and the carriage on them more expeditious. That from these advantages will result a great saving in the labor of men and horses, as well as in the expenses of the traveller.

Your petitioner also conceives that the introduction of a complete steam engine, formed upon the newest and best principles, into such a country as America, where labor is high, would entitle him to public countenance and encouragement, independent of its use in navigation. He begs leave to acquaint the honorable House, that the great length of time and vast sum of money expended in bringing the scheme to perfection, have been wholly occasioned by his total ignorance of the improved state of steam engines, a perfect knowledge of which has not been acquired without an infinite number of fruitless experiments; for not a person could be found who was acquainted with the minutiæ of Bolton & Watt's new engine; and whether your petitioner's engine is similar or not to those in England he is to this moment totally ignorant, but is happy to inform Congress that he is now able to make a complete steam engine, which, in its effects, he believes is equal to the best in Europe; the construction of which he has never kept a secret. That, on his first undertaking the scheme, he knew there were a great variety of modes of applying the power of steam to the propelling of boats through the water, perhaps all equally effective; but this formed no part of his consideration, knowing that, if he could bring his steam engine to work in a boat, he would be under no difficulty in applying its force; therefore he trusts no interference with him in *propelling boats by the power of steam, under any pretence of a different mode of application*, will be permitted; for, should that be the case, the employment of his time and the amazing expense attending the perfecting his scheme, would, whilst they gave to the world at large a valuable discovery, and to America peculiar and important advantages, eventuate in the total ruin of your petitioner; for a thousand different modes may be applied by subsequent navigators, all of them benefiting by the expense and persevering labor of your petitioner, and thus sharing with him those profits which they never earned; such a consequence he is confident will not be permitted by that body whom he has now the honor to address.

Your petitioner, therefore, prays that your honorable House will take the subject of his petition into consideration, and, by granting him an exclusive right to the use of steam to navigation in the United States for a limited time, do him that justice which he conceives he merits, and which he trusts will redound to the honor and add to the true interests of America.

Your petitioner begs leave to refer the honorable House to the 31st act of the 10th of William the Third, to show that the Parliament of Great Britain, notwithstanding their existing patent law, have granted special acts for particular valuable discoveries, without confining the grantee to any *specified mode*. This act is entitled "An act for the encouragement of a new invention, by Thomas Savory, for raising water and *occasioning motion to all sorts* of mill work *by the impellant force of fire*."

Bolton & Watt having taken out a patent for their improvement in steam engines, wasted several years (as your petitioner has done) in experiments, and then Parliament, by act of George III., 1775, granted a prolongation.—(See Doctor Price on Mining, page 313, folio.)

Sir Thomas Lombe had a patent for his famous silk mill, obtained from Italy, and erected at Derby, in England, in 1734; after which Parliament granted not only a prolongation of fourteen years, but a sum of £14,000 sterling, in consideration of the very great hazard he ran and the expense he had incurred by introducing it into England.—(See England Illustrated, vol. 1, page 152, quarto.)

The foregoing precedents your petitioner conceives sufficient to justify his application to Congress for a law in his favor, independent of the general one now in force. All which he prays they will take into their serious consideration, and afford him such relief as they, in their wisdom, shall deem expedient.

And your petitioner, as in duty bound, will ever pray.

JOHN FITCH.

1st Congress.] **No. 15.** [2d Session.

PLAN FOR ESTABLISHING UNIFORMITY IN THE COINAGE, WEIGHTS, AND MEASURES, OF THE UNITED STATES.

COMMUNICATED TO THE HOUSE OF REPRESENTATIVES, JULY 13, 1790.

SIR: NEW YORK, *July* 4, 1790.

In obedience to the order of the House of Representatives of January 15th, I have now the honor to enclose you a report on the subject of measures, weights, and coins. The length of time which intervened between the date of the order and my arrival in this city, prevented my receiving it till the 15th of April; and an illness which followed soon after added, unavoidably, some weeks to the delay; so that it was not till about the 20th May that I was able to finish the report. A desire to lessen the number of its imperfections induced me still to withhold it awhile, till, on the 15th of June, came to my hands, from Paris, a printed copy of a proposition made by the Bishop of Autun, to the National Assembly of France, on the subject of weights and measures; and three days afterwards I received, through the channel of the public papers, the speech of Sir John Riggs Miller, of April 13th, in the British House of Commons, on the same subject. In the report which I had prepared, and was then about to give in, I had proposed the latitude of 38°, as that which should fix our standard, because it was the medium latitude of the United States; but the proposition before the National Assembly of France, to take that of 45° as being a middle term between the equator and both poles, and a term which might consequently unite the nations of both hemispheres, appeared to me so well chosen, and so just, that I did not hesitate a moment to prefer it to that of 38°. It became necessary, of course, to conform all my calculations to that standard—an operation which has been retarded by my other occupations.

These circumstances will, I hope, apologize for the delay which has attended the execution of the order of the House; and, perhaps, a disposition on their part to have due regard for the proceedings of other nations, engaged on the same subject, may induce them still to defer deciding ultimately on it till their next session. Should this

be the case, and should any new matter occur in the mean time, I shall think it my duty to communicate it to the House, as supplemental to the present report.

