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WINBY'S EXPRESS LOCOMOTIVE AT THE COLUMBIAN EXPOSITION.

Among the striking exhibits at the great Exposition are the locomotives from foreign lands, of which several from England and France take high rank. One of the most imposing of these is the English locomotive designed by Mr. Winby, of the firm of Westwood & Winby, of London. We give an engraving of this fine piece of mechanism, for which and the following particulars we are indebted to *The Engineer*, London.

Dimensions of Winby's Locomotive.

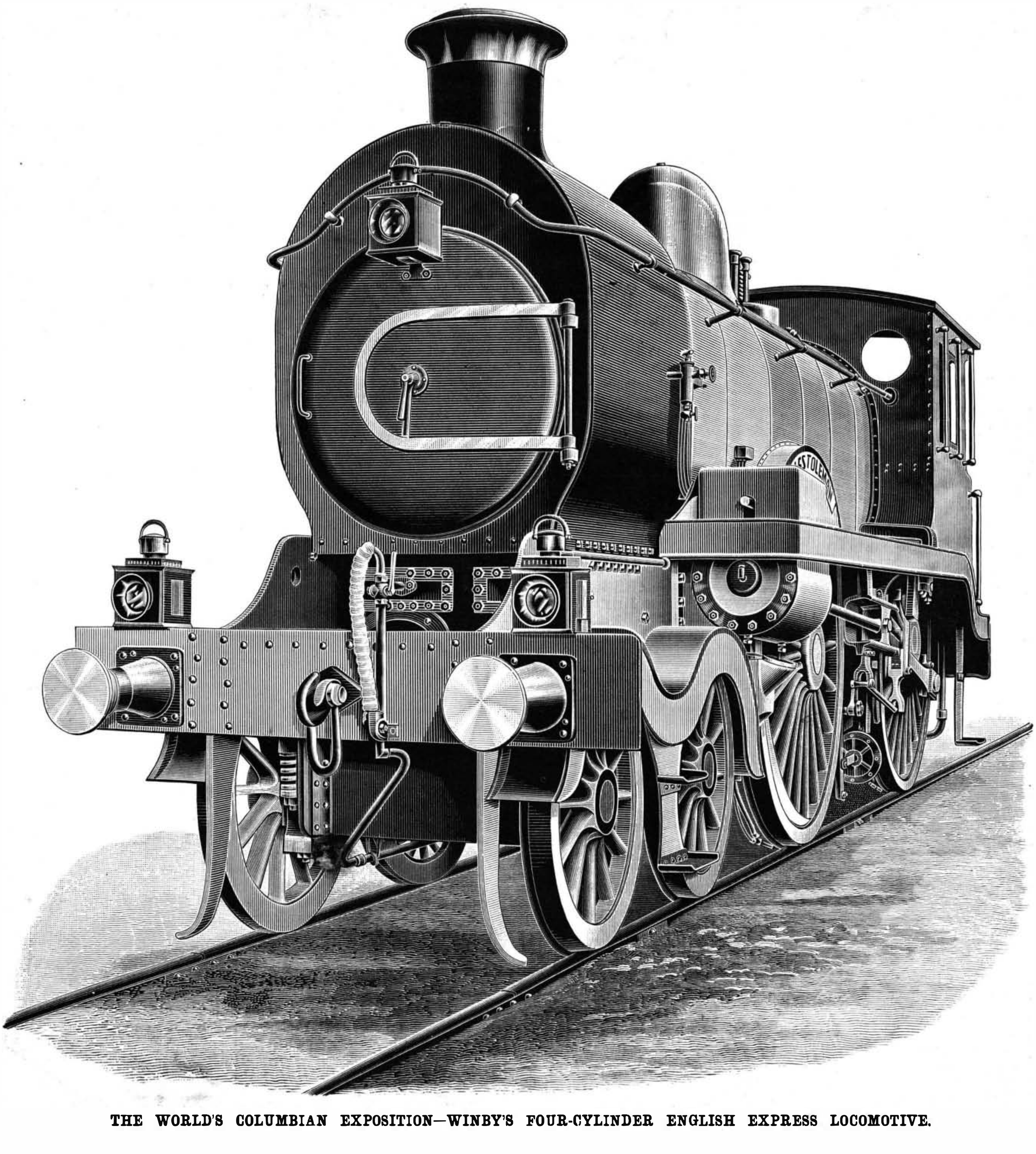
Boiler (steel)—	
Height of center from rail	8 ft. 2½ in.
Length of barrel	9 ft. 2¼ in.
Thickness of plates	$\frac{9}{16}$ in.
Thickness of smoke-box tube plate	¾ in.
Fire box shell (steel)—	
Length outside	8 ft. 11½ in.
Breadth outside at bottom	3 ft. 11¾ in.
Depth below center of boiler, front	6 ft. 8¼ in.
Depth below center of boiler, back	5 ft. 10¼ in.
Thickness of wrapper plates	⅝ in.
Thickness of throat plates	⅝ in.
Thickness of back plates	⅝ in.
Fire box (copper)—	
Length at bottom inside	8 ft. 3¾ in.
Breadth at bottom inside	3 ft. 4½ in.
Center of boiler to top of box front	1 ft. 4 in.
Center of boiler to top of box back	1 ft. 1½ in.
Thickness of tube plate	⅞ in.
Thickness of other plates	½ in.
Tubes (brass)—	
Number	235
Length between tube plates	14 ft. 9¼ in.
Diameter outside	2 in.
Chimney—	
Height from rail	13 ft. 6 in.
Diameter inside	1 ft. 9 in.
Heating surface—	
Tubes	1817·4 sq. ft.
Fire box	182·6 "
Total	2000·0 "
Grate	28·0 "
Working pressure	175 lb. per sq. in.

