and highly cultivated mind; his aims were high, and he soared above the sordid interests of the world. He never sought to make himself conspicuous, or to give publicity to his attainments or labors, but chose rather unobtrusive retirement. His deportment was always gentlemanly; his form fine, and his countenance highly intellectual. His conversation was ever interesting and instructive; and he lived and died with the respect and esteem of all who knew him. He was the last surviving member of his college class; and with two exceptions—Judge Farrar and James Lovell—the oldest living graduate of Harvard University.

As early as 1788, as already noticed, while a resident of Salem, he became especially interested in the purpose of applying steam-power to the practical end of propelling boats and land carriages. He foresaw the importance of attaining such a purpose, and set himself to work to contrive the necessary machinery to effect it, which at that time was felt by all intelligent men who had given their attention to the subject, to be a *desideratum*—a work yet to be accomplished. The idea as applied to boats was not new; various experiments had been tried, but were mainly directed to the mode of propulsion, without so much attention to the motive power; and all the experiments hitherto tried had proved a failure.

THE WIRE ROPE TRAMWAY AT BRIGHTON, ENGLAND.

[Condensed from Scientific Opinion.]

The wire-rope transport system may be described as consisting of an endless wire rope running over a series of pulleys carried by substantial posts which are ordinarily about 200 feet apart. This rope passes at one end of the line round a drum, driven by either steam, water, or even horse power, in small farming operations, at a speed of from four to eight miles per hour. The boxes in which the load is carried are hung on the rope at the loading end by a wooden Λ-shaped saddle, about 14 inches long, lined with leather, and having four small wheels, with a curved pendant, which maintains the box in perfect equilibrium while traveling, and most ingeniously, but simply, enables it to pass the supporting posts and pulleys. By a sliding-ring arrangement the boxes or buckets are easily emptied by tilting, without unshipping the saddle from the rope. The boxes can be made to carry from 1 cwt. to 10 cwt., and the proportions of the line and the loading and discharging arrangements can be varied to suit any particular requirement, ranging from 10 tuns to 1,000 tuns per diem. At each end of the line are rails placed to catch the small wheels attached to the saddles of the boxes, by which means the weight, having acquired momentum, is lifted from the rope, and, thus suspended from a fixed rail or platform, can be run to any point for loading or emptying, and again run on to the rope for transport, the succession being continuous and the rope never requiring to be stopped for loading and unloading.

Curves of sharp radius are easily passed, as well as steep inclines, and its applicability to cross rivers, streams, and mountains, or hilly districts, will be apparent at a glance, as the cost of construction increases but little under such circumstances, whilst that of a road or railroad is, perhaps, increased tenfold, and the daily working cost doubled or trebled. The rope being continuous, no power is lost on undulating ground, as the descending loads help those ascending.

In the case of lines for heavy traffic, where a series of loads, necessarily not less than 5 cwt. to 10 cwt. each, must be carried, a pair of stationary supporting ropes, with an endless running rope for the motive power, will be employed, but the method of supporting, and the peculiar advantage of crossing almost any nature of country with a goods line without much more engineering work or space than is necessary for fixing an electric telegraph, without bridges, without embankments, and without masonry, exists equally in both branches of the system.

In the minor applications, such as short transport from mines to railways, the landing or shipping of goods in harbors and roadsteads, and the carriage of agricultural produce on farms, some peculiar features of the system render it specially advantageous. Amongst these are the facility with which power can be transmitted by the rope and taken off at any required point for mining or other purposes. In lines terminating on the seaboard, or on great rivers, a manifest advantage is secured in the facility for taking goods direct to or from ships in harbor or roadstead without transhipment into lighters.

Seen from a distance, the posts which carry the tramway wires at Brighton, might be mistaken for telegraph poles, but a nearer inspection reveals a second line of wires on the same level, and upon these two wire-rope lines, supported on standards at intervals varying from 300 feet to 1,000 feet apart—according to the requirements of the ground—are suspended iron boxes for the carriage of the goods, which boxes pass on noiselessly and steadily, carried forward by the rope at the uniform rate of five miles an hour—the time required for performing the entire circuit of the line.

In laying out these five miles at Brighton the opportunity has been taken of exemplifying the working of the system under every variety of difficulty that could possibly present itself; thus we have at one part an incline of 1 in 6, up and down which the rope and boxes work with perfect facility, the descending weights assisting those which are ascending; then there are, besides several bends less acute, two instances of absolutely right-angles which are passed with the greatest ease; in some instances the standards are carried to the hight of 70 feet, to meet inequalities of the ground, undulating and hilly country being more trying to this system than craggy and mountainous—such as that for which this plant is designed, and where, from the long reaches taken, fewer posts will be required.

