retarding effect of elbows. Richards, who is a celebrated engineer on compressed air claims that one elbow has the same retarding effect as 14 feet of pipe. He also claims that gate valves should be used in place of the ordinary valves. Bends of large radius in pipes are therefore preferable to elbows. Not only will this have a less retarding effect on the flow of air, but it will also give less joints liable to leakage.

The leakage of air from joints and connections is I think the greatest loss in the transmission of air. These are generally small leaks all over the plant and are not noticed on account of the noise of the running machinery. The way that these small leaks are looked after at the Stratford locomotive shops is that after working hours, the air pressure is kept up and these leaks then can be heard and marked and repaired. To give you an illustration of the amount of air that will escape through a small opening (without going into a lot of figures) a 3-32 hole will keep a 9½ inch Westinghouse air pump running 45 single strokes per minute to maintain 70 pounds per square inch in the main reservoir. This illustration will show you the importance of looking after small leaks in any part of the plant.

One great objection that has been raised in the use of compressed air, is that freezing up of the air pipes under certain conditions. By the freezing up of the air, of course, we understand a disposition of moisture on the sides of the pipes that convey the air and its accumulating and freezing there until the area of the channel is reduced and the flow of air is prevent-This moisture alone can cause no trouble as long as the ed. temperature continues high enough, neither will a low temperature of the air freeze up as long as there is no freeze moisture present. The principal cause of the rapid freezing up of the air pipes when exposed to low temperatures is that it is generally taken too direct from the compressor, in some cases, quite hot and when it enters pipes exposed to a freezing temperature, it cools rapidly, depositing moisture which freezes and chokes the pipes. The after cooler, which I have previously mentioned, would reduce the liability of this freezing, but not altogether, as it would be impossible to cool the air so that when exposed to frost, it would not deposit some moisture, but the freezing process would then be slow. Another means to prevent freezing would be to compress the air to a greater pressure than required. It could then be cooled and used through a reducing valve and expanded to a lower pressure. In view of these facts. I consider that all out door compressed air pipes should be protected from frost, the same as water or steam pipes.

A great deal of discussion has taken place regarding the economy of reheating dry compressed air, but little is generally known as the actual economy of such a practice or the conditions under which, it is practicable. Some authorities claim that a