Weight in working order—	Tons	cwt.	qrs.
Bogie	25	0	0
Leading driving	18	0	0
Trailing	17	0	0
Total	60	0	0

Tractive force per lb. of pressure .... 143·2

Brake—The Westinghouse quick-acting brake is fitted.

(*Continued on page 327.*)



THE WORLD'S COLUMBIAN EXPOSITION—WINBY'S FOUR-CYLINDER ENGLISH EXPRESS LOCOMOTIVE.

WINBY'S EXPRESS LOCOMOTIVE AT THE COLUMBIAN EXPOSITION.

(*Continued from first page.*)

Sanding gear—Gresham and Craven's steam sanding gear is fitted to the four driving wheels.

Cylinder cock gear—Hawthorn's steam-worked drain valves working simultaneously.

Reversing gear—Steam and hand coupled together, and working all valve gear simultaneously.

Injectors—Two No. 10 Holden and Brooke's "1892" patent injectors.

Springs—All the bearing springs and the bogie controlling springs of Timmis' latest section.

Engine.—Cylinders (inside).	
Diameter	17 in.
Stroke	22 in.
Center to center of cylinders	2 ft. ½ in.
Center of cylinder to center of valve spindle	1 ft. 2 in.
Ports on top of cylinder.	
Diameter of piston rod	3¼ in.
Valve motion (inside)—	
Ordinary link.	
Slide bars, number per cylinder	4
Slide bars, width	3 in.
Crosshead (forged solid with piston rod).	
Length of shoe	1 ft. 1 in.
Cylinders (inside)—	
Diameter	16½ in.
Stroke	24 in.
Center to center of cylinder	6 ft. 5 in.
Center of cylinder to center of valve spindle	1 ft. 3 in.
Ports on top of cylinder.	
Diameter of piston rod	3¼ in.
Length of piston rod	9 ft. 8½ in.
Valve motion (outside)—	
Joy's patent.	
Slide bars, number per cylinder (in one steel casting)	2
Slide bars, width	6 in.
Crosshead (forged solid with piston rod).	
Length of shoe	1 ft. 3 in.
All piston rods and valve spindles have metallic packing.	
Wheels (cast steel centers)—	
Bogie, diameter on tread	4 ft.
Driving, diameter on tread	7 ft. 6 in.
Axles (steel)—	
Bogie.	
Diameter of journals	6 in.
Length of journals	12 in.
Centers of bearings	3 ft 4⅛ in.
Driving inside crank—	
Diameter of journals	8½ in.
Length of journals	9 in.
Diameter of crank bearing	8½ in.
Length of crank bearing	4½ in.
Cranks hooped and pinned.	
Driving outside straight—	
Diameter of journals	8½ in.
Length of journals	10¼ in.
Crank pin—	
Diameter	5 in.
Length	6 in.
Frames (steel)—	
From front end to center of bogie	5 ft. 3 in.
From center of bogie to center of driving wheel	9 ft. 8 in.
From center of driving wheel to center of trailing wheel	11 ft. 4½ in.
From center of trailing wheel to end of frame	4 ft. 4 in.
Total length of frame	30 ft. 7½ in.
Thickness of frames	1⅛ in.
Between frames	4 ft. 1⅛ in.
Between frames at front end	3 ft. 9 in.
Wheel base—	
Bogie wheel base	5 ft. 3 in.
Fixed wheel base	11 ft. 4½ in.
Total wheel base	23 ft. 8 in.

Mr. Winby has here aimed to design an engine which, while not intended to attain a higher maximum of speed than ordinary engines, should be capable of traveling at a much higher mean speed. To do this it was obviously necessary to increase largely the tractive power of the engine. It may here be stated that an ordinary modern express—say, for instance, Mr. S. Johnson's latest—has four wheels coupled, 7 feet diameter, and inside cylinders 18½ inches by 26 inches, giving a tractive effort of 106 per pound of steam, while Mr. Winby's engine is capable of exerting a tractive force of 143 per pound of steam, with wheels 6 inches larger in diameter.