The line is rather over five miles long; there are 112 posts, or standards, in the whole length; these standards can either be made of light angle and band iron neatly put together, as in the present case, or of wood. The rope is made of charcoal iron, is two inches in circumference, each strand as well as the center of the rope having a hempen core, to secure ductility. The power employed to drive the rope is a portable 16-horse power engine.

Some of the spans are 600 feet and 900 feet in length, and ingenuity has been shown in devising every possible mode of testing the merits of this system of transport; and we are bound to record that all difficulties have been overcome with complete success. The line is capable of delivering 240 tuns per day of ten hours, *i. e.*, 120 tuns in each direction.

This tramway has been erected by Mr. Hodgson the inventor, at the request of some gentlemen with whom he was in negotiation, for the supply of materials for a line sixty miles in length in Ceylon.

It is intended to divide the proposed Ceylon line of 60 miles into 5-mile sections such as the one described—one engine working every two sections, and the boxes passing each section by shunting arrangements, similar to those used at the termini, from one section to another. The line in work will be open daily to public inspection during the month of April, and is well worth a visit. It is hardly likely that so efficient and economical a means of transport will be for long exclusively confined, as at present, to the conveyance of goods. For ourselves, we venture to confidently predict an early adaptation of the principle of this ingenious system to passenger traffic.

FURROWING AND PITTING IN LOCOMOTIVE BOILERS.

BY JOHN G. WINTON.

Some theorists attribute furrowing to the expansion and contraction of the boiler, inducing a bending and unbending of the plates; if so, then the outside of the plates would show an abrasion similar to the end plates of the smoke-box, as with inside cylinders, or simply to a straight strip of iron bent and unbent by the hand. These furrows are observed with lap joints, with butt joints having inside strips, but when the strips are outside no furrowing takes place. Now, with this statement, I hold this theory of bending and unbending of a circular boiler to be perfectly erroneous, and look to natural laws for an explanation of the furrowing and pitting of steam boilers.

Mountain torrents very rapidly wear the bed of a river of the most compact material, and it is well known that the bilge-water in a ship rapidly wears off the rivet heads, by the mere friction of the water rolling forwards and backwards. Were water allowed to drop on an iron plate, drop by drop, pitting would follow, corrosion taking place, and the impact of the falling water washing away the rust as it formed—thus eating into the iron very quickly, more especially on soft spots of the surface.

Now, what is the mechanical action of the water in a locomotive boiler? I take it to be a racing of the particles from the fire-box to the smoke-box end, and as the steam is generated from the tubes, a partial explosion takes place in all directions, carrying the particles of water along with it. I am not so certain that the impact of the water propelled by the steam generated by the tubes acting on the surface of the boiler does not, in a great measure, account for pitting. When corrosion takes place, the incessant impact of the water on the soft spots of the iron must wash off the rust as it forms, leaving the surface always raw, as it were (assisted in some cases by galvanic action). The boilers generally show the center of the furrow about one inch from the lap joint. I will endeavor to give an explanation of this. Noticing pieces of wood floating on the surface of our silent Thames when the river had attained its greatest downward velocity, I was quite struck by observing at the piers of the bridges that the pieces of wood never came in contact with the pier, but invariably took a rapid current about one foot from the pier, and were carried away more rapidly than in the center water-way. How is this to be explained? I take it that the water flowing against the pier is repelled, the same as the sea dashing against a breakwater is thrown back again, and being met with a downward current, and the meeting of the waters, I will say, induces a rapid current one foot from the pier. Those interested can make this observation for themselves by simply looking over, say, Westminster Bridge, and observing materials floating on the surface. I am just going to state that this phenomenon is the cause of the furrowing of locomotive boilers. Where a boiler is made perfectly cylindrical, with butt joints and the strips outside, no furrowing is observed; with the strips inside, or with lap joints, furrowing takes place. Now, in my opinion, the strips and lap joints are the obstructions, as in the piers of a bridge, causing these furrows; the steam generated from the tubes, shooting the water against the edges of the plates, is repelled, and the racing of the water from the fire-box end causes a rapid current to flow parallel with the joints, this upward and repelling and onward action of the confined water inducing more friction, and, consequently, keeping this part of the boiler in a raw state, making it more subject to corrosion and galvanic influence. With these opinions I consider, when the edges of the plates are placed downwards, they are more liable to form furrows. Some bevel the edges of the plates, which I consider will tend to lessen this evil, but cannot imagine it would be easily calked, as it is very difficult to calk a knife-edge. The best cure is by making outside strips strong enough with butt joints and a proper form of rivet, which I maintain is a double counterlap; thus we shall have as strong a boiler with no furrowing, which must tend, in a great measure, to reduce the number of boiler explosions. The following shows the rivet I would adopt for lap and butt joints. A curved countersink is, I consider, the strongest form, as the iron is less distorted. Part of the head of the rivet is retained to resist the force of impact from the riveting hammers; and it is evident that if the head is reduced by corrosion the countersink will hold good. This is not a bending and unbending theory, neither is it a bulging one, as in some cases these theories may hold good; but at the same time the mechanical action of the water in either case I consider rapidly deteriorates the boiler.

