Scientific American.

ESTABLISHED 1845.

MUNN & CO.. Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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NEW YORK, SATURDAY, OCTOBER 5, 1895.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 1031.

For the Week Ending October 5, 1895.

Price 10 cents. For sale by all newsdealers.

THE LOCOMOTIVE OF THE FUTURE.

Is the electric locomotive to supersede the steam locomotive, as the future tractive power on our railroads? It is popularly supposed that it will, and striking developments are being looked for by the public in the trials that are now being made, both in France and America, with electric locomotives of the same weight and power as the standard up-to-date steam locomotive. From the day that electricity was first used as a tractive force, it has been the fashion to predict the early decline of the steam locomotive, and the substitution of some form of electrical traction in its place. It was confidently predicted that motors of half the bulk and weight of the modern engine would soon be hauling our trains at unprecedented speeds, and with that noiseless energy and cleanly operation that distinguishes electric power.

This swifter and more silent transportation was to be accomplished with less expense than the present method by steam locomotives.

It is now some years since these sweeping prophecies were first made and in the interval electric traction has had an extended trial on trolley and suburban lines. It is to-day being tested on standard gage trunk lines; and it is safe to say that, as the case now stands, there are no indications that the future existence of the steam locomotive is in any way jeopardized.

In judging of the relative efficiency of the steam and electric locomotives there is one ultimate test by which they will be tried and upon which the verdict will be given—the test of economy. Other things being equal, the engine which can haul a given train-load a given number of miles on the smallest consumption of fuel will be the engine of the future.

There is no sentiment in a question such as this. It is judged entirely from the shareholders' point of view. However much we might like to see our lightning expresses sweeping from city to city impelled by the silent force, it is certain we shall never see that sight until the day comes when electric traction can be produced at a consumption of fuel considerably less than the three pounds of coal per horse power per hour that marks the performance of the best locomotive practice of to-day.

As the case now stands, the economy lies with the steam locomotive, for the reason that the power generated in the boiler is transferred as tractive force directly to the rails, and it is subject merely to the loss occasioned by the internal friction of the engine itself.

In the case of the electric locomotive, in addition to this loss by internal friction in the engine at the power house, there is a loss between the engine and the dynamo; there is a loss in the resistance of the wire that transmits the current, and there is another loss in the motor itself. Now this treble loss of power must in some way be compensated for before the two engines stand even on equal terms. What compensation can the electric locomotive offer? It was claimed that it would be lighter, not having to haul a tender loaded with fuel and water. But it is not lighter.

The new Heilmann locomotive in France is to weigh over ninety tons; and the Baltimore and Ohio Railway engine weighs ninety-six tons; and these weights, for the work they are to accomplish, are rather over than under the weights of steam locomotives constructed for similar service. Nor can it be claimed that there is any saving in first cost. A ninety ton electric locomotive cannot at present be built for very much less than a steam locomotive of equal power; and what margin there might be in its favor is largely offset by the cost of the expensive installation of boilers, engines and dynamos, that must be erected at stated intervals along the line; and by the cost of the wiring for transmission of the current.

There remains then the question of maintenance and running expenses. In this respect, for the first time in this comparison, we can see a distinct advantage for the electric locomotive; inasmuch as the purely rotary motion of its moving parts is far less conducive to wear and tear than the combined reciprocating and rotary motion of the moving parts of the steam locomotive. As an offset against this, however, there must be placed the deterioration of the system of wiring, and the wear and tear of the engines and boilers at the power house. It is fair to suppose that the wear and tear at the power house—a part of which is justly chargeable to each of the locomotives that it serves—will fully offset any advantage that the electric may have over the steam locomotive in this respect.

At present there are no statistics available by which a comparison of the cost of labor in the two systems can be made. It is probable, however, that the engineer of a first-class electric locomotive would require the services of an assistant, in which case the expense of the power house staff would have to be reckoned against the electric system in a comparison.

There remains then the question of fuel economy. Unless the electric system can show a very marked economy in this respect, it is evident from the foregoing considerations that a strong case is made out in favor of the present system of steam haulage. The best steam locomotive practice of to-day shows that a modern express locomotive will produce one horse power per hour on the consumption of three pounds of coal. It is doubtful if the best electric light installations can show a better result.