I have the honor to be, with sentiments of the most profound respect,

Sir, your most obedient and most humble servant,

THOMAS JEFFERSON.

The SPEAKER *of the House of Representatives.*

The SECRETARY OF STATE, to whom was referred, by the House of Representatives, to prepare and report a proper plan or plans for establishing uniformity in the currency, weights, and measures of the United States, in obedience thereto, makes the following report:

To obtain uniformity in measures, weights, and coins, it is necessary to find some measure of invariable length, with which, as a standard, they may be compared.

There exists not in nature, as far as has been hitherto observed, a single subject or species of subject, accessible to man, which presents one constant and uniform dimension.

The globe of the earth itself, indeed, might be considered as invariable in all its dimensions, and that its circumference would furnish an invariable measure; but no one of its circles, great or small, is accessible to admeasurement through all its parts, and the various trials to measure definite portions of them have been of such various result as to show there is no dependence on that operation for certainty.

Matter, then, by its mere extension, furnishing nothing invariable, its motion is the only remaining resource.

The motion of the earth round its axis, though not absolutely uniform and invariable, may be considered as such for every human purpose. It is measured obviously, but unequally, by the departure of a given meridian from the sun, and its return to it, constituting a solar day. Throwing together the inequalities of solar days, a mean interval, or day, has been found, and divided, by very general consent, into 86,400 equal parts.

A pendulum, vibrating freely, in small and equal arcs, may be so adjusted in its length, as, by its vibrations, to make this division of the earth's motion into 86,400 equal parts, called seconds of mean time.

Such a pendulum, then, becomes itself a measure of determinate length, to which all others may be referred as to a standard.

But even the pendulum is not without its uncertainties.

1. The difficulty of ascertaining, in practice, its centre of oscillation, as depending on the form of the bob, and its distance from the point of suspension; the effect of the weight of the suspending wire towards displacing the centre of oscillation; that centre being seated within the body of the bob, and therefore inaccessible to the measure, are sources of considerable uncertainty.

2. Both theory and experience prove that, to preserve its isochronism, it must be shorter towards the equator, and longer towards the poles.

3. The height of the situation above the common level, as being an increment to the radius of the earth, diminishes the length of the pendulum.

4. The pendulum being made of metal, as is best, it varies its length with the variations in the temperature of the atmosphere.

5. To continue small and equal vibrations, through a sufficient length of time, and to count these vibrations, machinery and a power are necessary, which may exert a small but constant effort to renew the waste of motion; and the difficulty is so to apply these, as that they shall neither retard nor accelerate the vibrations.

1. In order to avoid the uncertainties which respect the centre of oscillation, it has been proposed by Mr. Leslie, an ingenious artist of Philadelphia, to substitute, for the pendulum, a uniform cylindrical rod, without a bob.

Could the diameter of such a rod be infinitely small, the centre of oscillation would be exactly at two-thirds of the whole length, measured from the point of suspension. Giving it a diameter which shall render it sufficiently inflexible, the centre will be displaced, indeed; but, in a second rod not the (1) six hundred thousandth part of its length, and not the hundredth part as much as in a second pendulum with a spherical bob of proper diameter. This displacement is so infinitely minute, then, that we may consider the centre of oscillation, for all practical purposes, as residing at two-thirds of the length from the centre of suspension. The distance between these two centres might be easily and accurately ascertained in practice. But the whole rod is better for a standard than any portion of it, because sensibly defined at both its extremities.

2. The uncertainty arising from the difference of length requisite for the second pendulum, or the second rod, in different latitudes, may be avoided by fixing on some one latitude, to which our standard shall refer. That of 38°, as being the middle latitude of the United States, might seem the most convenient, were we to consider ourselves alone; but connected with other nations by commerce and science, it is better to fix on that parallel which bids fairest to be adopted by them also. The 45th, as being the middle term between the equator and pole, has been heretofore proposed in Europe, and the proposition has been lately renewed there under circumstances which may very possibly give it some effect. This parallel is distinguished with us also as forming our principal northern boundary. Let the completion of the 45th degree, then, give the standard for our union, with the hope that it may become a line of union with the rest of the world.

The difference between the second rod for 45° of latitude, and that for 31°, our other extreme, is to be examined.

The second *pendulum* for 45° of latitude, according to Sir Isaac Newton's computation, must be of (2) 39.14912 inches English measure; and a *rod*, to vibrate in the same time, must be of the same length between the centres of suspension and oscillation; and, consequently, its whole length 58.7 (or, more exactly, 58.72368) inches. This is longer than the rod which shall vibrate seconds in 31° of latitude, by about $\frac{1}{679}$ part of its whole length; a difference so minute, that it might be neglected, as insensible, for the common purposes of life, but, in cases requiring perfect exactness, the second rod, found by trial of its vibrations in any part of the United States, may be corrected by computation for the (3) latitude of the place, and so brought exactly to the standard of 45°.

3. By making the experiment in the level of the ocean, the difference will be avoided, which a higher position might occasion.

