THE

PNEUMATIC TEST.

A SYSTEM OF INSPECTING PLUMBING AND DRAINAGE.

INVENTED AND PERFECTED BY

FREDERIC TUDOR, SANITARY ARCHITECT.

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1892.

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THE INSPECTION OF PLUMBING.

It is a common remark of the householder that one is at the mercy of plumbers; if you apply to them to tell you about the condition of the drains, they come in and go all over the house in a mysterious, solemn way, there is a strong odor of peppermint, and you are told that the pipes are all out of order, and that the only safe way is to replace the whole thing with new modern work. You have it done, and six months later, if another plumber is invited to give an opinion on this very same new plumbing, there will be the same odor of peppermint, and the same advice to rip the pipes all out.

The truth is, that the plumber's method of testing is worse than worthless, because it is misleading. He is as apt to get the odor of peppermint with a perfectly good job as with a bad one, and some plumbers who are not strictly conscientious do not hesitate to produce the odor anyhow and scare the householder into giving them a job of work, while the fairly honest man will give his trade the benefit of the doubt, and advise new work as the only guarantee of absolute safety. This is the general result of asking a plumber to report upon the condition of the traps and drains in any house, so much so that people are actually afraid to admit that they have any doubt about their plumbing, and go on simply hoping that the accident of sickness will not strike in their individual household.

Have the public then any safeguard in this matter? Is there any means whereby the suspicion and doubt which all refined people feel respecting plumbing may be replaced by confidence and positive knowledge?

Many who read this pamphlet will be surprised to learn that there is a method of testing drains, which, by steady growth, beginning as long ago as 1875, was finally per-

fected and patented in 1884, and has since that time been practised in Boston and vicinity with unfailing success and gratification to its patrons. In the last year named (1884) there was held in Brighton, England, an exhibition devoted wholly to hygienic and sanitary subjects and apparatus, where the merit and value of this process were considered so exceptional by the committee of awards that a special gold medal and diploma of honor were created for it, ranking it above all other exhibits whatsoever. No attempt has been made to advertise and introduce this process, because its inventor has been too much occupied with other things, and, moreover, because the invention was ahead of the times. He has recently, however, made arrangements to give more of his time to this very important branch of work, partly because he believes that the people have at last begun to feel the need of a method of testing that they can rely upon, and that they will appreciate the thoroughness and certainty of the one here described.

In order that scientific readers, physicians, and others to whom this subject is one of special interest, may have a clear understanding of this process and of its usefulness and merit as compared with all other processes, it is thought best to lay before them somewhat in detail a description of the apparatus employed and the mode of applying the test and ascertaining the condition of the drains by its means. In the first place, it is important to state that the first conception of the process and its gradually developed perfect adaptation in all its details to its purpose are wholly original with its inventor, the writer, by whom it has been constantly made use of for nearly fifteen years under all possible conditions. The process has been widely imitated by plumbers and experts, but never in its entirety; parts of the apparatus, which are indispensable to accurate results, have never elsewhere been employed, and are here described for the first time. The proprietors are unwilling to admit that the process, simple though it be, is capable of intelligent use except by trained and experienced persons. This is

why other experts condemn an imperfect job outright; they are unable to specifically locate the imperfections or to determine whether they are remediable or not; they are forced to guess that it is altogether defective, and, to be safe, are obliged to condemn it as a whole.

THE PNEUMATIC TEST.

The apparatus required for making the test comprises the following things: movable plugs for closing the open ends of pipes exterior to the building; an air-pump having a capacity three or four times greater than a gas-fitter's testing pump, or, much better, a trombe,* operated by water supplied by a garden hose; a canister packed with cotton waste soaked in oil of peppermint, so constructed that it can be placed in circuit with the pump and pipes without escape of the odor except into the latter; a large relief trap, for each open end, forming a temporary water seal of adjustable dip, usually set at about one half inch, and large enough to relieve the system of pipes and traps within the house of pressure in case any fixture should be discharged while the test is being made, and thus prevent any trap being forced or siphoned out; a manometer; clay or putty for closing leaks around plugs; tools, such as screwdriver, hammer, Stillson wrench, etc. Two or three persons are required to make the test, the application of which is as follows: —

The soil-pipe and trap-vent pipe extensions above the roof, and the fresh-air inlet at the foot of the system, are all closed, first selecting one to which the air-pump is attached. To this is also attached the peppermint canister, a relief trap, and the manometer.

