ation in the neighborhood of Derby, and has been worked for many centuries. The great bulk of it is used for making plaster of Paris, and as a manure; and it is the basis of many kinds of cements, patented —as Keene's, Martin's, and others.

"To get it for these purposes, it is worked by mining underground, and the stone is blasted by gunpowder; but this shakes it so much as to be unfit for working into ornaments, etc.; to procure blocks for which it is necessary to have an open quarry. By removing the superincumbent marl, and laying bare a large surface of the rock—the alabaster being very irregular in form—and jutting out in several parts, allows of its being sawed out in blocks of considerable size, and comparatively sound (as is illustrated by the large tazza in the Museum of Practical Geology). This stone, when protected from the action of water, is extremely durable, as may be seen in churches all over the country, where monumental effigies, many centuries old, are now as perfect as the day they were made, excepting, of course, willful injuries; but exposure to rain soon decomposes the stone, and it must be borne in mind that it is perfectly unsuited for garden vases or other out-door work in this country.

"In working, it can be sawed up into slabs with toothed saws, and for working moldings and sculptures, fine chisels, rasps and files are the implements used; the polishing is performed by rubbing it with pieces of sandstone, of various degrees of fineness, and water, until it is quite free from scratches, and then giving a gloss by means of polishing powder (oxide of tin) applied on a piece of cloth, and rubbed with a considerable degree of friction on the stone. This material gives employment in Derby to a good many hands in forming it into useful and ornamental articles, and is commonly called Derbyshire spar; most of the articles are turned in the lathe, and it works something like very hard wood.

"Another kind of gypsum also found in Derbyshire is the fibrous or silky kind; it occurs in thin beds, from one to six inches in depth, and is crystallized in long needle-like fibers; being easily worked, susceptible of a high polish, and quite lustrous, it is used for making necklaces, bracelets, brooches, and such like small articles."

CLYDONICS.

At the last meeting of the Polytechnic Association the following paper was read by Professor S. D. Tillman, the President, in conclusion of the paper on the same subject which was published on page 225 of our current volume:—

The celebrated historian, Buckle, believed the most effective way of turning observations of natural phenomena to account, would be to give more scope to the imagination and incorporate the spirit of poetry with the spirit of science. By this means our philosophers would double their resources, instead of working, as now, maimed and with only one half of their nature. They fear the imagination on account of the tendency to form hasty theories. But surely all our faculties are needed in the pursuit of truth, and we cannot be justified in discrediting any part of the human mind.

These views, if not applicable to methods of original research, are certainly of great moment in considering the best means of diffusing scientific knowledge; and if there is any branch of philosophy which is preeminently entitled to bring to its service the free play of fancy, it is that treating of the force of waves, whether propagated through liquids, æriform fluids, or more attenuated media.

THE PHAROS.

A discourse on the structure of the flame of the ordinary lamp might not gain general attention, yet how intense the interest as we speak of the particular light which a captain seeks when his vessels, freighted with human beings, midst storm and darkness, has nearly reached its haven. There are scattered along our vast boundary five hundred such beacons, kept in operation at an annual expense to the United States' Government of more than a million of dollars.

A description of one of these is given in the posthumous papers of the gifted Thoreau, just published under the title of "Cape Cod;" and although since the time of his visit a more imposing structure has arisen in the place of the old lighthouse, the account is so graphic, one feels, after its perusal, the satisfaction which he would probably have experienced by a personal inspection of the premises.

THE CAPE COD LIGHT.

