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 hydro-carbon 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, found 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 41,390 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 Department. 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	370,000,000
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.

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