For the Scientific American.

The Ratio of the Diameter to its Circumference is Exact.

This proposition has been denied by some, especially by Sir Isaac Newton, who alleged that there was no ratio between the diameter and circumference of a circle. Barrows, his instructor and predecessor, supposed there was none. This is incorrect, as the following observations and demonstration will clearly show:—

It can be proved that any number whatever can be made to assume the form of 10 (i. e. one principal measure in a system of notation and no (0 zero) more) and when this number is the denominator of a common fraction, the numerator can be exactly divided by the denominator, and the fraction be made to assume the decimal form. Having premised this we would state the following proposition:—

That any two lines whatever may be divided into such a number of equal parts that one of the parts shall exactly measure both lines.

Let A———B and C———D be the two lines, of which A B is the greater, and let C D be divided into a number of equal parts, one of which is a; then if a does not exactly measure A B, there will be a remainder, r, less than a, and will be expressed in terms of a by $r \div a$, which is a vulgar or common fraction. But any common or vulgar fraction may be assume the decimal or entire form, or be reduced to a complete expression, the unit ot which expression will exactly measure the equal part, a, and consequently will exactly measure the two lines, A B, C D, separately. Hence there is an exact ratio between any two laws considered with reference to each other. And since the diameter and circumference of a circle is equal to two straight lines of the same length, it follows that there is an exact ratio between them. This ratio is expressible by the common method of notation, for it can be a ratio of units, as is manifest from the preceding demonstration, so that in no sense was Newton correct in stating that it did not exist.

The difficulty respecting this subject we apprehend to consist in the restrictions which mathematicians inadvertently impose in respect to the measure by which the ratio shall be determined, namely, that after the units it shall decrease by tenths, hundredths, thousandths, tenths of thousandths, &c., of its length, from which it is manifest that it may or may not coincide with the circumference finally, but this does not indicate that a different measure may not coincide with it, or that there are not many measures that will, and it has already been shown that there is, that must do it, so that the attainment of this ratio may not be disposed of, for it is far from being a mathematical impossibility.

THOS. H. MCLEOD.

Middlebury, Vt., Feb. 26th, 1855.

The Sphygmograph or Pulse Writer.

In No. 26, present Volume SCIENTIFIC AMERICAN, under "Notes of foreign scientific matters," Prof. Vierordt's (correct name) machine to record the beating of the pulse is noticed. Allow me to state that there has been a machine for the same purpose, invented, made, and experimented with, in this country, which is much more accurate and ingenious than the German one. The invention of this instrument called Sphygmograph i. e. Pulse-writer, was occasioned by the wish of Dr. C. Hering, of Philadelphia, to have a machine for such a purpose. It was invented by Mr. E F. Hilgard, U. S. Coast Survey, and made in Washington about a year ago. It is an electro-magnetic machine, recording on the same strip of paper the time and the number of beats of the pulse; it is, in fact, a Morse's recording telegraph instrument, with two levers, two magnets, two batteries, and a clock. The current of one battery is broken by the stroke of the pendulum of a clock, each stroke making a dot. The current of the other battery is broken by the pulse. To a splint fastened to the arm of the person whose pulse is to be recorded, a lever is attached, one end of which rests on the pulse, so that each beat of the pulse raises with the lever a projecting piece of platinum from another insulated piece of platinum; to each of these pieces of platinum one end of the wire from the battery is attached, and each beat of the pulse breaks the circuit and makes a dot. The operators of this double telegraph being, in one instance a clock, in the other the pulse recording on the same paper, thus:

. . . . . time.
. . . . . pulse.

In an experiment, the pendulum made 72 strokes a minute, therefore 12 strokes are equal to 10 seconds, during the same time the pulse beats 10 times, making 60 beats per minute. The number of dots per ¼, ½, or 1 minute, are transcribed to a paper horizontally and vertically ruled, the time on the vertical and the pulse on the horizontal lines, showing at a glance the state of the pulse. During last fall the subscriber made with this instrument a series of experiments to ascertain the action of different articles of food and drugs on the system, and how they affected the pulse. Alcohol (1 oz. to 3 oz. of water) raised the pulse at first considerably above the normal number, then it lowered it for a much longer period, the line showing the rising was never a straight one, but always up and down, wave-like, and so was the falling pulse.