"The Highland Lighthouse, where we were staying, is a substantial-looking building of brick, painted white and surmounted by an iron cap. Attached to it is the dwelling of the keeper, one story high, also of brick, and built by Government. As we were going to spend the night in a lighthouse we wished to make the most of so novel an experience, and therefore told our host that we would like to accompany him when he went to light up. At rather early candle-light he lighted a small Japan lamp, allowing it to smoke rather more than we like on ordinary occasions, and told us to follow him. He led the way first through his bedroom, which was placed nearest to the lighthouse, and then through a long, narrow, covered passage way, between whitewashed walls like a prison entry, into the lower part of the lighthouse, where many great butts of oil were arranged around; a winding and open iron stairway, with a steadily increasing scent of oil and lamp smoke, to a trap-door in an iron floor, and through this into the lantern. It was a neat building, with everything in apple-pie order, and no danger of anything rusting there for want of oil The light consisted of fifteen argand lamps, placed within smooth concave reflectors twenty-one inches in diameter, and arranged in two horizontal circles, one above the other, facing every way excepting directly down the Cape. These were surrounded, at a distance of two or three feet, by large plate-glass windows, which defied the storms, with iron sashes, on which rested the iron cap. All the iron work, except the floor, was painted white. And thus the lighthouse was completed. We walked slowly round in that narrow space as the keeper lighted each lamp in succession, conversing with him at the same moment that many a sailor on the deep witnessed the lighting of the Highland light. His duty was to fill and trim and light his lamps, and keep bright the reflectors. He filled them every morning, and trimmed them commonly once in the course of the night. He complained of the quality of the oil which was furnished. This house consumes about eight hundred gallons in a year, which cost not far from one dollar a gallon; but perhaps a few lives would be saved if better oil were provided. Another lighthouse-keeper said that the same proportion of winter-strained oil was sent to the southernmost lighthouse in the Union as to the most northern.

"Formerly, when this lighthouse had windows with small and thin panes, a severe storm would sometimes break the glass, and then they were obliged to put up a wooden shutter in haste to save their lights and reflectors; and sometimes in tempests, when the mariner stood most in need of their guidance, they had thus nearly converted the lighthouse into a dark lantern, which emitted only a few feeble rays, and those commonly on the land or lee side. He spoke of the anxiety and sense of responsibility which he felt in cold and stormy nights in the winter, when he knew that many a poor fellow was depending on him, and his lamps burned dimly, the oil being chilled. Sometimes he was obliged to warm the oil in a kettle in his house at midnight, and fill his lamps over again; for he could not have a fire in the lighthouse, it produced such a sweat on the windows. His successor told me that he could not keep too hot a fire in such a case. All this because the oil was poor. A Government lighting the mariners on its wintry coast with summer-strained oil, to save expense! That were surely a summer-strained mercy

"This keeper's successor, who kindly entertained me the next year, stated that, one extremely cold night, when this and all the neighboring lights were burning Summer oil, but he had been provident enough to reserve a little winter oil against emergencies, he was waked up with anxiety and found that his oil was congealed and his lights almost extinguished; and when, after many hours' exertion, he had succeeded in replenishing his reservoirs with winter oil at the wick end, and with difficulty had made them burn, he looked out and found that the other lights in the neighborhood which were usually visible to him, had gone out, and he heard afterward that the Pamet River and Billingsgate Lights also had been extinguished.

"Our host said that the frost, too, on the windows caused him much trouble, and in sultry summer nights the moths covered them and dimmed his lights; sometimes even small birds flew against the thick plate glass, and were found on the ground in the morning with their necks broken. In the spring of 1855 he found nineteen small yellow birds, perhaps goldfinches or myrtle birds, thus lying dead around the lighthouse; and sometimes in the fall he had seen where a golden plover had struck the glass in the night, and left the down and the fatty part of its breast on it.

"Thus he struggled by every method to keep his light shining before men. Surely the lighthouse keeper has a responsible, if an easy, office. When his lamp goes out, *he* goes out; or, at most, only one such accident is pardoned.

"I thought it a pity that some poor student did not live there, to profit by all that light, since he would not rob the mariner. 'Well,' he said, 'I do sometimes come up here and read the newspaper when they are noisy down below.' Think of fifteen Argand lamps to read the newspaper by! Government oil! light enough, perchance, to read the Constitution by! I thought that he should read nothing less than his Bible by that light. I had a classmate who fitted for college by the lamps of a lighthouse, which was more light, we think, than the University afforded."

WAVE-MOTIONS.

Let us in imagination stand with Thoreau on the luminous tower and amid the agitations of ocean, air and æth, consider the laws by which The Presiding Power controls these elements. The restless sea through all its movements, from ripple to billow, obeys the same mandate; the time of each oscillation is proportional to the square root of the length of the wave. At great depths the motion of the fluid is wholly insignificant, because at a distance below, equal to the length of a wave, the motion is only $\frac{1}{535}$ of that at the surface.

