accumulated beneath the cellar floor. The same state of things was lately found to exist below the Rockland Bank Building in Boston. A case has been mentioned to the writer where it is thought that three deaths can be directly traced to the stoppage of a drain which was so clogged as not to act. Almost every one who has been led into this line of inquiry has some similar instance to relate, and evidence could be multiplied indefinitely. Of the house drains crossing the intercepting sewer trench during its construction last season, fully 25 per cent. were almost or entirely choked with sludge.

An example of semi-existence, observed while digging for the sewer in Charles street, is worth nothing, as showing the intelligent judgment sometimes exercised in doing this kind of work. It will be understood by referring to the sketch (Fig. 1). The drain was one for surface water; and the drain layer, in digging from the house toward the sewer, came upon a log lying across his trench, and here stopped short, chopped a hole in the log, found it hollow, and connected his drain to it without going further. It is true, the log led to no outlet, but then it saved trouble—to the drain layer.

As to the question of size of drains, it was found that of 113 observed while building sewers the past year,

11	were about	4	inches	in diameter.
4	"	5	"	"
21	"	6	"	"
5	"	7	"	"
27	"	8	"	"
8	"	9	"	"
11	"	10	"	"
26	"	12	" or over	"

The sketch above (Fig. 2) illustrates the wide range of this diversity. Most of them drained single dwellings similarly situated; and if the small ones were large enough, the others must have been unnecessarily large and *vice versa*.

But what is the proper size?

Probably nine engineers out of ten would answer, "By no means larger than 6 inches," and nine drain layers out of ten would now say, "Never smaller than 8 inches." The former argue that the drain need only be large enough to pass through it all that it can reasonably be expected to carry, and that anything beyond this tends to make the ordinary flow spread thinly over a broad bottom, without sufficient depth to carry solid matters along with it. The latter reply that, in fact, a drain never does receive only what can be reasonably expected, and that the larger the drain the more storage room for the unreasonable accumulations of clothing, tin and glass ware, dead animals, &c., usually found in it. "In practice," they say, "large drains take longer to choke up than small ones, and are therefore better."

Their facts are correct, but their conclusions may be doubted. In building a drain the object should be to prevent the beginning of a deposit; and this is much easier in a small drain than in a large one, as will be understood from Fig. 3, where an equal quantity of water is supposed to be flowing in a 4-inch and a 12-inch drain. It might be thought (by one who thought at all about such matters) that the discharge of a great volume of water, as from a bath-tub, would tend to scour out and clean a drain. So it might, a very small one. But in such a structure as our sketch represents, with a flat bottom 12 inches wide, the stream caused by such a discharge would probably meander over the bottom of the drain, and be nowhere over a quarter of an inch deep. Let a deposit once begin, and subsequent accretions as surely choke a large drain as a small one, only it takes longer to do it. And it may even be questioned whether it is an advantage to be able to use, for an additional year, a drain nearly full of putrescent filth, or whether it is not better to have the evil disclosed and remedied as soon as possible. It may safely be said that three-quarters, at least, of the house drains in Boston are too large, because, even if some of them perform efficient service, small ones would do as well, and be less liable to get out of order.

In respect to form, there is almost as much diversity as there is in size. Figs. 4 to 10 give the more common shapes.

The first three must be condemned at once, on account of their flat bottoms. The water, passing through them, spreads out into a thin sheet, which does not readily wash along solid matters. Floating matters also tend to stick in the angular corners more than they would on rounded surfaces. That this is so, is shown by the record. Of the 113 house drains whose condition was noted, 45 were constructed with flat bottoms; and of these, 26 were choked, or nearly so, with sludge; 19 were reasonably clean. Of the remaining 68, which had rounding bottoms, 12 were full, or partly so, of sludge; 56 were reasonably clean. The common appearance of these flat-bottomed drains, as they were uncovered, is shown in Figs. 11, 12 and 13. Fig. 13 represents the condition of a drain, now disused, which came from the City Hospital grounds.

The shapes shown in Figs. 7, 8, 9 and 10 are unobjectionable, although, in fact, these drains were often too large and had other defects. Fig. 8 is a kind of construction which was in vogue 25 years ago, and, except for liability to open joints, its angular bottom and its size, is passably good. Our facts seem to show that 40 per cent. of the Boston house drains are defective in shape.

A drain should be smooth, so as to afford no prominences for solid particles to lodge upon. Planed wood, slate and brick are smooth enough. In use they become covered with a film of slime that makes them very slippery. Unplaned wood, which until recently has been somewhat used, is apt to be rough, and to have splinters pointing against the flow, which catch solids moving upon them. The chief difficulty in making a brick drain smooth is the care required to see that no mortar is left projecting into the drain. Fig. 14 shows the manner in which such work is often finished.

It is possible to strike each joint of the lower half of the drain so as to leave a reasonably smooth surface, but a difficulty harder to avoid is caused by portions of the mortar, uniting the arch bricks, falling when the supporting centres are removed. These lumps of cement, indicated in the sketch, adhere to the bottom, and, unless carefully scraped off, harden and form serious obstruction to the flow of sewage.

Pipe drains, whether cement, clay or iron, are smoother than those of brick. Glazed clay pipes are especially smooth. In these, however, it is very common to find the mortar uniting the several sections of pipe projecting into the interior, forming a series of little dams which obstruct the flow. Fig. 15 illustrates this. This can be avoided by carefully cleaning the interior of each pipe, after laying it, with a swab or hoe—a simple precaution, but often neglected by a careless drain layer. It will not be an exaggeration to say that three-quarters of existing drains are defective as to their smoothness.

The best rule in practice for the inclination of a house drain, is to give it as much pitch as is possible, and in few cases is less than one-half inch to the foot safe. A great many drains are faulty in this respect. The actual inclination of drains crossing the trench of the intercepting sewer the past year was not taken; but of the 113 met with, 9 are recorded as level and 14 as pitching the wrong way—that is, toward the house. One of these, coming from a public school building, was about 7 inches lower at the street curbstone than at the sewer. The condition of such a drain is shown in Fig. 16.

The water stands in the depressed portion of the drain to the height of its connection with the sewer, and, having little motion, deposits are apt to occur. In the case referred to, it is but fair to say that the school drain was clean so far as seen. Very possible an abundant use of water or recent heavy rains had scoured out any deposit that may have taken place. It is possible that most of this inclination in the wrong direction occurs in the street near the sewer. The drain layer frequently begins to put in his drain simply with reference to the house, without enquiring what is the elevation of the sewer into which it is to empty. He digs his trench toward the street, and lays his drain on a slope which he judges by his eye to be sufficient. This in itself is a deceptive matter, as a trench generally seems to slope down toward the observer. When the sewer is reached, it is found to be higher than the portion of drain already laid. What is to be done? It is not the drain-layer's fault that the sewer is too high; he cannot take the trouble to dig up his pipe again; it is only a few inches anyway; and the pipe is run up and connected, the trench back filled, and "out of sight, out of mind."

It was stated that one of the essentials of an efficient house drain is that it shall be tight. Mr. Ernest Bowditch has called the writer's attention to a condition in which, at first sight, a leaky drain might appear better than a tight one. He says: "It is sometimes noticed, where plumbing is from 20 to 25 years old, and where all the drains outside the cellar walls are of open stone (technically, French drains), the soil pipe not being ventilated, that there is no perceptible leakage of sewer gas into the house. It is reasonable to suppose, in these cases, that the gas generated outside the house works up through the soil rather than forces the traps in the house. The modern method of tight drains and cesspools tends to drive all gases into the house. It