the sun's ray passed to the other side of the building. The exceptions occurred on days when the wind was high. The experiments were conducted on these latter pipes during hot weather only.

The observations on air currents in sewers showed that where sufficient free openings were provided the direction and force of the wind exercised a great influence and overbalanced all other local conditions due to temperature, gradients, character of sewage, and so forth.

Before the instruments were allowed to record, it was found necessary to restore the normal conditions within the sewer which are invariably disturbed by the opening of manhole or side entrance covers for the purpose of entry when placing the recording instruments in position. To effect this the writer devised a small case of sufficient size to hold each anemometer. At opposite sides, and facing the fan of the anemometer, were hinged doors; these were opened by pneumatic pressure applied by a small tube brought to the surface. The doors were balanced to close when the pressure was released. By this means the instruments were not brought into use until the normal conditions within the sewer were restored. In order to check the record of each instrument while exposed to the action of the air currents, two anemometers were placed side by side suspended in boxes from the crown of the sewer, and an interval of twenty minutes was allowed to elapse before these instruments were independently brought into action by the means described. Eight instruments in all were used and were carefully corrected from time to time during the progress of the work.

Records were taken under similar conditions with the ventilating spaces in the manhole covers closed and open for a distance of 1 mile on each side of the point of observation, and the results differed so slightly that the author came to the conclusion that the effect produced within the sewer by the ordinary type of ventilating cover was negligible. On the other hand, he found that the action of the wind and variation between internal and external temperatures on the open end of a large sewer, such as a storm overflow, will produce a very material current of air for a considerable distance along the sewer, but the velocity of the current will gradually diminish, and in time cease altogether.

Effect of Wind Pressure.—Where surface ventilating covers are used, wind pressure has undoubtedly an effect upon the air within the sewers, but even with high winds the author has found the effects much smaller than what has often been attributed to this cause.

These remarks apply to large sewers, sufficient for a man to enter. In the case of smaller sewers—pipes varying from 12 in. to 18 in. in diameter—he has found the effect of wind pressure on surface ventilators more pronounced.

In the type of ventilating manhole which has hitherto been in use in the city of Manchester, the proportionate ventilating area amounts to:—

24.5	p.c.	of the	cross	sectional	area of	12 in.	diameter	sewer.
2.7	"	"	"	"	"	3 ft.	"	"
.98	"	"	"	"	"	5 ft.	"	"
.24	"	"	"	"	"	10 ft.	"	"

The distances between the ventilating manholes varies from 100 yds. to 150 yds. in the case of the smaller sewers, and from 150 yds. to 300 yds. in the case of the larger sewers. It will therefore be seen that the effect or air pressures under such conditions must of necessity be much less in sewers of large section than in those of a smaller type.

The results of the author's observations may be briefly summarized as follows:—

(a) Where shaft ventilation only is relied upon, some of the shafts become inlets and others outlets.

(b) These conditions are not continuous, the directions of the air currents are at times reversed, the outlets acting as inlets, and vice versâ.

(c) The air currents within the sewers are governed to a large extent by the differences between the external and internal temperature, the flow of sewage, the construction and character of the sewer and other local circumstances.

(d) All these conditions are neutralized, and at times reversed by the change of direction and force of the wind.

(e) Ventilation by metal shafts is affected, and in some cases materially assisted, by the heat of the sun.

(f) No general rule can be laid down which would be applicable to all cases and under all conditions.

(g) Under normal conditions, in properly constructed and regularly flushed sewers not receiving trade refuse, the perceptible odors are less when they are unventilated than when ventilated.

(h) Air currents do not invariably flow from lower to higher levels, the reverse being frequently the case even where gradients are steep.

(i) Air in sewers in partial use is generally more offensive than that in similar sewers which are used to their full or nearly full capacity, other conditions being equal.

(j) That the regular and efficient flushing of sewers with fresh water is a more important desideratum than the introduction of large volumes of air. A case in support of this view may be quoted where intermediate manholes were inserted in an old sewer in fair condition, which increased the ventilation openings by 100 per cent., but did not appreciably improve the condition of the air within the sewer. Flushing was resorted to and a marked improvement was immediately effected.

(k) All methods which replace or retard natural ventilation are inadvisable except under very exceptional circumstances.

(l) Ventilation of sewers is necessary for the safety of the workmen, and for the free escape of air when sewers are rapidly filled in times of storm.

(m) Methods usually adopted in the ventilation of mines cannot be successfully applied to sewers.

Manchester Corporation's Investigations.—In 1902 the Manchester Corporation appointed a special committee with a twofold purpose: First, to determine—on the generally accepted hypothesis that the ventilation of sewers is necessary—the best method of accomplishing this object; secondly, to investigate the composition of sewer air bacteriologically and chemically obtaining under varying conditions, such as are to be found in the Manchester city sewers, and to determine as far as practicable the influence of sewer emanations on health.

The committee appointed Prof. Delepine, M.B., C.M., M.Sc., director of Public Health Laboratory, Manchester University; Dr. Fowler, D.Sc., F.I.C., consulting chemist, Davyhulme sewage works; and the author, to investigate and report. Prof. Delepine undertook the bacteriological work, Dr. Fowler the chemical work, and the author the experimental installations, investigation of air currents, etc.

As a rule, when matters of public interest are about to be officially investigated in England, numerous remedies are suggested by irresponsible persons from outside. These were anticipated by advertisement in the public press intimating that the special committee were prepared to receive particulars of methods for improving the ventilation of sewers. In response to this invitation twenty replies were received. Most of them contained particulars of some proprietary arrangement or method of ventilating sewers. Each case was carefully considered, and four of those who responded were invited to furnish additional particulars, and after further consideration arrangements were made for a practical test of the method advocated in each of these four cases, which will here be referred to by the letters A, B, C, and D respectively.