

render doubtful the analogy which had been established between the thermal and electrical conductivity. Wiedemann has accordingly determined the conductivity for heat and electricity of several alloys. He used the same method as in the previous researches, and the following Table contains the results at which he has arrived. The standard adopted is silver, the conductivity of which, both for heat and electricity, is taken at 100. Copper zinc  $\frac{8}{1}$  denotes an alloy containing 8 parts of copper to one of zinc.

	Conductibility for	
	Heat.	Electricity.
Copper, . . . . .	73·6	79·3
Copper-Zinc $\frac{8}{1}$ , . . . . .	27·3	25·5
Copper-Zinc $\frac{6\frac{1}{2}}{1}$ , . . . . .	29·9	30·9
Copper-Zinc $\frac{4\frac{1}{2}}{1}$ , . . . . .	31·1	29·2
Brass $\frac{2\frac{1}{2}}{1}$ , . . . . .	25·8	25·4
Zinc, . . . . .	28·1	27·3
Tin, . . . . .	15·2	17·0
Tin-Bismuth $\frac{2}{1}$ , . . . . .	10·1	9·0
Tin-Bismuth $\frac{1}{1}$ , . . . . .	5·6	4·4
Tin-Bismuth $\frac{3}{8}$ , . . . . .	2·3	2·0
Rose's Metal, . . . . .	4·0	3·2

From these results Wiedemann concludes—

1. That the agreement, which had been previously found to exist; between the thermal and electrical conductivity of metals obtains also for alloys.

2. That the conductibilities of alloys of zinc and copper, for heat as well as for electricity, differ but little, even with a considerable excess of copper, from the conductivity of the worse conducting metal, zinc. The alloys of zinc and bismuth, on the contrary, have nearly the mean conductivity calculated from their atomic composition.—Poggendorff's *Annalen*, Nov., 1859.

### *On a Method of Testing the Strength of Steam Boilers.\**

By Dr. JOULE.

The author adverted to the means hitherto adopted for testing boilers. 1st. That by steam pressure, which gives no certain indication whether strain has not taken place under its influence, so that a boiler so tested may subsequently explode when worked at the same or even a somewhat less degree of pressure. He trusted that this highly reprehensible practice had been wholly abandoned. 2d, That by hydraulic pressure obtained by a force pump, which does not afford an absolutely reliable proof that the boiler has passed the ordeal without injury, and moreover requires a special apparatus. The plan which had been adopted by the author for two years past, with perfect success, was

\* From Newton's London Journal, April, 1860.

free from the objections which applied to the above, and is as follows: The boiler is entirely filled with water; then a brisk fire is made in or under it. When the water has thereby been warmed a little, say to  $70^{\circ}$  or  $90^{\circ}$  Fahrenheit, the safety valve is loaded to the pressure up to which the boiler is to be tested. Bourdon's or other pressure indicator is then constantly observed; and if the pressure occasioned by the expansion of the water increases continuously up to the testing pressure, without sudden stoppage or diminution, it may be safely inferred that the boiler has stood it without strain or incipient rupture.

In the trials made by the author, the pressure rose from zero to 62 lbs. on the square inch in five minutes. The facility of proving a boiler by this method was so great, that he trusted that owners would be induced to make those periodical tests, without which, fatal experience had shown that no boiler should be trusted.

---

*On Tungsten Steel.\** By F. X. WURM.

Franz Mayr has produced, at his cast steel works at Kapfenberg, in Styria, cast steel of such dimensions, forms, and excellent quality, as could previously only be obtained from Krupp, of Essen. Oblique cog-wheels for coming machines and locomotives, axles for railway carriages, boiler plates, angle knees, and round, flat, and quadrangular rods, of various sections, have now been produced by Mayr for more than a year.

What particularly deserves to be mentioned with regard to these articles, is Mayr's unrivalled tungsten-steel distinguished by the fineness of its crystalline texture and its remarkable hardness, so much so, indeed, that the experiments made with it several months ago have shown that tools made from it for cutting toothed wheels, borers, chisels, punches, turning tools, planing blades, &c., retain their power of cutting four times as long as those made of Huntsman-steel, previously regarded as the best. This steel may therefore be recommended as the best for these purposes.

Tungsten has nearly the same specific gravity as gold, and this density is recognisable in the cast steel alloyed with it, by the alteration in the grain of the fractured surface, and by the heightened ring of the steel.

In hardness, metallic tungsten nearly approaches the hardest of natural bodies, and it communicates this property to cast steel, without injuring its tenacity and malleability when the addition is of 2—5 per cent.

The absolute solidity of tungsten-steel exceeds that of all other known steels, for fifteen consecutive experiments with a machine in the Polytechnic Institute of Vienna showed the highest power of resistance to be 1393 hundredweights, and the lowest 1015 hundredweights, giving an average of  $1158\frac{1}{3}$  hundredweights to the square inch; so that this steel exceeds all other kinds hitherto tried.

The ore of tungsten from which the metal is obtained, usually occurs

\* From the London Chemical Gazette, No. 403.