greatest cause for inaccuracy is due to the floating matters in the sewage, which displace the float and tend to clog the weir.

The diagram (Fig. 2) was obtained from a measuring tank to which sewage was conveyed in a system which admitted large quantities of ground water and probably some surface water, and the high heads indicated on the weir on the 22nd are accounted for by a heavy precipitation which occurred at a time when a large portion of the winter's snow was melting.

Another apparatus, described by F. A. Marston and in use at Marlboro, Mass., involves the use of a trapezoidal or Cippoletti weir, placed in a channel leading to the sedimentation tanks. The sewage enters the screen chamber through a long cast-iron pipe siphon, passes through a coarse bar screen, and along a channel 7 ft. wide, to the trapezoidal weir, as shown in Fig. 3. The crest of this weir is 2 ft. long and the sides have a batter of 1 in 4. The crest of the weir is set 18 ins. above the floor of the channel. The weir itself is made up of 6-in. by 3½-in. by ½-in. steel angles bolted together and set in concrete. The inner edge or crest is planed to a true, sharp edge. The depth of flow over the weir is measured

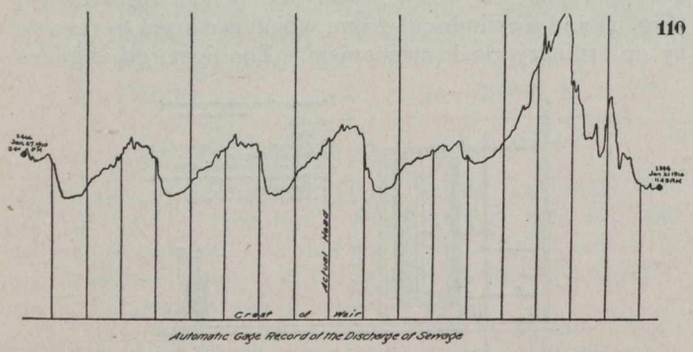

Fig. 2.—Weekly Record of Gauge Shown in Fig. 1.

either directly by hook gauge or rule, or by means of a recording gauge of the Bristol type.

The original plan provided a cast-iron pipe well, with connection to the channel a few feet above the weir, in which the diaphragm was suspended. The recording gauge was fastened to the wall of the screen house. After operating the plant for several months it was found that considerable sludge and scum collected in the diaphragm well and proved to be objectionable, although it may not have had any serious effect on the diaphragm or on the operation of the recording gauge. Because of this collection of scum the diaphragm was removed from the well and was suspended in the channel itself, which arrangement has proved more satisfactory.

The average depth of flow is obtained from the circular chart by the use of a circular planimeter, and the quantity discharged by the trapezoidal weir is computed from the following formula:

$$Q = 3.366\tfrac{2}{3}\, L\, h^{3/2}.$$

Q = quantity in cu. ft. per second.
L = length of crest of weir = 2 ft.
h = head on crest in feet.

There was considered, in the design of the plant, the possibility of using a Venturi meter or some other form of measuring apparatus which would obviate the necessity of constructing an open channel with its attendant difficulties due to the deposition of solid matter, but it was felt that the city would not be justified in going to additional expense for this purpose.

The trapezoidal form of weir was chosen because of the great variation in flow to be measured. During dry weather single daily flows have been recorded as low as 150,000 gallons per twenty-four hours, and during the spring flow has reached as high as 2,300,000 gals. per twenty-four hours for a single day.

In studying the operation of the plant, it was found desirable to know the number of doses discharged by the automatic siphon from the dosing tank each day, and to obtain this information another gauge was installed in the dosing tank. The charts from it show the rise and fall of the sewage level in the dosing tank, and are used not only as a check on the quantity of sewage, but especially to determine the quantity applied to the various filter beds.

From the beginning of the operation of the recording gauge in the screen chamber, the attendant has kept daily readings of the depth of flow over the weir, measured directly at a point a short distance above the weir. The attendant was instructed to take these measurements at approximately 4 o'clock each afternoon, and from the data thus obtained it has been possible to check the readings of the recording gauge and to fill in the records for the periods that the gauge was out of commission.

Another recording apparatus is described by F. B. Sanborn. It is used in the City of Providence, R.I. The flow of sewage is about 24,000,000 gals. per day, about one tenth of which comes from a gravity system, the remainder being lifted 27 ft. at a point about 2,000 ft. from the disposal works.

The pumping plant consists of three Holly engines, each of which is connected with two centrifugal pumps, whose combined capacity is 43 million gallons per day.

The large size of these units necessitates a system of intermittent pumping during periods of small flow, as at night, or on Sunday, the sewage at such times being allowed to rise to a certain height in the large sewer leading to the pumping station, when the pumps are started, and operated until a certain low level is reached.

The discharge from the pumps, together with that from the gravity system, flows through an 88-in. conduit into a semi-circular open mixing channel, 150 ft. long and 16 ft. wide. In this channel are placed 20 slate baffles, set 6 ft. apart on alternate sides, and projecting 6 ins. beyond the centre line of the channel. From this channel the sewage flows directly to the four large sedimentation tanks.

Briefly, the conditions to be met were as follows:

The location of the weir was limited to the mixing channel, in which the baffles caused a very great agitation of the sewage.

The weir must be higher than the level of the sewage in the tanks, to be independent of variations in the method of operation.

It must be as low as possible, to avoid increasing the work of the pumps.

The opening of the weir must be sufficient to accommodate a flow of 120 million gallons per day.

The recording device must give an accurate record of the flow, without being so delicate as to be disturbed by momentary variations in height, due to currents in the mixing channel.

Owing to the sudden fluctuations caused by starting and stopping the pumps, the chart must be in terms of volume rather than of height, so that the total flow per day could be determined by the use of the planimeter.

Since the weir would not correspond to the requirements of any formula, the actual flow must be determined by experiment.