

*In the House of Representatives,*  
*April 12, 1834. }*

On motion of Mr. Crawford, of Franklin,

*Resolved unanimously,* That the thanks of this House be presented to the "Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts," for the very able and elaborate investigation on the subject of Weights and Measures, undertaken by them in compliance with the resolution of the House of Representatives of the 5th of April, 1833, and for the report made by them on the 24th of March last, in pursuance thereof.

*Resolved unanimously,* That the Clerk of this House transmit to the Institute a certified copy of these resolutions; and of the report of the select committee to whom the communication of the Franklin Institute was referred.

Extract from the Journal.

FR. R. SHUNK, Clerk.

On motion, it was

*Resolved,* That the thanks of the Board be presented to the committee on weights and measures, to whose successful exertions in the performance of the important duties delegated to them, the Institute is indebted for the expression of legislative approbation which has recently been bestowed on it.

## REPORT OF THE COMMITTEE ON WEIGHTS AND MEASURES.

### APPENDIX TO THE REPORT OF THE COMMITTEE OF THE FRANKLIN INSTITUTE ON WEIGHTS AND MEASURES.

*Report on the subject of Weights and Measures made to the Commissioners for Revising the Laws of the State of New York.* By James Renwick, Professor of Natural Philosophy and Chemistry in Columbia College.

(1.) It is conceived that it would be inexpedient, indeed it may be said, impossible, to change the present denominations of weight and measure. The terms foot, yard, pound, ounce, bushel, gallon, quart, &c. are identified with our language; and it would be as easy to subvert the form and dialect of our ordinary colloquial speech, as to introduce new standards of weight and measure, with new names. All that could reasonably be attempted, is to refer the units of the several denominations to some measure in nature, constant, determinate and easily determinable, making such slight changes, not appreciable in the transactions of trade, as will tend to the facility of this determination; and, in addition, the means by which the accuracy of existing stan-

dards may be tested in future times, or the standards themselves restored, if lost, must be defined. To do more would be to attempt what is wholly beyond the reach of legislative power.

That this view of the subject is correct, may be shown by an appeal to the experience of the people of France. At the breaking out of the Revolution in that country, the steps necessary to form a system of weights and measures entirely different from those formerly existing, and resting not merely for their standards, but for their absolute units, upon a measure deduced from a constant dimension in nature, were undertaken. The result of this investigation was in a system that, if tested by the facility of applying to it the principles of decimal arithmetic, by the scientific and practical skill of the parties employed in the task, or by the great zeal and intelligence shown by them, is deserving of all praise. But in spite of the favourable circumstances existing at that era, when the whole nation was searching after novelties, and no prejudice in favour of any ancient customs could be considered as opposing, it was found that it could not be introduced in its full extent; and that the part on which the proposers most prided themselves, namely, the decimal division, by which it became accommodated to the existing scale of arithmetic magnitude, was the first which required modification. On the 12th of March, 1812, previous to the downfall of the Emperor Napoleon, the ancient denominations of lineal dimension, toise, foot, inch, &c. were restored, but appropriated to measures derived from the metrical system; and since the restoration of the Bourbons, that system has been further modified by the application of the ancient name of pound to the half kilogramme, with which that weight nearly corresponds. Nor does the necessity of making these changes arise from the inveteracy of prejudices, from which the French nation might be considered at the time as almost entirely free, but from causes actually existing in nature. The decimal notation, although long use has made it habitual, is by no means the most convenient for the calculations of arithmetic; it seems to have originated in no other cause than the habit of counting upon the fingers in the infancy of society; and although, from established habit, it would be proper in the ascending scale of weights and measures in ordinary use, and in the descending scale in scientific inquiry, is not applicable to the divisions of the unit in traffic. For this last purpose, a system admitting of binary division is alone fitted; and with this the duodecimal division of the foot is sufficiently agreeable; while it is found in the full extent in the customary divisions of the yard, the avoirdupois pound, and the bushel. Warned, therefore, by the example of the French, we should attempt no change of names, or new methods of division, for the several units of length, weight, and capacity; while, on the other hand, we learn that slight modifications of the magnitudes of either of these, that will render them

more consistent with each other, and with a standard existing in nature, if such be attainable, are perfectly possible.