The size of the wave depends, therefore, upon the force of the wind and the depth of the sea. The largest on the Atlantic observed by Capt. Scoresby were 550 feet long and 30 feet high.

AIR-WAVES.

The air, however, is not confined like the sea, which has only an upward and downward motion, except near the shore, where the force it contains would escape. But the whole mass of air, moving as wind, has also a vibratory or wave-motion producing sound. If the distant bell we hear is tuned to middle C of the musical scale, according to the new French standard, and the temperature is at 16° centigrade, its sound is produced by air-waves vibrating—not undulating—at the rate of 522 per second, each of which is about 2·15 feet in length. The lowest octave of this note which could be heard would, according to Savart, be the result of 16·31 waves per second, each about 68·8 feet long, and the highest octave by waves moving at the rate of 33,408 per second, each ·0492 of a foot in length.

ÆTH-WAVES.

Turning now to the light produced by the fifteen Argand lamps, we behold still more wonderful wave phenomena. The all-pervading æth is, for miles around, thrown into undulations moving at an average rate of 582 million of million per second, having an average length slightly exceeding twenty-one millionths of an inch. These numbers, determined by repeated experiment, appall us, and we turn to that branch of the subject where results are more palpable.

THE CHEMISTRY OF FLAME.

All the phenomena attending the artificial production of light is not yet fully understood. Light is only one of the effects of the burning of hydro-carbons in the gaseous state. The solid candle and the liquid contents of the lamp must be volatilized, and brought into the same expanded state as ordinary illuminating gas before they can be burned. This conditon is attained, in the case of the candle, by the heat of the flame; the liquid wax or tallow, by capillary attraction, is carried along the wick to the point where it is turned to gas. Yet light does not emanate from gases. Draper found that while gases heated to over 1100° centigrade do not give light, all the solids subjected began to be luminous at about 510° C, and they display the several colors of the prism, and finally emit white light.

In the process of burning illuminating gas, the hydrogen is first combined with the oxygen of the air, and the solid particles of carbon, thus deserted by the hydrogen and exposed to the heat generated by the burning gasses, become incandescent, and afterwards unite with oxygen forming carbonic acid gas.

It is, however, true that when the carbon is consumed at the same time with the hydrogen, no light is evolved; such condition exists when the oxygen is mechanically, but thoroughly mixed with the hydrocarbon gas before it arrives at the place of burning. This is effected by the Bunsen burner, in which the air is admitted at the bottom and mixed with the gas on its upward passage within the burner.

The result of this simultaneous burning of both carbon and hydrogen is an increased amount of heat and an almost entire absence of light. It seems, therefore, to be essential to the production of light, that the combustion of the carbon should take place after that of the hydrogen.

INCANDESCENCE.

Steel filings dropped into a current of heated gases give forth brilliant scintillations. Hare, soon after his invention of the hydro-oxygen blow-pipe, fonnd that a pencil of lime held before it, in the burning gases, emitted a light of intense brilliancy. Such a light, when its rays were thrown into parallel lines by means a parabolic mirror, has been seen in diffused daylight at a distance of more than one hundred miles. But to assert that light is generated because carbon or any other solid is incandescent, is not to explain the phenomenon.

Light is proved, beyond a doubt, to be the result of waves moving transversely to the line of propagation; the solid from which it proceeds must, therefore, have the power of producing such waves in the æth. The interesting question to be settled is whether the solid itself, or the æth within it, can be set into high vibratory action by means of waves of heat having a lower rate of velocity. Reasoning from analogy, we must decide in the affirmative.

WAVE INDUCTION.

Air waves have the power of exciting vibrations in solids which are more rapid than the waves producing them. This fact was brought forcibly to my notice many years ago, when I found the low tone in which I was conversing in a certain room was constantly followed, not by an echo, but by a musical note of very high pitch; after a search, the sound was found to proceed from a sheet of steel, 6 or 8 feet long by as many inches wide, standing on its end and resting against the wall.

This sympathetic action can be accounted for by the laws of harmonics. The proper tone of a bell is always accompanied by harmonic sounds readily perceptible to a fine ear. It is asserted by some musicians that every sound made by a musical instrument is thus accompanied.

