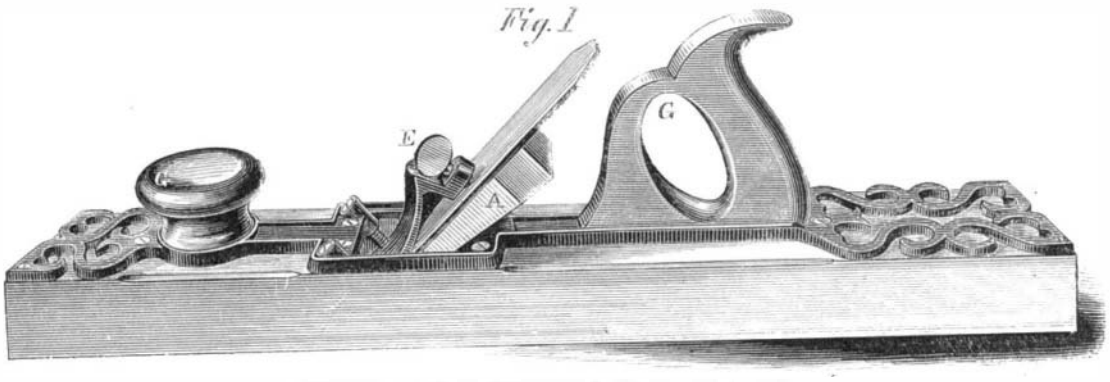
Improvement in Plane Stocks and Irons.

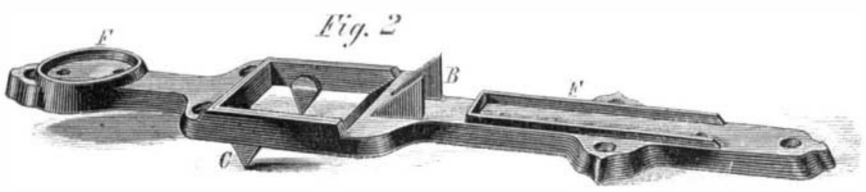
Even when constructed of the best seasoned wood and of such necessary dimensions as to make it heavy and unwieldy, the ordinary plane stock occasionally warps and has to be redressed on the face. The common method, also, of adjusting the bits or irons tends to spring the plane and to destroy the wooden key or wedge. Both these difficulties are intended to be obviated by the improvements shown in the accompanying engravings.

Fig. 1 shows an improved plane, the stock lighter than usual, and stiffened, strengthened, and adjusted, as to weight, by an ornamental malleable iron or brass casting extending its whole length. Fig. 2 is an iron cap similar to that in Fig.1 but specially adapted to planes as ordinarily used, these being susceptible of receiving this improvement without costly alteration. Fig. 3 is a common plane iron, or bit, with a metallic wedge instead of the wooden wedge, and double or stiffening iron, both of which it supersedes.

The plane—Fig. 1—has a fixed incline, A, secured in the throat of the plane by a common wood screw passing through a slot in the incline so that it may be adjusted as necessary. This has a bearing on the inclined supports of the metallic top, seen plainly at B, Fig. 2. The pointed, downward projections, C, same figure, engage with the upper surface of the wedge, D, Fig. 3, and the thumb screw, E, by turning one way, brings the wedge firmly against the bit near its edge, and by turning in the other direction, after being seated in the plane, presses the wedge, D, against the projections, C, holding both bit and wedge firmly. The recesses, F, Fig. 2, are for the reception of the handle and guide, G, Fig. 1. In the ordinary slotted plane iron the screw, E, turns in one end of a strap that slides in the slot of the bit, the other end being held to the bit by the ordinary flat headed screw.



SMITH & CARPENTER'S PATENT PLANE.



In the plane represented in Fig. 1 the screw, E, sets against the plane iron or bit, which has no slot in it. In this figure two adjustable screws passing through the metallic capping serve the same purpose as the projections, C, in Fig. 2, acting as fulcrums against the wedge. By this improvement the width of the mouth may be instantly adjusted to suit the different kinds of wood worked or the different demands of the work. The metallic covering of the stock may be removed from a worn out stock and adjusted readily to another block. Practical workmen will readily discover the advantages of this improvement.

