Mr. M. W. Baldwin gave an account of a method which he had employed for renewing files, by covering the projecting parts with a light etching ground, and immersing the file in diluted acid; the cavities are thus attacked, and the prominences increased. The removal of the etching ground, and immersion in an acid, sharpens the teeth thus raised.

A letter from Mr. Thos. Ewbank, of New York, was read, accompanying specimens of different parts of the boilers of the steam-boat New England, which exploded in November last. The specimens were placed upon the table for examination. They were transmitted by Mr. Ewbank to the committee on explosions, to test the relative strengths of the specimens from different situations in the boiler.

P. B. Goddard, M. D., explained the principle of a very simple and efficient stomach pump, invented by him. An account of this, with the cut required for its explanation, will, it is expected, be laid before the readers of the Journal.

REPORT OF THE COMMITTEE ON WEIGHTS AND MEASURES.

Appendix to the Report of the Committee of the Franklin Institute on Weights and Measures.

Report giving an account of the System of Weights and Measures of France. By T. M'EUEN, M. D.

The system of weights and measures in France, with the legislation respecting it, has been so ably treated by the late President John Q. Adams, that a reference to his report would fully answer the purpose of the committee. As it was, however, necessary to present to the committee the most important facts connected with this philosophical system, I have endeavoured to do so in a condensed form. A few extracts from the report of Mr. Bonne will serve to show in what confusion the subject was involved before the adoption of the metrical system.

The Roman pound, $\frac{2}{3}$ of the Mark pound very nearly, (8oz. Boyer) was in use in France until the age of Charlemagne, who introduced a pound of 12oz. Mark, divided into 20 sous and 240 deniers, which was employed till the reign of Philip I. who fixed the Mark at $\frac{2}{3}$ of the pound of Charlemagne. During feudal times the confusion of weights and measures became great. From that time the evil has been increasing, and efforts have been lately (1790) made to obtain a simple standard.

Monton has proposed the third of a degree of the meridian,

Bouguer, the pendulum vibrating in seconds.

La Condamine, one of its parts.

Pancton, the Egyptian foot which is half a cubit of the Nilometer.

Collignon, the billionth part of a great circle.

The Equatorial foot, obtained from the circumference of the earth at the equator, by observing the movements of the sun, moon, and a

star, is the base of a system offered to the National Assembly by Mr. Bonne in 1790.

This foot. = 14 inches Eng. very nearly.

The English foot, = $\frac{6}{7}$ ths of an Equatorial ft. = 11 in. 3 lines, 2.4 points Paris measure. It is also equal to the foot of Macedonia, those of Urbino and Pesaro, the half arschine of Russia.

The cubit of the Nilometer = 1.824 ft. English = 1 ft. 8 in. 6 lines 5 pts. Paris is to the Equat. ft. as 25 to 16, this relation being expressed by complete squares, these two measures will be in the ratio of the lengths of two pendulums which may be easily compared together.

It is divided into 16 digits or 12 inches, of which the ancient Roman foot = 10 inches, the Palm now used by the Roman architects = 10 digits.

From the measures in use based on this foot as the original standard, some of the most convenient may be chosen; for example, the ell of Bayonne is $2\frac{1}{2}$ ft. Equat.

If it were longer it would be inconvenient, as for instance with the Ell of Laval nearly 4 ft. Equat. the canne of Toulouse, that of Montauban and of Nozai = 5 ft. Equat. These measures are so long that a single individual cannot use them with convenience.

Measures of capacity, dry and liquid.—The Equat. ft. being 13 in. 1 li. $8\frac{5}{7}$ pts. in length, its cube is $2270\frac{4}{5}$ cubic inches. Following the example of the ancients, this is taken for the medimne or minot of grain.

An equal bulk of pure water would weigh $91\frac{4}{5}$ lb. mark at $15\frac{1}{4}$ Reaumur, and of wheat would weigh $70\frac{2}{3}$ lb.

Pure water is preferable to all other liquids for the purpose of a standard; it is always to be obtained, and is one of the most homogeneous of liquids: besides, it dilates very slightly at the temperature just referred to.