(2.) It is a well-known and established physical fact, that the pendulum vibrating seconds of mean time in any given place, is invariable in length. That is to say, that if made of a substance susceptible of variation in length with changes of temperature, the variation of its length will be attended with corresponding variations in the time of its oscillations; while, if so constructed as to remain invariable in length, the duration of its vibration in very small circular arcs, and in an atmosphere of unvarying pressure, will be constant: and although no experimental pendulum is invariable in length under differing temperatures, nor the pressure of the atmosphere constant, yet these two circumstances may be abstracted from, by means of corrections deduced from accurate experiments on the law of expansion by heat, and on the buoyancy of the atmosphere. The length of the seconds pendulum varies with the change of latitude, according to a regular and well-known law; and it has lately been shown to be affected by local circumstances. Still, however, the length of the seconds pendulum in a given position, when corrected for changes of temperature, and atmospheric pressure for the magnitude of its arc of vibration, and reduced to the level of the sea, is a standard, determinate and invariable in its dimension, that does exist in nature: it is also determinable, without any great difficulty, by persons furnished with the proper instruments, and possessed of the requisite scientific knowledge. For the best methods of determining the length of the pendulum, the world is indebted to Borda and Kater; and the method of the last is more especially remarkable as one of those brilliant discoveries that mark eras in science, and confer immortality on their inventors. The pendulum then should be recognised in the revised laws as the instrument whereby the standards may be restored, if lost; and with whose dimensions they are to be at present compared, by way of making them comparable with the measures of foreign nations. In confirmation of this opinion, I may urge the examples of the French, the Danish, and the British governments, and that, still more recent, of Sweden.

(3.) As to the mode of determining the unit of length in relation to the standard existing in nature, and of deducing thence the standard of weight, and of measures of capacity:—

I shall assume that the unit of lineal dimension that will be adopted by the State, is the yard in common use on the day of the declaration of independence, as prescribed in the law of 1784. This was, no doubt, identical with the British parliamentary yard made in 1760. It luckily so happens, that we possess the measure of the seconds pendulum made in the buildings of this institution in reference to that very standard, and consequently the

means of making a yard that shall be identical with the yard of the Revolution. For this purpose it will be sufficient that the law should recognise that the standard yard shall bear a certain proportion to that measure of the pendulum. When the necessary experiments shall have been made to determine the true length of this yard, its extremities should be marked upon disks of an imperishable material, (gold or platinum, for instance,) inserted at a proper distance in a bar of brass, or rather of a more durable alloy of copper than what, in ordinary language, is called by that name. The distance between the two extremities of a bar is inadmissible in a standard, in consequence of the alteration in length that is caused by wear, as known in practice in the history of the yard preserved in the British Exchequer.

Such a bar will be subject to dilatation and contraction by heat and cold; but the temperature at which its length is compared with the pendulum should be given, and when it is to be compared with, or its length transferred to, bars of the same material, as both will be equally affected, no legal enactment is in this case requisite; but as measures in ordinary use are most frequently of other materials, it will be necessary that the temperature at which such comparisons must be made, or to which they must be reduced by calculation, should be strictly specified. It would be proper to seek for this purpose a temperature, independent of the indications of instruments that, in the improvement of science, may become obsolete, and constant in all varieties of physical circumstances. Such a temperature is marked in nature while the process of liquefaction is going on, or what is commonly called the freezing point of water. This, therefore, should be declared, in the new law, to be the temperature at which such comparisons should be made, or to which they should be reduced.

The extension in length of the unit of lineal dimension will furnish the elements of measures of a larger size; its square, or that of one of its multiples, will be the unit of superficial measure, and its cube of solid.

