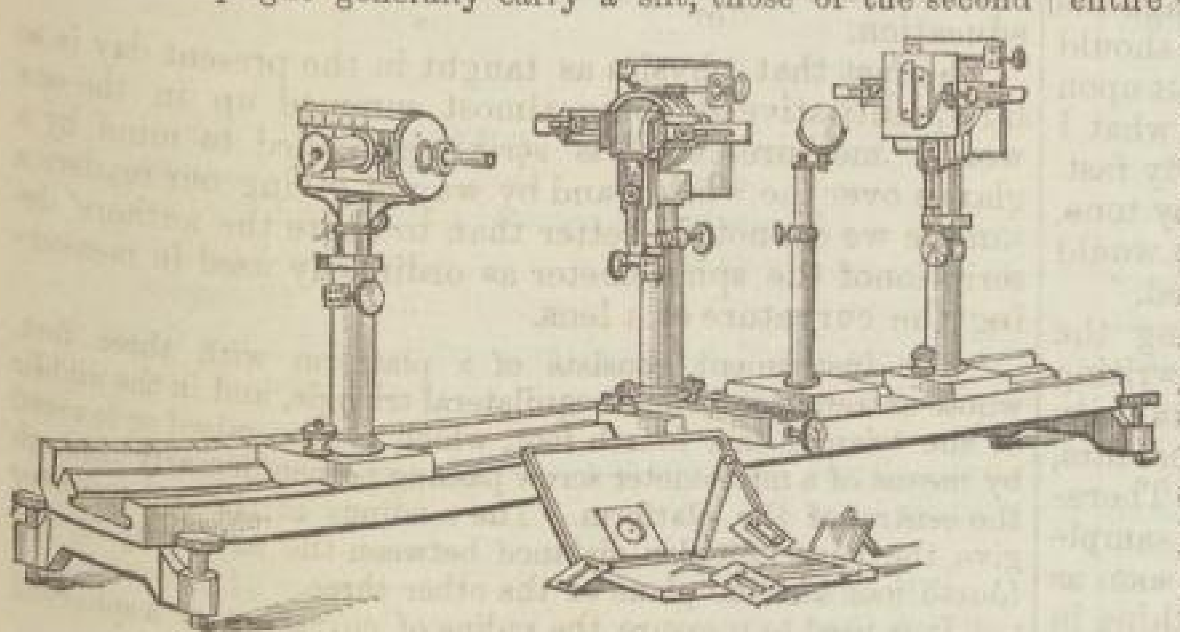
¼ mm. Thus a rotation through twenty-two divisions will carry it through 22/100 of ¼ mm. or ·24 mm."

For the details of some calculations and examples we must refer to the book itself.

The optical bench is an essential to the experimentalist with lenses, and in the following words it is described by Messrs. Glazebrook and Shaw:—

"The optical bench consists essentially of a graduated bar carrying three upright pieces, which can slide along the bar; the second upright from the right in the figure is an addition to be described later. The uprights are provided with verniers, so that their positions relatively to the bar can be read. To these uprights are attached metal jaws capable of various adjustments; those on the first and second uprights can rotate about a vertical axis through its centre, and also about a horizontal axis at right angles to the upright; they can also be raised and lowered.

"The second upright is also capable of a transverse motion at right angles to the length of the bar, and the amount of this motion can be read by means of a scale and vernier. The jaws of the first upright generally carry a slit, those of the second



are used to hold a bi-prism or apparatus required to form the diffraction bands.

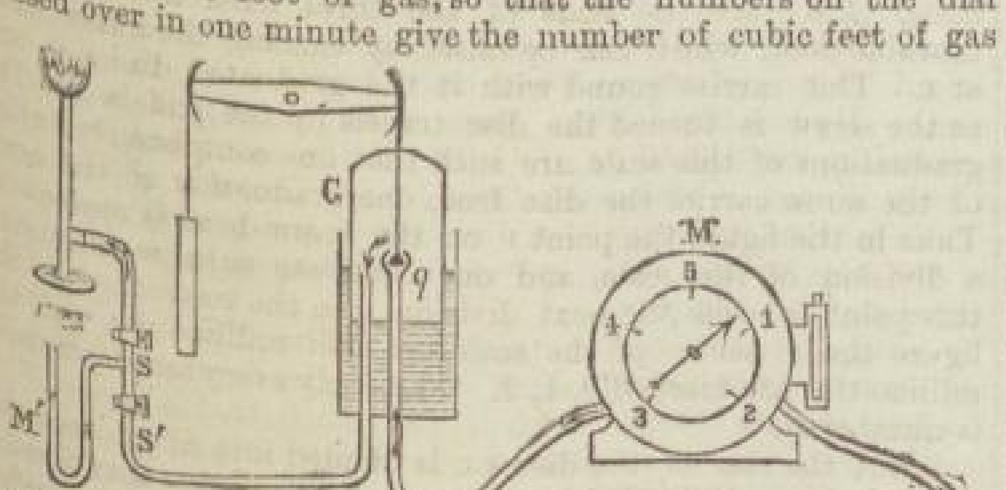
"To the third upright is attached a Ramsden's eye-piece in front of which is a vertical cross-wire; and the eye-piece and cross-wire can be moved together across the field by means of a micrometer screw. There is a scale attached to the frame above the eye-piece, by which the amount of displacement can be measured. The whole turns of the screw are read on the scale by means of a pointer attached to the eye-piece. The fractions of a turn are given by the graduations of the micrometer head.