Moreover, the peculiarities of this fluid have been ascertained by very nice experiments, reduced to the mean height of the barometer ($2\frac{1}{2}$ ft. Paris), at the level of the sea, in 45 degrees of Latitude, eight times the Equat. ft. would constitute the tun for wine and liquor, it would be the cube of two feet, weighing when filled with pure water 735 $\frac{2}{3}$ lbs., and containing 373 $\frac{1}{2}$ pints, Paris measure.

The Equat. cubic foot is also the bushel of water in English measure, and the wiertel of Arnstadt in Thuringia. The mesure of Beaugon is one half of this minot; it will be subdivided like the tun, into halves, thirds, quarters, sixths and eighths.

An eighth will be the *quarte*, or quarter, of the bushel; this filled with pure water will weigh $11\frac{4}{5}$ lbs. mark, and with wheat $8\frac{1}{2}$ lb.—thus half of the minot for grain will be the bushel, because it is the mean of all the measures of the same kind in France.

The thirds, sixths and twelfths have been proposed, because they correspond with many measures now in use; but if the smaller divisions are by halves, quarters and eighths, the former will be less necessary, as grain is not so valuable as to render very small measures necessary. The Equat. foot will also be the basis of liquid measures:

the mode of deriving the tun from it has been already shown. This foot will be the *metrète* or *amphora*, divided as we have already done the *minot*. The eighth will be the *vette* divided into thirds, sixths, and twelfths.

The eighth of the *vette* of pure water will weigh $1\frac{1}{5}$ lb. mark, this will be the *chopine* of which the double—the pinte will be preferred only because it corresponds with the mean of all the measures of the same denomination throughout the kingdom.

I proceed next to an analysis of the report on the measure of the meridian in France, and the results deduced from it, to determine the basis of the new system of measures, made to the National Institute of France, in the name of the class of Mathematical and Physical Sciences.

In pursuance of a proposition made by Talleyrand to the *Assemblée Constituante*, the Academy of Sciences was directed to decide upon a basis for a system of weights and measures.

The Academy named for this purpose, a committee, consisting of Messrs. Borda, Laplace, Lagrange, Monge and Condorcet; who reported the 19th March, 1791. In this report three methods for obtaining an invariable standard, are discussed.

1st, the length of a *pendulum*, 2nd, a *fourth part* of the *equator* of the earth, 3d, a *fourth part* of a *terrestrial meridian*.

The committee gave preference over other pendulums to that vibrating seconds in lat. 45° .

It must be observed that there enters into computations based on this instrument, a heterogeneous element, which is time, and an arbitrary one, viz: the division of the day into twenty-four hours, or 86400 seconds.

The other two proposed bases are not liable to this objection, as they depend only on linear extension; they have another advantage, which is, that being taken from the surface of the earth, they correspond to the use made of them for the common purposes of life. For instance, the measures of the distance between two points on the earth's surface, or the extent of a certain portion of that surface. It is certainly much more natural to compare the distance between any two places, to a part of a terrestrial circle, than to the length of a pendulum.

The relative advantages of a quarter of a meridian and of the same portion of the equator are now to be examined.

The regularity of the equatorial circle, and the regularity or correspondence of the degrees of the meridian are equally doubtful: but a circle corresponding with the equator is not very susceptible of being measured with accuracy. It may be said with truth that every nation of the earth has its meridian, while but few live at the equator: the operations necessary to determine exactly the equatorial circle, require to be carried on in countries remote from civilization, and the expense and difficulty would surpass the advantage to be derived from them. This would be the case, as well in the first observations, as in those that might become necessary to verify the results obtained. A fourth part of a degree of the meri-

dian is, therefore, to be preferred; a ten millionth part of this extent will be assumed for the ordinary unit of measure.

The customary division of the meridian into degrees, minutes, and seconds, is abandoned, because the decimal division corresponding with an arithmetical scale is more readily applicable to common use, and the inconvenience of two systems of division would be without end.

On the other hand, the difficulty of a change is temporary, and will fall on a few persons, accustomed to calculation: the perfection of the operation should not be sacrificed to considerations, which, in many respects, appear to the committee to be personal.