Patented through the Scientific American Patent Agency August 25, 1868, by Smith & Carpenter. Other features are covered by a caveat subsequently filed. For further information address F. Smith, 11½ West King street, Lancaster, Pa.

THE BAROMETER.---ABSTRACT OF A LECTURE BY PROF. GUYOT.

Reported for the Scientific American.

The third lecture of the scientific course before the American Institute, was delivered by the veteran physical geographer, Prof. Guyot, whose labors in this field were eloquently alluded to by Judge Daly, in introducing the lecturer to the large and appreciative audience present on the occasion.

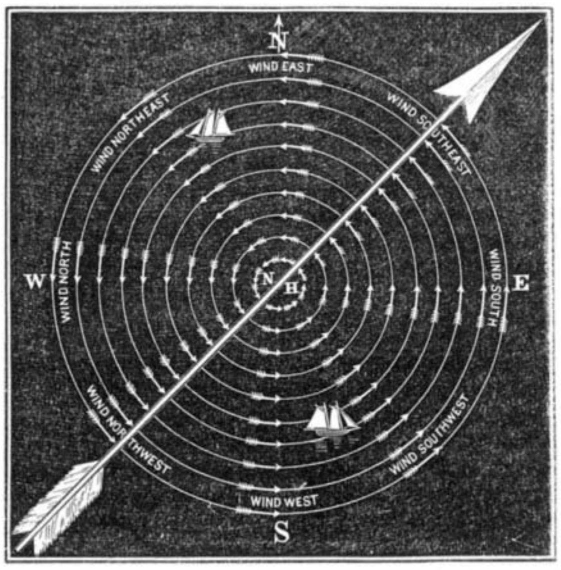
The lecturer introduced his subject by an allusion to the three forms of matter of which the earth is composed, viz., solid, fluid, and gaseous. The aqueous portions of the globe contain all, or nearly all, the lowest types of animal life, the solid land being the home of the higher types, including man, the crowning work of creative power. The gaseous portion of the globe —the atmosphere—is composed chiefly of oxygen and nitrogen; one volume of the former to four of the latter, or 23·82 parts by weight of oxygen to 75·55 parts of nitrogen.

The motive power of animals, as well as much of that used in engines for the propulsion of machinery, is derived from the union of the oxygen contained in the air with other substances. Most of the influences which affect the life and growth of the higher orders of animals and plants, and to which the general name of "climate" has been applied, originate in the atmosphere and depend upon changes in its heat, moisture, and weight. Although the subject of the present discourse pertained strictly to the weight of the atmosphere, it could not be considered independently of some of the phenomena of heat and moisture.

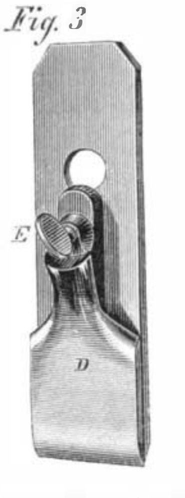
Prof. Guyot next discussed the depth of the atmosphere, and its variations of density for different altitudes. The depth of the atmosphere is estimated at forty-five miles, but the lower four miles of this depth contain more than one-half its entire weight. This point was illustrated by a large and beautiful colored diagram, in which the blue color of the atmosphere was shown gradually shaded out toward its upper limit, and the hights of the loftiest peaks of the Alps, Andes, and Himalayas, contrasted with the entire depth of the ærial ocean. It must not be supposed that a definite upper limit to the atmosphere can be fixed although it can be approximated. A very thin pellicle of air surrounding the globe contains nearly all the organic life upon it. If a globe fifteen feet in diameter should be taken as a representative of the earth, a stratum of any substance taken to represent the layer of air in which organic life exists would be only a small fraction of an inch in thickness.

The lecturer next proceeded to define the word barometer—a measurer of weight. Until the 17th century the air was generally believed to have no weight. Aristotle tried to demonstrate the weight of the atmosphere but failed to do so. Galileo determined it first. He showed that water would only rise in a tube when the pressure of the air was removed from its upper extremity beyond a definite hight. His pupil, Torricelli, following in the footsteps of his illustrious master, conceived the idea of substituting mercury on account of its greater weight for the water column. He filled a tube, closed at one end, with mercury, and, inverting it in a cup containing the same substance, found that the mercury settled to a given point, above and below which it fluctuated as the outside pressure varied.