4. The expansion and contraction of the rod with the change of temperature, is the fourth source of uncertainty before mentioned. According to the high authority, so often quoted, an iron rod, of given length, may vary, between summer and winter, in temperate latitudes, and in the common exposure of house clocks, from $\frac{1}{1728}$ to $\frac{1}{2592}$ of its whole length, which, in a rod of 58.7 inches, will be from about two to three hundredths of

an inch. This may be avoided by adjusting and preserving the standard in a cellar, or other place, the temperature of which never varies. Iron is named for this purpose, because the least expansible of the metals.

5. The practical difficulty resulting from the effect of the machinery and moving power is very inconsiderable in the present state of the arts; and, in their progress towards perfection, will become less and less. To estimate and obviate this, will be the artist's province. It is as nothing when compared with the sources of inaccuracy hitherto attending measures.

Before quitting the subject of the inconveniences, some of which attend the pendulum alone, others both the pendulum and rod, it must be added that the rod would have an accidental but very precious advantage over the pendulum in this country, in the event of our fixing the foot at the nearest aliquot part of either; for the difference between the common foot, and those so to be deduced, would be three times greater in the case of the pendulum than in that of the rod.

Let the standard of measure, then, be a uniform cylindrical rod of iron, of such length, as, in latitude 45°, in the level of the ocean, and in a cellar, or other place, the temperature of which does not vary through the year, shall perform its vibrations, in small and equal arcs, in one second of mean time.

A standard of invariable length being thus obtained, we may proceed to identify, by that, the measures, weights, and coins of the United States: but here a doubt presents itself, as to the extent of the reformation meditated by the House of Representatives. The experiment made by Congress in the year one thousand seven hundred and eighty-six, by declaring that there should be one money of account and payment through the United States, and that its parts and multiples should be in a decimal ratio, has obtained such general approbation, both at home and abroad, that nothing seems wanting, but the actual coinage, to banish the discordant pounds, shillings, pence, and farthings of the different States, and to establish in their stead the new denominations. Is it in contemplation with the House of Representatives to extend a like improvement to our measures and weights, and to arrange them also in a decimal ratio? The facility which this would introduce into the vulgar arithmetic would, unquestionably, be soon and sensibly felt by the whole mass of the people, who would thereby be enabled to compute for themselves whatever they should have occasion to buy, to sell, or to measure, which the present complicated and difficult ratios place beyond their computation, for the most part. Or, is it the opinion of the Representatives that the difficulty of changing the established habits of a whole nation opposes an insuperable bar to this improvement? Under this uncertainty, the Secretary of State thinks it his duty to submit alternative plans, that the House may, at their will, adopt either the one or the other, exclusively, or the one for the present, and the other for a future time, when the public mind may be supposed to have become familiarized to it.

I.—And first, on the supposition that the present measures and weights are to be retained but to be rendered uniform and invariable, by bringing them to the same invariable standard.

The first settlers of these States, having come chiefly from England, brought with them the measures and weights of that country. These alone are generally established among us, either by law or usage; and these, therefore, are alone to be retained and fixed. We must resort to that country for information of what they are, or ought to be.

This rests, principally, on the evidence of certain standard measures and weights, which have been preserved, of long time, in different deposites. But differences among these having been known to exist, the House of Commons, in the years 1757 and 1758, appointed committees to inquire into the original standards of their weights and measures. These committees, assisted by able mathematicians and artists, examined and compared with each other the several standard measures and weights, and made reports on them in the years 1758 and 1759. The circumstances under which these reports were made entitle them to be considered, as far as they go, as the best written testimony existing of the standard measures and weights of England; and as such, they will be relied on in the progress of this report.

MEASURES OF LENGTH.

The measures of length in use among us, are:

The league of 3 miles,
The mile of 8 furlongs,
The furlong of 40 poles or perches,
The pole or perch of 5½ yards,
The fathom of 2 yards,
The ell of a yard and quarter,
The yard of 3 feet,
The foot of 12 inches, and
The inch of 10 lines.

On this branch of their subject, the committee of 1757–1758, says that the standard measures of length at the receipt of the exchequer, are a yard, supposed to be of the time of Henry VII, and a yard and ell supposed to have been made about the year 1601; that they are brass rods, very coarsely made, their divisions not exact, and the rods bent: and that in the year 1742, some members of the Royal Society had been at great pains in taking an exact measure of these standards, by very curious instruments, prepared by the ingenious Mr. Graham; that the Royal Society had had a brass rod made pursuant to their experiments, which was made so accurately, and by persons so skilful and exact, that it was thought not easy to obtain a more exact one; and the committee, in fact, found it to agree with the standards at the exchequer, as near as it was possible. They furnish no means, to persons at a distance, of knowing what this standard is. This, however, is supplied by the evidence of the second pendulum, which, according to the authority before quoted, is, at London, 39.1682 English inches, and, consequently, the second rod there is of 58.7523 of the same inches. When we shall have found, then, by actual trial, the second rod for 45° by adding the difference of their computed length, to wit, $\frac{287}{10000}$ of an inch, or rather $\frac{3}{10}$ of a line (which in practice will endanger less error, than an attempt at so minute a fraction as the ten thousandth parts of an inch) we shall have the second rod of London, or a true measure of 58¾ English inches. Or, to shorten the operation, without varying the result,

Let the standard rod of 45° be divided into 587½ equal parts, and let each of these parts be declared a line.

