

der direction of the Navy Department. It has fired five hundred rounds with fifty-pound charges of powder, and with solid shot weighing 280 pounds. Its greatest enlargement during this enormous test was 87-1000ths of an inch; and there is not a visible defect to warrant a doubt of its capacity for another five hundred rounds. It is safe to declare that no gun in this or any other country has ever been subjected to and withstood a severer test.

"The guns made here are fabricated from an iron composed of hematite and magnetic ores, obtained in the vicinity of Reading. The magnetic oxides occur in the range of mountains known in Virginia as the Blue Ridge, and on the Susquehanna as the Conewago hills. The iron is associated with siliceous and feldspar, and generally occurs in rocky veins. When it is free from sulphur, and mixed with suitable proportions of hematite, it produces iron of the highest quality, and adapted for almost any desired purpose. The magnetic variety is what is termed a neutral ore, and makes iron of extraordinary strength and hardness, which may be modified at pleasure by the introduction of hematites. The success achieved in the manufacture of ordnance has created an unusual demand for that particular variety of metal, and it is eagerly sought for, not only by the gun foundries of Pittsburgh, Trenton and the East, but also by the manufacturers of wire, screws, cutlery, and every variety of iron requiring peculiar strength and hardness. Indeed, large quantities of the raw ore have already been sent to remote points—in some instances they have been hauled a distance of fourteen miles by wagons, and then shipped by railway a distance of 360 miles to be smelted. These facts indicate not only the local value of the iron mines tributary to Philadelphia, but would seem to justify the expenditure of large capital to manipulate them into the different manufactories now successfully carried on in distant regions under the stimulus of a more enterprising spirit.

"I may add, in conclusion, that the credit of making the strongest gun ever cast in the world belongs mainly to James McCarty, of the firm of Seyfert, McManus & Co. It was through his experiments in securing a proper combination and treatment of ores that the highest strength was secured to the metal; and although the task would now appear to be simple enough, yet at the outset it involved a vast amount of patient labor and research, the benefit of which will ultimately accrue no less to his fellow-countrymen than to himself. ELI BOWEN."

DEFECTS OF THE BRITISH IRON-CLADS.

We republish the following sensible remarks from an editorial in *Mitchell's London Steam Shipping Gazette* :—

"For sea-going ships the deck battery is a defect, for, no doubt, such vessels would roll badly. The weights could not be properly distributed. They would lie much better with the addition of guns between decks. No better specimens of war ships have ever been constructed than the two rams built by Messrs. Laird at Birkenhead. These vessels are armor-plated from bow to stern, and have projecting beaks. If one of them were to steam bow on to the *Warrior* or *Black Prince*, she would probably crack the unprotected hull of these big ships under water like egg-shells.

"We believe there is not a perfect iron-clad yet commissioned in the Royal Navy. All the partially-armor-plated vessels must roll in a seaway, and then they expose common iron-built hulls below the load-line, with screw propellers inviting well-aimed shots. No nation has succeeded in solving the problem of turning out vessels quite impenetrable and yet lively at sea. Our *Warrior* class are certainly magnificent ships, but they are expensive ones. They all leak badly, and require constant docking. The *Minotaur* and *Northumberland* carry their armor plating from bow to stern, but they are propelled by one screw, and are not adapted to attacks in shoal water, from their great draught. Mr. Reed, the Constructor of the Navy, has designed a new class of ship which, we suspect, will be found suitable for sea-service; and, as he is not wedded to ancient ideas, he may yet improve our fleets by attending to the suggestions and advice submitted to his department, and keeping pace with the advanced notions of those who give their attention to naval architecture."



Laplace's Correction for the Velocity of Sound.

MESSRS. EDITORS:—I wish to place on record in the *SCIENTIFIC AMERICAN*, a single numerical result of experiments made on a cubic foot of air, and repeated a score of times, from 1852, up to present date, 1864, for the purpose of verification. I wish to place it on record, because I know the attention of several European physicists is directed to this point at the present time.

Experiment.—A cubic foot of air was heated from 32° to 522° under constant pressure, thereby doubling its volume by expansion, and raising 144×15=2,160 lbs. 1 foot high. The same cubic foot of air was afterward heated from 32° to 522° under double pressure, and with a constant volume.

Now, in these two experiments, the quantity of matter heated is the same—one cubic foot of air; the range of temperature is the same—490°; but the quantity of heat imparted is not the same in both cases. The quantity applied, when the pressure is constant and the volume variable, is to the quantity applied when the pressure is variable and the volume constant, as—1.41724 : 1.00000.

In other words, 0.41724 additional grains of combustible matter were consumed in producing heat that lifted 2,160 lbs. 1 foot high. I wish to place this result on record, for the ratio of the two specific heats used by Laplace in his correction of Newton's formula for the velocity of sound, and also used by Meyer, Dr. Tyndall and other eminent physicists, for computing the mechanical equivalent of heat, is 1.421.

