instantly pushed into its place. The machines and lamp have done their duty during the past six months in a real and practical manner. The light has never gone out through any deficiency or cause in the engine and machine house; and when it has become extinguished in the lantern, a single touch of the keeper's hand has set it shining as bright as ever. The light shone up and down the Channel, and across into France, with a power far surpassing that of any other fixed light within sight, or anywhere existent. The experiment has been a good one. There is still the matter of expense and some other circumstances to be considered; but it is the hope and desire of the Trinity House, and all interested in the subject, that it should ultimately justify its full adoption.

For the Journal of the Franklin Institute.

Particulars of the Steamer Daniel Drew.

Hull built by Thomas Colyer. Machinery by Neptune Iron Works, New York. Owners, Daniel Drew and others.

HULL.—Length on deck, 251 ft. 8 ins. Do. at load line, 244 ft. Breadth of beam (molded), 30 ft. 6 ins. Depth of hold to spar deck, 9 ft. 3 ins. Frames—molded, 15½ ins.—sided, 4 ins.—apart from centres, 30 ins. Keel, depth, 3 ins. Draft, forward and aft, 4 ft. 6 ins.

ENGINE.—Vertical beam. Diameter of cylinder, 60 ins. Length of stroke, 10 ft. Maximum pressure of steam, 35 lbs. Cut-off, one-half. Maximum revolutions at above pressure, 26.

BOILERS.—Two—Return flued. Length of boilers, 29 ft. Breadth do., at furnace, 9 ft., at shell, 8 ft. Height do., exclusive of steam chimney, 9 ft. 4 ins. Number of furnaces, two. Length of grate bars, 7 ft. Number of flues, above, 14; below, 10. Internal diameter of do., above, 9½ ins. Do. do., below, 2 of 13½ ins., 1 each of 13, 11, and 7¼ ins. Length of do., above, 22 ft. Heating surface, 3350 sq. ft. Diameter of smoke-pipes, 4 ft. Height do., 32 ft.

PADDLE WHEELS.—Diameter over boards, 29 ft. Length of blades, 9 ft. Depth of do., 26 ins. Number of do., 24.

Remarks.—One independent steam, fire, and bilge pump.

This steamer has been built to attain a very high speed, having a very easy and a very superior model. The velocity of the periphery of her water-wheel blades is 27 miles an hour.

Date of trial, May, 1860.

C. H. H

*British Modular Standard of Length.** By J. F. W. HERSCHEL.

It may not be unwelcome to the scientific portion of your readers to have their attention directed to a simple numerical relation between our actual parliamentary standard of length and the dimensions of the earth, which, in effect, puts us in easy possession of a "modular" system, which might be decimalized, and which, abstractedly considered,

* From the Lond. Athenæum, April, 1830.

is far more scientific in its origin, and, numerically, very far more accurate than the boasted metrical system of our French neighbors. It is simply this,—if the British Imperial standard inch were increased by one-thousandth part it would be, with all but mathematical precision, one five-hundred-millionth part of the earth's axis of rotation.

The calculations of the present Astronomer Royal, published in the year 1830, have determined the length of this axis at 41,707,620 feet, that is to say, 500,491,440 inches of our Imperial standard. Those of Bessel, published in 1841, at 500,487,744 such inches. More recently an elaborate *résumé* of the whole subject, by M. Schubert, has conducted him to three separate and independent conclusions, based on arcs measured each in, or near, a meridian appropriate to the country in which they have been performed, viz: the Russian, the British Indian, and the French arcs. The Russian and the Indian combinations give respectively 500,532,120 and 500,550,168, while the French arc gives only 500,368,920. M. Schubert rejects the latter altogether; but the propriety of doing so appears to Mr. Airy questionable on grounds which we consider so far reasonable as to entitle it to at least half the weight of either of the former. On the other hand, M. Schubert, in computing his mean result, assigns to the Russian result double the weight of the Indian,—a decision in which I can by no means acquiesce. Allowing to each of the former the weight 2, and to the latter 1, the final conclusion from this calculation is 500,506,699; and from the mean of Airy, Bessel, and Schubert, 500,495,294, which differs from 500,500,000 by *less than its hundred-and-six-thousandth part*. This then is the fractional error of our “modular” unit in proportion to its own length of 1.001 British standard inch, or that of a “module” of 50.05 such inches, which, in this view of the subject, might be taken for the British unit of linear measure, or one ten-millionth of the earth's axis. The Astronomer Royal, in discussing these computations of M. Schubert (vol. xx, *Notices of the Royal Astron. Soc.* p. 105), insists, very properly, on the individuality of the polar diameter of the earth as compared with its equatorial diameters, which differ materially in different meridians (having regard to an imaginary sea-level, and independently of the heights of mountains or continents). If any axis be chosen for a scientific unit it should assuredly be the polar axis. The nature of things gives this an absolute, indefeasible preference to every other, not excepting even that of the equator in the meridian of Paris itself.