10 Lines an inch,
12 Inches a foot,
3 Feet a yard,
3 Feet 9 inches an ell,
6 Feet a fathom,
5½ Yards a perch or pole,
40 Poles or perches a furlong,
8 Furlongs a mile,
3 Miles a league.

SUPERFICIAL MEASURES.

Our measures of surface are, the acre of 4 roods, and the rood of 40 square poles; so established by a statute of 33 Edw. I. Let them remain the same.

MEASURES OF CAPACITY.

The measures of capacity in use among us, are of the following names and proportions:

The gill, four of which make a pint.
Two pints make a quart.
Two quarts a pottle.
Two pottles a gallon.
Two gallons a peck, dry measure.
Eight gallons make a measure called a firkin, in liquid substances, and a bushel, dry.
Two firkins, or bushels, make a measure called a rundlet or kilderkin, liquid, and a strike, dry.
Two kilderkins, or strikes, make a measure called a barrel, liquid, and a coomb, dry; this last term being ancient and little used.
Two barrels, or coombs, make a measure called a hogshead, liquid, or a quarter, dry; each being the quarter of a ton.
A hogshead and a third make a tierce, or third of a ton.
Two hogsheads make a pipe, butt, or puncheon; and
Two pipes make a ton.

But no one of these measures is of a determinate capacity. The report of the committee of 1757, -'8, shows that the gallon is of very various content; and that being the unit, all the others must vary with it.

The gallon and bushel contain—

224 and 1792 cubic inches, according to the standard wine gallon preserved at Guildhall.
231 and 1848, according to the statute of 5th of Anne.
264.8 and 2118.4, according to the ancient Rumford quart, of 1228, examined by the committee.
265.5 and 2124, according to three standard bushels preserved in the Exchequer, to wit, one of Henry VII., without a rim; one dated 1091, supposed for 1591, or 1601, and one dated 1601.
266.25 and 2130, according to the ancient Rumford gallon of 1228, examined by the committee.
268.75 and 2150, according to the Winchester bushel, as declared by statute 13, 14, William III. which has been the model for some of the grain states.
271, less 2 spoonfuls, and 2168, less 16 spoonfuls, according to a standard gallon of Henry VII., and another dated 1601, marked E. E., both in the Exchequer.
271 and 2168, according to a standard gallon in the Exchequer, dated 1601, marked E., and called the corn gallon.
272 and 2176, according to the three standard corn gallons last mentioned, as measured in 1688, by an artist for the Commissioners of the Excise, generally used in the seaport towns, and by mercantile people, and thence introduced into some of the grain states.
277.18 and 2217.44, as established for the measure of coal by the statute 12 Anne.
278 and 2224, according to the standard bushel of Henry VII. with a copper rim, in the Exchequer.
278.4 and 2227.2, according to two standard pints of 1601, and 1602, in the Exchequer.
280 and 2240, according to the standard quart of 1601, in the Exchequer.
282 and 2256, according to the standard gallon for beer and ale, in the Treasury.

There are, moreover, varieties on these varieties, from the barrel to the ton, inclusive: for, if the barrel be of herrings, it must contain 28 gallons by the statute 13 Eliz. c. 11. If of wine, it must contain 31½ gallons by the statute 2 Henry VI. c. 11. and 1 Rich. III. c. 15. If of beer or ale, it must contain 34 gallons by the statute 1 William and Mary, c. 24., and the higher measures in proportion.

In those of the United States which have not adopted the statutes of William and Mary, and of Anne before cited, nor their substance, the wine gallon of 231 cubic inches rests on the authority of very long usage, before the 5th of Anne, the origin and foundation of which are unknown; the bushel is the Winchester bushel, by the 11 Henry VII. undefined; and the barrel of ale 32 gallons, and of beer 36 gallons, by the statute 23 Henry VIII. c. 4.

The Secretary of State is not informed whether there have been any, and what, alterations of these measures, by the laws of the particular States.

It is proposed to retain this series of measures, but to fix the gallon to one determinate capacity, as the unit of measure, both wet and dry: for convenience is in favor of abolishing the distinction between wet and dry measures.

The wine gallon, whether of 224 or 231 cubic inches, may be altogether disregarded, as concerning, principally, the mercantile and the wealthy, the least numerous part of the society, and the most capable of reducing one measure to another by calculation. This gallon is little used among the mass of farmers, whose chief habits and interests are in the size of the corn bushel.

Of the standard measures before stated, two are principally distinguished in authority and practice. The statute bushel of 2150 cubic inches, which gives a gallon of 268.75 cubic inches, and the standard gallon of 1601, called the corn gallon of 271, or 272 cubic inches, which has introduced the mercantile bushel of 2176 inches. The former of these is most used in some of the grain States, the latter in others. The middle term of 270 cubic inches may be taken as a mutual compromise of convenience, and as offering this general advantage: that the bushel being of 2160 cubic inches, is exactly a cubic foot and a quarter, and so facilitates the conversion of wet and dry measures into solid contents and tonnage, and simplifies the connexion of measures and weights, as will be shown hereafter. It may be added, in favor of this, as a medium measure, that eight of the standard, or statute measures before enumerated, are below this term, and nine above it.