Air is now pumped in, when, if the drains are tight and the traps are in order, the existence of pressure within the system, due to the accumulated air, will be made evident by the manometer. If everything is all right, a single stroke of the pump will affect the gauge, three or four will complete the work, proving the pipes to be in perfect order, at this stage the dip of the adjustable

* For an explanation of the principle of the trombe, see Ewbank's Hydraulics.

relief traps being increased to three quarters of an inch. If, however, anything is wrong, the escaping air will prevent the accumulation of any pressure, and the manometer, although its level may be disturbed, will quickly return to zero if the pump is stopped. The temporary plugs are, in this case, all removed and the pump is kept in motion till the odor of peppermint appears at all the open ends, which are then closed again, and pumping is kept up till the odor carried along by the air escaping from some leak is detected within the house. This is traced up and temporarily stopped with putty. If it is the only one, the manometer will promptly manifest it; if not, pumping is continued till all the leaks, one after another, are traced up, marked, and temporarily stopped, and until a pressure can be established which is retained even after the pump has ceased to work.

An assistant, meantime, has been preparing a schedule of the leaks as they are revealed, noting their location and description, which is afterwards used as a guide by the repairing plumber, who checks off each item as soon as it is completed, until he has gone through the whole list, and the entire system of pipes has been thus put in perfect repair.

It will be seen that the process is both analytical and systematic. It develops all the facts and avoids all confusion. It also gives valuable assistance in tracing out old lines of drains and disused connections, such as are apt to exist where alterations have been frequently made.

Compared with this rational and practically perfect system of testing, what other system is there which merits a full description?

The water test, some one says. But it must be remembered that the water test is not practically applicable to a system of pipes after it has passed into actual use without great inconvenience, expense, and risk of damage to the house by escaping water. It is limited in application to new work, must be applied before any interior finishing or decoration has been begun, covers only part of the

ground, and does not in fact test the integral system of pipes and traps when completed for use. This is fully appreciated by a number of architects, whose custom is to require the pneumatic test to be applied to all finished new work before accepting it.

In another aspect it may be objected that the maximum pressure employed in this test is too feeble to be of any practical value, being equivalent to a column of water only three quarters of an inch high, or one thirty-sixth of a pound per square inch. In reply to this, it should be pointed out that this pressure, slight as it may be, is yet many times greater than any pressure which can be put upon the pipes and traps in actual use. If a bridge will carry safely a train of locomotives weighing five hundred tons, it will certainly carry safely a train of cars weighing only one hundred tons. It is not necessary to require a proportionally severer test than this, and by analogy, if the drains are proved to stand with success a pressure of three quarters of an inch of water, they are certainly perfectly safe under a pressure of about one eighth inch, which is about the maximum realized in actual use. Theoretically, there should be no pressure whatever, but this is hardly attainable, at least not at those times when the pipes are flushed by the discharge from some fixture.

One feature which should not be lost sight of is the fact that this test can be applied without interfering in any way with the regular use of the plumbing apparatus by the occupants of the building.

