ABOUT COPPER.

It is astonishing how little engineers as a rule know about copper, considering the important position the metal takes, in constructive work To the ordinary engineer, copper is copper and nothing more He may have a vague idea that traces of impurities may be found in the mass he purchases, in the shape of plates or otherwise, but as a rule it is generally supposed that commercial copper is fairly pure, and the purer the better. Engineers have had their eyes opened to their error in this respect, by a report recently issued by the Alloys Research Committee of the Institution of Mechanical Engineers. The chief author is Prof W. C. Roberts-Austen, who probably stands at the head of English metallurgists.

The report gives the result of a very large number of tests made in order to ascertain the effects of various impurities in copper. The experiments have extended over several months, and the committee have had at their disposal exceptional means of carrying on the work, in the shape of very complete apparatus.

Arsenic is naturally the first alloy considered in regard to copper. The tenacity of pure copper at 570 degrees, Fhr., is 9.38 tons per square inch, with an elongation of 34.6 per cent. This is, according to le Chatelier, while the experiments made by the research committee show that arsenical copper at that temperature, has a tenacity of 12 6 tons (28,320 pounds per square inch). The temperature is an important point, especially in the present day of high pressure steam. In England, copper fire boxes for locomotives are the favorite practice, and in that respect, therefore, temperature is a still more important fact. It appears safe to conclude that the superior strength ductility of arsenical copper is maintained at the temperatures reached by the plates of the fire boxes of locomotives; and copper alloyed with arsenic is harder than the pure copper. In the tables attached to the report, copper rods containing 1.2 per cent. of arsenic, were tested without preliminary work. At 68 degrees F., the tensile strength per square inch on original area, was 24,840 pounds, the co-efficient of contraction being 0.79. The elongation in the former of these tests was 20 per cent.: in the latter, 10 per cent. The arsenic here, of course, is very high. Other samples tested with 0 5 per cent. of arsenic (a more normal quantity) at a temperature of 64 degrees F., gave a tensile strength, on original area, of 33,420 pounds to the square inch; the elongation being 37 per cent. At 212 degrees F., the tensile strength was 30 920 pounds, with 30 per cent. elongation. At 496 degrees, the tensile strength was 30,030 pounds with 23 per cent. elongation, while at 835 degrees F., the tensile strength was 20,000 pounds per square inch, with 13 per cent. elongation. It has generally been supposed that arsenic and antimony, as impurities in copper, have very much the same action, and it may be said generally that the particulars given by Prof. Roberts-Austen bear out this assumption. The olden text-books, however, are strong in their condemnation of antimony in copper and arsenic also, but the above quoted tests indicate that it is only at excessive temperatures that the tensile strength of the material falls off to any great extent. That, of course, applies to arsenical copper in order to form an estimate for this purpose. Sets of rods were made from copper of a high degree of purity; they were hammered, rolled and slowly annealed; when tested at 52 degrees F., the tensile strength was 30,170 pounds to the square inch on original area; the elongation being 37 per cent. At 480 degrees the tensile strength was 28 240 pounds to the square inch, with 72 per cent. elongation. At 878 degrees the tensile strength was 21,730 pounds; the elongation is not given in the tables, but was certainly considerably below 15 per cent., if one may judge by the results of analogous experiments.

We therefore see, on comparing pure copper with that containing 5 per cent of arsenic, that in the former, at a temperature due to that of the atmosphere, we get a tenacity of 30,170 pounds, as compared to 33,420 pounds for the arsenical copper, showing a superiority for the latter, the elongation being the same in both cases. If we go to the temperature of boiling water at atmospheric pressure, the tenacity of the pure copper is 30,920 pounds, an increase in strength; in the arsenical copper tenacity has fallen off, until the strength of both samples are equal, the elongation being also equal in both cases. The effect of arsenic, however, at extremely high temperatures, is to reduce the strength until the absolutely pure copper has an advantage. The experiments, however, were made for laboratory purposes, and are not to be taken as conclusive in regard to engineering practice. Good fire boxes are made containing a percentage of arsenic of from ·2 to ·6 per cent. and even higher.