The measures to be made for use, being four-sided, with rectangular sides and bottom.
The pint will be 3 inches square, and 3¾ inches deep;
The quart 3 inches square, and 7½ inches deep;
The pottle 3 inches square, and 15 inches deep, or 4½, 5, and 6 inches;
The gallon 6 inches square, and 7½ inches deep, or 5, 6, and 9 inches;
The peck 6, 9, and 10 inches;
The half-bushel 12 inches square, and 7½ inches deep; and
The bushel 12 inches square, and 15 inches deep; or 9, 15, and 16 inches.

Cylindrical measures have the advantage of superior strength; but square ones have the greater advantage of enabling every one, who has a rule in his pocket, to verify their contents by measuring them. Moreover, till the circle can be squared, the cylinder cannot be cubed, nor its contents exactly expressed in figures.

Let the measures of capacity, then, for the United States be—

A gallon of 270 cubic inches;
The gallon to contain 2 pottles;
The pottle 2 quarts;
The quart 2 pints;
The pint 4 gills;
Two gallons to make a peck;
Eight gallons a bushel or firkin;
Two bushels, or firkin, a strike or kilderkin;
Two strikes, or kilderkins, a coomb or barrel;
Two coombs, or barrels, a quarter or hogshead;
A hogshead and a third one tierce;
Two hogsheads a pipe, butt, or puncheon; and
Two pipes a ton.

And let all measures of capacity of dry subjects be stricken with a straight strike.

WEIGHTS.

There are two series of weights in use among us; the one called avoirdupois, the other troy.

In the Avoirdupois series:

The pound is divided into 16 ounces;
The ounce into 16 drachms;
The drachm into 4 quarters.

In the Troy series:

The pound is divided into 12 ounces;
The ounce (according to the subdivision of the apothecaries) into 8 drachms;
The drachm into 3 scruples;
The scruple into 20 grains.

According to the subdivision for gold and silver, the ounce is divided into twenty pennyweights, and the pennyweight into twenty-four grains.

So that the pound troy contains 5760 grains, of which 7000 are requisite to make the pound avoirdupois; of course the weight of the pound troy is to that of the pound avoirdupois as 5760 to 7000, or as 144 to 175.

It is remarkable that this is exactly the proportion of the ancient liquid gallon of Guildhall of 224 cubic inches, to the corn gallon of 272; for 224 are to 272 as 144 to 175. (4.)

It is further remarkable still, that this is also the exact proportion between the specific weight of any measure of wheat, and of the same measure of water: for the statute bushel is of 64 pounds of wheat. Now as 144 to 175, so are 64 pounds to 77.7 pounds; but 77.7 pounds is known to be the weight of (5.) 2150.4 cubic inches of pure water, which is exactly the content of the Winchester bushel, as declared by the statute 13, 14, Will. 3. That statute determined the bushel to be a cylinder of 18½ inches diameter, and 8 inches depth. Such a cylinder, as nearly as it can be cubed, and expressed in figures, contains 2150.425 cubic inches; a result which reflects authority on the declaration of Parliament, and induces a favorable opinion of the care with which they investigated the contents of the ancient bushel, and also a belief that there might exist evidence of it at that day, unknown to the committees of 1758 and 1759.

We find, then, in a continued proportion 64 to 77.7 as 224 to 272, and as 144 to 175; that is to say, the specific weight of a measure of wheat, to that of the same measure of water, as the cubic contents of the wet gallon, to those of the dry; and as the weight of a pound troy to that of a pound avoirdupois.

This seems to have been so combined as to render it indifferent whether a thing were dealt out by weight or measure; for the dry gallon of wheat, and the liquid one of wine, were of the same weight; and the avoirdupois pound of wheat, and the troy pound of wine, were of the same measure. Water and the vinous liquors, which enter most into commerce, are so nearly of a weight, that the difference, in moderate quantities, would be neglected by both buyer and seller; some of the wines being a little heavier, and some a little lighter, than water.

Another remarkable correspondence is that between weights and measures. For 1000 ounces avoirdupois of pure water fill a cubic foot, with mathematical exactness.

What circumstances of the times, or purposes of barter or commerce, called for this combination of weights and measures, with the subjects to be exchanged or purchased, are not now to be ascertained. But a triple set of exact proportionals representing weights, measures, and the things to be weighed and measured, and a relation so integral between weights and solid measures, must have been the result of design and scientific calculation, and not a mere coincidence of hazard. It proves that the dry and wet measures, the heavy and light weights, must have been original parts of the system they compose—contrary to the opinion of the committee of 1757, 1758, who thought that the avoirdupois weight was not an ancient weight of the kingdom, nor ever even a legal weight, but during a single year of the reign of Henry VIII.; and, therefore, concluded, otherwise than will be here proposed, to suppress it altogether. Their opinion was founded chiefly on the silence of the laws as to this weight. But the harmony here developed in the system of weights and measures, of which the avoirdupois makes an essential member, corroborated by a general use, from very high antiquity, of that, or of a nearly similar weight under another (6.) name, seem stronger proofs that this is legal weight, than the mere silence of the written laws is of the contrary.

