

along the coast of Siberia, may frequently be made in a few weeks by a vessel specially adapted, and manned with experienced seamen, but that, so far as the conditions of the Siberian Polar Sea are at present known, the entire route can hardly have any practical importance for trading purposes.

2. That there are no obstacles to commercial traffic through the waters between the mouths of the Ob and the Yenisei and Europe.

3. That in all probability a sea passage between the Yenisei and Lena, and between the Lena and Europe, as a trade route, is also possible, providing the out and homeward voyages be not undertaken in one summer.

4. That further researches are requisite before it can be decided whether the waters between the mouth of the Lena and the Pacific are available for mercantile navigation. The experience already collected shows, however, that steamships with heavy implements and other goods, not easily to be forwarded by land or sledges, may at any rate pass from the Pacific to the Lena.

AMERICAN INDUSTRIES.—No. 25. BRASS MANUFACTURE.

In the city of Waterbury, Conn., long before the days of railways and steamships, the manufacture of brass was begun by Mr. Abel Porter. This was in 1802, and the business was then confined almost wholly to the manufacture of brass buttons. The industry, which was established by Mr. Porter, and for a time conducted by Abel Porter & Co., proved very satisfactory. The style of the firm passed through a succession of changes until, in 1850, Messrs. J. M. L. & W. H. Scovill, the gentlemen then composing the firm, united with other gentlemen in organizing a joint stock corporation under the name of the Scovill Manufacturing Company. Their works in Waterbury front on Mill street, and present a continuous line of nearly one thousand feet; the buildings are substantially built of brick, and for the most part are three stories high and are of neat architecture. The present officers of the company are, F. J. Kingsbury, president; C. P. Goss, treasurer; M. L. Sperry, secretary. W. I. Adams is the New York agent, E. H. Patterson at Chicago, and Allen G. Lovell at Boston. The company employ a capital of nearly \$1,250,000, and have in manufactured goods, and in process of manufacture, nearly \$500,000. The first forty years of this company's business career was slow, and not until the year 1850 did they realize that the turning point had been gained and they were rapidly becoming the leaders of this industry in the State, if not of the United States. One important branch of their manufacture is button making. To this one of their largest buildings is devoted; one of the lower views on the first page represents one of the button making departments.

They make a specialty of military and naval buttons, such as are worn by militia companies, firemen, railroad men, schools, colleges, and societies throughout the country. They supply to a large extent the Cuban and the Spanish American governments with buttons for their troops. They also make a great variety of buttons for liveries, from designs and dies to order. A corps of designers and die sinkers is employed on work of this sort, and in getting up new styles of buttons for ladies' wear. The company's cabinet of samples consists of many varieties of every imaginable pattern—gilt, silver-plated, nickel-plated, bronzed, enameled, oxidized, silvered, stamped, chased, or brightly burnished; also buttons of glass and metal combined, or of metal and cloth-covered buttons, lasting, worsted, and brocade for men's wear, and silks and velvets of all shades for ladies' wear.

Another department of the works, represented in one of the upper views in the engraving, is devoted to the manufacture of wrought brass—buts and hinges. The machinery for making them works automatically, and is the invention of mechanics in the employ of the company. These products vary in sizes, and the cheaper ones are used for furniture, inside blinds to houses, etc. More expensive ones, of ornamental patterns, gilt, silver-plated, and engraved, are made for use on pianofortes. Very many are for use on shipboard, where iron is objectionable from its liability to rust.

The company manufactures furniture casters, made entirely from wrought metal, by a newly invented process. The peculiar merit of the casters consists in the introduction of small iron balls, acting as friction rollers, and thus causing the caster to turn more readily than the ordinary casters. Being of wrought metal they are much stronger than the common ones of cast metal.

A large department, shown in one of the middle views, is devoted to the manufacture of kerosene oilburners, lamps, and lamp trimmings. In this department the company has had marked success, and is noted for the perfection of its work. A very large variety of burners and lamps is made there. Thimbles are made here of silver-plated brass and of German silver. The better grades are made with the same care as the best silver thimbles, and are for practical purposes equally good.

The "drawing department" is the name given to that part of the works devoted to the manufacture of brass ferrules for handles of canes, fish rods, etc. Seamless tube, solid drawn, is also made here, being drawn up from sheet metal without the use of solder.