When Newton calculated the theoretical velocity of sound in air by means of the formula

$$v = \sqrt{\frac{e}{d}}$$

in which v represents velocity, e elasticity and d density, both at zero; he found that it differed from the observed velocity by about one-sixth of the whole amount. In this calculation, Newton only considers the changes of elasticity due to changes of density; but Laplace accounted for this deficiency by assuming that the effective elasticity is augmented by changes of temperature produced by pressure in the condensations and rarefactions of sonorous waves. So that, according to Laplace, the effective elasticity must be multiplied by the square root of the quotient obtained by dividing the specific heat of air at constant pressure by its specific heat at constant volume.

But since the ratio was then not known by actual experiment, Laplace reversed the process of his calculation, and deduced from the velocity of sound, which had been well determined, the ratio of the two specific heats, which he found to be 1.421. The excess of 0.421 is now used to express the amount of heat consumed in external work, when the air is allowed to expand under constant pressure. And from this number also is deduced the mechanical equivalent of heat. But my own direct experiments with a cubic foot of air (made with great care, under favorable circumstances and with the best instruments) prove that this excess is too much; the correct value is between 0.417 and 0.4173, and the average is 0.41724.

Laplace's correction is purely inferential, and its correctness depends on the assumed value of the velocity of sound with no allowance for radiation. Although air is practically a vacuum, as regards the radiation of heat, and has no sensible power to neutralize, by radiation, the differences of temperature in the condensed and rarefied portions of a sonorous wave; yet the vapors mixed with the atmospheric elements—in the lower strata of the atmosphere especially, where the velocity of sound has been tested experimentally—are competent to neutralize this difference, because they have been proved to possess a sensible power of absorption and radiation. They will, therefore, so far diminish that portion of the elastic force on which Laplace's correction depends, that a less ratio for the two specific heats must be deduced from the velocity of sound, and more in accordance with the ratio I have deduced from direct experiment—it must be nearer 1.41724 than 1.421.

Dr. Tyndall's recent experiments on the radiation of vapors in the atmosphere, cited in his recently published work on "Heat as a Mode of Motion," and his anticipations in the form of a "note" in the *Philosophical Magazine*, coupled with the published views of other eminent physicists, all lead to the expectation of a correction in Laplace's formula, and a slight diminution in the excess (0.421) which his formula gives, which deduction is due to radiation from every condensed portion of a sonorous wave. Direct experiment with atmospheric air is the only satisfactory mode of settling this question; and my experiments, made for this very purpose, and often-times repeated, prove that the ratio of the two specific heats for condensed and rarefied air is as 1.00000 to 1.41724.

S. BESWICK.

Brooklyn, N. Y., January 30, 1864.

Ventilation of Public Buildings.

MESSRS. EDITORS:—I presume that there are very few who have not suffered from the inconvenience of ill-warmed and poorly ventilated public buildings, but more especially churches. When these last are of modern construction and high in pitch, open timbered and with lead sashes, it is a difficulty to treat them; and this difficulty, particularly in country places, is rarely overcome. I have recently furnished the plans for a building of this kind, and the method of warming and ventilating that I have adopted has proved so efficacious and is, withal, I believe, so novel, that I am led to offer in your columns a description of it for the benefit of others.

The building that I had designed and purposed warming was a church of the usual cruciform style, having a nave and transept. The whole length of the nave in the clear is 82 feet, while the arms or transepts are 12×30 feet; the height of roof to ridge, 32 feet; the side walls, 12 feet. My plan was to do away with the great absorption of heat in the mass of masonry usually surrounding a furnace, and to take the whole space under the church for a hot-air chamber. The foundation was well laid and the wall closely built, making all tight up to the sills. I caused the ground to be excavated under the cross section to the depth of 8 feet, and about the same size as the transept; thus making under that part of the building a room of 11×24 feet. From this the ground was excavated on an inclined plane up to the extreme end of the church, where the distance from the floor to the ground was about 18 inches. The entrance to this room was from the end of the building near the transept, in which, as usual, was a door under the floor. Into this space below, two chimneys (carried up through the wall) entered and carried up the smoke of two large-sized "box stoves." These stoves had pipes of some twelve feet in length, to secure the transmission of all the heat ere entering the chimney. Directly over the stoves two openings in the floor formed registers, 4×3 feet, capable of being opened or closed at pleasure. Then in all the seats, at such distance as the feet of persons sitting or standing would come, there were bored in the floor with an inch auger, five holes, in diamond form, making a kind of small register to each person.

The system of heating is this:—The inclined plane of the ground under the floor, through the whole length of the building, acts as a descending grade for the cold air dropping through all these numerous apertures in the floor. The cold air flows down and is drawn toward the stove in the chamber, either for combustion or heating. The hottest air meantime, passing directly up through the large opening over the stove, ascends into the building and aids in pressing down the colder air falling through the other apertures. The result is that the building is heated with great rapidity; two or three hours sufficing for doing what an ordinary furnace would, by mere radiation or compression, require six or seven hours to accomplish.

When the time for divine service has arrived and the congregation have assembled, the registers over the stove are to be closed and the process thus far going on is in a degree reversed: the warm air then flows up the inclined plane pressing against the floor and rising through the numerous openings, to the feet and clothes of the individual seated or standing above, effectually warming them. By this contrivance the air above, instead of being much (as usual with one column of furnace heat) hotter than that around