Be this as it may, it is in such general use with us, that, on the principle of popular convenience, its higher denominations, at least, must be preserved. It is by the avoirdupois pound and ounce that our citizens have been used to buy and sell. But the smaller subdivisions of drachms and quarters are not in use with them. On the other hand, they have been used to weigh their money and medicine with the pennyweights and grains troy weight, and are not in the habit of using the pounds and ounces of that series. It would be for their convenience, then, to suppress the pound and ounce troy, and the drachm and quarter avoirdupois; and to form into one series the avoirdupois pound and ounce, and the troy pennyweight and grain. The avoirdupois ounce contains 18 pennyweights 5½ grains troy weight. Divide it, then, into 18 pennyweights, and the pennyweight, as heretofore, into 24 grains, and the new pennyweight will contain between a third and a quarter of a grain more than the present troy pennyweight; or, more accurately, it will be to that as 875 to 864—a difference not to be noticed, either in money or medicine, below the denomination of an ounce.

But it will be necessary to refer these weights to a determinate mass of some substance, the specific gravity of which is invariable. Rain water is such a substance, and may be referred to every where, and through all time. It has been found by accurate experiments that a cubic foot of rain water weighs 1000 ounces avoirdupois, standard weights of the Exchequer. It is true that among these standard weights the committee report small variations; but this experiment must decide in favor of those particular weights, between which, and an integral mass of water, so remarkable a coincidence has been found. To render this standard more exact, the water should be weighed always in the same temperature of air; as heat, by increasing its volume, lessens its specific gravity. The cellar of uniform temperature is best for this also.

Let it, then, be established that an ounce is of the weight of a cube of rain water, of one-tenth of a foot; or, rather, that it is the thousandth part of the weight of a cubic foot of rain water, weighed in the standard temperature; that the series of weights of the United States shall consist of pounds, ounces, pennyweights, and grains; whereof

24 grains shall be one pennyweight;
18 pennyweights one ounce;
16 ounces one pound.

COINS.

Congress, in 1786, established the money unit at 375.64 troy grains of pure silver. It is proposed to enlarge this by about the third of a grain in weight, or a mill in value; that is to say, to establish it at 376 (or, more exactly, 375.989343) instead of 375.64 grains; because it will be shown that this, as the unit of coin, will link in system with the units of length, surface, capacity, and weight, whenever it shall be thought proper to extend the decimal ratio through all these branches. It is to preserve the possibility of doing this, that this very minute alteration is proposed.

We have this proportion, then, 875 to 864, as 375.989343 grains troy to 371.2626277; the expression of the unit in the new grains.

Let it be declared, therefore, that the money unit, or dollar of the United States, shall contain 371.262 American grains of pure silver.

If nothing more, then, is proposed, than to render uniform and stable the system we already possess, this may be effected on the plan herein detailed; the sum of which is: 1st, That the present measures of length be retained, and fixed by an invariable standard. 2d, That the measures of surface remain as they are, and be invariable also as the measures of length to which they are to refer. 3d, That the unit of capacity, now so equivocal, be settled at a medium and convenient term, and defined by the same invariable measures of length. 4th, That the more known terms in the two kinds of weights be retained, and reduced to one series, and that they be referred to a definite mass of some substance, the specific gravity of which never changes. And 5th, That the quantity of pure silver in the money unit be expressed in parts of the weights so defined.

In the whole of this no change is proposed, except an insensible one in the troy grain and pennyweight, and the very minute one in the money unit.

II. But if it be thought that, either now, or at any future time, the citizens of the United States may be induced to undertake a thorough reformation of their whole system of measures, weights and coins, reducing every branch to the same decimal ratio already established in their coins, and thus bringing the calculation of the principal affairs of life within the arithmetic of every man who can multiply and divide plain numbers, greater changes will be necessary.

The unit of measure is still that which must give law through the whole system; and from whatever unit we set out, the coincidences between the old and new ratios will be rare. All that can be done, will be to choose such a unit as will produce the most of these. In this respect the second rod has been found, on trial, to be far preferable to the second pendulum.

MEASURES OF LENGTH.

Let the second rod, then, as before described, be the standard of measure; and let it be divided into five equal parts, each of which shall be called a foot; for, perhaps, it may be better generally to retain the name of the nearest present measure, where there is one tolerably near. It will be about one quarter of an inch shorter than the present foot.

Let the foot be divided into 10 inches;
The inch into 10 lines;
The line into 10 points;
Let 10 feet make a decad;
10 decads one rood;
10 roods a furlong;
10 furlongs a mile.

SUPERFICIAL MEASURES.

Superficial measures have been estimated, and so may continue to be, in squares of the measures of length, except in the case of lands, which have been estimated by squares, called roods and acres. Let the rood be equal to a square, every side of which is 100 feet. This will be 6.483 English feet less than the English (7) rood every way, and 1311 square feet less in its whole contents; that is to say, about one-eighth; in which proportion, also, 4 roods will be less than the present acre.

MEASURES OF CAPACITY.