The rolling mill, shown in one of the lower views, is a building 200 feet long by 120 feet, and the casting shop, which is shown in one of the upper views, is 100 by 75 feet. This will produce annually about 2,000,000 pounds of sheet

metal, oreide, German silver, etc. It is rolled of all thicknesses, down to that of the thinnest writing paper, and made of all qualities and tempers to suit all the requirements of manufacture, some of it being made tough and ductile for spinning and stamping into irregular shapes, and some highly tempered for springs or reeds for musical instruments.

Sheet brass is made in various widths, from a mere ribbon to sheets of 20 inches or more. The alloy is melted in crucibles, cast in large ingots, and reduced in thickness between heavy rolls. The sheet is then scraped on both sides to discover imperfection and to remove any scale that may exist on the surface. It is then rolled and rerolled until it is reduced to the required thickness. During the process of rolling the sheets are occasionally annealed, less frequently, however, for spring brass than for tough soft brass.

The brass for the inside works of all American watches is made here, as is also the nickel metal for the same purpose. The oreide is a close imitation of gold, and is much used by jewelers. The German silver, otherwise called albata, is used to some extent on show cases, for the ornamentation of steam fire engines, for cornets and other musical instruments; but by far the largest part of it is used for making silver plated spoons, forks, and other table ware. For this latter purpose thousands of pounds are consumed daily.

Another article made by the company is the novelty lock-box for post-offices. These boxes are made in three sizes, with brass or nickel plated fronts. Each lock is provided with keys of unique pattern, and no two locks are alike.

In the manufacture of most of the articles the company has introduced many original processes and perfected special machinery at a great cost, which enables it to produce a grade of goods superior to any formerly imported and unsurpassed by those of other domestic manufacturers.

The manufacture of photographic materials has become very extensive, and now embraces several distinct departments in this establishment, either of which is of sufficient magnitude to require separate and individual management.

It is impossible to describe in detail the great variety of articles made in this establishment. We have already intimated that the goods made by the Scovill Manufacturing Company are sent to all quarters of the globe, and enormous quantities are consumed in this country alone. The prosperity of this company is the direct result of cheapening production while improving the quality of the articles.

The Scovill Manufacturing Company have a large warehouse located at Nos. 419 and 421 Broome street, New York. They also have salesrooms at No. 183 Lake street, Chicago, and No. 177 Devonshire street, Boston.

Correspondence.

THE EDISON ELECTRICAL GENERATOR.

To the Editor of the Scientific American:

Your issue of November 15 contains a letter from Mr. Edison accompanied by a reply to the strictures contained in mine of the 1st November.

I feel confident that so far as the opinion of thoughtful electricians is concerned I might leave the matter as it now stands without detriment to my reputation; but I am not willing the general public should suppose I acquiesce in the statements made by Mr. Upton, or that my views are, to any great degree, modified by anything he advances.

Mr. Upton says I have "confounded the obtaining of a maximum current with the obtaining of a maximum of economical efficiency." Now I submit I have done no such thing. In my letter I have assumed that in dynamo-electric machines the electromotive force is a function of the external resistance, and decreases as the external resistance increases.

The article on page 242 says nothing about the electromotive force being constant. Mr. Upton, it is true, does say that this is the case with Mr. Edison's machine; but this is a mere assertion, the truth of which I do not only not concede, but positively deny.

I do not lose sight of the statements on page 242, that "although the current from the armature may be used to excite the field magnet, Mr. Edison finds it more economical to charge the field magnet by means of a separate machine." Then follows an intimation that such is his intention in the future.

Mr. Upton says, "according to the reasoning in the letter in question," it would be "mathematically absurd to connect a battery with a resistance nine times greater than itself," and it undoubtedly would be if, as was beyond all question claimed on page 242, that *simply by so doing it necessarily rendered that battery twice or three times as efficient as any other battery*, or if the electromotive force of the battery was a function of the external resistance, and decreased as the external resistance increased.

I now propose to re-examine some of the statements on page 242. I quote first: "The internal resistance of the armature is only $\frac{1}{2}$ ohm, and Mr. Edison claims that he realizes 90 per cent of the power applied to this machine in effective external current." Second: "Now the energy converted is distributed over the whole resistance; hence, if the resistance of the machine be represented by 1, and the exterior circuit by 9, then of the total energy converted, 0.9 will be useful, as it is outside of the machine, and 0.1 lost in the resistance of the machine." Now, Mr. Upton, claiming for Mr. Edison's machine constant electromotive force, fully indorses both of the above statements, which I again pronounce

mathematically absurd, and again assert that the statement, it true, proves beyond all doubt that Mr. Edison has discovered perpetual motion. For Mr. Edison and Mr. Upton both distinctly countenance the assertion that 0.9 of the power applied is available in effective external current, and concede that 0.1 is lost in the resistance of the machine. Consequently there is no escape from the conclusion that no power is required to overcome the inertia of the mass of metal comprising the armature, nor the friction of the journals, none is lost in the production of currents which are not available in the working circuit, and none in the production of spark and heat at the commutator, etc. etc. In other words, you have only to start the machine and it will continue to revolve for ever, and perpetual motion is an accomplished fact.