In adopting these principles, nothing arbitrary enters into the measures but the arithmetical scale by which they are divided. And with regard to weights, the choice of a substance homogeneous and at all times easily procured equally pure and dense, to serve as a standard, is the only thing assumed arbitrarily.

To fulfil these conditions we propose distilled water, in vacuo, or reduced to the weight it would have in that situation, and at the temperature at which it passes from the solid to the fluid state.

It is therefore proposed to measure, as soon as practicable, an arc of the meridian from Dunkirk to Barcelona, comprehending a little more than nine and a half degrees. This extent is quite sufficient, and it embraces about six degrees to the north and $3\frac{1}{2}$ to the south of the mean parallel of latitude. To these advantages, is added that of having the two extremities at the level of the sea, points invariably fixed by nature. By extending the line beyond the Pyrenees, all uncertainty as to the influence which these mountains may exercise on the instruments employed, will be avoided.

The operations necessary for this purpose are, 1st, to determine the difference of latitude between Dunkirk and Barcelona, and to make, on this line, all the astronomical observations which may be thought useful.

2nd, To measure the old bases employed in the measure of a degree made at Paris, and in the construction of the map of France.

3d, To verify, by new observations, the series of triangles used in measuring the meridian, and to prolong it to Barcelona.

4h, To make at the forty-fifth degree of north latitude, observations to determine the number of vibrations made in a day, in vacuo, by a simple pendulum, at the level of the sea, and at the temperature of melting ice, the simple pendulum to be equal to the ten millionth part of an arc of the meridian; the number of these vibrations being known, the standard of measure may be formed again at any time by observations of the pendulum. By this plan are combined the advantages of the system adopted, and of those that would arise from assuming the length of the pendulum as the unit of length.

The observations on the pendulum may be made before the ten millionth of the arc is ascertained: as, when the number of vibrations of a pendulum of a given length is known, it will be sufficient for deducing the number sought, to compare the known length of the pendulum to the ten millionth part of the arc.

5th, To ascertain by new and careful experiments, the weight in *vacuo* of a given bulk of distilled water at the temperature of melting ice.

6th, To compare together the different measures of length, surface or capacity, and the weights used in commerce, in order to find eventually their corresponding values in the new measures and weights, when these shall have been determined.

This report was adopted by the Academy, and presented to the National Assembly; by which body measures were taken for carrying the project into effect.

The Academy was authorized to appoint committees for each of the proposed investigations. This was immediately done; and the selecting and preparing instruments, was the preliminary step taken.

The successful use of the repeating circle of Borda in measuring the distance between Paris and Greenwich, in 1787, the facility with which it is applied to taking altitudes, and its small dimensions, proved that it might be used to replace other larger instruments.

Four were constructed by Lenoir, with a radius somewhat longer than that of the instrument used in 1787 (which was 14 inches.)

The same artist made the platinum rules used in measuring the bases, another platinum rule for observations on the pendulum, and two spheres, one of gold, the other of platinum, for the same purpose.

The rules of platinum for measuring the bases were twice the toise of Peru (i. e. 12 feet French) in length, having a strip of copper on the upper surface to serve as a thermometer, placed upon a support of wood and protected by a roof; there were four of them, numbered one, two, three, and four. When used they were not in contact, but placed near each other, and the distance between them measured by a slip of platinum graduated so as to form a vernier.

The measure of the meridian was made by Messrs. Mechain and Delambre, the latter, that portion between Dunkirk and Rhodéz: Mechain, whose operations were between the last named point and Barcelona, was prevented by death from extending the line to the Island of Cubrira, as he had intended. This intention was afterwards carried into effect by Messrs. Biot and Arago.

Two bases, one between Melun and Lieusaint, 6075.90 toises, the other between Vernet and Salies, 6006.25 toises, were measured by Delambre: each about 7 miles.

The latitude of the several points was observed by the same gentlemen.

It is unnecessary to enter into the minute detail of these operations, they were made with the most scrupulous nicety: the results were examined by a number of scientific men of several nations, invited by the French government to constitute a part of the committee on weights and measures. They afford all the data necessary for determining the base of the new metric system; and in addition give rise to some very interesting questions on the form of the earth.

