SCIENTIFIC AMERICAN

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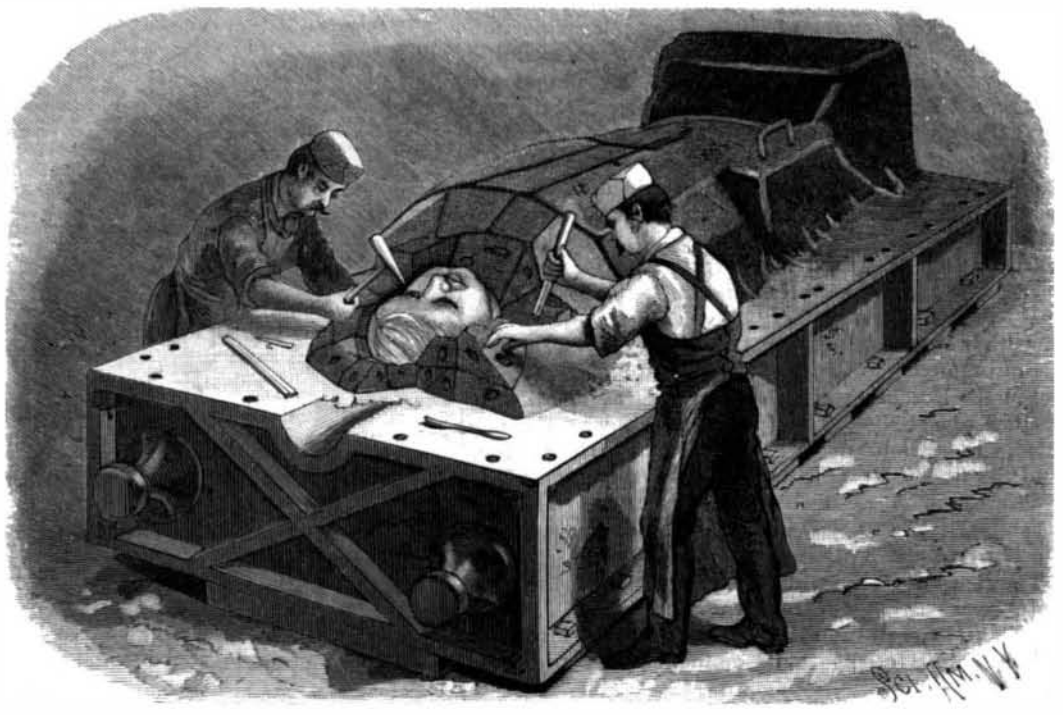
CASTING THE HENRY WARD BEECHER STATUE FOR THE CITY OF BROOKLYN.

The Henry-Bonnard Bronze Company, of this city, have recently completed the casting of a statue of the late Henry Ward Beecher, to be erected in front of the Brooklyn City Hall. The statue is remarkable as being cast practically in a single piece, the head being of one piece with the body. Originally metallic statues were made in small pieces and were united by rivets or soldering. Some were cast solid. The present practice is to cast them hollow, and as thin as possible. This secures rapid cooling and tends to prevent any separation of the constituents of the alloy. It also economizes in metal.