Every geometer will agree that the radius of a circle is a more fundamental or primary parameter, or unit of linear dimensions, than its circumference. To beings of other psychological constitution than man, it may be otherwise; but take the genus *homo* and the species *geometer* as they stand, this is a fact. *A fortiori*, the axis, major or minor, of an ellipse is a more primary and fundamental unit of its dimensions than its periphery, leaving the question as to *which* axis, major or minor, to be decided on its own grounds.

The French *mètre* is assumed to be the ten-millionth part of the quadrant of the earth's elliptic meridian passing through Paris. Its

value is authoritatively stated in the Annuary of the French Board of Longitude at 39.37079 British Imperial standard inches; and, therefore, in reference to the natural unit in which it originates, is erroneous by one part in 8400 of its proper length, that is to say, between 12 and 13 times more in proportion than our proposed module.

The adoption of such a "British Modular System" of measure requires no Act of Parliament. It is so easy to convert "Imperial standard" lengths, of whatever denomination, into "British modular" lengths of the same denomination by subtracting (or modular into imperial by adding) one-thousandth, that it is not worth while to legislate on the subject, so far as measures of length are concerned. The difference between one part in 1000 and one in 999, in the conversion and re-conversion, being only one in 999,000, is of no importance whatever. Nor is it worth while to change our ordinary parlance. 1 foot or 1 yard, in 1000, is a difference telling as nothing in any practical contract for work on a great scale. On a small one it is quite inappreciable. The scientific man only is interested in it; and it suffices him to know (and the knowledge, to him, is important) that he can refer all his measurements to the best unit nature affords, by subtracting a thousandth (that is, by writing his figures twice over, in two lines, one under the other, shifting the lower three figures to the right, and executing a subtraction sum) far better than by referring to the *Annales des Bureaux* of metricized countries, and performing a calculation of greater complexity, landing him in twelve or thirteen times the amount of error. Of course, I am not speaking of a system of decimalization. To decimalize our measures we must reduce them to "modular inches," or to "modules" of 50 such inches; but we may speak of modular miles, yards, feet, or inches with reference to a modular unit, while retaining the associations of our actual metrical system. A similar remark applies to the Russian metrical system, which is based upon the English—the fundamental unit being the *Sagene* of 7 British feet.

I ought, in fairness, to mention that my attention was drawn in the first instance to this *rapprochement* by the statement, over and over again repeated in Mr. Taylor's recent work, entitled "The Great Pyramid, Why was it Built? &c." (Longman, 1859) (pp. 35, 36, 67, 87, 280, 298, &c.) that the diameter of the earth in the latitude of the Pyramid is 41,666,667 English feet, or 500,000,000 of English inches; which it is not; and it is singular that the reduction of Mr. Airy's polar axis from feet to inches, in page 87, which is rightly performed, does not appear to have suggested the least misgiving as to the correctness of the statement, or (which is more to our present purpose) led him to notice the important practical facility of reduction from the parliamentary to the modular standard above insisted on. It is not my object here to criticize the work in question, which, in the midst of much confusion and no small amount of error, contains some valuable and (so far as we are aware) original remarks. Of these I may mention the conclusion its author has drawn from the angle of slope of the casing-stones discovered by Col. Vyse, that the builders of the Pyra-