The arc of the meridian between Dunkirk and Montjouy subtends

a celestial arc of $9^{\frac{6738}{10000}}$ degrees; its length is $275,792^{\frac{36}{100}}$ modules, about 650 miles. From this base a fourth part of the meridian has been deduced by strict calculations; the flattening of the earth toward the poles being determined from the above measure and others made in different parts of the world, to be $\frac{1}{334}$ th of the diameter at the equator.

The fourth part of the terrestrial meridian is found to be 2,565,370 modules; and as a final result, its ten millionth part, or the *metre*, the unit of length is $\frac{256537}{10000000}$ of the module, or 3 ft. 11 lines of the toise of Peru, at 13° Reaumur, equal, according to the Academy, to 39.3827 inches English; according to Capt. Kater, to 39.39079; according to Mr. Hassler, to 39.3802 inches.*

The measures of length are $\frac{1}{100}$ th. of a metre or Centimetre.

$\frac{1}{10}$ th.	„	„	Decimetre.
		„	Metre.
10 metres	„	„	Decametre.
100 „	„	„	Hectometre.
1000 „	„	„	Kilometre.
10,000 „	„	„	Myriametre.

The measure of surface is the *are* = 10 metres square; and the *stère* is a solid measure the content of which is a cubic metre.

The determination of the unity of weight was made by Lefevre Gineau and Fabbroni, with equal care and skill.

The points to be decided previously to an experimental inquiry, are; 1st, to fix on the volume to serve as a standard of comparison.

2nd, the choice of a proper substance.

3d, to ascertain the weight, or the quantity of matter, which the substance contains in a given volume.

The volume may be taken arbitrarily, but convenience requires that it should be moderate, and the decimal system that it should be expressed by a cubic number, which is at the same time a decimal submultiple of the metre.

The Academy therefore adopted the thousandth part of the cube of the metre, or, what is the same thing, the cube of the decimetre. They also made choice of water, for the substance of which the weight of a cubic decimetre should be the unit of weight.

This substance, remaining fluid at a temperature easily obta

* As the flattening of the earth's surface towards the pole is not exactly known, the following table shows the difference in length of the metre: when the flattening is,

$\frac{1}{100}$	443.25370
$\frac{1}{200}$	443.24980
$\frac{1}{300}$	443.24854
$\frac{1}{400}$	443.24817
$\frac{1}{500}$	443.24814
$\frac{1}{600}$	443.24812
$\frac{1}{700}$	443.24811
$\frac{1}{800}$	443.24811
Sphere	443.25171

every where; being of such a density, that accurate experiments may be made in it without difficulty; and above all, being easily obtained in a state of purity, is more appropriate than any other for the purpose in view.

The method which naturally presents itself of determining this weight, that of filling with distilled water a vessel of which the sides are decimetres, and weighing it, offers so little hope of accuracy that it cannot be adopted. Recourse must obviously be had to the principle in Hydrostatics, that the weight of any fluid contained in a given volume, is equal to the weight which that volume loses by immersion in the fluid.

But the experiment in confirmation of the principle which ordinarily appears to be so easy and simple, is singularly difficult, when it is made with a view to determine an absolute quantity; great precision is required, in ascertaining the volume of the body employed, and in weighing it in the air and in the water: reductions are also to be made for the weight and temperature of the air.

To fulfil these conditions, a hollow cylinder of brass, the form most easily made regular, of which the diameter was about equal to the height, and the volume something more than eleven cubic decimetres was constructed. Its sides within, were so sustained that no change of form could take place when it was immersed in water. Notwithstanding the care taken in making this cylinder, it was found to be not quite perfect; it became necessary, therefore, to find its dimensions by the nicest measurement; the exact solid content was 0.0112900054 cubic metre, or 11.29 cubic decimetres.

Weights of brass divided decimally and strictly compared, were used; and the balance employed, was, when loaded with two pounds mark in each dish, sensible to the millionth part of that weight. In weighing the cylinder, it was placed in one of the dishes, and counterbalanced, it was then removed and the weights put into the same dish.

The mean of fifty-three trials, differing in the extremes only by 45 millionth parts, gave as the true weight of the cylinder $11.466\frac{6}{8}$ units, and as the counterpoise was of the same substance with the material weighed, the weight in air was exactly what it would have been in vacuo.

