I claim, by itself, increasing the width of the roadway and other parts of the bridge at the ends; neither the mere employment of side guards or braces; as all these, or similar devices or applications, belong to common carpentry or ordinary bridge building; they, however, are necessary details, or contain principles essential to the construction of my bridge, involving a combination having the effects and advantages specified.

"But what I do claim as my invention is, 1st, The combination of parts, constructed and arranged as described, in formation of a wooden tubular suspension bridge; that is, the several suspension stringers D D, of catenary form, and constructed and united in pieces as explained, (the outer ends of the extreme stringers being locked, as represented in the back stays,) the stringers H H and I, for construction thereto or thereon of the inclined roof, made of diagonal planking; the roadway stringers G G, connected by suspension rods to D D and H H; the direct arch M, united by suspension rods, and further direct arch N, bearing under the upper stringers, together with the transverse floor timbers and roadway; the bridge thus constituted, being formed—that is, its stringers, arches, and coverings—of short pieces of wood, united, and having their fibres running in appropriate directions, as shown, and the bridge being in form wider at its extremities, gradually narrowing towards the centres; by which combination and arrangement of parts, the tensile strength of the wood in the suspension stringers is fully employed, vertical and lateral vibration are reduced, the roof more than assists towards the support of its own weight, and the bridge may be extended over a considerable space.

"2d, The continuous angular side guards formed by fender raves P P, inclined rafters Q Q, diagonal plank covering R R, and extensions of the transverse roadway timbers O O, the said side guards projecting most, and being of greatest extent at the extremities of the bridge, gradually diminishing towards the centre; and the specified side guards serving not only as braces to reduce the lateral motion, but as a covered roadway, and to break the effect of wind upon the structure."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Remarks on the Screw Steamship "City of Pittsburg." By Chief Engineer
B. F. ISHERWOOD, U. S. N.

The new steamship *City of Pittsburg*, bought to trade between Philadelphia and Liverpool, has made her first voyage out under steam, and on her return has had the misfortune to break the three blades of her screw propeller. Understanding it to be the intention of her owners to use different proportions for her new screw, it will be of interest to know the performance of the vessel with the old one. The dimensions given in this article were furnished me by her able Engineer; the results were taken from the steam log of the vessel.

HULL.

Length on Deck,	266 feet.
" Water Line,	249 "
Beam on Deck, extreme,	40 " 9 inches.
Depth of Hold,	32 " 6 "
Deep Load of Draft,	{ 22½ feet forward.
	{ 23 feet mean.
	{ 23½ feet aft.
Draft with coal half out,	21½ feet.
Immersed Amidship Section of vessel at 21½ feet draft,	800 square feet.
Burthen, Custom House measurement,	3370 tons.

The hull was originally intended for paddle wheels, and was designed with flat floor and sides, not being the model proper for screw propellers.

ENGINES.

Two vertical trunk condensing engines.

Diameter of Cylinders,	85½	inches.
“ Trunks,	39	“
Being equivalent to a cylinder having a diameter of	76.09	“
Stroke of piston,	51	“
Space displacement of both pistons per stroke,	267.392	cubic feet.
Mean effective steam pressure per square inch of piston,	10.4	pounds.
Total power developed by the engines,	777	horses.

SCREW.

One of cast iron; not a *true* screw, but twist bladed.

Diameter,	16 feet 2 inches.
Pitch at hub,	30 “
“ periphery,	36 “
Mean pitch in function of total surface,	33 “ 6 “
Fraction of pitch used,	0.563
Length on periphery,	5 feet.
“ hub,	3 feet 2 inches.
Total helicoidal surface,	126 square feet.
Total surface projected on a plane at right angles to axis,	110.5 “ “
Number of blades,	3.

RESULTS.

The vessel steamed from Philadelphia to Liverpool, in November, 1851. Total distance by observation, 3480 geographical miles of 6140 feet. Total time of steaming the above distance, 17 days, 4 hours, or an average of 8.447 geographical miles per hour. Total number of revolutions of the screw, 790,070, or an average of 31.96 per minute. Average steam pressure in the boiler, 10 pounds per square inch above the atmosphere; cut off at ¼ths the stroke from the commencement. Throttle one-fourth open. Lift of valve reduced one-half. Vacuum in condenser, per gauge, 19 in. of mercury.

The weather throughout was fine, with an ordinary sea, and a moderate wind forward the beam. No sail set.