mid were acquainted with the ratio of the circumference of a circle to its diameter—a piece of knowledge they were desirous to embody in its dimensions. In fact, the slope of the original faces of the Pyramid comes out from Vyse's (or Perring's) measurement of the linear dimensions of these stones, $51^{\circ} 52' 15\frac{1}{2}''$, and by Brettel's measure of their angle, $51^{\circ} 50' 0''$, the mean of which differs *only by a single second* from the angle whose cotangent is the length of an arc of 45° of the circle, so as to make the whole periphery of the base all but mathematically equal to the circumference of a circle described with the height for a radius. So stated, the coincidence is certainly very striking. It by no means follows, however, that the ancient Egyptians were in possession of any *calculus* by which they could have arrived at a theoretical knowledge of the true ratio. It should be observed that the linear measures above mentioned are given only to entire inches, and those, inches of a scale which may or may not have been verified with extreme precision, and therefore can lay no claim to minute accuracy. Computing, moreover, on these measures alone, the ratio of the periphery to the height comes out 6.2784, while that resulting from the direct measure of the angle is 6.2878, the true ratio being 6.2832. The individual results differ by one 640th part of the whole quantity, and as we do not know with what instruments or what precautions the angle was measured, and it is given only to the nearest minute, it seems but reasonable to admit an equal proportional latitude of uncertainty in the original workmanship and in the numerical relation to which it was intended to conform. Now this is a very considerable approximation, much better than that of Archimedes a thousand years later. Still, it would be easy for people in possession of such appliances as they must have had at command, to ascertain the ratio in question to this, or even to a greater degree of precision, by tracing, for instance, on a flat pavement a circle of 100 feet in diameter and actually measuring the circumference. This they certainly might have done to the nearest half-foot, which, on a length of 314 feet, would correspond to such a latitude of error. If aware of the importance of the problem, they might have gone much further.

But, again, it by no means follows, from any thing which the dimensions of the Pyramid indicate, that they did possess a knowledge of the ratio of the circumference of a circle to its diameter, even approximately. By a very remarkable coincidence, which Mr. Taylor has the merit of having pointed out, the same slope, or one practically undistinguishable from it ($51^{\circ} 49' 46''$), belongs to a pyramid characterized by the property of having each of its faces equal to the square described upon its height. This is the characteristic relation which, Herodotus distinctly tells us, it was the intention of its builders that it should embody, and which we now know it did embody, in a manner quite as creditable to their workmanship as the solution of such a problem was to their geometry. This problem, however, has no relation to that of the rectification of the circle. The coincidence is one as purely accidental as any thing relating to abstract number can be; and although in solving the one problem which we know they did intend,

they at the same time, practically speaking, resolved another which stands in no rational connexion with it, or any connexion beyond that of happening to have, very approximately, the same numerical solution, —we are not entitled to conclude that they were aware of this coincidence, and intended to embody *both* results in their building.

Another curious and novel relation, for pointing out which we are indebted to Mr. Taylor, is one ("Great Pyramid," page 37) which may be most intelligibly expressed under the following form of announcement, viz:—that a belt, encircling the globe, of the breadth of the base of the Great Pyramid, would contain one hundred thousand millions of square feet.* If the feet be Imperial Standard, and the belt Equatorial, this is approximate only to one part in 288 of the whole. But if we suppose the belt meridional, and the area expressed in "modular" square feet, the approximation is within one part in 1100. The fact is interesting as offering the only tolerable approach in round numbers to an arithmetical relation between any of the dimensions of this Pyramid and those of the earth.

* Mr. Taylor has (*in words*) one hundred millions, which is a misprint.

Collingwood, April 23, 1860.

*The Production of Photographic Images on Plates of Glass or Porcelain, by the Action of Light, enabling them to be permanently fixed by being Burnt in with Ceramic Colors.** By JOHN WYARD.

The plates of glass, or porcelain, or other substance, on which the pictures are to be produced, may be glazed prior to the application of the sensitive mixture, or otherwise this glaze or flux may be carried over the finished picture before burning. The first preparation of the plates after cleaning consists in the application of the following sensitive mixture:—

I make separate solutions of gum arabic and gelatine.

Gum Arabic,	.	.	72 grains.
Sat. Sol. Bichromate of Potass,	.	.	$\frac{1}{2}$ oz. by measure.

Dissolve without heat.

Gelatine (Bell's)	.	.	15 grains.
Water,	.	.	1 oz. by measure.
Sat. Sol. Bichromate,	.	.	1 dr. "

Dissolve in a water bath. When cool, add the sol. bichromate.—Shake well and filter.

Take of the solution of—

Gum Arabic,	.	.	11 parts.
Solution of Gelatine,	.	.	5 "
Water Distilled,	.	.	5 "

To every dram of this mixture add 9 or 10 drops of honey syrup, formed by mixing equal parts in volume of honey and water, and filtering.