

onwards till in 1905 it has attained 23,360,258 tons, out of the world's total of 54,610,269, to which Germany contributes 10,875,061, and Great Britain 9,608,086 tons.

Steam transport by sea and land, steam and electric-driven instruments for dealing with the ship's contents when they arrive at the discharging quay, have alone rendered these extraordinary results possible. The vast distances which so lately as 1890 made a judge as competent as my father doubt the possibility of utilizing the great deposits in the West have been reduced to insignificance, and the coal fields of Pennsylvania placed, commercially speaking, alongside the iron deposits of Lake Superior, from which they are separated by 800 miles of land and water.

But precisely because the distances in Great Britain were small, it was here that the first attempts to annihilate them by mechanical means were made. To this cause we must attribute the growth of the iron trade having in the earlier period been so much more rapid than elsewhere. When the century opened the production of Great Britain did not exceed one-quarter million tons. Even thirty years later it was considerably under three-quarter million tons, and about half the total production of the world.

By 1830 the improved means of support had begun to tell, and the progress in the mechanical arts to place better implements in the hands of the ironmasters. A glance at the chronological table shows what was taking place and absolves me from a catalogue of events. The next twenty years raised the British output to two and one-quarter million tons, out of four and one-quarter million tons for the world. In the following twenty years Britain more than doubled her output, which in 1870 reached five and one-quarter million tons out of ten and one-half for the world. By this time the means of transport first adopted in Great Britain had spread to other countries. The distances separating ore and fuel in America, in Germany, and in France were becoming of less and less importance, and by 1870 the total production of these countries was only about a million tons less than that of Great Britain. Ten years later, the three countries together produced as much as Great Britain. In 1890 she was called upon to yield the premier place to America. In 1903 Germany overtook her, and now, for the year 1905, which is the latest date to which we have complete statistics, the pig iron output of the world stands as follows:—

Country.	Tons.	Percentage of Total.
United States	23,360,258	42.7
Germany & Luxemburg	10,875,061	20.0
United Kingdom	9,608,086	17.6
France	3,076,550	5.5
Russia	2,715,063	5.0
Austria-Hungary	1,540,896	2.8
Belgium	1,310,290	2.4
Sweden	539,437	1.0
Canada	403,449	0.8
Spain	383,100	0.7
Italy	143,079	0.3
Other countries	655,000	1.2
Total	54,610,269	100.0

This enormous quantity may well fill us with surprise. Some fifteen or twenty years ago my father expressed to me alarm at the rapidly increasing output of iron, and doubted whether the powers of consumption of the world were equal to disposing of the huge mass of metal. In this he followed Scrivenor, who, in the pre-

face to the 1854 edition of his "History of the Iron Trade," remarks on the increase from 1,300,000 tons in 1840 to 2,700,000 tons in 1852, and proceeds:—

"This did certainly appear a matter of sufficient importance to justify an inquiry—especially considering the striking events of the period which had elapsed—as to the causes by which this enormous increase had been encouraged, whether to the advantage of individuals as well as of the country, and whether the supply is likely to be supported, or, on the contrary, whether reckless make has not brought us to a position from which—unless mineral fields, at present unknown, come into operation, with similar advantages to the blackband ironstone of Scotland—we must retrograde . . . and reduce the manufacture to somewhat more moderate limits."

That these fears were in both cases unfounded the sequel proved. In 1854 Cleveland was just about to enter on the scene with a production which, in 1855, was under 100,000 tons, by the end of the decade was 248,655 tons, in 1864 was 409,106 tons, rose to 1,158,471 tons in 1874, and continued to grow till it reached 2,213,584 tons in 1900, and now (1906) stands at the estimated amount of 3,600,000 tons. Within the last twelve months we have seen the world short of iron and clamouring for more, the clamour taking a form which the manufacturers regarded with much complacency, for it resulted in a large increase in price.

And when we ask how the world, which a hundred years ago was content with considerably under a million tons of iron, to-day calls for more when we try to satisfy it with upwards of fifty million tons, the answer is not far to seek. The ingenuity of man was not exhausted when our grandfathers invented railways and steamships. Iron gives place to steel. The puddling furnace having served its purpose, is tossed aside for the Bessemer converter. An instrument with which the arduous labor of several men produced in twenty-four hours about two and one-half tons of malleable iron, is rejected for one in which the forces of nature, guided by human skill, gives us thirty tons of steel in twenty minutes. Iron, but sparingly used when the century opened, is demanded in continually increasing quantities to-day. The iron trade, responding to the call of the world, seeks new methods for producing still better results, and would seem to be about to reject the Bessemer converter for the open-hearth furnace. The remarkable invention of the regenerative furnace made fifty years ago is being continually perfected. Even now the great improvement of a continuous instead of an intermittent process is touched.

If we ask whence come these manifold perfectionments, we are led to look to another aspect of the question. Those to whom were due the great improvements which one hundred years ago were beginning to be effected were, on the whole, men who owed little to schools or colleges. "Self-made," as the expressive phrase goes, it was to their indomitable courage and energy that they owed success; to these and to that in-born perception of the possibilities presented to them which school or college seems to do nothing to create and little to strengthen. But the first barriers broken down, and the pioneers having shown the way, the carefully trained mind is needed to make straight the path. It must be admitted that we in this country have been disposed to neglect that careful training of the mind, and to rely on the native powers of insight more than on the trained intelligence. The workshop rather than the college was the technical school in Great Britain.