To determine the unit of weight, it will be necessary to have recourse to some fluid that can at all times, and under all circumstances, be obtained pure and homogeneous. Distilled water is a fluid of this nature, and the law should declare that the weight of a certain bulk of it shall be equal to a certain defined proportion, or multiple, of the unit of weight. To make this declaration specific, the circumstances under which the comparison is to be made, must be declared in the law; for water, like all other substances, will be of different weights under equal bulks, at different temperatures; and its apparent weight will be affected by the varying pressure of the atmosphere, as well as that of the weights employed, while their absolute gravity is that they would possess *in vacuo*. There appears at first sight to be a practical difficulty in this determination, in consequence of its being almost

impossible to ascertain with the necessary precision the interior dimensions of a vessel; but we have a remedy in the well-known physical fact, that a solid body loses, when weighed in a liquid, a portion of its weight of an equal bulk of the liquid; and the exterior dimensions of a regular solid are determinable within the requisite limits. But this experiment will be affected by the caloric expansion of the substance employed, and by the buoyancy of the air affecting its absolute weight. The law then must not only express the absolute weight (in vacuo) of a certain bulk of water in terms of the standard of weight, but must describe the temperature of the water, and the substance of which the weights and the experimental solid are to be made. It so happens, that in this case also we have a temperature, or rather a state of water, defined by a physical fact independent of instruments or extrinsic causes. Water does not follow the general rule of contraction; contracting to a certain limit, it again expands while cooling for several degrees above its freezing point. This fluid, therefore, has a maximum of density, and varies so slowly in bulk on each side of this maximum, as to afford room for the greatest accuracy of experiment.

Two methods exist of defining the magnitude of measures of capacity. The first and most obvious would be to prescribe the cubical dimensions of the unit in terms of the unit of length; but this is liable to the objection already stated, viz., the great difficulty of ascertaining with accuracy the internal dimensions of a vessel; the second consists in prescribing the weight of water that the measure shall hold, and this is in all respects preferable, but especially so from the very great ease with which the determination can be made. Here also it will be necessary to declare the atmospheric pressure and temperature at which the experiment shall be made, and this may be simply done by enacting that the water shall be at its maximum density, and pressure of the atmosphere at a mean.

(4.) The law of the province of New York of 1703, the act of 1784, and the revised law of 1813, recognise two standards of weight, without prescribing their relation to each other. Of these, the troy pound has long ceased to be used in any purely mercantile transaction, except in the retail trade of the apothecary; gold and silver are indeed also weighed by the troy pound; the former object is of very trifling importance, and the latter being governed by the practice of the mint of the United States, may be considered as a subject on which the national government has virtually legislated, and on which it would be improper for the state government to act. No other unit of weight then should be retained but the avoirdupois pound; and as the quintal of 112lbs. has been abolished in practice, no other denomination of that species of weight, except the usual binary subdivisions of the pound.

Did the original law of 1703, or the act of 1784, authorize two different units for liquid and dry measures of capacity, I should recommend the abolition of one of them as useless, and particularly from the confusion that arises from two different magnitudes being called by the same name. But it appears evident from the law of 1784, that but one measure is contemplated for both objects. The introduction of the British wine gallon is, therefore, unwarranted by the law of 1703, by the ancient practice of the province, or by the law of 1784, and has probably crept into the revised law of 1813, in consequence of its being used in the Customs of the United States: it is, therefore, consistent with the ancient law to prescribe but one standard for measures of capacity; but it might be expedient to permit the retail of articles paying duties to the United States in measures derived from the offices of the several surveyors of the Customs.

(5.) The act of 1784 adopts, as the standards of the state, certain weights and measures in the custody of William Hardenbrook, the sealer of the city and county of New York; and directs that he shall deliver them to the clerk of the city, in the presence of the mayor, recorder, and one or more aldermen, declaring upon oath that they are the identical articles received by him from the British exchequer. The importance of the object justified the solemnity of the manner pointed out for the transfer of these ancient and venerable standards of the province to the custody of the authorities of the state. But no corresponding means of preserving them were pointed out, and it is to be believed that they are no longer in existence; for a law of the 24th of March, 1809, adopts as the standard yard a brass measure, procured by the corporation of New York, in 1803, from the British exchequer; the liquid measures of capacity in the custody of the Secretary of State bear date in 1822, (at least nine years later than any existing law,) and the standards of dry measure are dated 1804. Now, as it has been found that the yard, purporting to be a copy of that described in the law of 1809, and deposited in the Street-commissioner's office, in this city, is shorter than the usual English yard of the beginning of the present century, which was itself shorter than the standard, as examined in 1760, and perpetuated by the celebrated *Bird*, and as we know of no adequate means employed in 1804 and 1822 to determine the truth of the new measures of capacity, I conceive I am warranted in stating that the original standards of weight and measure of this State, as they existed on the day of the declaration of its Independence, have been lost; and the present is one of those junctures that call for scientific investigations to recover such of the ancient denominations as it may be expedient to restore identically, and to deduce from them the others in the most unexceptionable manner. With a view to this object, I have already stated that I consider the parliamentary standard of 1760, as unquestionably identical