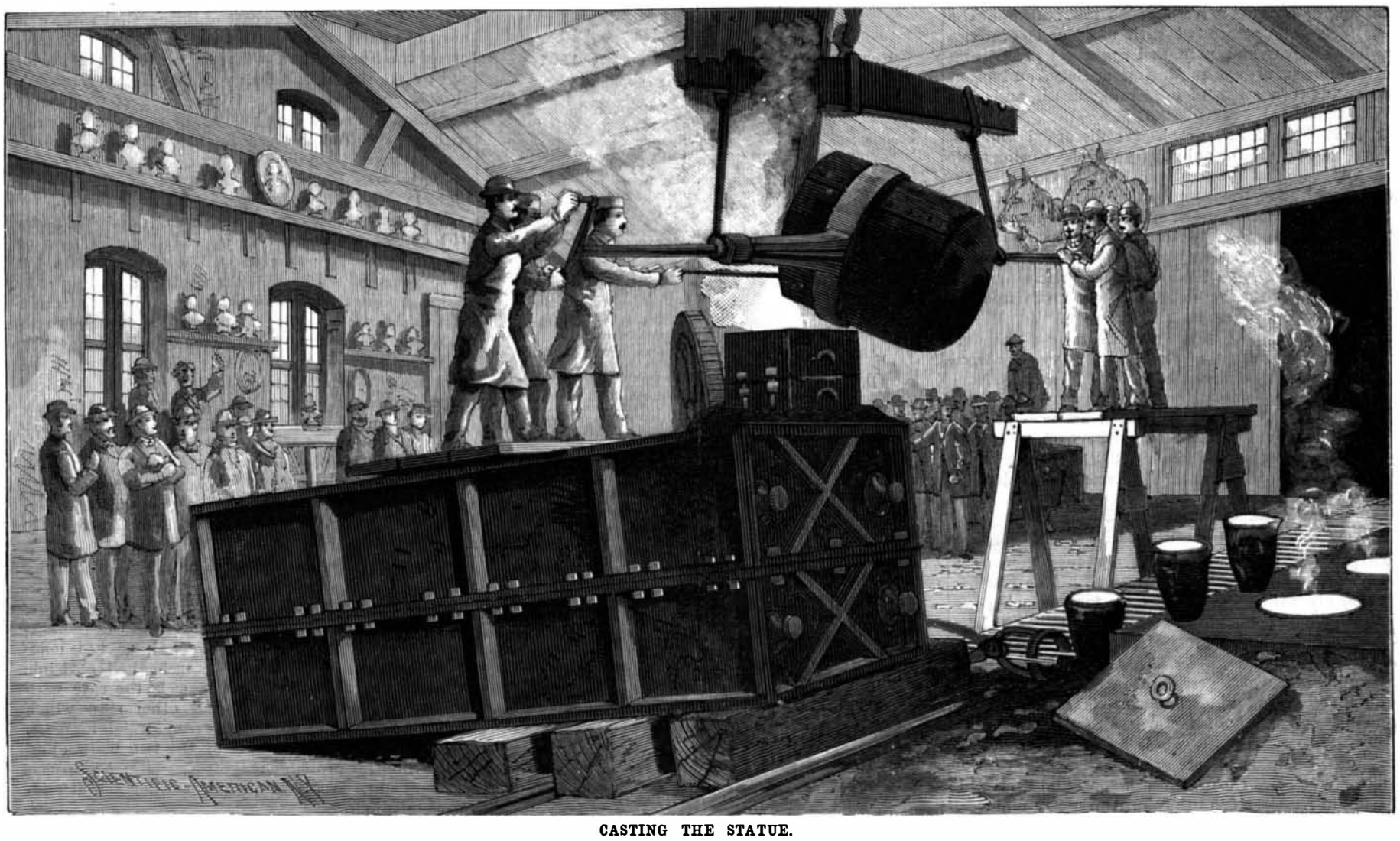
The first step in making a statue is the production of the plaster model. This is supplied by the artist, and it comes from his studio of the exact size required for the final statue. The original studies in the case of colossal statues such as the present may be very small, but before the artist is done with his work, the full sized model is produced.

In the present case the statue was to be about nine feet high. The area of the flask in which the mould was to be made was seven feet four inches wide by thirteen feet six inches long. The model was established upon the lower section of the flask and the work of building up the mould began. The sand used is mined in France. It possesses to a high degree the property of consolidating, yet is very porous. A famous bed of the material is at Fontenay-aux-Roses, about 16 miles from Paris. This is compacted by wooden mallets and hand rammers of different shapes. As the artist produces his statue without any reference to its capacity for "drawing" from the mould, the bronze founder has to adapt his work to the most exacting conditions of undercutting and complicated outlines. The mould is therefore built up in very numerous sections, some of them extremely small. An exact count was not kept, but in the present statue between one thousand and fifteen hundred pieces were used in the mould. In one of the cuts, where the operation of moulding the head is shown, the idea of the subdivision of the mould appears. It will be seen that its sections represent irregularly shaped bricks, all fitting together with the utmost nicety and accuracy. The statue is eventually completely embedded in clay. The mould has now to be opened up, the edifice

MAKING THE MOULD.



TAKING THE MOULD TO PIECES.



CASTING THE STATUE.