Unfortunately in most cases a great deal of time is lost in getting access to the pipes on the roof. They are often so placed as to require temporary scaffolds in order to reach them, giving the inspectors some risky climbing to do. Then old unfit work, such as catch-basin traps, are frequently combined with new work, and the pressure is lost through the old joints of the masonry. Where work is properly constructed and if it is in good order, the test can be completed in half an hour, but this happens almost never. Owing to the inaccessible location of the outlets, and the unsystematic way in which plumbers lay

out and connect up their work, often two or three hours' time is consumed simply in getting ready, and less than one minute in making the test. The most difficult cases are those which combine inaccessibility of the outlets with complicated or obscurely located branch drains and imperfect joints, making a great number of leaks to be traced up ; such cases sometimes use up a day or even a day and a half of the time of three persons accustomed to the work. This, however, is much cheaper than condemning the whole apparatus, as is the usual custom, because the inspector is unable to find out what the matter is, when it may be that after all only a few trifling repairs may be required. Even if it should prove that the drains are seriously defective, it is better to know exactly what the defects are, and act with full knowledge of the facts ; there is no satisfaction in guessing in matters of this sort.

To more effectively illustrate the kind of facts which are developed by this process, and the convincing way in which it replaces doubt, supposition, and error by positive knowledge, a few examples are quoted from experience obtained.

A FEW CASES.

House of J—— G——. The owner was urged to have the plumbing renewed by a prospective tenant, a physician, whose suspicions were doubtless aroused by the fact that some of the fixtures were old-fashioned. The test, although completed with difficulty, showed everything within doors to be in perfect order, except that the hand-hole plate on the running trap had never been properly fastened down, also that in the yard there was a leaking cesspool trap, neither defect being of much importance.

House of Mrs. W—— E——. Inspected by plumbers three months previously, who said they left everything in order. The owner declared that the odor of peppermint hung about the house for a week after. The pneumatic

test revealed a half-dozen imperfect joints in the main horizontal, a bad joint in a third-story branch, three leaking trap screws, and a hole in the kitchen sink waste-pipe ; the latter having been "burnt" by a too hot soldering iron when originally put in place,—a dangerous accident, but fortunately rare with careful workmen.

R—— F——. A summer and health resort in a wealthy town. In the summer of 188– a prominent citizen died in the hotel of typhoid fever, there being other cases of sickness besides. The drainage being suspected, the establishment was speedily abandoned by nearly all the guests. Thereupon, at the request of the proprietor, the local Board of Health, consisting of three persons, of whom two were physicians, inspected the house, and gave him a written certificate signed by them, and stating that they had inspected the premises and found the drainage and sanitary conditions perfect. The owner, to save, if possible, the reputation of his house, desired to re-enforce this opinion by the testimony of an expert, and ordered the pneumatic test to be applied. The result showed that a five-inch elbow at the base of one of the upright lines of soil-pipe had never been calked ; that in one of the other lines a number of calked joints had been destroyed by the action of steam, in one case the ring of lead being quite out of the socket and hanging loosely around the pipe ; that the meat-rooms and refrigerators drained directly into the soil-pipe through common bell traps. Everything was repaired and made right throughout, and proved to be in order by a final test. The house, however, only partially recovered its good name, and shortly afterwards and in the middle of the season was closed, in which state it remains to this day.

Building occupied by the Boston Board of Health at No. 12 Beacon Street. Test made in 1889. This and the adjoining house and a connecting building in the rear had been recently purchased by the city. New plumbing had been put in under the direction of the city architect, and in

supposed accordance with his specifications, which required each building to be treated separately, supplying an independent iron drain, and a main trap with air inlet, all to be connected to a new underground iron drain extending to the sewer.

The test was desired by Dr. Durgin, the chairman of board, to be an object lesson to the inspectors, in which respect it did not prove wholly successful, for the reason that the inspectors looked for an immediate revelation of the condition of the drain, with a detailed explanation from the testing party. They had themselves exhaustively tested the house by pouring quantities of oil of peppermint into the top of the pipes, repeated during several previous days, and, not detecting the odor of the oil within doors, had pronounced the drains O. K.

