is not preheated, but arrives from the producer with practically all of its sensible heat and without losing any tar or carbon. The fuel consumption under producer practice is 40%, which, in view of the small capacity of the furnace, seems excellent. Analyses and of calorific values clearly show that while the products of combustion of Ovens Gas are less voluminous than those of Producer Gas, they are nevertheless considerably more bulky than either an equivalent of Producer Gas or the air required to burn it. Wigny's furnace does not preheat the gas, therefore, the air downtakes must be ample to accommodate freely all the products of combustion and insure proper draught. The Hubertushütte furnace, on the other hand, being of the usual Producer Gas type, must needs keep both air and gas downtakes in commission, in order to ensure good working draught. This has been effected in one of the two practical ways, viz., by keeping gas and air distinct and throwing the rich gas into a carrying medium of lean gas. The other way is to merge gas and air ports and utilize the whole regenerative system for air, introducing the rich gas cold at the neck of the furnace, as is done in the Pittsburg district with natural gas and which is in principle the method followed in the four ton furnace at Seraing.

There is no reasonable doubt that scrubbed by-product Coke Ovens Gas of average quality can be substituted for natural gas and successfully burned unmixed with any other gas in the present Homestead type of open hearth furnace without detriment either to furnace or to production, though there would be anticipated, other things being equal, a certain increase in the sulphur content of the product, dependent upon the character of the coking coal used; nor can we doubt that with the same general type of furnace, successfully burning fuel oil, a tar tank could be coupled to the oil pumps, due regard being had to the fluidity of the tar without prejudice either to the furnace or to production. Admitting this to be so, let us see to what extent in a self-contained steel plant the by-product coke oven installation may be depended upon for open hearth fuel.

Let our blast furnace plant, with a fuel ratio of 2,000 pounds, deliver 1,000 tons of molten basic iron per day to our mixers; let us use exclusively our own scrap which we shall suppose amounts to 20%; let our open hearth yield (ore not reckoned) be 98%, and let our fuel consumption be 8,000 (3) cubic feet of natural gas per ton of steel; let our natural gas have the following composition and calorific value:

Carbon dioxide	6.0	
Oxygen	0.2	
Ethylene	2.2	
Carbon Monoxide	.3	
Hydrogen	3.0	
Methane	91.8	
Nitrogen	2.5	
Net calorific Value (calculated)	8298	calories per cubic meter.
Volumes of air required to burn one volume of gas	9.13	

Let our Coke Ovens Gas have the following composition and calorific value: (4)

Carbon dioxide	3.2	
Oxygen	0.4	
Ethylene	2.8	
Carbon Monoxide	6.3	
Hydrogen	41.6	
Methane	29.6	
Nitrogen	16.1	
Net calorific Value (calculated)	4240	calories per cubic meter.
Volumes of air required to burn one volume of gas	4.34	

We can, therefore, figure roughly on an Ovens Gas consumption of 16,000 cubic feet per ton of steel. (5).

The following is fairly typical of the charge and yield of a well-known type of by-product oven with a good average gas coal:

Charge:—

5.65 gross tons of coal

Yield:—

Coke	4.43 net tons.
Tar	57 U.S. gallons.
Surplus gas	22600 (6)

On this basis we figure from our one thousand net tons daily of coke a surplus of 5,100,000 cubic feet, or enough—none being diverted to other uses—to take care of 320 tons of steel daily, that is about 25% of our ingot production, which we may calculate as 1,219 tons. With a higher fuel ratio at the blast furnaces, we should, of course, have a correspondingly larger surplus of gas.

In addition to this gas surplus we have also $\frac{1,000 \times 57}{4.43} =$ 12,867 gallons of tar as a by-product from our daily quantum of coke. Figures on the calorific value of coal tar are by no means plentiful, but from an abstract of an address by President Godinet of the Societe Technique du Gaz en France, and which appears in the Journal of Gas Lighting, Water Supply, etc., July 13, 1909, Page 99, we select a heating value of 8,000 calories, that being the lowest of the several values there given. The highest value quoted by M. Godinet is 11,000 calories and some authors give 10,500 as a representative value. Using 8,000 calories and a specific gravity of 1.18, we calculate calories per gallons of tar as 5,736, virtually the same value as 35,961 per gallon of fuel oil of the usual 10,555 calories and specific gravity .900. Assuming like thermal efficiency in the furnace for both tar and oil, we find ourselves enabled with 12,867 gallons daily of tar to provide for the production of a further 250 tons of steel, on the basis of 50 U.S. gallons of fuel oil per ton of basic open hearth steel—a reasonably liberal allowance.

We have thus substituted gas and tar for 47% of our fuel consumption. In other words, figuring the coal con-

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(3) This is a most liberal allowance. Under standard conditions this figure should be well under 7,000 cubic feet per ton for basic furnaces.

(4) The figures here given represent a typical analysis of the Sydney gas, and are taken from trustworthy notes in the writer's possession. This gas has at times been poorer, but was practically always at least of the excellence recorded for the Hubertushütte gas.

(5) This estimate is somewhat higher than the consumption given above for Wigny's four ton furnace. He reports the equivalent of 15,355 cubic feet for a gas with a net calorific power of only 3,640 calories, which, in view of the coal consumption of 40% reported by him for the same furnace under producer practice, shows our forecast to be conservative in the extreme. Our estimate also takes no account of suspended tar and benzol, which quite appreciably enhance the actual heating value of Ovens Gas.

(6) The figures given by Director Amende, of Hubertushütte, are equivalent to approximately 37,400 cubic feet of surplus gas for the same oven charge. His figures seem to indicate a thirty-six hour coke.