Total consumption of fuel, 519 tons, 1677 pounds, or 2825.8 pounds per hour of Cumberland (bituminous) coal.

SLIP OF THE SCREW.

Practically, the effective propelling portion of the screw is about that comprised between the diameters of 6 feet 2 inches, and 16 feet 2 inches, or the exterior 5 feet radially of each blade.

The average pitch of this surface in function of surface is 34 feet.

From the foregoing data, the slip of the screw will be as follows, viz:

$$\begin{array}{l}
 8.447 \times 6140 = 51864.58 = \text{speed of vessel per hour in feet.} \\
 34 \times 31.96 \times 60 = 65198.40 = \text{“ screw “ “} \\
 \hline
 13333.82 = \text{slip of screw “ “ or 20.45 per cent.}
 \end{array}$$

BOILERS.

Three iron boilers, of the double return drop flue variety, placed side by side.

Total amount of heating surface,	8028 square feet.
“ “ grate “ “ “ “	226 “ “
Aggregate cross area of upper row of flues,	28.4 “ “
“ “ “ middle “ “ “	37.6 “ “
“ “ “ lower “ “ “	28.4 “ “
Area of smoke chimney,	37.6 “ “
Height of chimney above grate,	59 feet 6 inches.
Consumption of coal per square foot of grate per hour,	12½ pounds.
Pounds of sea water evaporated per hour per pound of coal, inclusive of loss by blowing off, supposing the cylinder pressure to be 7 lbs. per square inch above atmosphere, caused by throttling,	4.93 pounds.

PROPORTIONS.

Proportion of heating to grate surface,	35.52 to 1.00
“ heating surface per cubic foot of space displacement of both pistons,	3.00 “
“ heating surface per cubic foot of space displacement of both pistons multiplied by number of double strokes of piston per minute,	0.94 “
“ grate surface per cubic foot of space displacement of both pistons,	0.85 “
“ grate surface per cubic foot of space displacement of both pistons multiplied by number of double strokes of piston per minute,	0.026 “
“ cross area of upper row of flues to grate surface,	7.96 “
“ “ middle “ “ “	“ “
“ “ lower “ “ “	7.96 “
“ “ chimney to grate surface,	6.01 “

The loss by “blowing off” has been calculated on the supposition that the water was carried at $\frac{2}{3}$ of Sewell’s Salinometer, with which instrument the boilers were fitted. This is a maximum loss. The evaporation has also been calculated for only 3 lbs. *less* steam pressure in the cylinder than in the boiler; though the steam was wire drawn, both at the throttle, which was but one-fourth open, and at the valve, which had but half its proper lift.

The evaporation obtained of only 4.93 pounds of water per pound of coal, although exceedingly low, was what might have been anticipated from the above proportions, which gave a maximum of heating to grate surface, viz: 35.52 to 1.00, reducing the temperature of the gases delivered into the chimney so low, as necessarily to produce a very sluggish draft; while the proportion of *least* calorimeter, or cross area of flue, to grate surface was only 7.96 to 1.00; a proportion entirely too small, with the low velocity of draft, to supply the proper quantity of atmospheric air for combustion. The inevitable result of such proportions is, that the constituents of the coal is not fully oxidized, and of course a large portion of the products of combustion pass off in the form of carbonic oxide, instead of carbonic acid gas.

Boilers of such proportions should contain double the present amount of grate and heating surface, to supply these engines for driving a screw of the present pitch and surface, in which case a high rate of speed could be obtained.

The present mean effective pressure per square inch of piston is 10.4 pounds, with steam of 7 pounds initial pressure. Supposing now that steam were supplied of 14 pounds initial pressure in the cylinder, cutting

off at $\frac{1}{4}$ ths, as at present, and instead of the present vacuum in the condenser, the usual one of 26 inches were carried: the mean effective pressure per square inch of piston would then be 19 pounds; and as the number of double strokes made by the piston (with the same load) is as the square roots of the pressures on it, the double strokes would be increased in the proportion of 31.96 to 43.18, and the speed of the vessel increased from 8.447 to 11.41 geographical miles per hour. The consumption of fuel, with boilers of the same proportions as the present ones, (supposing enough of them to furnish the cylinders with steam of 14 pounds above the atmosphere, cutting off at $\frac{1}{4}$ ths,) would be just doubled, or equal to 60 tons of coal per 24 hours steaming. The time of making the passage would be reduced to 12 days, 17 hours, and the consumption of coal for the passage, instead of 520 tons, would be 762 tons.

