temperature. It was deduced from the tests that steel sustains no permanent damage from subjection to severe cold. As to the effects of very low temperatures in respect of the resistance to transverse shock, the conclusions arrived at were:—(1) The fragility of the steel increases as the temperature decreases. The untempered bars withstood, on an average, 14.6 blows at ordinary temperature, and 5.9 blows at the low temperature. The tempered bars withstood, on an average, 17 blows at ordinary temperature, and 12.6 at the low temperature. (2) A comparison between the tempered and untempered bars shows that under the action of the cold the fragility of the untempered bars increases in a large proportion. (3) The stiffness increases as the temperature diminishes. The broad results of the experiments are set forth in the following terms:—Under the influence of severe cold the molecular state of steel is modified temporarily as follows:—The elastic limit, the breaking load, the hardness and the stiffness increase as the temperature diminishes, the fragility under shock also increases, and the elongation decreases. These modifications have not a permanent character, and the metal returns to its original state under the ordinary temperature.

The cost of making Tin-plates.—According to a "Retired Ironmaster," who says he has followed the course of the tin-plate industry in England and America for the last twenty years, tin-plates could be profitably made even now in the United States. He gives the following figures as to the prime cost:

Calculation showing at what cost tin-plates can be manufactured at various points in the United States.

2,240 lbs. of steel billets, freight paid		$26.00
5 per cent. waste in heating the same		1.30
7 per cent. crop-ends	$1.82	
Less available scrap	1.40	
		0.42
Labor in bar-mill, heating and rolling		2.25
Fuel (coal at 1.25 per ton)		0.75
2,240 lbs. tin-plate bar		$30.72
Sheet scrap, 15 per cent	$1.68	
Less available scrap	1.53	
		3.11
Tonnage labor in sheet-mill, Amalgamated Association rates		14.40
Total		$48.23
60 lbs. acid for black pickling at 1½c		0.90
Waste in pickling, 2 per cent		0.97
Pickler, per ton		1.50
Annealer, per ton		1.00
Fuel for sheet-mill and annealing (1 ton coal)		1.25
Cold-rolling (smoothing plates)		1.00
Total		$54.85
Wear and tear, repairs and maintenance		3.50
Day labor and salaries		9.50
Current and incidental expenses		3.00
2,240 lbs. black plate ready for tinning		$70.85

(Cost per lb. 3.16c.)

Hence the following estimate of the cost of one box of tinned plate:—

100 lbs. of I.C. short-weight plates per box	$3.16
2 lbs. acid for white pickling at 1½c	0.03
Pickler's wages	0.08
1 lb. palm oil	0.06
2 lbs. flux (muriatic acid and zinc) at 2 c	0.04
2½ lbs. pig tin at 21c	0.53
Bran or middlings	0.03
Tin-house labor	0.30
Fuel	0.03
Incidentals	0.10
Box	0.12
Loss on one box wasted out of every ten=$1	0.10
Total	$4.58
10 per cent. profit added	0.46
Average freight to market	0.25
Cost of one box of coke tin	$5.29

This is the cost, he says, of plates about equal to Penlan grade, which is now quoted at New York at $5.40. For plates equal to Melyn the cost is put down at $6.25. He estimates that it would cost about $160,000 to build and equip the works necessary to produce the plates, and on a production of 65,000 boxes a year he figures out that the profits ought to be $32,500 per annum, at an average gain of 50c. per box. In connection with this subject it may be of interest to look at the following statement of the cost of making good common sheet iron of No. 27 gauge at the American works:—

2,240 lbs. muck bar		$27.00
7 per cent. waste in reheating		1.89
7 per cent. crop-ends	$ 1.89	
Less available scrap	1.40	
		0.49
Bar-mill labour		2.25
Fuel		0.75
Cost of 2,240 lbs. finished sheet bar		$32.38
15 per cent. scrap in sheet-mill	$ 4.86	
Available at	1.50	
		3.36
Sheet-mill labour, per ton		10.30
Annealing		1.00
Fuel for mill and annealing		1.25
Total		$48.29
Repairs and manufacturing expenses		3.00
Day labour and salaries		8.50
Current and incidental expenses		3.00
Cost of 2,240 lbs. No. 27 gauge		$62.79

This is equal to about £12 11s. per ton, or a good deal more than the equivalent prime costs in England.

Wages of Scotch Furnacemen.—The following are the rates of furnacemen in Govan Ironworks, Scotland:—Hematite brands—Keepers (in charge of furnace), 4½d per ton; shift wages, 5s 10d; assistants, 3½d per ton; shift wages, 4s 6d; fillers, 4¾d for Nos. 1, 2 and 3 brands, 4½d for No. 4 brand; shift wages, 5s 6d; pig lifters, 5¼d per ton, with no shift wages. Ordinary brands—Keepers, for No. 1 brand 5½d, for No. 3 brand 3⅞d; shift wages, 5s 6d; assistants, for No. 1 brand 3⅝d, for No. 3 brand 2⅝d; shift wages, 3s 10d; fillers, for No. 1 brand 4⅞d, for No. 3 brand 3⅞d; shift wages, 5s 1d; pig lifters' shift wages, 5s 1d; scale men, 4s 7d. The masters also make an all round deduction of 7½ per cent. for sand, and when selling off allow 2½ per cent., being a general deduction of the above rates of 5 per cent. Dixon's furnace men state that these rates are from 5 to 10 per cent. lower than those allowed at Coltness.

The Basic Process as Applied to Copper Smelting.

At a meeting of the English Society of Chemical Industry, Mr. Percy C. Gilchrist read a paper on basic copper smelting. Arguing from the great advantages which ensue from the replacement of the ordinary siliceous linings of steel smelting furnaces by a lining composed of basic material, when phosphoric pig iron has to be converted, the author thought it might reasonably be expected that the substitution of a basic lining for the siliceous lining hitherto employed in copper smelting furnaces should also be followed by similarly advantageous results, especially when the cupriferous material to be treated contains any notable percentage of arsenic or antimony.

In the case of steel manufacture, the result aimed at in substituting a basic lining for the acid was well defined—viz., the removal of phosphorus, a problem incapable of solution in acid lined furnaces, owing to the acid nature of the slags necessarily formed with such linings, but which was readily accomplished so soon as the presence of a basic lining in the furnace allowed of a basic slag being formed and maintained. No such direct improvement, however, was to be looked for in the case of copper smelting, as the only deleterious element occuring with any frequency in crude copper, viz., arsenic, can be very perfectly eliminated in the acid lining at present made use of. A careful study, however, of the composition of copper roaster and refinery slag reveals the fact that, unlike steel slags from acid practice, the copper slags formed during the removal of the arsenic are basic and not acid in character, the basicity being chiefly due to the presence of copper oxide in quantity more than sufficient to neutralise the silica, which latter, in the roaster and refinery furnace, originates almost wholly from the sand or clay used to form the furnace bath. Lime or lime and soda ash are used very generally in the ordinary sand lined refinery, but the quantity which can be added without detriment to the lining is not large, and does not compensate for the large amount of siliceous material which is dissolved away from the sides of the furnace. It was therefore rather in the direction of lessened oxidation, and therefore in-