At the outset of the test made by the pneumatic apparatus it was discovered that all three houses had to be tested as one ; the venting of the pipes had been so unsystematically carried out that about two hours were spent in tracing them out and closing them. Finally, when this was done and pressure was applied, the monometer indicated loss of air by leaks in the system, which fact was duly announced to the inspectors as being evidence that the drains were not tight. Unfortunately for the test, there was no odor of peppermint within the buildings, and as the test did not establish instantly the location of the leaks, the inspectors shortly left, evidently with a poor opinion of the process as compared with their own, which consists simply of pouring peppermint into the pipes and then trying to detect its odor within the house. Such a test can establish nothing more than a probability, for it can readily be shown that the conditions must be extremely bad if the odor can escape into the house in the absence of all pressure within the pipes. In the case of the test under consideration, parts of two days were consumed before all the facts were revealed; these proved to be that the main iron drain and the separate main traps had all been omitted (*i. e.*, "skinned out of the job") ; all three drains connected without traps into an old system of

brick drains with several branches extending to catch-basins, through whose numberless joints the air escaped before any pressure could be established. The only leak found and located was at the connection of the boiler blow-off to the old drain above referred to, the odor escaping freely into the house at that point, although the pressure applied was so slight as not to be indicated by the gauge, which is very sensitive. It is not known what other leaks might have been discovered had the full pressure been employed, which, however, was not practicable, owing to the bad condition of the drains. It may fairly be claimed in this case that the test revealed a state of things which could not have been established in any way short of digging up the whole system, and which but for it would have remained a perpetual secret with the rascally plumber who scamped the job, and the inspector who permitted it.

On the other hand, the Board of Health test revealed nothing, except that, relying upon it, the Board's own inspectors were misled into pronouncing the job all right.

Here are two cases which are interesting by contrast, the test in each case showing the exact contrary of what was expected: —

House of T—— P——. An old house with new plumbing was offered for rent. The new tenant, a well-known architect of large practice, for reasons satisfactory to himself, one of which was that he knew the plumber, would not sign papers until the plumbing had been thoroughly tested. The pneumatic test proved everything to be perfect both in arrangement and operation.

House of C—— A——. In this the entire construction, from foundation to ridgepole, was carried on under the personal supervision of the owner, a wealthy manufacturer of large experience. His oldest son had died in the house of typhoid fever a few months previously. The reason for applying the test, however, was the fact that the house was to be let, and the lessee, F—— L—— A——, demanded inspection before occupying it. The plumbing

was "one of ——'s best jobs." Neither the owner nor any member of his household had ever suspected for a moment the possibility of imperfections in the drains, and the first statement that the test indicated serious defects was received by all with incredulous surprise. The owner was sent for from his office by a member of the family, and he arrived in what may be well enough described as "a state of mind," and began to express himself very freely, evidently supposing the inspectors were merely giving an opinion about a matter concerning which they could know but little. While he was still talking, the inspectors had exposed one of the defects, the character and danger of which were at once explained to him. He listened without a word and went away in silence, appearing to have been quite stunned by the shock of the discovery. Money could not measure the value which the knowledge then obtained would have been to him had he had it a year previously. The test showed that all the vertical lines, under the effect of expansion and contraction, had separated from the main horizontal, and the latter to be of such a character that it had to be entirely replaced by new work. This house, although new, had been in a dangerous condition from its completion.

The following is an unusual case, — unusual only because it was that of one of the best built houses in the best location in Boston. It may be found commonly among the cheaper class of block-built houses in certain parts of the city : —

House of D—— A——. Every detail of construction of this house which had a bearing upon health had been most carefully attended to. After painstaking inspection the plumbing appeared to be perfect. The only questionable thing was the duct for cold air to the furnace, which was built up against the foundation party wall, which formed one side of it. The latter was built of Roxbury pudding stone, with joints only partly filled with mortar. On the other side of this wall there lived a distinguished physician, and the possibility of a defect here was not

suspected. However, on testing the drains in the physician's house the odor of peppermint promptly appeared at all the hot-air registers in the house of D—— A——, having entered by way of the party wall and the furnace cold-air duct. The doctor gave the order for the immediate renewal of all his drains; but the only child of D—— A—— had already been dead some time.

House of W——M——. Country plumbers' work. There had been sickness in this house, followed by the death of the owner and one of his children. Those who remained desired to be reassured that the plumbing was all in order, having previously had entire confidence in the judgment and careful superintendence of their late paterfamilias, a practical man of wide knowledge, and a successful manufacturer.

