THE

# Scientific American.

MUNN & COMPANY, Editors & Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

O. D. MUNN, S. H. WALES, A. E. BEACH.

VOL. XIII., NO. 20...[NEW SERIES.]...*Twentieth Year.*

NEW YORK, SATURDAY, NOVEMBER 11, 1865.

**Contents:**

(Illustrations are indicated by an asterisk.)



## TO OUR READERS ON THE PACIFIC COAST.

The SCIENTIFIC AMERICAN has now a large and increasing subscription list in California, Oregon, and other Pacific States. Our professional business in those States is also increasing, which clearly indicates a healthy progress in the manufacturing and mechanic arts.

We now desire to thank our patrons and friends upon the Pacific coast for their generous encouragement, and also to remind them that a new volume of the SCIENTIFIC AMERICAN will commence January 1, 1866, at which time there are a large number of subscriptions that will expire. We make the announcement at this early date for the purpose of securing the co-operation of our friends in getting up clubs for the next volume.

Notwithstanding the increasing cost of paper, we have determined to offer the SCIENTIFIC AMERICAN in clubs of ten and upward for $2 50 per year, at which rate we hope to largely increase our circulation.

Of the future value of the SCIENTIFIC AMERICAN the past twenty years must be our guaranty. No other journal of the kind in this country, or Europe, can compare with it in the extent and value of the information which its columns supply.

Send in your clubs and subscriptions early, in order to secure the first numbers of the new volume.

## SMALL BOILER AND ENGINE.

Many of our readers are amateur mechanics and apprentices who make small steam engines and boilers for the sake of the experiment. The inquiry contained in this letter, with the answer, will probably be read with interest by others than the writer of it.

MESSRS. EDITORS:—Will you answer these few questions? I have an engine, the cylinder of which is two inches in diameter and the stroke of the piston is four inches and three-quarters. What I want to know is, how much power it has, and much steam it will take to make it work; also the capacity of the boiler. A. O.

The power of this engine depends on the revolutions and the pressure of steam. It will work up to 0·6 of a horse power at 50 lbs. pressure, and 120 turns per minute.

The boiler should be vertical, for small boilers, where there is limited steam room, are less apt to prime than when horizontal It should be fourteen inches high, eight inches in diameter of shell, seven inches internal diameter of fire-box, eight inches from grate to crown of furnace, one-eighth inch thick, and contain forty-eight tubes, half an inch in diameter by four and a quarter inches long. The furnace must all be cast in brass of one piece, or brazed up in copper, and the shell riveted to it at the bottom. The tubes must be expanded in the crown of the furnace and in the upper tube sheet, and the latter must be riveted to the shell at the top. The upper tube sheet may be dished so that the top of the tubes will be under water, though this is not necessary. Such a boiler exposes a total heating surface of 337·01 superficial inches, exclusive of fire-box sides, which is ample for this engine, although smallsteam boilers require a much greater proportion of heating surface per horse-power than larger ones. Combustion is less perfect and radiation is greater in them than in those of larger size.

The grate to this boiler should be set one inch from the bottom, and air holes, one-quarter of an inch in diameter, must be inserted two or three inches *above* the grate, so as to let air in over the fire. This is a great advantage to a small boiler, since it insures a more perfect burning of the fuel. The air holes are made by screwing quarter-inch brass pipe quite through the shell and the furnace wall; they also serve as stays. The furnace door must be let in five inches above the grate, so as to prevent small sticks, or the fuel, from poking out when the fire is started; also to allow a good heavy fire to be carried.

There must be a smoke jacket on top, two inches above the tops of the tubes, which will make the boiler just fourteen inches high, as we stated. The smoke pipe must be two inches in diameter and four inches long. If thought advisable, a steam jet may be put in. We have used steam jets with pipes no larger than a pin in the bore.

The safety valve must be one-half inch in diameter, and the lever one inch from the short end to the center of the stem, and four inches from the center of the stem to the end of the lever; the weight on the end must be one pound. The lowest gage cock must not be less than two inches from the furnace crown.

Charcoal is good fuel, and anthracite, where it can be burned. We have made many small steam boilers, and many experiments with them, and we have succeeded in burning anthracite coal in lumps about the size of a rifle ball in a grate four inches square. It is proper to add that the fuel was first ignited by charcoal urged by a blow-pipe, but burned freely to ashes when once s[redacted]

The shell should b[redacted]heet brass three thirty-seconds thick, and the fire-box crown should be three-sixteenths thick, so as to carry the tubes. There is no brazing or solder about the boiler, and, if well made, would be as tight as a bottle.