Prof. Guyot here reproduced the Torricellian vacuum, with a glass tube and a tumbler, and stated that that apparatus was the best barometer that had yet been invented, although some improvements for convenience of transportation, but not affecting the essential principle, had been added to better adapt the instrument for scientific investigation. Scales of different kinds have been devised, but they all have for their object the measurement of the distance between the level of the mercury in the cup and the top of the column in the tube. This being the case, it is always important that the mercury in the cup should be adjusted to a fixed level, the zero of the scale, or that the error arising from its variation from that point, should be allowed for in reducing the observation. Other sources of error arising from differences in temperature, etc., were pointed out. The Torricellian vacuum could not be relied upon as being sufficiently perfect, unless all air had been removed from the mercury by boiling it in the tube before inverting it. The surface of the upper end of the column is convex, owing to the mutual repulsion of the glass and the mercury. The highest point of the convexity, is therefore, not the true reading. A mean between it and the lowest point must be taken. This can, however, be easily corrected by calculation.



The speaker next proceeded to describe various other barometers. The aneroid barometer was described as being an air-tight box with elastic walls, which are compressed when the weight of the atmosphere increases, and expand when the external pressure diminishes. The motion caused by the compression and expansion is multiplied by an ingenious mechanism and marked upon a dial by a hand. Although the instrument is sufficiently accurate for many purposes of observation, it can not be reccommended for scientific investigation. The circumstances which render elasticity constant are subject to frequent disturbance; and a slight blow upon the exterior of an aneroid barometer is sufficient to change its zero, and give rise to grave errors. The instrument, although good for home use, is a bad traveler. Another instrument, invented by a French savant, consists of a hollow angular tube bent like a bow, which straightens or contracts with the varying external pressure, and which, by mechanism similar to the aneroid, marks the variations upon a dial. The same remarks were applicable to this instrument as were made of the aneroid barometer. The siphon barometer is the only one that approaches in reliability the original Torricellian barometer. This form of instrument, instead of having a tube of mercury inverted in a cup of mercury, has the lower end of the tube bent upward in the form of the letter *U*. The external pressure upon the open end of the upturned leg of the tube sustains the column in the leg of the tube, sealed at the upper end, so that the mercury in that branch receives no pressure from the external air. The addition of an ivory float upon the surface of the mercury in the open end of the tube having a thread attached to it, the thread passing over a small wheel attached to a hand upon a dial, and a counterpoise fixed to the end of the thread opposite the float, the whole being inclosed in a case, constitutes the commom well-known wheel barometer. Another common form of the barometer is the tube and cup fitted into a wooden case with a vernier scale at the top. These different forms of the instrument were illustrated by diagrams. Two of the diagrams displayed upon the stage, one illustrating the self-registering and printing barometer invented by Prof. Hough of the Albany Observatory, and another the curve of hights from Oct. 5 to Nov. 3 1868, as delineated by that instrument, were not alluded to by the lecturer, probably for want of time. It is much to be regretted that an explanation of this beautiful and intricate device could not have been given. It depends upon the making and breaking of an electric circuit by the rising and falling of the mercury, for the communication of impulses to electro-magnets, which unlock a train of clockwork so devised as to not only to describe a constant curve upon a piece of paper, representing the hight of the column at anytime of day and night for many days in succession, but also to print upon pages, which may be subsequently bound, the hights of the column as often as may be desired; thus, making a printed record with great accuracy, and with scarcely any attention being required other than to renew the battery and to substitute new slips of paper as often as they are filled with the record. The tube used is a siphon, and the means by which the above results are accomplished rank among the most ingenious and remarkable of modern in ventions. The value of such an instrument to science can scarcely be overestimated. Neither was any mention made of the barometrograph, illustrated and described on page 149, of the current volume of the SCIENTIFIC AMERICAN, but it could scarcely be expected that more than a mere allusion to these ingenious devices should have been made in a single lecture. Such an allusion, however, was due to these instruments, as a tribute to their great scientific value and the genius displayed in their construction.