Now if, as Mr. Upton leaves us to infer, the electromotive force is constant and independent of the resistance of the external circuit, there is no escaping the conclusion that power has to be applied to excite the field magnet, and in the absence of any information other than is afforded by Mr. Edison and Mr. Upton, we are obliged to assume that this power is supplied by a machine which furnishes the current for this purpose and *runs itself*. Perpetual motion is more than possible.

The question to be considered is: Is it true that a machine, in which the resistance of the armature circuit is only $\frac{1}{2}$ ohm and the external resistance $4\frac{1}{2}$ ohms, necessarily more efficient than a machine in which the resistance of the internal and external circuit must be made equal in order to obtain the maximum efficiency? I answer, no; Mr. Upton says yes, and introduces the expression $E^2(r+R)^{-2}R$ to prove his assertion and the efficiency of Mr. Edison's machine. It proves neither.

It is true that Mr. Upton's statement differs materially from anything first stated, in that it takes into consideration the electromotive force as an element of efficiency. But what does it prove? Nothing more than was proven years ago by Joule and Favre, and the reference to a *recent* number of *La Lumière Electrique* is not the best that can be made.

There have been numerous machines built in which the resistance of the armature of the working circuit was only a fraction of that of Mr. Edison's machine, and the difference between the internal and external circuit much greater. One instance out of many may suffice.

Professor Trowbridge, of Harvard University, made tests of three well known machines, the results of which are published in the *Philosophical Magazine* for March, 1879. The results obtained are given in the following table:

WILDE MACHINE (Large Size).					
Resistance of Circuit, in ohms.	Current, Webers per sec.	Speed of Mach. per min.	Metre-grammes consumed per sec.	Eqv. of Current in metre-gram per sec.	Efficiency.
0.594	62.33	548	350,658	235,480	67.1
0.733	61.76	508	392,403	285,293	72.7
0.857	43.82	532	283,107	167,907	59.4
0.907	60.25	500	453,123	335,966	74.1
1.039	39.28	520	298,356	163,682	54.9
1.120	43.44	548	343,827	215,660	62.7
1.241	50.43	504	542,685	322,047	59.3
1.453	44.94	520	553,311	309,658	56.0
1.593	47.51	536	633,765	366,910	57.9
2.305	32.86	528	643,632	253,968	39.4

GRAMME MACHINE (Large Size).					
Resistance of Circuit, in ohms.	Current, Webers per sec.	Speed of Mach. per min.	Metre-grammes consumed per sec.	Eqv. of Current in metre-gram per sec.	Efficiency.
0.675	86.0	432	589,743	509,418	86.3
0.760	75.6	462	534,336	442,211	82.7
0.781	75.6	452	607,200	465,377	74.9

SIEMENS MACHINE (Large Size).					
Resistance of Circuit, in ohms.	Current, Webers per sec.	Speed of Mach. per min.	Metre-grammes consumed per sec.	Eqv. of Current in metre-gram per sec.	Efficiency.
0.973	79.8	264	831,105	632,255	76.0
1.055	68.8	294.5	743,820	509,569	68.5
1.066	66.0	325	839,454	472,805	56.3

The resistance of the Gramme armature is 0.129 ohm; the resistance of the magnet, 0.212 ohm. The total resistance is therefore 0.341 ohm.

The total resistance of the Siemens machine is 0.586 ohm.

The Wilde machine differs essentially from the other two, the magnets not being included in the working circuit. The armature has two circuits, the one for exciting the magnet, and the other for working circuit. The resistance of the armature coils of the working circuit is 0.074 ohm. The resistance of the coils of the armature for exciting the magnets is 0.454 ohm. The coils of the field magnet have a resistance of 2.83 ohms.

In this machine the resistance of the coils of armature of the working circuit was about one-fifth the internal resistance of the Gramme machine, and the ratio of the resistance of the internal to the external circuit, when the maximum efficiency was obtained, was not far from that given by Mr. Edison for his generator on page 242. Yet the efficiency was much less than the Gramme, in which the internal and external resistance was about equal when the maximum efficiency was obtained. It is therefore evident that there is something more than the matter of resistance to be considered in the building of dynamo-electric machines.