with the standard of our state as it existed at the Revolution, and that the experiments of Sabine, in Columbia College, have provided the facility, within our own state, of restoring the yard to its original magnitude. After the experiment shall have been made in this building, the measure should be transferred to some proper public edifice, the site at least of which may, in all succeeding ages, be resorted to, in order to confirm, or restore to their primitive dimension, existing weights and measures.

If, however, it should be preferred that the yard at present in the office of the Secretary of State should be the standard, it will be essential, in order to perpetuate it, to make similar experiments of comparison with the pendulum, one set of which should be made in this institution, as in this way alone its ratio to foreign measures (particularly to those of England) can be obtained. But I conceive this plan to be objectionable in several points of view, particularly as more difficult and expensive, and as adopting for a standard a measure whose authority is at least questionable. It would also prevent any positive legislation on the subject until after the experiments shall be made. The English avoirdupois pound, as a separate standard, appears to have been lost. So long since as 1798, Sir George Shuckburgh could find none in the public offices that could be considered as authentic,\* and it has, therefore, been customary in England to deduce it from the troy pound, on the principle that it was equal to 7000 grs., of which the troy pound contained 5760. The experiments of Graham, in 1743, on weights of 15lbs., made the avoirdupois pound of which, at that time, authentic standards still remained, equal to 6998.5 grs. troy, while on the comparison of the single pound it was equal to 7004 grs.† The avoirdupois pound might, therefore, be fairly taken at 7000 grs. troy. But this is evidently of the customary weight as usually employed, and not of the pound discovered by Kater, in the custody of the clerk of the British House of Commons. Of the customary weight used in the mints of this country and England, the weight of Sir George Shuckburgh made by the celebrated Troughton may be considered as the most authentic specimen. Assuming the true magnitude of the avoirdupois pound to be 7000 grs. troy, the weight of a cubic foot of water, as calculated from the experiments of Shuckburgh, at its maximum of density, and weighed with brass weights, is 999 ounces and  $\frac{67}{100}$ , the measure of the experimental solid being performed upon a scale, whose standard temperature is 62° of Fahrenheit‡. The experiments of Shuckburgh have been recently repeated by Kater,¶ and from these I have calculated the weight of a cubic foot of water at its maximum of density to be  $999\frac{32}{100}$

\* Philosophical Transactions Abridged, vol. xviii.

† Philosophical Transactions Abridged, vol. xviii.

‡ Young's Natural Philosophy, vol. ii.

¶ Third Report to the British Parliament on weights and measures. Philosophical Transactions for 1821.

ounces, assuming the measure of the experimental solid to be made on a scale whose standard temperature is the melting point of ice: no danger then need be apprehended in taking the weight of a cubic foot of water at 1000 ounces avoirdupois, and prescribing that the legal weight shall be such as will give that determination.

The discrepancy between this and the present received weights (if accurate transcripts of the former British standards) will not exceed three-tenths of an ounce in a hundred pounds, a quantity absolutely insensible in the course of traffic, less than the difference in the current standards of the avoirdupois pound, in 1743, and far less than the amount of discrepancy discovered in the several States of the Union, as detailed in the able report of Mr. Adams.

For the unit of measures of capacity, I would propose the adoption of the gallon. It is sufficiently large to prevent any chance of error in the determination of the most usual denomination of dry measure (the bushel,) and it is itself the customary unit of liquid.