It is very doubtful, however, if the engines are adapted for making 43 double strokes of piston; and a better result would probably be obtained by making a true screw of 37 feet initial pitch, expanding to 43 feet, being a mean of 40 feet, and adding another blade to compensate the effective surface lost by increasing the pitch, retaining of course the present length of screw on axis, or even increasing it by 6 inches, if practicable. The slip would then remain about the same as at present. The engines have so much cylindrical capacity that, with the increased pitch of screw, they could still, with the above consumption of fuel, develop sufficient power to make the passage in the reduced time stated.

It is of course understood, that the foregoing conclusions do not pretend to critical accuracy; but it is believed they are sufficiently near the truth for any practical purpose.

It has frequently been stated that high speed cannot be obtained with a screw propeller, and an instance challenged where speed has been given by it to a large vessel, equal to the speeds obtained from fast ocean steamships, like the *Collins'* and *Cunard* liners; but I think the results furnished from the *City of Pittsburg*, a vessel probably of equal resistance to the steamers of these celebrated lines, will be found as high, comparing them with the actual powers applied to the propelling instruments.

With the *Collins'* steamers, there is required to make a 10 days 20 hours passage from New York to Liverpool, a mean effective steam pressure of 19 pounds per square inch of piston, furnished by a consumption of about 83 tons of coal per 24 hours, cutting off at $\frac{1}{4}$ ths. The space displacement of both pistons per stroke is 888.03 cubic feet. Mean number of double strokes per minute, $14\frac{1}{2}$. Allowing then the mean effective pressure in the cylinders of the *City of Pittsburg* to be 19 pounds per square inch, and the double strokes of piston per minute 43.18, the powers and results would compare as follows, viz:

	Powers.	Speeds.	Cube of Speeds, or Results.
Collins,	1.115	1.039	1.122
City of Pittsburg,	1.000	1.000	1.000

The foregoing is, of course, but an approximation obtained from general data; but it is sufficiently close to demonstrate that the screw will, for ocean steamships of very deep draft, give equal speeds with equal power,

compared to the paddle wheel, provided it be properly proportioned and well managed.

The screw has never, to my knowledge, been tried in a first class ocean steamship, with any approximation to the power that is applied to the paddle wheels of such vessels; of course, the reason is obvious why as great speeds have not been obtained.

General Proportions of Power and of Surface of Screw to Immersed Amidship Section of Vessel.

Square feet of immersed amidship section of vessel per cubic foot		of space displacement of pistons,		2.992 to 1.000
Do.	do.	per cubic foot of space displacement of pistons multiplied by number of double strokes of piston per minute,	0.093	"
Do.	do.	per square foot of area of screw, viewed as a disk,	7.240	"
Do.	do.	per actual horse power developed by vessel,	1.030	"

For the Journal of the Franklin Institute.

A Series of Lectures on the Telegraph, delivered before the Franklin Institute. Session, 1850-51. By DR. L. TURNBULL.

Continued from page 111.

The House Printing Telegraph.

This instrument has been appropriately termed one of the wonders of the age; its apparent intricacy of construction arises not so much from the use of electricity and magnetism, as from the number of minute physical contrivances, and the various methods by which they are brought into action.

Of the origin and life of the inventor, Mr. Royal E. House, it seems difficult to obtain any definite or conclusive information; while the results of his labors are spread before the public, form a prominent object of its curiosity, and are made subservient in a high degree to its utility, the man himself seems almost a recluse, and veiled, as it were, from the sight of the world. If some tell us that he originated in New York, more authentic sources affirm that he was born in Pennsylvania, and reared among the Green Mountains of Vermont. To the old Keystone, then, may we ascribe the honor of having given birth to one who has achieved so much in the progress of American artizanship.

To converse and carry on intelligent discourse at the distance of many hundreds of miles, is not new; nay, it has become common; but to impress with the subtle electric spark through vast space, solid material, with the symbols of our language in the fulness of their proportionate beauty; to make the cold, dull, inanimate steel speak to us in our own tongue, surpasses the mythological narratives of ancient Greece and Rome, throws into the shade the fabulous myths of superstitious Arabia, and sinks into insignificance the time honored traditions of the Oriental World.

A letter dated Boston, Dec. 23, 1850, received in reply to some inquiries, relative to Mr. House, affords the following interesting information: "Mr. House is a self-educated man, and was engaged nearly six years in perfecting his instrument; he is decidedly scientific, but not learned,