The speaker pointed out the fact that in the use of the ordinary wheel barometer errors were liable to occur, owing to the friction upon the float caused by the oxidation of the mercury and from other causes. These errors, and the fact that the public had in general been led to expect too much from them as weather indicators, had tended to make this form of the instrument unpopular. The value of a barometer as a weather indicator depends upon the correctness of the interpretations put upon its indications. It does all that it purports to do, that is, it indicates variations in the weight of the atmosphere. These variations are intimately connected with changes of weather, as they depend upon differences in heat, moisture, and direction of winds; but as the precise nature of the relations existing between these phenomena are in general very imperfectly understood, it follows that observers are by far more numerous than competent interpreters.

The form of instrument best adapted to scientific use is that adopted by the Smithsonian Institute, and hence known as the Smithsonian instrument. It is a mountain and observatory barometer, so called from its use in measuring hights in mountains and for observatory purposes. The lecturer himself had the honor of introducing these instruments into this country on behalf of the Smithsonian Institute. It can be divided into pieces of suitable lengths for easy transportation; has an adjustment for bringing the level of the mercury in the cistern to zero, a vernier scale for reading fractions of an inch, and adjustments which can be made to correct all the errors above enumerated, so that a simple reading can be made as exactly as can be done with the old form of the mountain barometer, without the necessity of subsequently reducing the results of the observations. This instrument is so perfect in its operations that a variation of $\frac{1}{2000}$ of an inch can be read. The lecturer has determined the hights of mountains with it within three feet of their actual hight as determined by angular measurement.

The lecturer next proceeded to show the causes for fluctuation of the mercurial column. These fluctuations may be divided into regular and irregular. The irregular fluctuations increase from the equator toward the poles. At the equator the fluctuations are mostly regular and uniform. The regular fluctuations are monthly, daily, and hourly. The monthly fluctuations are caused by the change in the relations of the position of the earth to the heavenly bodies. The daily fluctuations are caused by atmospheric tides, and the hourly to a variety of causes some of which are yet obscure. These variations are so uniform that Humboldt said of them that it was quite possible at the equator to determine the time of day by the barometer. The monthly variations are greatest in the tropics. The barometer stands lower generally in summer than in winter, the difference depending chiefly upon the greater amount of moisture contained in the air during the summer season, which renders the atmosphere lighter, the gas of water having only about six tenths the weight of air. The speaker dwelt at some length upon this point, but entirely omitted to mention the effect upon the atmosphere, of water existing as water in the air, as it occurs during the fall of rain or when it is suspended in the vesicular condition known as fog.

The irregular fluctuations are caused by changes in the temperature, hygrometric condition, and disturbances of the atmosphere by winds, which, as it were, roll a wave or swell of the ærial fluid before them. Such variations increase toward the poles, so that in our latitude the barometrical column is in a state of almost constant perturbation. These perturbations are so small, as in the ordinary mode of observation to be imperceptible, but they are none the less real.

The lecturer next introduced and explained diagrams illustrative of the variations in the barometrical column corresponding to the direction of winds, both in North America and Europe, and followed these with a diagram, which we reproduce herewith, illustrative of Redfield's theory of storms or cyclones, which he said was now fully established.

The large arrow in the diagram shows the general direction of a storm for the northern hemisphere, but while the storm, as a whole, proceeds from the southwest toward the northeast, it at the same time revolves around a center in the direction of the arrows, or in an opposite direction to the hands of a watch, the wind blowing in any part of the area covered by the storm as indicated by the direction of the arrows in that part of the diagram. As these storms approach, the barometer first rises abruptly then rapidly falls. As the first part of the storm that reaches us at any point to the right of the large arrow is the northeast part, the wind will consequently at first blow from the south east. As the storm advances the wind will blow successively from the south, southwest, west, and northwest, at which time the weather clears up and becomes settled. If at the approach of a storm to any point the wind blows from the northeast or east, that point lies to the left of the line of approach, as shown by the large arrow. The wind will then change, first to the north and from thence to the northwest which will end the storm.