"The divisions of the scale are half-millimetres, and the micrometer head is divided into 100 parts."

In connection with the subject of photometry, a sketch is given of the meter and governor, these being essentials in connection with determination of the illuminating power of gas; and it may be mentioned that in using gas as a light for testing plates, it is very advisable to use the governor, if not the meter also.

We quote the description of the arrangement:—

"The gas is passed from a gas-holder, where the pressure can be altered by altering the weights on the cover, through a meter, M, which measures the quantity of gas passed through. One complete revolution of the needle corresponds to 1/12 of a cubic foot of gas, so that the numbers on the dial passed over in one minute give the number of cubic feet of gas



which pass through the meter in an hour. The gas enters at the middle of the back of the meter, and leaves it at the bottom, passing thence to a governor, G, which consists of an inverted bell, partly sunk in water, and counterpoised so that the conical plug attached to its top is very close to the conical opening of the entrance pipe *q*. Any increase of pressure of the gas in the bell raises the bell, narrows the aperture, and diminishes the supply until the pressure falls again. By this means the pressure of the gas at the burner is maintained constant.

Messrs. Glazebrook and Shaw are to be congratulated on having produced a good working manual for the physical laboratory.

SYSTEMATIC RECOVERY OF GOLD AND SILVER IN SILVER PRINTING.

BY W. D. VALENTINE.*

In a photographic publishing business such as mine, the quantities of gold and silver used are so large that it is imperative that the recovery of residues be conducted in a systematic manner. The fact that by the system in use in my establishment I have been able within the past year to recover nearly two-thirds of the entire value of gold and silver used, will, I hope, be sufficient excuse for the subject chosen.

I shall commence with the different operations of sensitizing, toning, and fixing, taking them in their due order, and describing the means used for preventing waste, and recovering the large proportion of metal not actually used in forming what is known as a silver print. The sensitizing bath is made of the strength of 51 grains to the ounce, and is used slightly alkaline. The sheets of paper are floated for two minutes, and are then drawn over a glass rod, fixed in such a position over the sensitizing tray as to cause all surplus solution to run back into it. When treated this way, there is only one drop to fall off the sheet, and this is at once removed. In practice I use three trays, large enough for full sheet of paper, and by the time the last sheet is taken from the bath, the first one is ready to be surface-dried between sheets of card blotting-paper; it is then suspended by two corners in a room heated with hot water pipes for ten or fifteen minutes, the drying being completed on a metal water box heated by gas. The first saving of silver takes place here by the means described; there are no droppings of silver bath lost, the blotting pads are periodically burnt, and the ash saved; next the paper is cut by means of a guillotine knife to the required sizes, a number of sheets being cut at one time. This answers two purposes: first, a clean cut edge is got for the print, which minimises the risk of tearing during washing; and second, the cuttings fall at once into a box preparatory to being reduced to ash. The various trimmings, spoiled prints, &c., are burnt once or twice a week in an iron box, with flap lid and small flue; the ash is allowed to accumulate for a few weeks, and is then sent to the assayers. To illustrate the relative value of the different residues as I proceed, I shall give the sums received for them. In a given time I used £720 worth of nitrate of silver; from this I received as value of paper ash the sum of £104 0s. 2d.

I now come to the washing of prints preparatory to toning. For this purpose I use slate trays fitted on a long bench, and connected by pipes with the depositing troughs, which are in the open air. This latter I consider of the utmost importance. In bright sunny weather the chloride of silver is precipitated more quickly than in dull weather. I am convinced that much of the chloride remains in suspension, and is thrown away. When the jars for this purpose are kept in the dark, common salt is used for precipitating the chloride; the addition of small quantities of quicklime from time to time, I find materially assist precipitation. The prints are washed in batches of 50 to 100, and receive eight changes of water, six of which are considered of sufficient value to save. At intervals the deposit of chloride of silver in the troughs is lifted, and placed in trays with canvas bottoms, these being previously covered with blotting-paper. After draining for a few days, the mass is put in a flat iron pan, and quickly dried over the fire. From £720 of silver used in the given time, I received as value of chloride residue the sum of £178 10s. 8d.

I now come to a most important item, viz., chloride of gold residue for the purpose of toning the prints, to produce which the £720 worth of silver was used. I converted into chloride and pure gold to the value of £274. Of this I recovered, by means I will now describe, £101 14s. 3d. The prints are toned in porcelain dishes placed in a long sink, provided with rails for them to rest on. The whole of the inside and edges of this trough are covered with

* Read before the Dundee and East of Scotland Photographic Association.