tion in the rim of a cast iron wheel extends at right-angles to the chill-block, and only to a certain depth, this depth being dependent on the quality of the iron, etc. The effect is a slight depth of metal with strong resistance, backed with ordinary gray iron of far less resistance, bordering, comparatively speaking, upon sponginess. When this strong surface metal had been worn so thin as to be unable to support the service-load which was on it, it would, having but a comparative sponginess or cushion beneath, mash-up and fall away in a manner which left the appearance of the outside of an oyster shell, and hence the term "shelling."

I have always opposed the use of the term "shelling" as applied to solid steel wheels, for I have believed, and my belief has been based on specific study, that no such condition should exist in properly designed and made solid steel wheels. But I must now go on record as saying that if some railway officials persist in using wheels with a 3 in. rim thickness, or over, and can succeed in inducing manufacturers to supply such types, then I must, though most regretfully, add the item of shelling to the liabilities of solid steel wheels, for close observation of many wheels of this type, not confined to any one manufacturer's product, convinces me that in a properly made solid steel wheel with a 2½ in. rim thickness there is good opportunity for knowing what you are getting, whereas with a 3 in. rim thickness you cannot be sure of anything, except that there will be a considerable percentage of dissatisfaction and trouble in the results. Let those who doubt the correctness of my position in this matter take note of the fact that the roads which have had the longest and most extensive experience with solid steel wheels have nearly all given up the use of wheels with a 3 in. rim thickness and have adopted the 2½ in. thickness as standard.

For years I have been an advocate of the idea of producing wheels so true to dimensions that the machine work was reduced to a minimum. I am still a firm believer in the theory, but only to the extent to which it can be carried in justice to the quality of the material produced. Machine work increases the cost of production, and it may often remove metal of particular service value, yet if the effort to produce material on which machine work is unnecessary opens the door to a product which lacks uniformity, lacks many of the other virtues which it should possess, and borders on the dangerous, then extreme caution should be used in order that a "penny wise, pound foolish" policy be avoided. It may be all right to produce some of the commodities of life on the basis of tonnage, or general average, but in dealing with wheels let us not forget that we are dealing with units, each and every one of which should possess integrity; otherwise, much time will be spent in settling claims for low mileage, in providing for adjustments covering defective material, and, worse yet, in explaining how wrecks occurred. Uniformity in manufacture is perhaps the feature most to be desired in connection with solid steel wheels. But uniformity of quality should be held as paramount to uniformity of mere dimensions.

The production of proper solid steel wheels does not entail the mere forming of a bulk of steel into the shape of a wheel. It carries with it far greater requirements and responsibilities. Proper production means not alone mere shaping, but, and particularly, the working into shape along such lines as tend to preserve and develop the virtues of the material for the service in which the finished product is to be used, and the doing of this in such a way as to assure uniformity and quality as between wheels which are subsequently mated in service. Irregularity of dimensions can be easily overcome by a few pennies' worth of machine work, but lack of uniformity in quality is incurable and is sure to assume more or less serious, if not actually dangerous, forms when the wheels go into service.

Manufacturers of solid steel wheels are particularly accommodating when engaged in close competition for an order, and it is for that reason that wheels of all sorts and sizes can be obtained. But clear-headed railway officials certainly realize that the production of small quantities of an endless variety of designs means a higher cost than when a minimum number of designs permits of proportionately larger quantities, and that cost is always reflected in price. They certainly realize that in the heat of close competition a sales department will frequently offer odd designs which may or may not have been thoroughly demonstrated as unifying the possibilities of proper manufacture and the requirements of service, and they surely appreciate how standardization of wheel designs is an end to which we all should strive.

ELECTRO-METALLURGY OF TIN.

In speaking of recent experiments upon the electrometallurgy of tin, le Journal du Four Electrique (January, 1912), reaches the conclusion that the solution of the problem has been found as regards general lines of work, and that it remains only to study the minor questions of detail. The statement is made that the yield of tin ores is much increased by electric-furnace treatment, that the process is continuous as against intermittent smelting in the reverberatory, that the formation of "hardhead" is reduced greatly, and that the quantity of carbon necessary for reduction is no more than 14 per cent. in the electric furnace, as against 20 to 25 per cent. in the reverberatory. The floor space necessary for the installation is smaller, and the consumption of the electrodes is negligible.

Some calculations are given as to the energy required for the reduction of cassiterite; the basis of these calculations is as follows: For the reduction of 118 grams of tin from stannic oxide, 145,300 gram cal. are required. The reaction, $C+O_2=Co_2$, gives out 96,960 cal., and the reaction, $2\,C+O_2=2\,CO$, 58,000 cal. It is necessary. then, in order to set free 118 grams of tin that we should have, for the first reaction, 145,300—96,960 cal., or 409,661 kg.-cal. per kilogram of tin set free, and since 1 kw.-hr. equals 864 kg.-cal.. it is necessary per ton of tin to have 474 kw.-hr. of energy. This figure becomes 855 kw.-hr. if we apply the equations $2\,C+O_2=CO$. As in practice, each of these reactions gives about 50 per cent. of the reduction, it is necessary to count on the average as the consumption of energy required, which is 665 kw.-hr. per ton of tin. The temperature in the smelting zone is estimated at 1,400 or 1,500° C., and the calorific balance of the furnace is then as follows: For the reaction, 665 kw.-hr.; for heating the slag, 130; for the specific heat, 45; losses by radiation, 130; losses through hot gases, 130 kw.-hr.; a total of 1,140 kw.-hr. per ton of tin.

The experiments were made in the furnace like that of Harmet for the reduction of iron ores, constructed of magnesite brick. A product was obtained containing about 99 per cent. tin, little iron, and free from arsenic. At the beginning of the campaign, which usually lasted from 10 to 12 days, the furnace was heated for a day with wood and coke in order to dry the bricks and then charged with about 14 kg. of anthracite coal per 100 kg. of ore, this proportion, however, depending on the nature of the latter. A current was then passed of about 1,000 amp. at 60 v., these figures changing to 40 v. and 2,500 amp. when the reaction commenced. A half-hour afterward the slag commences to