Dr. C. Hering had this instrument made for merely scientific investigations, and as soonas a sufficient number of experiments shall have been made, the results will be published. Th instrument may be seen at the office of its proprietors in Philadelphia.

A. ZUMBROCK., M. D.

Baltimore, March 10th, 1855.

Rifle Shooting.

MESSRS. EDITORS.—In reading over your answers to correspondents in No. 25, present Volume of your paper, I notice an answer to a Texas correspondent, in which you state that "the Minie bullet would be an advantage in the common rifle." From this statement I beg leave to differ; that is, so far as the common acceptation of the term "advantage" is concerned, when used in connection with rifle shooting among us. The principal advantage which our rifle makers strive to obtain for the rifles of their respective manufacture, is as to *accuracy*, and not so much as to distance. Now it is a fact well known to rifle makers, but one which it is not always for their interest to acknowledge, that a rifle which is loaded at the breech cannot be made to throw its balls with that precision which is attained by the muzzle-loading rifle, when constructed upon the right principle. The reason is this; it is impossible to get exactly the same explosive force at every charge, hence the bullets are "slugged" more at one time than another, and consequently fall short of, or over reach the mark. Again, the ball does not always receive the force of the powder in an equal proportion on all sides, which causes it to be driven deeper into the groove of the rifle on one side than the other; this of course would cause it to go wide of the mark. The Minie bullet acts the same in principle as the common bullet, in a breech loading rifle; the Minie rifle has no joint through which a part of the gas can escape, as is the case with the breech-loading rifle, hence its longer range. I venture the assertion that no rifle has ever been made that will shoot with such accuracy as the muzzle-loading rifle, especially when a patent muzzle is used.

G. L BAILEY.

Portland, Me., March 15, 1855.

[The advantage of a Minie over a common bullet in a common rifle, is simply in rapid loading—not for accuracy, respecting which, we believe our correspondent is right.

Depth of the American Lakes.

It has hitherto been asserted that Lake Huron was 860 feet deep, but it has lately been ascertained by U. S. Coast Survey. that it is only 420 feet deep. Lake Erie is from 60 to 70 feet deep; Lake Ontario 452 feet—as low as most parts of the bottom of the Gulf of St. Lawrence. All the Lakes cover an area of 43,040,000 acres.

Properties of the Electric Spark.

The following is the condensed abstract of a recent lecture by Faraday, before the Royal Society in London. It will be found interesting in facts, not generally known, while at the same time it is clear on a very important subject, lightning conductors:—

The heat of the electric spark is intense, though the momentary duration of its effects prevents its heat-giving power from being felt to its full extent. The inflammation of ether and the explosion of gunpowder were shown as illustrative of the heat contained in the electric spark, and the effect of momentary action in diminishing the heating power was exemplified by sending an uninterrupted charge through some loose gunpowder, and then repeating the experiment with a wet string introduced as part of the conducting circuit. In the first arrangement, when the spark passed instantaneously, the gunpowder was scattered and not exploded, but when the resistance of the wet string prolonged the discharge, the gunpowder was ignited. The electric spark is sometimes applied in blasting rocks as well as voltaic electricity, and voltaic agency, is, for general blasting purposes, very convenient. The effects of the electric discharge are only perceived when resistance is offered to the passage of electricity, and several experiments were exhibited in which it was shown that a charge which passed without producing any apparent effect, when a thick wire formed the circuit, was sufficient to deflagrate interposed pieces of thin wire and gold leaf, that were not adequate to conduct the same quantity freely. The ingenious contrivance of Prof. Wheatstone for measuring the duration of an electric spark was exemplified by lighting a disk, colored in stripes, and revolving rapidly in the dark, with a succession of electric sparks. Though the colors were mingled together, and invisible when seen by ordinary light, the momentary light of the electric spark exhibited each color distinctly, and the disk for the instant appeared stationary. By increasing the velocity till the colors became confused, even when seen by the spark, an approximation is attained to the duration of the light; and in this manner Mr. Swaine, of Edinburgh, proved that the electric spark lasts only the hundred thousandth part of a second. A flash of lightning is of equally short duration, and every object in motion, when seen at night by the glare of lightning, appears to be stationary. The apparent duration of an electric spark is about one-tenth of a second, because an impression once made on the retina is retained for that time, though the object that produced it, as in the case of lightning, is no longer present.