Let the unit of capacity be the cubic foot, to be called a bushel. It will contain 1620.05506862 cubic inches, English; be about one-fourth less than that before proposed to be adopted as a medium; one-tenth less than the bushel made from 8 of the Guildhall gallons; and one-fourteenth less than the bushel made from 8 Irish gallons of 217.6 cubic inches.

Let the bushel be divided into 10 pottles;
Each pottle into 10 demi-pints;
Each demi-pint into 10 metres, which will be of a cubic inch each.

Let 10 bushels be a quarter, and
10 quarters a last, or double ton.

The measures for use being four sided, and the sides and bottoms rectangular, the bushel will be a foot cube.

The pottle 5 inches square and four inches deep;
The demi-pint 2 inches square, and $2\frac{1}{2}$ inches deep;
The metre, an inch cube.

WEIGHTS.

Let the weight of a cubic inch of rain water, or the thousandth part of a cubic foot, be called an ounce; and let the ounce be divided into 10 double scruples:

The double scruple into 10 carats;
The carat into 10 minims or demi-grains;
The minim into 10 mites.

Let 10 ounces make a pound;
10 pounds a stone;
16 stones a kental;
10 kentals a hogshead.

COINS.

Let the money unit, or dollar, contain eleven-twelfths of an ounce of pure silver. This will be 376 troy grains, (or more exactly, 375.989343 troy grains,) which will be about a third of a grain, (or more exactly, .349343 of a grain, more than the present unit. This, with the twelfth of alloy already established, will make the dollar or unit, of the weight of an ounce, or of a cubic inch of rain water, exactly. The series of mills, cents, dimes, dollars, and eagles, to remain as already established (8.)

The second rod, or the second pendulum, expressed in the measures of other countries, will give the proportion between their measures and those of the United States.

Measures, weights and coins, thus referred to standards unchangeable in their nature, (as is the length of a rod vibrating seconds, and the weight of a definite mass of rain water,) will themselves be unchangeable. These standards, too, are such as to be accessible to all persons, in all times and places. The measures and weights derived from them fall in so nearly with some of those now in use, as to facilitate their introduction; and, being arranged in decimal ratio, they are within the calculation of every one who possesses the first elements of arithmetic, and of easy comparison, both for foreigners and citizens, with the measures, weights, and coins of other countries.

A gradual introduction would lessen the inconveniences which might attend too sudden a substitution, even of an easier for a more difficult system. After a given term, for instance, it might begin in the custom-houses, where the merchants would become familiarised to it. After a further term, it might be introduced into all legal proceedings, and merchants and traders in foreign commodities might be required to use it in their dealings with one another. After a still further term, all other descriptions of people might receive it into common use. Too long a postponement, on the other hand, would increase the difficulties of its reception with the increase of our population.

THOMAS JEFFERSON, *Secretary of State.*

Appendix, containing illustrations and developments of some passages of the preceding report.

(1.) In the second pendulum with a spherical bob, call the distance between the centres of suspension and of the bob, 2×19.575, or 2d, and the radius of the bob = r.; then 2d : r :: r : $\frac{r}{2d}$ and $\frac{2}{5}$ of this last proportional expresses the displacement of the centre of oscillation, to wit: $\frac{2r}{5\times2d} = \frac{r}{5d.}$ Two inches have been proposed as a proper diameter for such a bob. In that case r. will be = 1. inch, and $\frac{r}{5d.} = \frac{1}{9787}$ inches.

In the cylindrical second rod, call the length of the rod, 3×19.575, or 3d, and its radius=r. and $\frac{r}{2\times3d} = \frac{r}{6d}$ will express the displacement of the centre of oscillation. It is thought the rod will be sufficiently inflexible if it be $\frac{1}{5}$ of an inch in diameter. Then r. will be =.1 inch, and $\frac{r}{6d} = \frac{1}{11745}$ inches, which is but the 120th part of the displacement in the case of the pendulum with a spherical bob, and but the 689,710th part of the whole length of the rod. If the rod be even of half an inch diameter, the displacement will be but $\frac{1}{1879}$ of an inch, or $\frac{1}{110356}$ of the length of the rod.

(2.) Sir Isaac Newton computes the pendulum for 45° to be 36 pouces 8.428 lignes. Picard made the English foot 11 pouces 2.6 lignes, and Dr. Maskelyne 11 pouces 3.11 lignes. D'Alembert states it at 11 pouces 3 lignes, which has been used in these calculations as a middle term, and gives us 36 pouces 8.428 lignes = 39.1491 inches. This length for the pendulum of 45° had been adopted in this report before the Bishop of Autun's proposition was known here. He relies on Mairan's ratio for the length of the pendulum in the latitude of Paris, to wit: 504 : 257 :: 72 pouces to a 4th proportional, which will be 36.71428 pouces = 39.1619 inches, the length of the pendulum for latitude 48° 50′. The difference between this and the pendulum for 45° is .0113 of an inch: so that the pendulum for 45° would be estimated, according to Mairan, at 39.1619—.0113=39.1506 inches, almost precisely the same with Newton's computation herein adopted.