The vibratory action arising from periodic pulses sometimes appears to be greater than the cause; this arises from the fact that a new impulse is given just before the force of the previous impulse is expended. The same remark may be applied to oscillations. In the gymnasium, the self-swingers exert themselves only at the extremities of the arc. The danger of regular pulses where weight is sustained is well known. Soldiers in crossing a wooden bridge are required to break ranks and step out of tune. I have often seen the long span of a timber bridge, which was firm under the tread of a herd of cattle, thrown into quick vibration by the rapid passage of a dog across it.

The condition required in this case is, that the tread of the dog shall harmonize in time with the vibratory action due to the elasticity of the timber. Many points connected with the subject of secondary vibrations are yet to be further elucidated by experiment.

LIGHT FROM RAPID DILATIONS.

Only one other cause for æth-undulations by means of carbon can now be suggested; it arises from the characteristics and conditions of the three important simple bodies which play the principal parts during ordinary combustion. Oxygen, the element of which more than one-half of our globe is composed, when isolated, is a permanent gas. No power yet applied has reduced it to the liquid state. Hydrogen, a gas sixteen times lighter than oxygen, has also no cohesive power. Natterrer, of Vienna, subjected these gases separately to a pressure of 3,000 pounds to the square inch, when at a temperature of 106° centigrade below the freezing point of water, without producing cohesion. Yet these two gases, when mixed in the proportion of two volumes of hydrogen to one of oxygen, are, by the electric spark, instantly condensed to steam, and, on cooling, to water. Carbon, on the other hand, when isolated, is always a solid. No amount of heat yet applied has brought it to a gaseous, or even a liquid state. In its most condensed condition—as the diamond—it had 3·55 times the specific weight of water; it is 41,890 times heavier than an equal bulk of hydrogen, 2,618 times heavier than oxygen, and 2,992 times heavier than olifiant gas (C_4H_4).

In the process of illumination by the combustion of hydro-carbon gases, as described, the isolation of the carbon seems to be essential. It must, therefore, instantly change its volume and become a solid, and then as quickly assume the gaseous state, in the formation of carbonic acid gas. These rapid contractions and expansions of carbon may act as pulsations on the pervading æth, and thus generate the whole series of waves, which, commingling, form white light.

It is passing strange that carbonic acid gas, a resultant in generating light and heat—including the vital heat of myriads of animals—should, after its passage from the lamp or the lung to the leaf, be again separated from oxygen by a force similar to that its constituents can generate under certain conditions.

MOLECULAR FORCES.

Turning again to the Highland Lighthouse, let us estimate the power expended on its lamps. The average weight of oil consumed nightly was about 16 pounds at the time of Thoreau's visit. Taking the mean of the results of experiments by Favre, Silbermann, Dulons, and Andrews with olifiant gas (oil-gas not being given), we find that 11,943 pounds of water are raised 1°C by the combustion of one pound of oil. This sum multiplied by 16, the number of pounds used per night, and that product by 1,390, the number of foot-pounds which measures the force expended in raising one pound of water 1°C—that being the mechanical equivalent of heat as correctly determined by Mayer in 1842—we have 265,612,320 foot-pounds as the amount of energy expended in generating the light required for a single night.

In order to fully appreciate the power of these molecular forces, it is only necessary to refer to Dr. Tindall's admirable work on "Heat as a Mode of Motion." After calculating the mechanical value of the energy developed when the atoms of one pound of hydrogen and eight pounds of oxygen attract each other, fall and clash together, when the molecules of steam thus generated condense to water, and this water is converted to ice, the author says:—

"Thus our nine pounds of water, in its origin and progress, falls down three precipices; the first fall is equivalent to the descent of a tun weight, urged by gravity down a precipice 22,320 feet high; the second fall is equal to that of a tun down a precipice 2,900 feet high; and the third is equal to a descent of a tun down a precipice 433 feet high.