We shall now proceed to consider what ought to be the size of this unit. The Act of Parliament, of 13th William III. cap. 5. prescribes that the standard bushel shall contain 2150 inches. But among the standards preserved in the British Exchequer, for the bushel and its several parts, considerable discrepancies exist, and it would be difficult to determine from which of these the bushel of the Revolution was derived. Their several magnitudes are as follows:—

<i>Bushel.</i>	<i>Gallon.</i>
2215.2	276.9
2234.4	279.3
2163.2	274.4
2128.9	266.1
<hr/> Mean 2185.4	<hr/> 272.5

Still greater discrepancies exist in the usual bushels of different parts of the United States, which vary in the two extremes from 1925 to 2358.6 inches, (giving the gallon the two dimensions of 241.25 and 294.8,) as stated in the report of Mr. Adams.

Instead, however, of prescribing the cubic contents of measures of capacity, it would, as has been already explained, be much better to determine their magnitude by declaring the number of pounds of distilled water at the maximum density and mean pressure of the atmosphere that the unit should contain. If this weight be taken at 80 lbs., the bushel will be 2214.36 cubic inches, and the gallon 276.8. These dimensions differ less from the standard now adopted in England of 2217.6 and 277.2 than either of the above dimensions do from each other.

This method has a great advantage over that of actual measurement, inasmuch as the weight can be determined with suffi-



cient accuracy, wherever good balances and just weights are to be had : while, to determine the cubic contents of a vessel is one of the most difficult operations of practical geometry, and is liable to such uncertainty, that in all recent investigations into the magnitude of measures, their weight when filled with distilled water has been resorted to in preference as the surest criterion.

It might, in this stage of the discussion, be asked, Why propose a system founded upon principles and facts requiring so much accuracy of determination and knowledge of science ? And, Why not have recourse to England at once, and obtain thence their new standards ?

To the first of these it may be replied, that the practical adjustment of weights and measures is always liable to certain errors ; that these, in the lapse of years, where no checks are provided, would reach such an extent as wholly to obliterate the recollection of the original standards. The more strict then the provisions of the law, in respect to accuracy, the less will be the danger of error, from the discouragement it will give to rude and inartificial methods of comparison ; and the more scientific the means of recovery and examination that are pointed out, the greater will be the certainty of perpetuating, or restoring, the standard in after-ages. As to a recurrence to England, a variety of reasons would oppose it, each of them valid and sufficient in itself : a proper feeling of national pride would forbid our asking aid of a foreign country, in a matter for which our own artists and men of science are competent. Economy also forbids it, as standards identical with those of the British government could only be obtained by sending out a competent person to superintend their construction, and compare them strictly with the originals. The articles vended in trade as accurate measures are not to be depended upon implicitly, and, however suitable to commerce, would be unfit for a national object ; moreover, there are certain inaccuracies in the English law itself, which I cannot but believe must ere long require its revision in that country, and we should in that event obtain and bring into use a system differing from that which now exists among us, with every probability that it could not be permanent. Neither is it likely that any agent of our State, however fully authorized and accredited, could obtain all the necessary facilities.

The errors I allude to in the English law, which will be fatal to its own permanence, are—that the comparison with the pendulum which is used to define the unit of lineal dimension has been made in a private house, which cannot be reasonably considered as accessible for public purposes ; that the length there determined has been assumed to be the universal length in the same parallel of latitude, while it has been conclusively proved that this length is influenced by local causes, a fact, that although not then absolutely demonstrated, was so far foreseen by the French commis-

sion, that they define, as the means of restoring the metrical system, if lost or impaired, not the pendulum of the latitude of Paris, but that of a specific place, the national observatory in that city ; that the unit of weight (one nearly abandoned in this country) is derived from an experiment that requires a legal enactment to define and perpetuate an arbitrary thermometric scale, instead of taking, as is here proposed, a temperature defined by a physical fact, or law of nature, unsusceptible of modification or mistake under any circumstances ; that the bulk of the water whose weight is given (a cubic inch) is much too small for accuracy ; and that the unit of measures of capacity is deduced from that of weight, upon principles equally objectionable with those on which the latter is derived from the lineal measure. In addition, it is to be remarked, that the direct comparison and transfer of measures of length is hardly susceptible of accuracy equal to that obtained by means of the pendulum ; that the system proposed, looking for its era to the date of the declaration of the independence of our State, would be exclusively and pre-eminently American. Another strong and important argument may be used : the city of New York possesses artists adequate to the construction of almost every part of the necessary apparatus ; their skill and talent are now devoted to objects of inferior importance, that neither enhance their reputation nor add to the mechanical credit of the country : let them be employed upon an object of national, nay, universal, interest, and the name they will acquire will probably create a branch of commerce in similar articles, that will add much to the wealth and resources of the State. The importance of this argument was well understood by the French government, and such was the success of the attempt, that it transferred to France, for the supply of its own demands, a branch of manufacture that had previously carried large sums to Great Britain, and struck the first blow to the hitherto pre-eminent reputation of the articles of that country.

