards from the well itself. One of these rivers was a limestone river, the bed of which was nearly pure carbonaceous limestone. The other was a boggy river deeply tinted with peat. It was perfectly easy, from a comparison of the colour alone of the three waters, to prove that the spa water was not contaminated from either of the other sources. It would not have been easy with merely a standard solution to go upon, because, although such a solution as had been mentioned in the paper would very fairly represent the colour of peaty water, it would not represent that of the limestone water, and still less that of the spa water. He had used in this case Lovibond's tintometer, by which with coloured glasses practically any tint or colour in water could be matched.

Mr. BURGESS, in reply, said that it was, of course, impossible to form a proper opinion about a water merely from its colour, but he kept a record of the colour of all samples of water that he examined for reference in dealing with the same water subsequently. He had not had much experience with Lovibond's tintometer, but when he had tried it very carefully he had found it to suffer from one serious difficulty—namely, that in the case of waters containing very little colour the coloured discs themselves produced a dulness, and the light was considerably reduced in intensity. That was a difficulty which he, at any rate, had not been able to get over, and he had accordingly arranged the apparatus he had described, in which there was nothing to interfere with the brilliancy of the illumination. The standard solutions could be easily varied for different tints, and it would be easy to use tubes of different lengths, as suggested by Dr. Rideal.