In ascertaining the weight in water many other circumstances were to be considered. The mean of thirty-six trials, in which the greatest difference amounted to but 45 millionth parts, gave very nearly $\frac{202}{1000}$ ths. of the unit, (exactly 0.2094190) for the apparent weight.

The following allowances were made to obtain the true weight.

1st. The air sustains the weight employed, and not the cylinder which is immersed in water, therefore the weight of a volume of air equal to the bulk of the weights employed, is to be deducted.

2nd. As the cylinder is hollow, the weight of the air contained in the cavity is also to be deducted.

3d. The temperature of melting ice had been assumed for the state of density of the water; it was however found impracticable to re-

duce the temperature below two-tenths of a degree of the centigrade scale; and the mean temperature of the water during the experiments was three tenths.

The experiments of De Luc rendered it probable that the point of greatest density of water was about 5° centigrade. New experiments were made to obtain exact results, from which it appeared that the point of greatest density of water is a little above 4° Cent. = 39.2° Fahrenheit. A highly important fact, affording a point of density which is invariable, and being the only instance of the kind in a liquid.

The committee determined to employ it, and to deduct $\frac{1.44}{100000}$ ths. of the unit from the apparent weight, this being the difference between the weight lost by the cylinder when weighed in water at $\frac{3}{10}$ ths. of a degree Cent, and that lost when the water is at its maximum density.

With these allowances the weight of the cylinder in distilled water at its maximum density was $\frac{1.95}{1000}$ ths.

Two other circumstances are to be considered, the weight in air was taken at the temperature of $17\frac{1}{4}^{\circ}$ that in water at $\frac{3}{10}^{\circ}$; the contraction of the brass is therefore to be allowed for, according to the result of experiments instituted to ascertain the rate of expansion in brass by increase of temperature.

Again, a small excess of volume arises from the tube of brass by which the cylinder was suspended, these farther reductions bring the true volume to 11.27 cubic decimetres, which is the volume of water weighing 11.27 units.

Whence a cubic decimetre of water at its greatest density weighs $\frac{999.9}{1000}$ ths. of the unit, which is the Kilogramme of the new metric system.

The relation of the arbitrary weight we have called the unit, to the old weights, remains to be considered; for this purpose a comparison was made between it and the "pile de Charlemagne," and it was found that the fifty marks which constitute the pile were equal to 12.227944 units of the weight employed. Its unit was, therefore, equal to 13342.088025 grains mark.

Whence it results that the true Kilogramme or the cubic Decimetre of distilled water at maximum density, weighs, in vacuo, 18827.15 grains mark; or 1644.579 grains English.

The weights are, the Kilogramme,	divided into	1000 grammes.
Hectogramme	"	100 grammes.
Decagramme	"	10 grammes.
Gramme		Unit.
Decigramme		$\frac{1}{10}$ th. gramme.
Centigramme		$\frac{1}{100}$ th. gramme.
Millegramme		$\frac{1}{1000}$ th. gramme.

The measures of capacity are likewise based on the metre, they are, the

Decalitre	=	10 metres.
Hectolitre	=	100 „
Kilolitre	=	1000 „
Centilitre	=	$\frac{1}{100}$ th metre.
Decilitre	=	$\frac{1}{10}$ th „
Litre	=	cubic metre.

The standards prepared by the committee were, for measures of length:

A Platinum metre to be deposited with the Corps Legislatif, to be preserved with the greatest care, and to be used only on the most important occasions.

For ordinary adjustments there were prepared with the same care and precautions, metres of iron, corresponding exactly with each other, and at the temperature of melting ice, with the platinum standard. The ends of these iron metres are preserved from wearing by projections of brass.

As however different metals expand unequally by the same change of temperature, convenience requires that the ordinary standards should be made at 10° or 15° Cent; because a change of 10° above or below that temperature will produce a variation of but $\frac{3}{1000}$ ths. of a millimetre between a metre of iron and one of platinum, and of $\frac{6}{1000}$ ths. of a millimetre when the metres compared are of brass and iron.