In place of expanding the tubes in the furnace crown, as directed above, they may be screwed in. The threads should not be coarser than twenty-eight to the inch, and great care must be taken not to make the threads too deep, otherwise the tube will be weakened. The tubes must not be over one-thirty-secondth of an inch thick. This thickness will carry twenty-eight threads easily.

There will be plenty of steam room if the water is carried three inches over the furnace crown, for the upper ends of the tubes being bare will superheat the steam and prevent priming. This boiler will take some time to make it, and will test the workmanship of the maker.

A common boiler without flues may be made by taking a teakettle, soldering a steam pipe on the top, and putting a tight cover on, with a hole left to put the water in. Such a boiler is good for nothing, since it will not bear any pressure.

Small boilers, made to work by alcohol or spirit lamps, are rather costly things to use just now, when alcohol is $4 per gallon. Petroleum burns well under small boilers when properly arranged, but there is always fuss with oil, wicks, smoke, and muss generally, where, with a boiler such as described previously, a good working pressure can be maintained, fuel that costs little or nothing can be burned, and more *learned* about burning it in an hour than with liquid fuel for any time.

The cost of such a boiler will be, for the tubes, five dollars; for the shell and castings, whatever founders charge per pound where the boiler is built; the total will not exceed twenty dollars.

## WHAT IS SUPERHEATED STEAM?

A corres pondent, writing from Tan Farm, Pa., asks us, "What is superheated steam, and how is it obtained?" Those of our subscribers who know all about superheated steam can pass over this article; they will find, we trust, in the variety of matter presented in this number something to interest them all, and will recognize the propriety of our devoting this small space to the gratification of our correspondent and others, who, like him, do not understand the difference between superheated and saturated steam.

When heat is applied to a steam boiler under the surface of the water, the steam that is formed is saturated. Steam thus formed and heated has always the same density and pressure at a given temperature; for instance—omitting fractions—at a temperature of 243° one pound of saturated steam occupies fifteen cubic feet, and exerts a pressure of eleven pounds to the square inch; and at a temperature of 280°, one pound of steam occupies eight cubic feet, and exerts a pressure of thirty-four pounds to the square inch—the density and pressure increasing by a fixed law with the temperature.

If a quantity of steam be inclosed in a tight boiler or other vessel, and heated out of contact with water, it becomes superheated steam. It is manifest that, in these circumstances, the density can no longer increase with the temperature, as there is no additional water to be formed into steam and forced into a cubic foot of space. The pressure, however, increases with the temperature, but in a different ratio from that of saturated steam.

If superheated steam be allowed to expand, its density will, of course, be diminished, and the pressure will decrease with the density; thus superheated steam may have any density and pressure at any temperature, less than those of saturated steam at the same temperature.

To form superheated steam, it is not necessary to inclose it in a vessel separate from that in which it is formed. If a pipe is led from the steam space of a boiler through a flame, so that heat may be imparted to the steam without passing through the water, the steam will be superheated; in this case the density of the steam will be diminished, but its pressure must plainly be the same as that of the saturated steam in the boiler with which it communicates.

If the temperature of saturated steam is reduced the least fracti[redacted] of a degree without reducing the pressure, a p[redacted] of it is condensed to water; but the temperature of superheated steam must be reduced below the point of saturation before any condensation takes place. Superheated steam is, therefore, better adapted than saturated steam for working at high measures of expansion.

## THE PRODUCE EXCHANGE AND THE COURSE OF THE GRAIN TRADE.

In the lower part of the City of New York, at the corner of Pearl and Whitehall streets, there is a large, new, brick building, of massive, peculiar, and questionable architecture, called the Produce Exchange. It is one of the few large buildings erected in this city during the war, having been built by an association of capitalists for the accommodation of the dealers in domestic produce. Here, from eleven o'clock to half past twelve every day, are to be seen some three or four hundred of the solid men of New York, who are engaged in buying and selling flour and grain—hook-nosed Jews, big-nosed Scotchmen, pug-nosed Englishmen, and sharp-nosed Yankees—all the noses, whatever their shape, employed in the useful task of ascertaining the quality of the great staples in which these men deal.

The object of building the Produce Exchange was to provide a place where the dealers in produce might meet daily, so that every man who had flour or grain to sell might offer it to every purchaser in the city, and every man who wished to purchase might easily and quickly ascertain what lots were offered for sale, and for what price. At each entrance to the building is stationed a doorkeeper, who admits none but members, the several members paying twenty-five dollars a year for this privilege; then tables are prepared for the display of samples, and are rented to such dealers as choose to hire them. Each dealer covers his table with a shallow box, divided into compart-