The test showed what no ocular inspection would have detected without uncovering all the pipes, and tracing out each one, and accounting for each connection, and what no test short of the pneumatic would have revealed positively. A receiver vent-pipe, apparently extending above the roof, had been connected to the main soil-pipe, where such a connection would have been least expected. The condition was that the drain was open into the house through the w. c. receiver, in which there was a vent opening, and another small one for the passage of the handle.

The "peppermint test" would have disclosed this defect only in the event of there being a strong indraft into the room. The pneumatic test is independent of such accidents.

In justice to the proprietors of the Pneumatic Test, an account of it ought not to be concluced without contrasting with it the plumbers' method of saturating everything with oil of peppermint in their so-called tests, and a statement of what the process is in their hands. It consists simply in the unstinted use of oil of peppermint. The writer knows of one case where ten pounds of oil of peppermint

were poured into the pipes, quantities of it getting on to the hands of the men or their clothes. The plumbing foreman who stood by and saw this done, when arraigned by the writer for permitting such clumsy work and for throwing away nearly $40 worth of a costly essential oil into an old drain without result, defended himself by the statement that forty pounds, worth $160, were used in testing the drains of Mr. Vanderbilt's house in Newport. The writer forbears to make further comment on this than to say that in his entire practice, covering fifteen years, he has not used so much as five pounds of the oil altogether. In new work the amount which is volatilized is only a small fraction of an ounce. It is never poured into the drain.

In the city of Boston the Board of Health is willing to make tests of plumbing without charge on application by any resident, and is frequently appealed to by lodgers and tenants, and sometimes by landlords who want a disinterested opinion. The test made by them is simply the plumbers' test above described, with the difference that the Board's inspectors do not carelessly slop the oil of peppermint about. They use it in comparatively small but amply sufficient quantities. This test had some value before the adoption of the main running trap and the soil-pipe extension above the roof, constructions which are now quite general, and exacted by the plumbing ordinances of most well-regulated municipalities. Where these essentials are not found, there is commonly, but not always, an indraft from the sewer, caused by the aspirating action of the chimneys, and where pronounced defects exist in such cases the common peppermint test will reveal them, except when the condition prevails which is explained below. In the case of modern work, however, there is usually, but not always, an outdraft, since the soil-pipe extension itself acts as a chimney, when the peppermint test can show nothing. So, too, where the drain has no main trap, and there is no soil-pipe extension, the effect of the sun or the wind on the rain-water leaders may create in them a powerful outdraft, sufficient to

protect the house for the time being from all sewer air, and prevent the discovery of all defects, although extremely bad ones may exist. There are thus conditions under which the peppermint test gives only negative results, even in the presence of the worst conditions. These remarks are equally applicable to the smoke test. It was to obtain positive results under all conditions that the pneumatic test was invented, and it hardly needs further demonstration to show that the ordinary tests, even the official tests of the Board of Health, are practically worthless, except occasionally, when the defects are extremely bad and the conditions favorable for the test. In other words, such tests give results by accident and chance, and are therefore unreliable and untrustworthy.

ADVERTISEMENT.

The Sanitary Agency is the sole proprietor of the Pneumatic Test, and undertakes the inspection of buildings, giving a full report upon their sanitary condition in the respects both of drainage and ventilation.

These examinations are conducted by skilful persons, one of whom is a practical plumber who has become, by extended experience, quite familiar with the operation of the test under all possible circumstances.

The terms of the Agency for making the tests depend upon the difficulties encountered. An ideal case of great simplicity, where everything is in perfect order, costs $20. Ordinarily the cost is from $25 to $30; sometimes, where the case is very difficult, this may be as great as $75, to which travelling expenses must be added, if beyond the city limits. Persons ordering the test will save expense by giving the Agency full information as to the accessibility of the open extensions of the pipes exterior to the buildings. These are the fresh-air pipe, the top of the soil-pipe, and of the back-air pipe; the last two, of which there may be several lines, are always on the roof, and are often so located as to be out of reach, except by the aid of ladders or temporary scaffolding.