"I have seen the wild avalanches of the Alps which smoke and thunder down the declivities with a vehemence almost sufficient to stun the observer. I have also seen snow-flakes descending so softly as not to hurt the fragile spangles of which they were composed; yet to produce from aqueous vapor a quantity of that tender material which a child could carry, demands an exertion of energy competent to gather up the shattered blocks of the largest avalanche I have ever seen, and pitch them to twice the hight from which they fell."

Such is the impressive estimate of the force expended in the formation of a pound of ice from its component elements in the gaseous state, yet it will be observed, by the figures already presented, that the energy developed in one nocturnal display of the Highland beacon was sufficient to have thrown the fragments of five such avalanches to the same hight.

Thoreau, the student and lover of Nature in her wild moods and original garb, doubtless, with mingled feelings of awe and delight, beheld from that beacon-tower the surging of the sea, and heard, in sullen sounds, the threatenings of a tremendous force; but as he turned toward the light, which fixed the gaze of many an anxious mariner, he did not realize the truth that Art had there trained Nature to perform the common service which must ever be regarded as one of her greatest miracles; and that, to guide the sailor along the dangerous coast, she sent forth her messengers of light amid the ambient æth, whose undulations, in each and every minute of time, outnumber all the ocean waves that have culminated since man first ventured on the deep.

The National Debt.

The entire debt of the United States is officially reported, under date of May 31st, at a little over twenty-six hundred and thirty-five millions of dollars, which is near five hundred millions more than was estimated in the last report of the Treasury Depart ment. The exact figures are as follows:—

Interest payable in gold	$1,108,113,842
Interest payable in currency	1,053,476,371
Treasury Notes not bearing int	472,829,270
Past due, and interest ceased	786,270
Total	$2,635,205,753

The estimated receipts for the year ending June 30, 1866, are three hundred and ninety-six millions, as follows:—

From Customs	$70,000,000
From Internal Duties	300,000,000
From Lands	1,000,000
From Miscellaneous Sources	25,000,000
Total	$396.000,000

The annual interest in coin and currency together is over one hundred and twenty-four millions, which is an inconsiderable fraction less than six per cent on the interest-paying portion. We are now able for the first time to assign a proximate limit to the debt, and to estimate very closely its yearly burden on the country. When all the expenses of the war are settled the mass will doubtless be near three thousand millions of dollars. The policy of the Government will be to convert the Treasury Notes into bonds with as little delay as possible. At six per cent, which is the present average rate, our annual interest will be one hundred and eighty millions of dollars.—*Evening Post.*

MISCELLANEOUS SUMMARY.

At the Academy of Sciences, M. Collignon read a paper on a method of representing the surface of the earth on a plane, by making the poles the common centre of a series of circles representing the geographical parallels. By this system of projection, the deformation of the angles and changes of length may be easily ascertained, and thus, by easy rules and tables, constructed by the author, the real dimensions may be easily determined at each point of the map. Mr. Reboul sent in a paper on a new carburet of hydrogen, which he calls *valylene*, and which is composed of ten equivalents of carbon and six of hydrogen. It is obtained by distillation from the bromide of valerylene, treated with an alcoholic solution of potash. The new substance only distils from the latter at a temperature of from 40° to 50° centigrade.—*Galignani.*

Test for Rum.—Mix a little of the rum to be tested with about a third of its bulk of sulphuric acid, and allow the mixture to stand. If the rum is genuine, its peculiar odor remains after the liquid has cooled, and even after twenty-four hours' contact, may still be distinguished. If, on the contrary, the rum is not genuine, contact with sulphuric acid promptly and entirely deprives it of all its aroma. The author affirms that he had never found this very simple process fail, and that all spurious rums may thus easily be distinguished from the genuine.—*Pharmacie & Chem. News.*

Adulterated Lard.—Dr. Crace Calvert, of Manchester, England, says that the snowy appearance of American lard is obtained by thoroughly mixing, by means of machinery, starch in a state of jelly and a little alum and lime, with the lard, by which means two ends are attained, viz., the introduction of twenty-five per cent of useless matter, and a perfect whiteness from the high state of division of the same.

A huge raft of logs, estimated to contain 700,000 feet of lumber and measuring half a mile in circumference, was towed up Lake Memphremagog the other day. It belonged to a company in Newport whose steam mill sawed 13,000 feet of lumber in nine hours and forty minutes.