The standards of weight were also a Kilogramme, one of platinum, to be preserved by the Legislature, and several of brass, all exactly equal, to be used as standards for common use.

It is to be observed that the platinum standard when weighed in the air would be heavier than those of brass, by $1\frac{1}{2}$ gr. and that this difference, arising from the greater density of the platinum, renders it unfit to be used as an ordinary standard.

Experiments for ascertaining the length of a pendulum vibrating seconds at Paris were made by Messrs. Borda and Cassini; the following is an outline of their operations.

The experiments were made on the ground floor of the observatory at Paris: the apparatus made use of was attached to a wall of 12 feet high, 8 feet wide, and 2 feet thick. The instruments consisted of a time-piece beating seconds, with which the vibrations of the pendulum were compared; the pendulum fell a little in front of that of the clock, and was suspended from a mass of stone, containing about three cubic feet, placed on the top of the wall.

The weight of the pendulum vibrated at about the height of the bob, and its oscillations were observed through a small telescope at the distance of six feet. The whole apparatus was protected by a case, glazed in front.

The pendulum was supported by a knife edge, and to remedy the weight added to the pendulum, the suspension itself constituted a small pendulum, of which the motions were synchronous with those of the pendulum used for the experiment. So that the centre of

motion may be supposed to be on the plane on which the knife edge moved.

The plane was of hardened steel; to the knife edge was attached an iron wire, which, with the sphere to be described, constituted a pendulum twelve feet long, making a vibration in two seconds: this was preferred to the seconds pendulum, because, as it is four times as long as the last, any error, in measuring the length, would have but one fourth of the effect on the longer one.

The oscillating body was a sphere of platinum of $16\frac{1}{8}$ lines in diameter, weighing 9911 grains, and of the specific gravity of 20.71 at 20° cent.

The wire was attached to the sphere by means of a copper cap, the lower part of which was concave and corresponded with the surface of the sphere.

A thin coating of tallow between the sphere and the cap, produced sufficient adhesion to support the weight; and by these means the sphere could be suspended by different portions of its surface, so as to correct errors arising from unequal density, or want of sphericity.

The length of the pendulum was such that its oscillations were not quite so long as two of those of the clock. The comparison of the pendulums was made when they were both arriving at the vertical, being the time of most rapid motion: a black screen was placed a little in front, the edge of which coincided with the centre of the wire of the pendulums, and with diagonal cross lines on the pendulum-bob of the clock, when they were at rest.

The two pendulums, thus arranged, being set in motion, if the wire disappeared before the cross-lines and the pendulum of the clock made rather more than two oscillations while the pendulum was making one, the interval of time between the disappearance of the two became constantly less; and finally the two objects passed the edge of the screen together. This was the first coincidence. Soon afterwards the oscillations no longer agreed; the clock gaining on the pendulum; after some time another coincidence took place; and the coincidences were observed until the oscillations became so small as to be uncertain.

The oscillations of the pendulum continued for more than twelve hours, but, for the reason above given, the observations were continued but four or five, a length of time amply sufficient to ascertain the relative movements of the pendulum and clock. In fact, when the interval between the coincidences was fifty minutes and the oscillations not too small, the uncertainty, as to the time when the coincidence took place, was not, at most, over thirty seconds, which indicates that the discordance was perceptible when one of the objects arrived at the perpendicular $\frac{1}{50}$ th of a second before the other. Whence the duration of the experiment being 4 hours, the rate of the pendulum was determined to the *three hundred and sixty thousandth part*.

The rule used for ascertaining the length of the pendulum was about 12 feet long, of platinum, covered with another of copper of

about 11½ ft. long: the two forming a metallic thermometer of which the indications were read on a vernier at the lower part.

At the upper part of the rule of platinum was a cross bar of steel to lie on the horizontal plane, on which the knife edge of the pendulum was placed; the rule was so arranged that when it was in the place of the pendulum its upper end was exactly in the plane of suspension.

At the lower end of the platinum rule, was a slip of the same metal, moving with a little resistance in a rebate, and on this slip were divisions constituting a vernier indicating 200 thousandths of the whole rule.