Mr. Upton also gives two examples of the performance of Mr. Edison's machine, but they neither prove the efficiency of the machine as a generator nor as compared with other machines.

The only proof of the efficiency of a machine is the ratio of the work done in the external circuit to the horse power expended in driving the machine, and, other things being equal, it may

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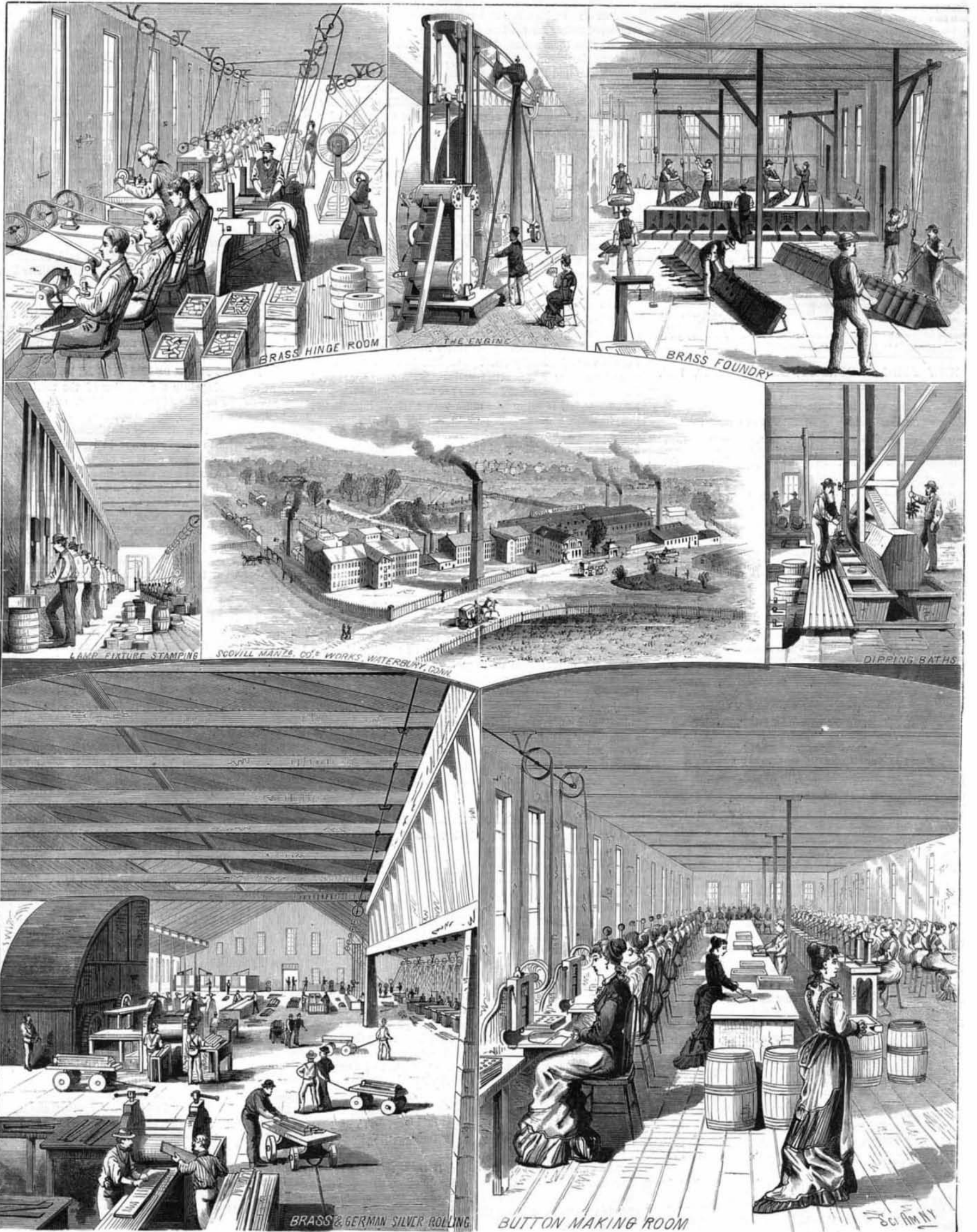
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BRASS WORKS OF THE SCOVILL MANUFACTURING COMPANY.—[See page 380.]