small gusset on each side. These breeches or combustion chambers have already proved a very fruitful source of explosion, and it is important that any steam users, who are employing boilers of this construction, should have these chambers stayed with vertical water tubes which act as internal columns or struts, and thus prevent the top and bottom plates of the chamber coming together; while, in addition, it is frequently if not always desirable, that the flue should be encircled with an angle iron hoop just at the waist or termination of the breeches piece. In some cases, where the pressure is low, this hoop of itself would be sufficient, and under many circumstances would perhaps be more easily obtained than the water tubes. Had these precautions been adopted in the boiler under consideration, the collapse of the breeches or combustion chamber, and the consequent explosion, would have been prevented.

Sir John Herschel on the French and English Standards of Measurement.

From the Lond. Civil Eng. and Arch. Jour., July, 1864.

We extract the following letter to the editor from a recent number of the *Times:*

In the *Times* of Thursday, the 16th inst., I observe a letter addressed by Mr. Ewart to the editor of the *Journal des Debats* on the subject of the introduction into this country of the French metrical system. In this letter Mr. Ewart appears to be at a loss to understand why the *Times* has all along raised its voice in opposition to the proposed change; and speaks of the prevalent repugnance to its adoption as arising merely from British prejudice, which he considers to be gradually yielding to the efforts making by himself and his coadjutors to enlighten us as to its advantage.

It is well for those who have adopted a contrary opinion, whether from the exercise of their own judgment, or from a perusal of the many able expositions of the confusion and inconvenience the change would create which have from time to time appeared in your columns, to be enabled to render an account of the faith that is in them; and you will excuse me if I observe that, in the articles referred to, I nowhere find any clear and distinct statement of those reasons which appear to myself decisive against the change on purely scientific grounds, and which lead me to regard it, scientifically considered, as a retrograde step. These, with your permission, I will endeavor to state as briefly as may be, for the benefit of that very large portion of the public who may not have read my recent remarks on the subject in one of our most widely circulated monthly periodicals.

Whatever be the historical origin of our standards of weight, capacity, and length, as a matter of fact our British system refers itself with quite as much arithmetical simplicity, through the medium of the inch, to the length of the earth's polar axis (a unit common to all nations) as the French does through that of the metre to the elliptic quadrant of a meridian passing through Paris (a unit peculiar to France). It does so as regards our actual legal standards of weight and capacity

with much more precision than the French system, and as regards that of length (with a correction which, if legalized, would be absolutely imperceptible, from the smallness of its amount, in any transaction of life, and which can be applied, *currente calamo*, almost without calculation to any statement of lengths) with even still greater, and indeed with all but mathematical, exactness.

If the earth's polar axis be conceived divided into five hundred million inches, and a *foot* to be taken to consist of 12 such inches, then one hundred of our actual legal imperial half-pints by measure, or one thousand of our actual imperial ounces by weight, of distilled water at our actual standard temperature of 62° Fahr., will fill a hollow cube having one such foot as its side. The amount of error in either case is only one part in 8000.

The theoretical French metre is one ten-millionth part of the elliptic quadrant above mentioned; the theoretical litre is one-thousandth of a cubic metre; and the theoretical gramme, one millionth part of a cubic metre of distilled water at 32° Fahr. The actual error of the French legal or standard litre or gramme, or the deviation of these standards as they actually exist, from their true theoretical value, is one part in two thousand seven hundred and thirty (2730), and is consequently relatively nearly three times as great as the error in our standards of capacity and weight when referred to the earth's polar axis as their theoretical origin in the manner above stated.

Our actual imperial measures of length deviate, it is true, by more than this amount from their theoretical values so defined; that is to say, by one part in one thousand; so that a correction of one exact thousandth part subtracted from the stated amount of any length in imperial measures suffices to reduce it to its equivalent in such units as correspond to similar aliquots of the polar axis; a correction performed if needed, as already remarked, *instanter*, and *currente calamo* requiring no tables and almost no calculation. So corrected the outstanding error is only one part in sixty-four thousand (64,000). The actual legal metre in use in France is however, not immaculate in this respect, its amount of error being one part in six thousand four hundred (6400), which is ten times that which our British measures so corrected would exhibit.

If it were worth while to legalize so trifling an alteration (and were an Act passed rendering permissive the decimalization of our own system, it would be necessary to do so as a means of bringing the national units of length, weight, and capacity, into exact decimal correspondence), no mortal would be aware, practically speaking, that any change had been made in our mile, yard, foot, or inch. I have in common use two foot rules bought at respectable shops, and neither the worse for wear, which differ by more than the amount of change required.

The writer in the *Journal des Debats* is pleased to say that England stands in extensive commercial relations with only one considerable nation (North America) employing the British system of weights and measures. British commerce extends, however, to Russia, British India

and Australia, all of them superior in area, and the two last, at least, of equal importance, commercially speaking, with the totality of the metricised nations. The Russian sagene is an exact multiple of the English foot (imperial). The hath (the legal measure of length in British India) is 18 imperial inches. The Australian system is identical with our own. Taking into consideration this immense preponderance, both in area, in population, and in commerce, we are not only justified in taking our stand against this innovation, but entitled to inquire, if uniformity be insisted on, why, with an equally good theoretical basis (to say the least), the majority is called upon to give way to the minority.

J. F. W. HERSCHEL.

Collingwood, June 18.

For the Journal of the Franklin Institute.

Atmospheric Pressure as a Traveling Force, versus *Animal Power and Steam Locomotives.*

(Continued from page 279.)

It may readily be supposed that to establish Pneumatic passenger lines, the dimensions of the tunnels or tubes should be as small as possible, not only because their cost swells greatly with their bore, but because the larger one is the larger are the volumes of air to be drawn out, and the longer the time and greater the outlay of force to do that. This may be said to depend on the arrangement of the passengers seats. In common cars it matters little how they are placed, in the direction of the length or breadth of the cars, but in an air tube the difference is very great. Every addition to its width enlarges its capacity and cost. A company of soldiers can march in single file through a passage less than three feet wide, but not in squads of three or four abreast; so a pneumatic tunnel adapted for a single row of passengers can pass the same number through as a much larger one seated across it, and in the same time. If length be thus substituted for breadth, the result would be a tube, the cost of which would be reduced to a minimum, and, as it would seem, the expense of working it also.

What then is the form and size of such a tube? We assume that one whose section is a circle five feet in diameter could receive two rows of passengers seated *vis à vis* as in fig. 1, with the space under the seats excluded. The sitting posture would be uneasy for tall travelers and there would be a lack of head-room on going in and out. This would suggest the drawing in of the sides so as to form an ellipse by dividing of which vertically and taking half of it, we should have, with a slight modification, the second figure. But though here taken for a section of a tube of the smallest dimensions it can only be considered as that of the car, to which the tube proportionately enlarged would have to conform.

It is, however, obvious that so severe an economy of space and such a disposition of travelers would militate against, if they did not prove fatal to the system. The comforts and conveniences of travel would be materially lessened, social and confidential converse, except with