Another instrument, used in measuring the pendulum, remains to be mentioned. It was a plate of copper placed immediately under the sphere of the pendulum, and attached to a stone projecting from the wall. This plate, which was horizontal, could be elevated and depressed by means of a screw, with a very fine thread.

After an observation with the pendulum was concluded, it was set at rest, and the copper plate carefully elevated till it just touched the lower part of the sphere: the pendulum was then removed, and the rule put in its place. The slip bearing the vernier was then advanced till it touched the copper plate, and thus gave the length of the pendulum from the point of suspension to the lowest part of the sphere. The centre of oscillation of a sphere around a point being $\frac{2}{3}$ ths. of the square of the radius divided by the distance of the point of suspension from the centre, its position was known.

Twenty experiments, similar to that described, were made with the greatest care; the results being corrected for the temperature, barometric pressure, varying length of arcs, and in fact, every circumstance that could be supposed to exert any influence: it appears that when each result was compared with the mean result, the greatest difference was but 134 thousandths. Corresponding with one 300th. of a line in the deduced length of the pendulum, vibrating seconds.

Consequently the length of the pendulum, vibrating seconds, in Paris, is equal to 50999.75 parts of the rule, each part being one two-hundred thousandth of the whole rule.

The rule was compared with that numbered (1), used in measuring the bases for the determination of the terrestrial arc. The length of the pendulum was found to be equal to the fraction 0.2549919 of the rule No. 1. at the temperature of melting ice.

By a comparison of this measure with the toise used in former comparisons, it was found that the length of the Pendulum vibrating seconds, is, in lines of that toise = 440.5593 lines = 0.7413875 metres = 29.12166534 English inches; found afterwards by Biot and Arago 0.7419012 metres, or $\frac{14}{1000}$ millimetres less.—The mean being 0.7413943.

Reduced to the level of the ocean, in North lat. 48° 50' 14'' = 0.7419176.

Length of the pendulum at the level of the sea at			
Un	60° 45' 25" N. lat.	742.723	Biot.
Fort of Leith	55° 38' 37" "	742.413	Biot.
Dunkirk	51° 2' 10" "	742.977	Mathieu, Biot.
Paris	48° 50' 14" "	741.917	Bouvard, Mathieu, Biot.
Clermont	45° 46' 48" "	741.705	Mathieu, Biot.
Bordeaux	44° 50' 26" "	741.608	Mathieu, Biot.
Figeac	44° 36' 45" "	741.612	Mathieu, Biot.
Formentera	38° 39' 56" "	741.252	Arago, Chaix, Biot.

If the earth were elliptic, the length of the simple pendulum would vary as the square of the sine of the latitude.

The difference, or irregularity of the degrees measured is still unexplained. It does not seem to arise from error in the observations, as it is corroborated by the results of different persons, in different places. It is very great, if attributed to local causes. It is still an unsolved problem.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1833.

With Remarks and Exemplifications, by the Editor.

1. For a *Machine for Setting Carriage Springs*; David C. Andrews, Westmoreland, Oneida county, New York, September 6.

This machine consists, in part, of two rollers, fixed horizontally in a frame, like flattening mill rollers; the uppermost moves up and down in slots made in the uprights for that purpose, so that it may advance towards, or recede from, the lower roller. A piece of metal, called a driver, fits over the top of the roller frame in such a way that its two ends bear upon the gudgeons of the upper roller; and a weighted lever crosses the top of the driver, to press this roller downwards with any required degree of force, a second lever being employed to raise this when necessary, acting in the manner of the combined levers commonly used for pressing upon the drill stock in drilling iron at the vice.

When springs of any kind are to be set, such as horizontal, elliptical, cradle, or C springs, the first plate, or leaf, is to be bent into the required form, and cooled; the second leaf, heated, is then to be laid upon this, and the two passed together between the rollers, the lower of which is to be turned backward and forward by means of a crank, after which the other half is to be heated, and treated in the same way. All the leaves of which the spring is to consist, are to be successively set in this manner. A groove is left in the upper roller, to receive the button upon the spring; and there are to be vertical friction rollers on the inside of the frame, to prevent the springs from coming into contact with it.

There is no claim made, and as, so far as we are informed, no similar