material, when re-dipped in the process of coating, resists corrosion from moist, and especially from salt air, much better than the former.

The so-called galvanized iron is either black sheet iron covered directly with a coating, consisting chiefly of zinc, or it is sheet tin so covered, the iron in this case receiving a double coating.

Far superior to either tin or galvanized iron is copper, which is practically unaffected by the ordinary agents producing corrosion of roof coverings and leaders. It has been very considerably employed in first-class work, but its cost is at present a serious bar to extensive use. Galvanized iron leaders cost perhaps twenty per cent more than tin leaders of the same size. Two or three years ago, before the rise in copper, leaders of the latter material cost approximately half as much again as those of galvanized iron, but I am informed that they now (September, 1888) cost about two and one-third times as much as the galvanized iron.

Copper leaders are made of all shapes and sizes used for other materials. Hot rolled copper was the variety formerly employed on buildings, but prejudice was aroused against it because of its softness and the ease with which it loses its shape. Cold-rolled copper, which is now utilized in good work, is harder and stiffer, and if selected of a grade weighing 18 or 20 ounces per square foot, is found to be a superior and satisfactory material. Copper expands and contracts under changes of temperature much more than iron, and allowance often has to be made for this when the metal is used in construction. In a long vertical rain leader of copper, provision for change of length is often made by introducing one or more slip joints, at which there is a lap of perhaps three inches, and at which solder is omitted. The slip joint of course offers some opportunity for the escape of sewer air, if that is allowed to enter the leader; but if well made, the joint is claimed to be soon rendered fairly tight by a slight coating which forms on the metal. The protection afforded to tin and galvanized iron pipes by their distinctive coatings may be further increased by coating with tar and asphalt or by use of the adamanta or other coverings.

But while a suitable material is essential to the endurance of the pipe against corrosion, its protection against bursting by ice is to be obtained partly by the mode of joining the material, but chiefly by the shape given the pipe in cross section. The common tin pipe is made in short lengths soldered together at the transverse joints, each length having a straight longitudinal seam, which is either a soldered lap joint or a simple locked joint. The lap joint is not so strong as the rest of the pipe, and under the great expansive pressure of ice is opened. Whatever, then, tends to strengthen the longitudinal jointing of the pipe gives greater resistance against moderate ice pressure, although no plain pipe of ordinary thickness is proof against rupture by ice. The locked joint is an improvement upon the plain soldered lap joint, and is used for galvanized iron and copper as well as for tin. The plain lap joint can be strengthened by riveting, and I have seen copper leaders made with a straight soldered and riveted seam which is claimed to be stronger than the main body of the pipe, the latter yielding first to ice. Galvanized iron leaders are also made with a patented spiral and riveted seam, which renders them very strong.

Economy of material for a given cross section of pipe demands the use of a plain circular form; but it is evident that no shape would be more unyielding against the expansive power of ice, and in order to accommodate the latter and prevent rupture, the expedient of a fluted or corrugated pipe was hit upon some fifteen or twenty years ago, and patented. This form of pipe has been very extensively used and appears to have been generally satisfactory in resisting ice, readily changing its shape under pressure. Tin, galvanized iron, and copper pipes are all to be had of the corrugated form, being usually circular in general shape, but often made rectangular as being more ornamental. A good corrugated copper pipe would appear, all things considered, to be the best available construction. The patent upon corrugated pipes expired a year or two since and they are now manufactured by a number of competing firms.

Even if a leader pipe be used which will not be ruptured, it is, if exposed, liable to become so chocked with ice as to be unable to carry off water, and the same thing also happens in the case of gutters. Hence, in a climate as cold as that of Boston, resort is frequently had to the use of steam, not so much, however, for the purpose of preventing the formation of ice in freezing weather as to clear a passage for the water when a thaw comes on. Most large buildings at the present time have a supply of steam, either for heating or for power, which can without much difficulty be drawn upon during the day time for use in the way that has been mentioned.

The most common method of using steam for thawing out leaders, is to introduce a small jet from perhaps a ⅜-inch or a ½-inch pipe at the base, and allow the steam to rise up through the leader. This plan is followed at the Wakefield building, on Canal street, in Boston; and as a precaution steam is thus at times introduced also into the base of an iron leader in the Wilde estate building. At the Sloane building, in New York, the same plan has been successfully tried, but has practically been superseded by allowing hot water to drip into the tops of the leaders. Waste steam from the heating and elevator systems passes into small drum-shaped condensers on the roof, and the hot water of condensation is conducted through drip pipes to the leaders. The climate of New York city is so much milder than that of Boston that comparatively little trouble from ice is experienced; and the common practice of an untrapped connection with drains and sewers, the air of which is warm, tends to prevent serious accumulations within the leaders.

Another method which is sometimes, but less commonly, used, is to carry up a steam pipe through the interior of the leader. At the Cheney building in Hartford, Conn., a ⅜-inch steam pipe is thus employed.

This pipe has an iron cap a foot or so above the roof, the cap being perforated by a small hole to permit some circulation of steam, but the hole quickly becomes stopped by rust. The condensation of steam within the pipe, and the freezing of the water thus formed, has split the pipe at various points; but the steam escapes all the more readily in consequence, and the arrangement is entirely successful in clearing out the leaders.

Even if the leaders are kept open, the gutters are very likely to become clogged with ice, and then fail to perform their duty. Attempts have therefore been made to clear these also by the aid of steam, and on the Studio and Museum buildings in Boston may be seen arrangements of steam pipes for this purpose. The gutters are of the common half-round metallic type, projecting out from the edge of the roof, the steam pipes extending along over the centre of the gutters and about on a level with the top. On the Studio building the pipes are pierced beneath with small holes at intervals of say six inches, with the object of directing downward into the ice of the gutter a great many small jets of steam. This device is not satisfactory, however. A hole is melted in the