Hundreds of millions of dollars might be saved if sea captains would understand and apply this theory. The position a vessel occupies in relation to the general line of progression, can be determined by the direction from which the wind blows at the point it occupies, and the vessel can then be headed so as to get out of the gale by the shortest route, as shown in the diagram, which explains itself.

Our limited space prevents us from doing full justice to this interesting and practical lecture, which was listened to throughout with profound attention, and frequently applauded, although more than usually protracted.

PHILOSOPHY OF THE TEA-KETTLE--A LECTURE BY PROFESSOR SILLIMAN.

[Reported for the New York Tribune.]

Professor Silliman delivered a lecture on the above subject before the American Institute, Dec. 16, 1868. After the usual introduction Professor Silliman commenced his lecture by narrating briefly the story of Watt's experiments with the tea-kettle in his youth, which first attracted his attention to the study of steam and its application to mechanical works. After some remarks upon the phenomena of heat, while the water in a vessel upon the stand was gradually rising in temperature, by the heat of a Bunsen burner, he said: This vessel which we are heating has now become filled with bubbles. Fishes breathe water because it contains atmospheric air, while it is richer in oxygen than common air. The first phynomenon therefore in seeing that kettle boil is the displacement of the air. Tasting water that has been boiled, after the air has been expelled, and before the air has time to return, it is flat and unpalatable. The tea-kettle is boiling under the pressure of the atmosphere. Every individual carries a tun weight in the pressure of the atmosphere upon his person. Ordinarily we do not feel it; but in walking on the surface of miry clay we feel it, because then the upward pressure on the soles of our feet is removed. The second condition we have to consider, then, in the boiling in the tea-kettle, is that we are boiling the water under the pressure of 15 pounds to the square inch. Boiling is not always necessarily connected with temperature. If the pressure of the atmosphere is taken off, in whole or in part, there may be ebullition without great heat. [Water at 120° was here boiled in the air pumps.] Boiling consists simply of little bubbles of vapor rising and escaping from the surface of the fluid. An egg might be boiled all day in water at 120° without being cooked. because it requires a greater heat to cook it. As these little bubbles rise in the tea-kettle, they strike a colder stratum of water and are condensed, the water failing to fill the vacuum, producing the sound we call the singing of the tea-kettle. The next stage of our process of boiling will be the process of distillation, which consists in the transfer of particles of water out of the liquid state into vapor, then its translation and final recondensation in another place.