(6.) From what has already been stated, it will appear that I am not of opinion that the pendulum of lat.  $45^{\circ}$ , the northern boundary of our state, could be advantageously used, either as the unit of lineal measure, or as the standard existing in nature whence the unit of lineal measure is to be derived, and with it all other measures.

This, however, is a subject on which I venture to speak not without some hesitation ; the authority of Mr. Jefferson is so high, both as a man of science and a statesman, that I do not differ from him without a feeling of extreme diffidence. Still, however, being satisfied that in the present state of knowledge, he would have concurred with me, and that the difference is one, not of opinion, but of existing facts, I do venture to differ from his views, stated as long ago as 1790.

I do not conceive that the pendulum of that latitude is to be

preferred before that of any other as a standard existing in nature, while, as the absolute unit of length, it must be rejected upon the ground of the impossibility of introducing it, in consequence of its discrepancy, and that of all its derivatives from the habitual measures of the country. The latitude of  $45^{\circ}$  appearing at the first view as the mean between that of the Equator and the Pole, might have been thought peculiarly advantageous. On this head it is to be observed, that it is a matter of question at the present moment between the governments of the United States and Great Britain, what this lat. of  $45^{\circ}$  is; are we to take for it the latitude determined by Astronomic observation at the surface of the earth, or the latitude corrected for ellipticity which is known by the appropriate name of Geocentric? And in connexion with the present subject, a third view of the question arises, for neither of these is distant from the Equator, the half of the itinerary distance between that circle and the Pole, but the point of bisection falls between them; which, then, of these three positions are we to choose for our experiments, particularly when the two best adapted, and between which the choice would most reasonably appear to fluctuate, are actually within the limits of possession of another nation? It is, besides, to be remarked, as has been before stated, that it is now well known that the length of the seconds pendulum does not depend upon the latitude merely, but is affected by the geological and mineral structure of the place where the experiment is performed, and its vicinity\*. Neither is the pendulum of  $45^{\circ}$ , even were the earth a sphere and the density of its surface uniform, the mean pendulum, for that would be found in the latitude of  $35^{\circ} 16'$ . For these reasons I cannot see any important advantage to be gained from naming the pendulum of  $45^{\circ}$  in the revision of the statutes relating to this subject.

For all immediate purposes, the inference drawn from the experiments of Sabine in this institution may be received as sufficient, and the liberal spirit of the trustees guarantees that the place of experiment will be accessible for the purpose of the first investigations, and the construction of the standards to be deposited in the proper public office. But it cannot be too strongly urged, that this measure should be transferred to a building, the property of the state, as early as possible, and that in it the instruments and documents connected with this investigation should be deposited. For this purpose, a location near the present seat of government, or perhaps one more central, in relation to the ultimate population of the state, should be chosen; and a preliminary law should provide for this important object.

(7.) The legislative provisions necessary to attain the objects of a well-regulated system of measures, and its recovery, in case of loss, would be most advantageously comprised in two different

\* Sabine. Experiments on the Pendulum.

acts; one to become a permanent part of the revised laws—the other to be preliminary and temporary. The provisions of the first should be:—

1. That there shall be but one standard of measure of length and surface, one of weight, and one of measures of capacity, in this state.