Another remarkable property in the electric spark is the action it exerts on the light-storing power of phosphate of lime. That substance, together with some others, possesses the power of absorbing light in a latent state, which is given out on the application of heat in the dark. This light, when once taken from the phosphate of lime, can be restored to it by the electric spark, and by that means alone. Prof. Faraday concluded by explaining and illustrating the influence of the non-conducting property of the air on the length of the spark. By partially exhausting a glass tube a spark passed through a much greater space, and when the exhaustion of the air was more complete, and the resistance thus removed, the electricity from the prime conductor of the machine passed in continuous flashes, imitating the effects of the aurora borealis.

Clock Statistics.

Connecticut is called "the land of wooden clocks," from the fact that she is more extensively engaged in the manufacture of clocks than any other State in the country. She has $1,000,000 invested, employs 1,279 workmen, and manufactures 794,000 clocks each year. Bristol has 14 factories, 410 hands, and produces 201,000 finished clocks annually; Plymouth has 3 factories, 175 hands, and manufactures 70,000 clocks; Ansonia has 2 factories, 140 operatives, and makes 102.000 clocks; Winsted manufactures 30,000 clocks, has 1 factory, and employs 40 hands, while Southampton, with 2 factories and 45 hands, makes 40,000; and New Haven, with 3 factories and 405 hands, annually produces 374,000 clocks. One of the New Haven factories is owned by Chauncy Jerome, the Mayor, and pays out nearly $10,000 per month in wages.

On Gum Mezquite.

The following article by Campbell Morfit, M. D., of the University of Maryland, Md., and published in Silliman's *Journal* for this month, will be interesting to many of our readers:—

Gum mezquite, known synonymously as *Muckeet*, *Mezqueet*, and *Musquit*, and recently presented to public notice by Dr. G. G. Shumard, U. S. Army, is said to be the product of a tree flourishing extensively in the high and dry regions of the plains of Western Texas, New Mexico, and the adjacent Indian Territory. The facility with which it may be obtained in large quantities, and its very probable prospective value as an article of commerce, give it an interest that led me to a chemical examination, which I have caused to be made in my laboratory by one of my students, Mr. Frederick W. Alexander.

It is a spontaneous semi-fluid exudation concreting by exposure into tears and lumps of variable size and and form. One sample, which was a part of that brought in by Dr. Shumard, and obtained directly from the U. S. Bureau of Indian Affairs, consisted of small irregular pieces and rounded balls about the size of a hazel nut, semi-transparent, and shading in color from a lemon white to dark amber. When broken, the fracture faces were brilliant; and the gum was easily reduced under the pestle to a dull white powder. One of the balls was enveloped with an outer pellicle of gum of about 1-16th of an inch in thickness.

These proportions approximate very closely to those obtained from gums Senegal and Arabic by Guerin and Mulder. The general appearance, too, of the gum, is similar to that of gum Senegal, and the dark inferior qualities of gum Arabic. In chemical properties, also, it is allied to them; being insoluble in absolute alcohol, partially soluble in common alcohol, and readily forming with hot or cold water a very adhesive mucilage. It is in fine, a true gum, and promises, in its physical and chemical behavior, much of the advantage, expected by its discoverer, as an economical substitute for gum arabic or Senegal.

The specific gravity of the gum was 1·5, but this determination may possibly admit of correction upon purer samples than were disposable for the experiment.

Its proximate composition was found to be,

Water, - - - - - - - -	11·640
Foreign Matters, - - - -	0·236
Bassorin, - - - - - - -	0·206
Arabin, - - - - - - - -	84·967
Ash, - - - - - - - - -	3 000
	100·049

Cerasin was also sought for, but not found. The ash was estimated by burning a given quantity in an atmosphere of oxygen and weighing the residue.

The ultimate analysis, made also by effecting combustion of the carefully dried gum in oxygen gas, yielded, in two separate experiments, the following numbers:

Carbon, - -	43·63	43·10
Hydrogen, -	6·11	6·50
Oxygen, -	47,26	47·40
Ash, - - -	3·00	3·00
	100·00	100·00

A California Lamprey.

Dr. Ayres presented a specimen of a lamprey at the meeting of the California Academy of Sciences, Feb. 5. It is the only one yet discovered in that country. Its length was only 4¾ inches.

By the late news from Europe, we learn that old Joseph Hume, M. P., is dead. He arose from being a poor boy to be one of the most respected and best informed men in England.