of disease, and in all well-designed systems of sewerage stringent precautions (which will be presently described) are taken to keep it out of houses. It is equally certain that the dangerous character of sewer gas is reduced, if not entirely removed, by free admixture with the oxygen of fresh air. Sewers should be liberally venti­lated, not only for this reason, but to prevent the air within them from ever having its pressure raised (by sudden influx of water) so considerably as to force the “traps” which separate it from the atmosphere of dwellings. The plan of ventilation now most approved is the very simple one of making openings from the sewer to the surface of the street at short distances,—generally shafts built of brick and cement,—and covering these with metallic gratings. Under each grating it is usual to hang a box or tray to catch any stones or dirt that may fall through from the street, but the passage of air to and from the sewer is left as free as possible. The openings to the street are frequently made large enough to allow a man to go down to examine or clean the sewers, and are then called “manholes.” Smaller openings, large enough to allow a lamp to be lowered for purposes of inspection, are called “ lampholes,” and are often built up of vertical lengths of drain-pipe.

the tank accumulates so that it reaches the top of the annular siphon, and begins to flow over the lip, it carries with it enough air to produce a partial vacuum in the tube. The siphon then bursts into action, and a rapid discharge takes place, which con­tinues till the water level sinks to the foot of the bell-shaped cover.

III. Domestic Sewerage.—In the water-carriage system each house has its own network of drain-pipes, soil-pipes, and waste-pipes, which lead from the basins, sinks, closets, and gullies within and about the house to the common sewer. These must be planned to remove sewage from the house and its precincts quickly and without leakage or deposit by the way ; the air within them must be kept out of the dwelling, by placing a water-trap at every opening through which sewage is to enter the pipes, and by making all internal pipes gas-tight ; the pipes must be freely ventilated by a current of fresh air, in order to oxidize any deposited filth and to dilute any noxious gas they may contain ; finally— and this is of prime importance—the air of the common sewer must be rigorously shut out from all drains and pipes within the house. To disconnect the pipes of each indi­vidual house from the atmosphere of the common sewer is the first principle of sound domestic sanitation. When this is done the house is safe from contagion from without, so far as contagion can come through sewer gas; and, how­ever faulty in other respects the internal fittings may be, the house can suffer no other risk than that which arises from its own sewage.

Protection against the passage of gas through open­ings which admit of the entry of water is secured by the familiar device known as the water-trap.

The simplest and in many respects the best form of trap is a bent pipe or inverted siphon (fig. 5) which is sealed by water lying in the bend. The amount of the seal (measured by the vertical distance between the lines *a* and *b)* varies in practice from about A an inch to 3 inches. If the pressure of air within the pipe, below

To facilitate inspection and cleaning, sewers are, as far as possible, laid in straight lines of uniform gradient, with a manhole or lamphole at each change of direction or of slope and at each junction of mains with one another or with branches. The sewers may advantageously be stepped here and there at manholes. Sir R. Rawlinson has pointed ont that a difference of level between the entrance and exit pipes tends to prevent continuous flow of sewer gas towards the higher parts of the system, and makes the ventilation of each section more independent and thorough. When the gradient is slight, and the dry-weather flow very small, occasional flushing must be resorted to. Flap valves or sliding penstocks are introduced at manholes : by closing these for a short time sewage (or clean water introduced for the purpose) is dammed up behind the valve either in higher parts of the sewer or in a special flushing chamber, and is then allowed to advance with a rush. Many self-acting arrangements for flushing have been devised which act by allowing a continuous stream of comparatively small volume to accumulate in a tank that discharges itself suddenly when full. A very valuable contrivance of this kind is Mr Rogers Field’s siphon flush tank, shown in fig. 4. When the liquid in

the trap, is greater than that of the air above the trap by an amount exceeding the pressure due to a column of water equal in height to the seal, the trap will be forced and air will bubble through. This is one way in which a trap may fail, but this may be prevented bv sufficient ventilation of the pipe below the trap. Other possibilities of failure are, however, only too numerous.

If the pipe is disused for some time, the water may eva­porate so considerably as to break the seal. The pipe, if of lead, may bend out of shape, or it may even be so badly set in the first instance as to make the trap in­operative. The seal may be

broken by the capillary action of

a thread or strip of cloth, hang­

ing over the lip of the trap and

causing the water to drain away.

A rush of water down the pipe,

suddenly arrested, may pass the

trap with such momentum as to

leave it wholly or partly empty.

Another and a common cause of

failure can be explained by re­

ference to fig. 5. Let a column

of water rush down the soil-pipe

*c* from a closet or sink which

discharges into it at some higher point. As the water passes the junction with the branch *d* it will produce a partial vacuum in the branch, and so tend to suck over the contents of the trap. This process, which is sometimes called the siphonage of traps, can be guarded against by ventilating the branch, either by a separate ventilating pipe leading to the open air or by a pipe *e* (shown by dotted lines) connecting the top of the branch *d* with a point sufficiently far up on the soil-pipe to be above the column of water which is passing the junction. One more imperfection in traps may be named. The experiments of Dr Fergus have shown that the water in traps will allow gases to pass through by absorbing the gas on one surface and giving it off at the other. It is improb­able that this action occurs to such an extent as to be dangerous by permitting the transfer of disease germs from one to the other side. Apart from any risk of this kind, however, it is clear that a trap is open to so many possibilities of failure as to form a very in­sufficient barrier between the air of a room and the foul air of a sewer. Nevertheless the practice was until very lately almost universal, and is still far from uncommon, of connecting closets, sinks, and