Unless a system of stationary boilers and engines can be produced that will furnish the electric locomotive with its power for one-half the coal consumption that is necessary for the generation of the same power in the steam locomotive, we may rest assured that George Stephenson's invention will remain among us for years to come as the greatest triumph of the modern mechanical world.

THE WORLD'S PRODUCTION OF TIN.

We have before us an extract from the sixteenth Annual Report of Mr. Charles D. Walcott, Director of the United States Geological Survey, for the year 1894-95. It consists of a printed report on the production of tin in the various parts of the world by Mr. Charles M. Rolker.

In the past ten years the total output has risen from 50,299 tons in 1884 to 83,387 tons in 1894. The subjoined table shows that more than one-half of the world's output for 1894 came from the Straits Settlements in the Malay Peninsula.

WORLD'S OUTPUT OF TIN, 1894.

1. The Straits to Europe and America	46,724
2. England	8,800
3. Australia to Europe and America	5,824
4. Banca sales to Holland	6,139
5. Billiton sales to Holland and Java	4,764
6. Bolivian imports into England	3,482
7. Straits to India and China	4,655
8. Sundry countries	642
9. Germany	896
10. Austria	65
Total	83,387

The Straits tin mines are the most prolific, and they are probably the oldest, in the world. Before the Christian era the Ethiopians, and later the Arabians, traded with India and "used the Indian name 'Naak' to designate tin, a fact which would point to farther India as the source of the tin industry in those days."

There was a Roman coin in use in the year 500 B.C. which contained 7·66 per cent of tin; and this antiquity of the use of tin is shown by a coin of Alexander the Great, 335 B.C., which contains 13·14 per cent of tin. Historical records for the past two thousand years speak from time to time of the tin that is brought from the Malay Peninsula. The present tin mines of this district are alluvial. The constituent parts of the alluvium vary, as does the depth; but the characteristic covering that has to be removed is of an average depth of ten to eleven feet, and consists chiefly of clay seams, alternating with sand and gravel. The pay gravel has an average depth of eight feet. The process of recovery is by washing in boxes; and Chinese labor is largely employed.

The well known tin mines of Cornwall, England, vary very little in their yearly output; the amount running from 8,000 to 9,000 tons per annum. The metal is recovered from the lode ores by crushing and by smelting. The Australian mines are rich and full of promise, Tasmania alone being in itself the third largest producer of tin in the world, coming next to Cornwall.

The United States, though such a large consumer of tin, does not at present figure as a producer of the metal. The report states that "no tin is being produced in the United States, and the tin occurrences of this country are so far only of geological or mineralogical interest, with indications of prospective value in a few instances." The most promising indications are those found in the Black Hills of Dakota.

Hardening Steel by Gas.

Consul Monaghan, of Chemnitz, reports (June 16) that the Germans are interested in a new process for hardening steel by means of gas. The invention originated with the famous French steel and iron firm Schneider & Company, of Creusot.

It is a well known fact that gas, under great heat, deposits carbon in solid form. Upon this depends its light effects, and also the formation of the so-called retort graphites, a thick covering of pure carbon on the walls of the gaslight retort. The gas that strikes the retort walls deposits part of its carbon upon them. This is the fact on which Schneider bases his very useful invention—a process for cementing together (uniting) steel armor plates.

It is said to be very important in the production of armor plates to have them comparatively soft inside and hard outside. This hardening is obtainable by the application of carbon. Formerly, the process of hardening consisted in covering the plates with layers of coal and heating them till they glowed. Schneider's process puts two plates into a furnace, one on top of the other, with a hollow space between. This space is made gas tight by means of asbestos packing put on around the edges, and the plates are heated red hot, while a stream of light gas is poured into the hollow space indicated. The carbon thrown out by the gas is greedily taken up by the glowing plates until they are thickly covered. The depth of this carbon covering can be regulated by the amount of gas admitted. In order to secure regular and uniform act-