The Agency arranges to REPEAT TESTS each year or every six months at a greatly reduced price, providing the outlets are arranged so as to be easy of access. Where several neighbors form a

club to have the test regularly made, the price is still further reduced, since the time of the inspectors is thereby much economized over making widely separated tests at different times.

CERTIFICATES.

The Sanitary Agency issues only one grade of certificate, which is assurance that the tested work is in a perfect condition. It is evident that in the matter of plumbing there cannot be degrees of safety, yet there may be degrees of excellence of materials and workmanship, or of both, indicating a greater or less degree of permanency. Consequently, the best class of work receives a certificate of perfect condition good for a period of five years. Cases where a light-weight quality of soil-pipe is found, and where the traps and fixtures are not up to the standard of modern requirements, receive a certificate for one year only. At the expiration of the term a new inspection will be made, if desired, at a reduced rate, depending chiefly upon the time required to make it.

It is hoped that architects will hereafter require work to be so constructed as to remove the chief difficulties now encountered in making the test, and so lead to its cost being much lessened.

The Sanitary Agency believes that the time is at hand when self-interest will compel the proprietor of every hotel, apartment and boarding house to keep the certificate of the Agency posted in a conspicuous plaee, and when without it no summer or health resort can exist.

The certificate of the Agency, when a clean bill of health is given, adds value to real estate, in case of lease or sale, many times above its cost.

NOTICE.

The public are hereby informed that parties who make a specialty of testing plumbing have been for some time making unauthorized use of part of this process, and, although their tests are not reliable, have made a reputation thereby which does not belong to them. The complete process as above described, involving the use of special apparatus by whose aid alone positive results can be obtained, is operated solely by the Agency. It is not possible with the apparatus in its incomplete form as used by others to be more than an aid in forming an opinion, which can never be anything but an opinion.

The test of the Sanitary Agency develops absolute facts, and supports them by evidence which cannot be questioned. Infringers are hereby notified that they must respect the rights of the proprietors of the Pneumatic Test.

THE SANITARY AGENCY ENGINEERING DEPARTMENT.

The Agency furnishes designs, plans, specifications, and superintendence of all branches of sanitary construction, including, besides plumbing and drainage, steam and water heating and ventilation, and in the case of new work acts jointly with the architect. This department, as well as that of inspection, is under the direction of Mr. Frederic Tudor, who, as sanitary architect, was employed by the trustees of the New Public Library, and by the city architect in the cases of the Roxbury High School and the Long Island Hospital. He has had charge of other public and private works of importance throughout the country, especially in New York and Albany, to which recommendation he adds the knowledge gained during twenty years' experience in the practical construction of sanitary apparatus in all its branches.

CONSTRUCTION DEPARTMENT.

The Sanitary Agency, in co-operation with a first-class plumbing house, carries on the work of plumbing, especially in the line of repairs.

Where patrons employ a plumber regularly, the Agency prefers not to interfere to his disadvantage, and will aid him in the prosecution of his work; if, however, employers have no preference, the Agency will gladly accept orders. It is the custom of the Agency to test its own completed work, and, after it has been proved to be in perfect order, to deliver to the owner a certificate to that effect without extra charge.

REFERENCES.

Mr. Tudor, by special permission, gives the names of a few persons which he has selected from among the hundreds for whom he has performed expert service: —

Mr. F. L. Ames.
Mr. Martin Brimmer.
Rt. Rev. Phillips Brooks, D. D.
Mr. James B. Francis, C. E.*
Hon. Horace Gray.
John Homans, M. D.
Gen. John Newton, U. S. A. Eng'r.
J. P. Oliver, M. D.
Gen. Francis A. Walker.

Messrs. McKim, Mead & White, Architects.
Messrs. Shepley, Rutan & Coolidge, Architects.

* Deceased Sept. 18, 1892.