CASTING THE STATUE OF HENRY WARD BEECHER.

of over a thousand sections is carefully taken down and the model is lifted from its resting place upon the lowest flask section. The mould is next rebuilt, the inner surface receiving a coating of foundry facing and the interior is rammed full of clay to form the core. This core need not be solid. Some spaces may be left in it for the gases to collect in. Thus the mould is a second time complete and intact, but is filled with a clay figure instead of a plaster one.

The mould is a second time dismantled and the core is taken in hand. From its entire surface a layer of clay is removed, to average, as nearly as possible, one quarter of an inch in depth. This delicate operation provides the space for the metal to occupy in the casting process. This core thus reduced in size is replaced upon the flask and is properly supported. The mould is a second time built up, surrounding in this case the reduced core. A number of channels or gates are worked in the mould to allow the metal to run through to different parts of the figure. These resemble somewhat the trunk and branches of a tree. They start of comparatively large section near the pouring reservoir, and fork and diminish repeatedly, reaching the space between core and mould in many places. When all is perfectly dry, and the flask filled with sand so as to hold all the pieces in place, the operation of casting is proceeded with. In the present case seventeen weeks were required for the moulding.

The process of casting a bronze statue is executed either by surface or bottom casting. In the latter method a reservoir is arranged over the gates, which reservoir is large enough to hold all or a large portion of the metal. It has holes in its bottom corresponding exactly to the gates in the mould. These holes are plugged. The metal is poured into the reservoir, and by withdrawing the plugs the metal runs down into the space in the mould. The Beecher statue was cast by surface pouring. The metal held in crucibles was poured directly into the gates. This enabled a constant watch to be kept upon its fluidity and general nature as far as shown in its fusion. A man, as the metal was poured, kept scraping back all scoria, slag, and oxide from its surface. The adoption of one or the other system of pouring the metal rests, as a matter of preference, with the individual founder.

For the Beecher statue 7,400 pounds of metal were melted repeatedly. The fourth fusion was the one used. Eleven minutes were occupied in the casting, and the finished statue weighed 3,600 pounds. The rest of the metal represented the contents of the gates, waste, etc. The alloy was composed of copper 90 parts, tin 10 parts, zinc 3 parts.

The Beecher statue will be unveiled about the time this paper reaches our readers. The artist is J. Q. A. Ward, and the statue will, in the artistic and mechanical sense, be a credit to its eminent artist and to its founders.

Angina Pectoris—Its Nature.

Dr. R. Douglas Powell, in *The Practitioner*, argues that angina pectoris is a disturbed innervation of the heart or vessels, associated with more or less intense cardiac distress and pain, and a general prostration of the forces, always producing anxiety, and often amounting to a sense of impending death, and concludes that:

1. In its purer forms we observe disturbed innervation of the systemic or pulmonary vessels, causing their spasmodic contraction, and consequently a sudden extra demand upon the propelling power of the heart, violent palpitation or more or less cramp and paralysis ensuing, according to the reserve power and integrity of that organ—*angina pectoris vasomotoria.*

2. In other cases we have essentially the same mechanism but with the extra demand made upon a diseased heart—*angina pectoris gravior.*

3. The trouble may commence at the heart through irritation or excitation of the cardiac nerves, or from sudden accession of anæmia of cardiac muscle from coronary disease—*primary cardiac angina.*

4. In certain conditions of blood or under certain reflex excitations of the inhibitory nerves, always, however, with a degenerate feeble heart in the background, we may observe intermittence in its action prolonged to syncope—*syncopal angina.*

Artificial Gold.

There are a great many metallic substances known for producing metal closely resembling gold. The *Western Jeweller* gives the following formula for producing one of the artificial gold substances:

Take 100 parts (by weight) of pure copper, 14 parts zinc or tin, 6 parts magnesia, 56 parts sal ammoniac, 18 parts quicklime, 9 parts cream of tartar. Melt the copper, and add gradually the magnesia, sal ammoniac, quicklime and cream of tartar, each by itself, in the form of powder. Stir the whole for half an hour, add the zinc or tin in small pieces, and stir again till the whole is melted. Cover the crucible, and keep the mixture in a molten condition for thirty-five minutes. Remove the dross, and pour the metal into moulds. It has a fine grain, is malleable, and does not easily tarnish.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 808.