This design has two pairs of cylinders, an inside pair, 17 inches by 22 inches, being coupled to the leading drivers in the usual manner, and an outside pair, 16½ inches by 24 inches, being coupled to the trailing drivers; there being no coupling rods, each pair of wheels may go as it pleases, and there is no necessity to pinch the fire box in any way.

Terms of Water Measurement for Mining, Irrigation and Mill Power.

BY G. D. HISCOX, M.E.

The designation of the terms of water measurement seems to be somewhat misunderstood, or has become misleading in many parts of the United States, from the manner in which a primitive custom of water measurement has been adopted in different localities and afterward in some of its forms been made legal by the courts.

Differences in elevation above the sea and the latitude make a slight difference in the flow of water by gravity for a length of time, too small for practical consideration, but just enough for a legal quibble when water measure is referred to the courts.

Variation in the form of the orifice varies the actual delivery per square inch of orifice, and with all the conditions of variation in head, form of orifice, elevation of locality, latitude and dissimilarity in the lengths of orifice, there is found a variation in the accepted unit flow through a square inch of orifice of over half a cubic foot per second.

In this view the *miner's inch* of water used in the early days of California mining has become a standard of varying proportions in different localities, most perplexing as a definite and legal measure; so that the nominal miner's inch may deliver any quantity from 1·20 to 1·78 cubic feet of water per minute.

The largest volume for a miner's inch is the measure used at Smartville, Yuba County, Cal., called the *Smartville inch*, is derived from a horizontal rectangular orifice 4 inches in depth, through a 2 inch plank, under a head of 9 inches from the center of the orifice, and of the required width for the total flow, this being equal to 1·78 cubic feet per minute per square inch of orifice.

The miner's inch of the Park Canal and Mining Co., El Dorado County, Cal., is equal to 1·45 cubic feet per minute, with an orifice 2 inches deep through a 1½ inch plank—head 6 inches above center of orifice—this being the rating of several ditch companies in California.

By a series of experiments at Columbia Hill, Cal., lat. 39°, 2,900 feet above the sea, 1·5744 cubic feet per square inch per minute was assigned as a miner's inch, this being the flow per square inch through a rectangular slit 50 inches long, 2 inches deep, equal to 100 square inches, under a head of 7 inches from the center of the slit; this being also the rate with the North Bloomfield, Milton and La Grange Ditch Companies.

In other parts of California 50 miner's inches are rated at 60 cubic feet of water, or 1·20 cubic feet per miner's inch. The statutory or legal miner's inch of California is equal to a flow of 1·394 cubic feet per minute, and is defined as the flow through a square orifice 1 inch in depth by 1 inch in width through a 1 inch plank, under a head of 4½ inches above the center of the orifice.

In Colorado, previous to statutory regulations and still in use by agreement, 40 miner's inches are reckoned at 60 cubic feet, or 1·50 cubic feet per square inch of orifice under a head of 6 inches above the orifice in the bottom of the delivery box, the stream falling vertically, the actual flow being 1·556 cubic feet per minute.

The statutes of Colorado now provide that "water sold by the inch by any individual or corporation shall be measured as follows, to wit: Every inch shall be considered equal to an inch square orifice, under a 5 inch pressure, and a 5 inch pressure shall be from the top of the orifice of the box, put into the banks of the ditch to the surface of the water."

The practice much in use in Montana is to deliver the water through a horizontal slit 1 inch in depth, of sufficient length for the required supply, under a head of 4 inches above the center of the slit, and is equal to a flow of 1·25 cubic feet per minute per square inch of orifice.

Six and a half inches head above the center of a 1 inch square orifice, or a long horizontal gate 1 inch in depth, is becoming the more usual practice in California, where the miner's inch originated, and will no doubt come into general use as the most satisfactory working condition of water supply for mining and irrigation purposes.

From experiments of the Pelton Water Wheel Co., the relation of flow under various heads and increasing widths of slot, with a uniform thickness of plank and distance of orifice from the bottom of flume, becomes interesting, in view of the varying practices in different States and localities. With a square orifice 2 inches in depth, 4 inches wide, a 5 inch head above the center of the orifice gave a flow of 1·348 cubic feet per minute; 6 inch head, 1·473 cubic feet; 7 inch head, 1·589 cubic feet per minute per square inch of orifice. By lengthening the orifice horizontally the flow increased in quantity per square inch of orifice, owing to the increase of area relative to the increase of perimeter; so that at 16 inches in width, 5 inch head, flow 1·365; 6 inch head, 1·489; 7 inch head, 1·60 cubic feet per square inch of orifice.