(3.) Sir Isaac Newton's computations for the different degrees of latitude, from 30° to 45°, are as follows;

	Pieds.	Lignes.		Pieds.	Lignes.
30°	3	7.948	42°	3	8.327
35	3	8.099	43	3	8.361
40	3	8.261	44	3	8.394
41	3	8.294	45	3	8.428

(4.) Or, more exactly, 144 : 175 :: 224 : 272.2̇.

(5.) Or, more exactly, 62.5 : 1728 :: 77.7̇ : 2150.39̇.

(6.) The merchant's weight.

(7.) The English rood contains 10,890 square feet = 104.355 feet square.

(8.) *The measures, weights, and coins of the decimal system, estimated in those of England, now used in the United States.*

1. MEASURES OF LENGTH.

	Feet.	Equivalent in English measure.
The point,	.001	.011 inches.
The line,	.01	.117
The inch,	.1	1.174, about $\frac{1}{7}$ more than the English inch.
The foot,	1.	11.744736 / .978728 feet, about $\frac{1}{48}$ less than the English foot.
The decad,	10.	9.787, about $\frac{1}{48}$ less than the 10 feet rod of the carpenters.
The rood,	100.	97.872, about $\frac{1}{16}$ less than the side of an English square rood.
The furlong,	1000.	978.728, about $\frac{1}{3}$ more than the English furlong.
The mile,	10000.	9787.28, about 1 $\frac{6}{7}$ English mile, nearly the Scotch and Irish mile, and $\frac{1}{2}$ the German mile.

2. SUPERFICIAL MEASURE.

	Roods.	
The hundredth, -	.01	95.79 square feet English.
The tenth, - -	.1	957.9
The rood, - -	1.	9579.085
The double acre, -	10.	2.199, or say 2.2 acres English.
The square furlong, -	100.	22.

3. MEASURE OF CAPACITY.

	Bushels.	Cub. Inches.
The metre, -	.001	1.62
The demi-pint, -	.01	16.2, about $\frac{1}{24}$ less than the English half-pint.
The pottle, -	.1	162.005, about $\frac{1}{6}$ more than the English pottle.
The bushel, -	1.	1620.05506862 } about $\frac{1}{4}$ less than the middle sized English .937531868414884352 cub. feet. } bushel.
The quarter, -	10.	9.375, about $\frac{1}{5}$ less than the English quarter.
The last, -	100.	93.753, about $\frac{1}{7}$ more than the English last.

4. WEIGHTS.

	Pounds.	Avoirdupois.	Troy.
The mite, -	.00001 -	- - -	.041 grains, about $\frac{1}{5}$ less than the English mite.
The minim, or The demi-grain,	.0001 -	- - -	.4101, about $\frac{1}{5}$ less than the half grain troy.
The carat, -	.001 -	- - -	4.101, about $\frac{1}{40}$ more than the carat troy.
The double scruple,	.01 -	- - -	41.017, about $\frac{1}{40}$ more than 2 scruples troy.
The ounce, -	.1 -	.937531868414884352 oz.	410.170192431 about $\frac{1}{16}$ less than the ounce .85452 oz. avoirdupois.
The pound, -	1.	9.375 .585957417759 lb.	.712101 lb., about $\frac{1}{4}$ less than the pound troy.
The stone, -	10.	93.753 oz. 5.8595 lb.	7.121 about $\frac{1}{4}$ less than the English stone of 8 lbs. avoirdupois.
The kental, -	100.	937.531 oz. 58.5957 lb.	71.21 about $\frac{4}{10}$ less than the English kental of 100 lbs. avoirdupois.
The hogshead, -	1000.	9375.318 oz. 585.9574 lb.	712.101

5. COINS.

	Dollars.			Troy grains.
The mill,	.001	The dollar, -	1.	375.98934306 pure silver. 34.18084937 alloy.
The cent,	.01			410.17019243
The dime,	.1			
		The eagle, -	10.	

[NOTE.—See Nos. 18, 21, and 28.]

[1st CONGRESS. No. 16. [3d SESSION.

DELETERIOUS EFFECTS OF DISTILLED SPIRITS ON THE HUMAN SYSTEM.

COMMUNICATED TO THE SENATE, DECEMBER 29, 1790.

To the Senate and House of Representatives of the United States in Congress assembled: the memorial of the College of Physicians of the city of Philadelphia respectfully showeth:

That they have seen, with great pleasure, the operation of a National Government, which has established order in the United States.

They rejoice to find, amongst the powers which belong to this Government that of restraining, by certain duties, the consumption of distilled spirits in our country.

It belongs more peculiarly to men of other professions to enumerate the pernicious effects of these liquors upon morals and manners. Your memorialists will only remark that a great proportion of the most obstinate, painful, and mortal disorders which affect the human body are produced by distilled spirits; that they are not only destructive to health and life, but that they impair the faculties of the mind, and thereby tend equally to dishonor our character as a nation, and to degrade our species as intelligent beings.

Your memorialists have no doubt that the rumor of a plague or any other pestilential disorder, which might sweep away thousands of their fellow-citizens, would produce the most vigorous and effectual measures in our Government to prevent or subdue it.

Your memorialists can see no just cause why the more certain and extensive ravages of distilled spirits upon human life should not be guarded against with corresponding vigilance and exertions by the present rulers of the United States.