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ARCTURUS.

This brilliant star in the constellation of Bootes, now visible nearly overhead in the evening hours, was the subject of a very interesting lecture by Mr. Wm. H. Knight, recently delivered before the Cincinnati Society of Natural History. We give herewith a few extracts from the paper, which will appear in full in our next week's issue of the SUPPLEMENT:

Within the last two or three years a new and surprising value has been given to the parallax of Arcturus by Dr. Elkin, the astronomer of Yale University. Previous to his work at Yale he had acquired a reputation for painstaking observations and accurate results in the British observatory at the Cape of Good Hope. Equipped with a 7" heliometer provided with the latest improvements, he set himself the task of measuring the parallax of several prominent stars. Devoting himself specially to Arcturus, from no less than 89 observations, taken in connection with 10 comparison stars, he deduced the very small parallax of $\frac{1}{1000}$ or about $\frac{1}{8}$ of a second of arc, which is equivalent to a distance of 181 light years. This minute parallax (which is assumed to be approximately correct by other astronomers), combined with its large proper motion, gives Arcturus the tremendous velocity of 381 miles per second—a distance 40 miles greater than that which separates Cincinnati from St. Louis. Imagine a body moving from this city to the Mississippi River between the ticks of a clock.

Now, Dr. Elkin admits that there is what is technically called a "probable error" in his observations, but that error is + or —, and would be as liable to make the value of the parallax less than the figure named as to make it more. So that while the velocity of Arcturus *may* be 50 or even 100 miles less per second than computed, it may *possibly* be 50 or 100 miles more.

But until we get new data, based on more extended observations, made with better instruments, we may, in company with the leading astronomers of the world, accept Dr. Elkin's startling figures, and consider Arcturus as 181 light years away, and rushing through space with the unparalleled velocity of 381 miles per second, or about 21 times faster than the earth travels in its orbit around the sun.

Is such a velocity impossible? Is it incredible? Is unreasonable?

It has been mathematically demonstrated that the velocity with which matter, drawn from distant space, would fall upon the surface of the sun is no less than 383 miles per second, a velocity, it will be seen, almost identical with that of Arcturus.

Many comets which come from interstellar regions and visit our solar system sweep around the sun at perihelion with velocities even higher than that ascribed to Arcturus, and, moving in parabolic curves, again plunge outward into distant space, and passing beyond the dominion of our own sun, enter that of some other mighty star.

Thus far I have been considering the velocity of Arcturus *perpendicular* to or *across* the line of sight. But we have seen in the case of Sirius, that while it is moving with the comparatively low speed of 9 miles *across* the line of sight, it is receding *along* the line of sight with the high velocity of 20 miles per second. How is it with Arcturus? Is he approaching or receding from us? Mr. Huggins again comes to our aid with his spectroscope, and finds that, while Sirius is moving *away* from us at the rate of 20 miles per second, Arcturus is rushing down *upon* us with the far higher velocity of 55 miles per second.

But we need have no fear of a collision. While he will doubtless continue to approach us for tens of thousands of years to come, till he arrives within 140 light years or so, he will then, after a computable period gradually and then rapidly recede from us and from our part of the sidereal universe, and pursuing an unswerving course, with unabated velocity, he will, in a few million years, pass entirely out of the ken of the most powerful earthly telescope. For, while Arcturus is now approaching us at the rate of 55 miles per second, he is moving athwart our line of vision 381 miles in the same moment of time.

But *part* of that apparent motion of approach on the part of Arcturus is caused by the movement of our *own* sun, which, with its train of attendant worlds, swinging along through space at the estimated rate of 15 miles per second. Its course is directed toward the constellation Hercules, between Acturus and the Milky Way.

And now, having obtained some idea, however crude, of the great distance and rapid motions of this remarkable star, we are curious to learn something of his magnitude and physical structure. If he had a visible companion circling around him, as is the case with Sirius, Alpha Centauri, and some other stars which exhibit a measurable parallax, we could weigh his mass, or rather the combined mass of the two bodies, and thence infer his probable magnitude. But Arcturus is a solitary star. No telescope has revealed any attendant companion.

Our only resource, then, is to compare his light-giving power with that of other luminous bodies, and accept such conclusion as may be fairly drawn.