For the purposes of irrigation, the irrigating duty of water takes its base of computation from the flow per second or minute; but as this is not a constant quantity for different localities, owing to variation in the value of the miner's inch, the acre duty will be an uncertainty until some general law fixing a uniform standard of measure or detail, as to head and area to constitute a unit of measure, is made to extend over the different States and Territories requiring a system of irrigation.

As an irrigation term the "duty of water" means the area of land upon which a definite volume of water, applied during a given period, will successfully raise crops.

In Utah, where irrigation laws have largely covered the details of water rights, the "unit" of water measurement is designated as one cubic foot of water per second, called the "second foot," is the standard of expression for water service for irrigation, and is equal to 86,400 cubic feet per day. The "acre foot" is the equivalent of one acre covered one foot deep, or 43,560 cubic feet, to which is added the time requirement.

In Utah the "second foot" is equal to two "acre feet" per day—"60 acre feet" per month; 100 California inches equal 4 acre feet per day; and 100 Colorado inches equal 5¼ acre feet per day.

The "second foot" is becoming popular throughout the Western States and Territories, from its definiteness of meaning and understanding, and with which there is little chance for technical quibble.

The measurement of water for power in the eastern portion of the United States is the "inch," under a stated head. The "inch" or "inches," meaning the number of square inches opening in a gate, or orifice, leading to a water wheel under some specified head.

The practice varies largely in different States. In New England, the water power companies have specific measures of gate opening, from one foot head upward, and also rate by the theoretical horse power for any form of flow.

Where no specified head is named, a 4 feet head from the center of the gate orifice to the surface of the water in the flume has become legalized in some of the States by statute or court decision; the height or head above or below the statutory 4 feet being reckoned by its relation to the unit, in power-producing effect.

This is made the basis in water power leases in Wisconsin from the time of the earliest leases in that State.

In some cases the actual heads are named. The valuation of variation in the head below and above 4 feet, when named as a unit, has been a cause of legal contention in several States, and in Wisconsin it has been fairly defined that the power derived from a unit orifice varies proportionately with the variation of the head, and that the area for a given power varies inversely as the square roots of the heads, less the proportion of increased head and the reverse for decreased head. The following table shows the relation of area in percentage of the unit area for various heads:

Head in Feet.	Inverse Velocity Ratio. $\frac{\sqrt{4}}{\sqrt{\text{Head}}}$	Inverse Ratio of Area Due to Head.	Proportional Area of Orifice for Varying Head.
3	1·155	+ 0 25	= 1·443
4	1·000	Unit, 0·00	= 1·000
5	0·8944	— 0·1788	= 0·7156
6	0·8162	— 0·2721	= 0·5441
7	0·7561	— 0·3240	= 0·4321
8	0·7036	— 0·3518	= 0·3518
9	0·6666	— 0·3699	= 0·2969

Foul Water Main.

Mr. James Duane has described in a paper read before the American Society of Civil Engineers the effect of tuberculation on the delivery of a 48-inch water main. The author remarks that authentic data relating to the effect of tuberculation on the discharging capacity of water mains are rare, and when obtainable are correspondingly valuable. He has had an unusually favorable opportunity for observing the loss of head due to this cause in a large water main, and comparing it with that in a perfectly clean coated new main discharging under the same conditions; both being parallel mains of the Croton water supply system of New York. One line of mains was laid as clean castings, just as they came from the sand. The result was that in seven years the inside was discovered to be tuberculated to a surprising extent. All the lumps were of the same general shape, which was that of a rough frustum of a cone, with a height of one-half or one-third the width of the base, and a roughly flattened top. The largest were at the bottom of the pipe and the smallest at the top. The greatest projection of the lumps was about one inch; and they were so thick as to completely cover the interior surface of the pipe. As compared with the clean tar-coated pipe, the discharging capacity of these corroded mains showed a reduction of about 30 per cent. It was also observed by Mr. Duane that, having reached a certain stage in corrosion, a water pipe does not get worse with age. He regards a properly applied coating of tar composition as giving absolute protection against tuberculation, and cites in support of this belief the fact of a 48-inch main so treated showing as high a coefficient of duty after eleven years' service as when first brought into use.

Tin from Tin Scrap.

By T. Twynam.—The scrap is coated with a film of chloride of calcium or similar fusible salt and heated to redness. It is then cooled by plunging in water, when a scale falls which contains all the tin and leaves the iron practically clean and suitable for many metallurgical processes. The insoluble scale may be smelted direct for tin after mixing with carbon and siliceous matter, or it may be heated with sufficient acid, preferably hydrochloric, to dissolve out the iron, leaving the oxide of tin in a nearly pure state, or the tin may be recovered as a soluble stannate after fusion of the scale with alkali.