2. That the unit of lineal measure shall be the yard, as used in this State at the date of the declaration of its independence, and that for its more precise definition, and in order to its recovery in case of loss, it is declared (until the measure of the pendulum shall be transferred to some appropriate public building), that the said yard has been found, by experiments made with a pendulum, with a brass rod, at Columbia College, New York, in the latitude of  $40^{\circ} 42' 43''$ , to bear to the pendulum of that place vibrating seconds in vacuo, and at the level of the sea, at the temperature of melting ice, the proportion of one million (1,000,000) to one million, eighty-six thousand, one hundred, and fifty-eight (1,086,158).\* That the yard shall be divided into three equal parts, called feet, and each foot into twelve equal parts, called inches, and shall be measured between two points, engraven upon golden disks, inserted into a brass rod.

This yard will be identical with that adopted in England, each being taken at its standard temperature, according to the principle of comparison pointed out by Wollaston, and used by Kater in his experiments on the measures of France. I am not fully satisfied that this principle is correct, being rather inclined to think that measures should be compared at a common temperature; but it is that which is now received in practice, and has, besides, certain conveniences as applied to this subject, in keeping the proposed system of weight and measures of capacity more near in magnitude to those received in England.

3. That the unit of weight shall be the pound of such magnitude, that the weight of a cubic foot of distilled water at its maximum density, weighed in vacuo with brass weights, shall be sixty-two and a half ( $62\frac{1}{2}$ ) pounds, that the pound shall be divided into sixteen equal parts, called ounces, of which parts the cubic foot of distilled water, under the same circumstances, shall weigh one thousand (1000) ounces.

4. The unit of measures of capacity, whether dry or liquid, shall be the gallon, which shall be a vessel of such capacity as to contain at the mean pressure of the atmosphere at the level of the sea, ten pounds of distilled water at its maximum density; that all other measures of capacity shall be deduced from the gallon by continual multiplication or division by the number 2, being in the descending scale, half-gallons, quarts, pints, half-pints, and gills; and in the ascending scale, pecks, half-bushels, and bushels. And that, for greater precision, the last, or measure of eight gal-

\* The length of the said pendulum is 39.10158 inches.

lons, shall contain at the mean pressure of the atmosphere at the level of the sea, eighty pounds of distilled water at its maximum of density.

(To be continued.)

## AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1833.

*With Remarks and Exemplifications, by the Editor.*

1. For a *Socket for Holding Awls and other Tools*; Herrick Aikin, Dracut, Middlesex county, Massachusetts, December 16.

This invention has undoubtedly received the sanction of ages, although the experience of practical workmen has not induced them to adopt it. A common awl handle has a ferule at the end, with a socket to receive the shank of an awl. This is the whole affair, and if the patentee had examined the *tool chests* which are prepared in Europe for the use of *gentlemen*, he would have seen, like many others, that he had been anticipated in his *discovery*. We could cite, also, two or three domestic patents for socket awl handles, but, so far as we can recollect, these had about them some new nicnackery which gave to them some claim to novelty, if not to utility. A workman always finds it better to lay out a penny for a handle to each awl, than to be obliged to change it from one to another.

2. For a *Machine for Tempering Clay*; Nathaniel Adams, Cornwall, Orange county, New York, December 16.

The tempering is to be effected by the usual mode of causing a wheel to revolve on a circular bed of clay; and the novelty, or supposed novelty, of the invention, is the construction of the wheel, and the causing it to roll upon the bed of clay, spirally, alternately approaching the vertical shaft in the centre, and the outside of the bed.

The wheel is to consist of several separate rims, with a space of an inch, or more, between each, the more perfectly to divide and temper the clay. In order to give it the spiral motion, the horizontal shaft, which is drawn round by the horse, is a square bar, having on it a sliding socket, which is round on the outside, that the wheel may revolve upon it. A toothed wheel on the vertical shaft in the centre, gives motion to a pinion which takes into a double rack, connected with the sliding socket, and moves the wheel in and out in the way required. This "contrivance, in combination with the wheel above described, constitutes the claim.

A machine very similar in its construction, and intended for the same purpose, was patented by Mr. O. W. Seely, of Wayne county, New York, on the 20th of July, 1831, and is described in vol. ix. p. 54. The revolving wheels, in that machine, were carried in and out by a screw upon the shaft, which was a more simple plan, and equally efficacious with the one now proposed: and each wheel in it was described as furnished with four rims, or sets of felloes.