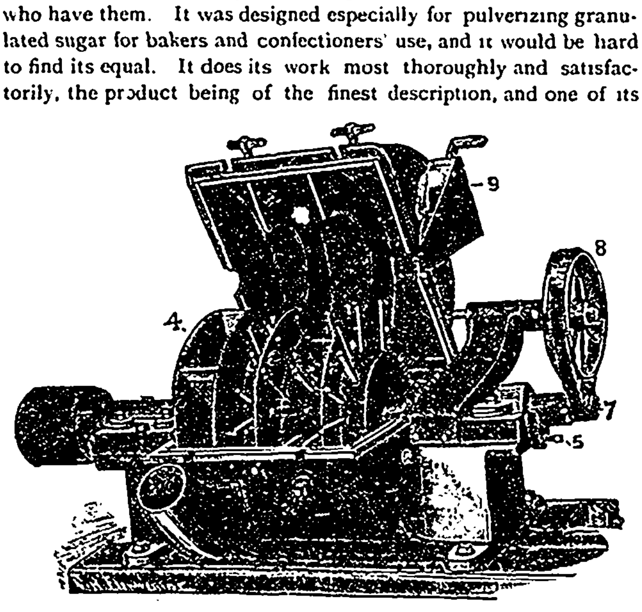
Dr. Watson referred to this matter. The influence of impurities on copper in the oxidized condition in which it is ordinarily used, by engineers, in some cases differed from their influence when the copper is de-oxidized. He had made experiments, in which he found that arsenic does not increase the strength of the oxidized copper. Professor Roberts-Austen took elaborate precautions in casting his test rods to prevent oxidization, but it is impossible, the mechanical methods he employed, and which were devised with great ingenuity, were not so efficient as those of the ordinary copper smelter, as used in general commercial work, when phosphorus is introduced for the purpose of removing oxide, which it does, in the shape of a slag.

With regard to antimony, it appears from the report that its influence is even more marked than that of arsenic, the strength of copper with 0.26 and 0.529 per cent being respectively 73,800 pounds and 77,900 pounds to the square inch. No attempt was made to ascertain the strength of an antimony alloy of copper above atmospheric temperatures, and it may be said that in commercial copper antimony is rarely present in sufficient quantity to materially influence the properties of the metal as wrought, but its tendency is to cause cold shortness.

One of the most important results of the investigations of this committee will be to call the attention of engineers to the influence of bismuth in copper. Hitherto this alloy has been, we think we may say, generally ignored by those who work in copper, although, of course, chemists have known that its influence is by no means inconsiderable. It has been generally supposed that bismuth acts on copper chiefly by lessening its ductility, but the experiments of the committee tend to prove that it renders copper singularly weak. A sample containing 0.1 per cent. was too brittle to work, and at ordinary temperatures had a tenacity of 18,000 pounds to the square inch; but when tested at gradually rising temperatures, the fall in tenacity was very rapid, and there was practically no elongation. The effect of bismuth, however, did not appear to be quite proportional to the amount present, as copper containing 0.2 per cent. had a tenacity of 7,000 pounds. The prejudicial effects of bismuth did not seem to vanish, even though but a trace be present, for instance, in one case, with a singularly pure copper, there was but 0 002 per cent of bismuth, and although strong, the elongation was very small.

THE WOODBURN PULVERIZER.

We add to our list of advertisements that of E. S. Stephenson & Co., St. John, N.B., who are the manufacturers of the "Woodburn Patent Pulverizer." This is a machine that has been on the market for a number of years, and gives entire satisfaction to all who have them. It was designed especially for pulverizing granulated sugar for bakers and confectioners' use, and it would be hard to find its equal. It does its work most thoroughly and satisfactorily, the product being of the finest description, and one of its



great advantages over the old style of mills is that it produces XXX or XXXX sugar without the use of a bolting machine. All who have to use a bolting machine know the trouble and expense of getting fine sugar in this way. The Woodburn Pulverizer does away with all this trouble and expense; it works equally well with cream of tartar, spices, drugs, paints, black lead, etc, etc. It is now being used by a large number of bakers and confectioners in England and the United States, as well as in Canada, and many of the spice and drug houses in these countries are now running them satisfactorily There is nothing complicated about the pulverizer, and it is easily run and requires little or no attention. Messrs. Stephenson & Co. are also manufacturers of shafting, pulleys, and hangers, as well as other kinds of machinery. Those who are interested should send for a circular.