The amount of heat passing into the water in the tea-kettle would be measured by the thermometer until it reached 212°. At that point the thermometer would cease to rise, although the heat was still passing as rapidly as before into the water; the surplus being employed in converting the water into steam, which escapes from the vessel. Having heated water in a glass vessel to the boiling point, we remove the fire and cork it up. It continues to boil; and upon pouring cold water upon the surface, it boils still more violently. Why? Because the condensation of the steam removes the pressure, and the water boils more readily, even at a lower temperature. He proceeded to try Count Rumford's experiment of building a hot fire, with a temperature of not less than 2,000° above a vessel of water. The surface of the water boiled, as shown by its condensation upon a cold glass plate laid above it; but the water in the vessel was not heated. It is necessary, therefore, to heat the tea-kettle at the bottom, and not at the top. If we desire to boil substances which will be injured by the temperature of 212°, we may readily boil them at any lower temperature above 100° by removing the pressure of the atmosphere. Taking equal quantities, by weight, of ice at 32°, and boiling water at 212°, the ice was melted by the water, and the temperature of the mixture was 52°. There had disappeared 140° of heat, and this was the latent heat, without which the water would remain ice. Everyone has noticed that the melting of ice in the spring causes a great chill in the atmosphere; for whenever and wherever ice is melted, it absorbs inevitably 140° of heat. On the other hand, the vaporization of water takes up a great deal of heat, which is rendered latent; for steam itself, at the pressure of the atmosphere, has only a temperature of 212°. If we measure the heat thus becoming latent, we shall find that it amounts to about 970°. By adding constantly a given quantity of heat, we shall find that it takes 5½ times as long to convert a given quantity of water into steam as to raise it from 320° to 212°. This latent heat would be enough to heat water, if a solid, red hot. If we add to the pressure of the atmosphere, we shall have a higher temperature of the steam; but the amount of latent heat in the steam will be less, the sum of the latent and the sensible heat being a constant quantity, equal to 1,180° Fahrenheit. The conversion of water into steam will expand it into 1,700 times its former bulk, and this exerts a prodigious amount of mechanical force which is utilized in the steam engine. Heat is nothing but a mode of motion; and the steam engine enables us to make that motion useful in the form of mechanical power. He illustrated the reconversion of motion into heat by rapidly turning a brass tube containing ether and corked up, and holding around it a wooden clamp until sufficient heat was generated to convert the ether into vapor and blow the cork from the tube. Count Rumford, in the latter part of the last century, tried a similar experiment upon a much larger scale. When in the employment of the Bohemian government at Munich, he made those remarkable experiments which have signalized his name in this department of knowledge; for he employed horse power in the boring of cannon held in a vessel of water at the ordinary temperature, noting the time occupied, and the amount of force supplied. In about two hours and twenty minutes he brought this large body of water into a state of ebullition, simply by the mechanical power applied in boring; and he determined by these experiments that in order to raise a pound of water through one degree of Fahrenheit, there must be a different power applied to raise one pound to the hight of 772 feet. This is what is called the mechanical equivalent of heat. Professor Silliman next treated heated water in a closed spherical vessel connected with a column of mercury and a thermometer. When the pressure of the steam had forced the mercury to the height of 33 inches, corresponding to a pressure a little more than that of the atmosphere, the thermometer had risen to 245°. He then opened a tube to allow the steam to escape into a vessel, at first producing a rattling sound in consequence of the condensation of the steam by the water and the falling of the water to fill the space thus left vacant; but very soon the water was raised to the boiling point, and the rattling ceased, and the steam passed noiselessly through the water, and escaped. It is easy to convey heat in the form of steam; and it is now common to convey it in pipes sometimes for long distances to wooden vessels, where it is desired to boil water. Steam is the most wonderful vehicle for transporting heat with which we are acquainted. This hall is heated by steam from a boiler in the celler, giving us 1,000 degrees of heat, the latent heat of the steam becoming sensible as it is condensed in the pipes, and with such astonishing rapidity that it sufficiently warms the atmosphere of the room, furnishing one of the most efficient means of heating which is known. Heating either by hot water or by steam, the relative merits of which I am not now discussing, is by far the most economical, the most efficient, and the most agreeable of all artificial means. Professor Silliman then exhibited a toy steam engine, rated at two-mouse power [laughter], and proceeded to give an explanation of the steam engine as invented by Watt. The first step of improvement was to close the cylinder at the upper end; hitherto it had been open. In the former steam engine the steam had forced up the piston, and upon the condensation of the air in the piston by cold, the atmospherial pressure brought it back again. Watt had introduced other improvements, among which were the injector, the governor, and the cut-off. There has never been in the history of inventions since the world began any machine or apparatus which was so perfect as it left the hands of the inventor, as the steam engine was when it left the hands of Watt. You may stand to-day beside the most stupendous piece of steam engineering in the world, and you will see connected with it no essential change from his invention. It is true that he had no machinery or tools competent to reach the exact results that we can now produce. He had no turning lathes, boring-machines, planing machines, but all was done by a cold chisel, the hammer, the file, etc.; and the marvel is that he produced such results as he did. I have often thought with what delight that great man would stand upon one of our first-class steam frigates, or by one of our first-class pumping engines, such as are used at the reservoirs in Brooklyn and New York, and see the perfection, the finish, and the smoothness of the work, a result possibly solely due the genius of Watt, because without that power we could not have had the apparatus with which to apply it. Professor Silliman next proceeded to illustrate the irregular expansion of water near the freezing point. He filled a vessel with water at 55° and surrounded it with ice and salt to reduce its temperature. A freezing mixture is composed of two solids having an affinity for each other, but which cannot unite without becoming fluid; and in order to become fluid a large amount of latent heat is required, which must be borrowed from the surrounding substances. In the vessel of water he immersed two thermometers, one near the top and the other near the bottom. As the temperature of the water fell, the temperature of the lower thermometer descended to 39½°, and there remained stationary, while the upper thermometer continued to fall, and at last reached the freezing point. Why does not that system of currents keep going on like the boiling of water in a flask, so that the whole shall freeze at the same time? That is just where this wonderful exception takes place, and it is the great delight of a devoted mind to believe that the exception is a part of the original intention of the Great Architect in the formation of the world in adapting it to be inhabited by human beings, because we may readily believe that, except for this irregularity in the expansion of water the world would be uninhabitable. At the temperature of 39½° the very contrary effect takes place, and the water begins to expand, it increases in bulk, and consequently becomes specifically lighter, and, like a cork, floats upon the surface, or immediately beneath it; so that you will have the surface of the water cooled down to 32°, and converted into ice, and yet that freezing does not extend much below the surface. You rarely find in the coldest winter that ice is formed more than two feet thick. If you observe a caldron of molten iron as it cools, does it solidify first on the top? No. Does a mass of lead in a ladle solidify at the top? No; but equally at the bottom. In most cases the solid, which is the result of congelation, is heavier than the fluid in which it is formed and sinks to the bottom, whereas in the case of the water the solid is much lighter than water. We have here another exception that the ice which is formed is lighter than the water and it floats upon it. When we see an iceberg from 100 to 200 feet above the surface of the sea we know that for every foot of elevation above water there are 10 feet of depression beneath the surface; so that what we see is only one eleventh of the whole bulk. Lake Superior has a uniform temperature of about 40°, and beneath the surface in the Winter, in any of our lakes we shall find water at about that temperature. This is an important fact with reference to the inhabitability of our globe; because, you observe, that if water as it solidified continued to shrink and to become heavier, the whole mass would become frozen in a single winter so that no summer would be long enough to melt it, and eternal death would rest upon the surface of the globe. In the freezing mixture Professor Silliman inserted one end of a closed tube, containing vapor, and containing water in a bulb at the upper end, and the condensation of the vapor from the abstraction of the heat by the freezing mixture, in its turn, abstracted the heat from the water in the bulb above so rapidly that it was frozen solid.

