the *leang*, corresponding to our ounce, became the weight of metal put into a coin, so that the modern *tael*, in which mercantile quotations are found every day in the *Times*, is merely an ounce of silver, and is thus directly connected with the musical scale. Finally, says Dr. Wagener, it appears from this account that, in China, weights, measures, coinage, and the tuning of musical instruments have been derived quite consistently from a constant unit supplied by Nature herself, and that the essentials of this system are over 4600 years old.—*Nature.*

EXPERIMENTS UPON AUTOMATIC SPRINKLERS.*

BY G. J. H. WOODBURY.

(*Continued from page* 299.)

SENSITIVENESS.

Any method of measuring the sensitiveness of sprinklers is confessedly an artificial one; and, in the endeavour to apply uniform conditions, the sprinklers are subjected to exposures which bear little analogy to those met with in a mill fire.

The writer has made some trials of sprinklers where measured quantities of fuel were ignited in a building equipped with sprinklers; and, notwithstanding that the utmost care was taken to preserve uniform conditions, the results were exceedingly variable and of no value, unless to serve as a basis of comparison between two sprinklers tried simultaneously. These test fires possess a commercial value, where it is desirable to show to possible purchasers that automatic sprinklers would extinguish a sharp fire kindled beneath them. Ovens heated with a large gas flame have been used to demonstrate various merits of automatic sprinklers; but the heat applied to the oven is variable, because both the pressure and calorific value of gas is constantly changing. The temperature of such an oven varies in different parts of the oven at the same time. These oven tests are of use to those engaged in the manufacture of sprinklers; but neither a bon-fire in a room, nor the gas-oven half a yard in either dimension, has the elements of precision necessary for this work.

With the purpose of employing a method which would give precise results, the following apparatus was devised for the object of learning the relative sensitiveness of automatic sprinklers under pressure: A box of thirty cubic feet capacity, measuring three by four feet, and two and a half feet deep, was swung top downwards over a large table. A Parmelee sprinkler-head projected through the centre of the table, and was connected with a piece of four-inch pipe about two feet long, which was beneath the table, and capped at both ends. Water was placed in the lower end, and connections were made with a steam supply and a steam gauge. This arrangement served to furnish a supply of saturated steam at any desired pressure, and therefore the quantity of heat and its temperature could be known and controlled. The sprinklers were screwed into a frame-work of fittings which was placed on the table, so that the sprinklers under trial were about two feet above the table. The sprinklers were filled with water at the temperature of the room, and weights applied in such a manner as to be equivalent to a water pressure of fifteen pounds to the square inch upon the sprinklers. Electric apparatus was attached, so that when any sprinkler opened, a bell corresponding to each sprinkler would ring in an adjoining room. On making a trial, the box was lowered upon the table, and the temperature increased very slowly to 112 degrees, and then the valve was opened and steam blown through the Parmelee sprinkler-head into the box. It required two minutes to increase the temperature within the box one hundred degrees, and the circulation of the steam was so rapid that thermometers inserted through orifices in various parts of the box varied less than one degree from each other. Although this was not the heat proceeding directly from a fire, yet it enabled the use of constant conditions; and the results with any one sprinkler, as given in the record, do not vary from each other more that would correspond to varying masses of solder in the joint.

A cubic foot of steam at 212 degrees contains 2 6-10ths times the amount of heat that a cubic foot of air does at the same temperature, but in these experiments the influx of steam heat was a constant, and in the rapidity of its results corresponded to that which might be expected from air at a much higher temperature.

Whenever one sprinkler opens upon a fire, it is probable that in many instances, other sprinklers are opened by the steam generated as a result of the application of the water upon the fire, rather than by the air directly conducting the heat of the fire; and in such instances this method must represent the facts in the case.

Accepting these results as accurately representing the relative sensitiveness of these sprinklers when exposed to steam, the question naturally arises as to the analogy between this action and its cause and the actual mill fires, and the consequent operation of sprinklers. In fact, the steam method probably gives results as different from a mill fire as one mill differs from another.

In a fire on light stock in process of manufacture, such as a card or picker room, the difference between the sprinklers at either end of the list would probably be greater than here stated, while a fire of any kind would reduce the difference to a point that the two kinds might be quite nearly alike in the time of the action.

If the temperature produced by the fire rose so slowly that the heat could be conducted through the metal of the sprinklers to the soldered joint as fast as the temperature of the room increased, then the relative sensitiveness of the diverse types of sprinklers would be diminished. A sealed sprinkler, with its soldered joint next to the water, is assuredly the strongest form of construction; and, in order to produce a sensitive sprinkler, with its joint away from the water, it is necessary to introduce complications in the way of valves, deflector joints, and links; and he who utilizes these mechanical makeshifts to the least disadvantage, produces the best sprinkler. A sprinkler joint should be rather narrow in the direction of sliding open; and as far as necessary for strength, increase the width; because, when a sprinkler is in the act of opening, the least particle of water which reaches the partially opened joint at once seals it in that position, and it requires an exceedingly fierce fire to melt open a sprinkler with leaking water trickling over the soldered joint.

The Parmelee sprinkler is shown to be about the least sensitive head on the list, and the least in capacity of discharge; and yet the whole experience with the Parmelee sprinklers has been a success, and we have no record of a fire getting away from them. If such is the fact with this sprinkler, what results may we not expect from the latter forms of sensitive types of sprinklers?

BURSTING STRENGTH.

The results were obtained with a pump used in the graduation of hydraulic gauges. The piston was slowly moved by means of a screw, and the pressure applied steadily and without any violent motion. The effect of a pressure applied rapidly upon a solder joint is different from that of a lower pressure remaining constantly upon the sprinklers, and still less destructive than a constant water hammer. Save in three

* A paper read before the British Association at the recent Montreal Meeting.