He then illustrated the heating of houses by hot water pipes, showing that the heated water would rise, from its being lighter than not heated, and thus a circulation of water never heated above the boiling point, and therefore not liable to burn the atmosphere by charring particles of dust in it, would be constantly maintained. He proceeded to speak of the chemical constituents of water, being two atoms of hydrogen and one of oxygen. These two gases which have never been reduced to liquid form by mechanical power, would readily unite by the magical power of chemical combination, and form that wonderful matter which we call water. The ancients in their philosophy said the earth is composed of four elements, earth, water, air, and fire. We may interpret this under the light of modern science thus: Earth is the solid, water is the liquid, air is the gaseous condition of matter, and fire is the force that converts them all from one condition into the other. We have in water the solid ice, and permanent as granite, so long as the temperature is unchanged. We have in water an inelastic, mobile, transparent fluid. We have in water the perfectly elastic invisible gas which we call steam. Although we cannot by mechanical means compress the gases which constitute water into liquids or solids, yet by their union we can condense them into water, and we can by their union produce the highest degree of artificial heat which it is in the power of man to produce mechanically. Two vessels, one containing hydrogen and the other oxygen gas, were connected with a single tube. The former being turned and lighted produced an ordinary flame (the gas not being pure), but upon turning on the oxygen gas the two produced a much whiter and more brilliant light. Placing in the blaze a mass of cold iron, the water produced by the union of the gases was condensed upon its surface, falling from it in drops. He next placed in the blaze a slender bar of steel, and the heat was so great as to burn the steel, scattering it in a shower of intensely brilliant sparks. These two elements, by their collision, produce an amount of heat, as a mode of motion which is beyond that which we can produce by any other artificial means which is purely mechanical. We can, indeed, by this voltaic current, acting chemically, produce a current of electricity in the focus of which everything which can be melted, melts, and everything that melts volatilizes. That, as I have said, is a mode of motion. It can be converted into motion, and motion in like manner can be converted into heat. We are living upon a ball of matter moving through space with planetary velocity, and if that mechanical motion with which the earth is moving in its orbit could be suddenly arrested the amount of heat which would be equivalent to that mechanical motion