Girdling Fruit Trees to Make them Bear.

A correspondent of the *Boston Journal of Chemistry* states that there is no doubt that the girdling of fruit trees is a cause of abundant fruitage, but it by no means follows from this fact that a general principle can be deduced, that trees would be improved, or the crop increased for a series of years, by such treatment. It is well known that gardeners frequently girdle a branch, by removing a narrow ring of bark around it, when they wish to increase the size and beauty of the fruit; but it is done at the expense of its vitality, and, unless the operation is skillfully performed, will invariably destroy it before the season of bearing the next year.

The crude sap, taken up from the soil by the roots of the tree, ascends principally through the vascular tissue of the alburnum or sap-wood to the leaves of the branches, and there both this and the carbon of the carbonic acid, absorbed from the air by the leaves, are organized into the proper substance for the growth of the wood and fruit. It then descends on the outside, principally through the sieve tissue of the cambium layer, forming a new layer of wood and bark; while a part also goes to the nourishment of the fruit. If there is no obstruction of the elaborated sap in its downward course, it is equally distributed to the branches, fruit, stem, and roots; but, if the bark and cambium layer are removed by girdling, it is stopped in its descent, and consequently received into the branches and fruit in excess, and they are thus increased at the expense of the part below. In this way we account for the increase of the fruit by girdling.

Professor John Lindley, when speaking of this subject in his late treatise on horticulture, quotes Mr. T. A. Knight approvingly, as follows: "When the course of the descending current is intercepted, that naturally stagnates, and accumulates above the decorticated space, whence it is repulsed and carried upward, to be expended in an increased production of blossoms and fruit." This theory is adopted by the best physiologists of the present time, and can be demonstrated with almost mathematical certainty. Therefore, this unnatural development of fruit, instead of indicating an improvement of the trees, must be looked upon as a premonitory symptom of disordered physical action, and of premature death.

If the bark and the cambium layer have been removed by girdling, as seems to be the case with the trees, the downward circulatory connection on the outside between the upper and the lower part is destroyed, and the upper part at least must die. If, however, the cambium layer has not been destroyed, and has been so covered by wax and bandages as to prevent evaporation and drying of the surface of the decorticated part, there is a chance for some of them to live. It is true that some few cases are recorded of trees which have lived several years after the bark and cambium layer have been removed, but they are of very doubtful authority.

M. Ernest Faivre, a French physiologist, gives a statement of his recent investigations on this subject, published in the *Gardener's Chronicle*, about two months ago, in which he says: "In mulberry trees, as in all trees deprived of latex, annular incisions generally produce the following manifestations: 1. Formation of a swelling, or tissue restorer, at the upper lip of the wound. 2. Diametrical growth of the parts above the zone of bark taken off. 3. Hardening of the wood in that region. 4. Stationary condition of the parts below, if they are deprived of leaves and buds; or, if not, vigorous shoots from below the lower lip of the wound. 5. More easy, more early, and more abundant flowering and fructification. 6. Destruction, after a variable time, of all the parts above the annulation."

From the foregoing observations it appears that girdling trees in any form is ruinous, and almost always fatal; therefore I heartily concur in the advice given in the *Journal* that orchardists should not experiment on their trees too freely before they see what the final result will be with those already girdled.

Speed of Electric Signals.

Professor Gould has found that the velocity of the electric waves through the Atlantic cables is from 7,000 to 8,000 miles per second, and depends somewhat upon whether the circuit is formed by the two cables or by one cable and the earth.

Telegraph wires upon poles in the air conduct the electric waves with a velocity a little more than double this, and it is remarked, as a curious fact, that the rapidity of the transmission increases with the distance between the wire and the earth, or the hight of the support. Wires buried in the earth likewise transmit slowly, like submarine cables. Wires placed upon poles, but slightly elevated, transmit signals with a velocity of 12 000 miles per second, while those at a considerable hight give a velocity of 16,000 or 20,000 miles.—*Journal des Telegraphes.*

THE Boston *Journal of Chemistry* recommends a mixture of equal parts of dry white lead and red lead mixed into a paste with mastic varnish, and used as soon as made, as a cement for aquariums.

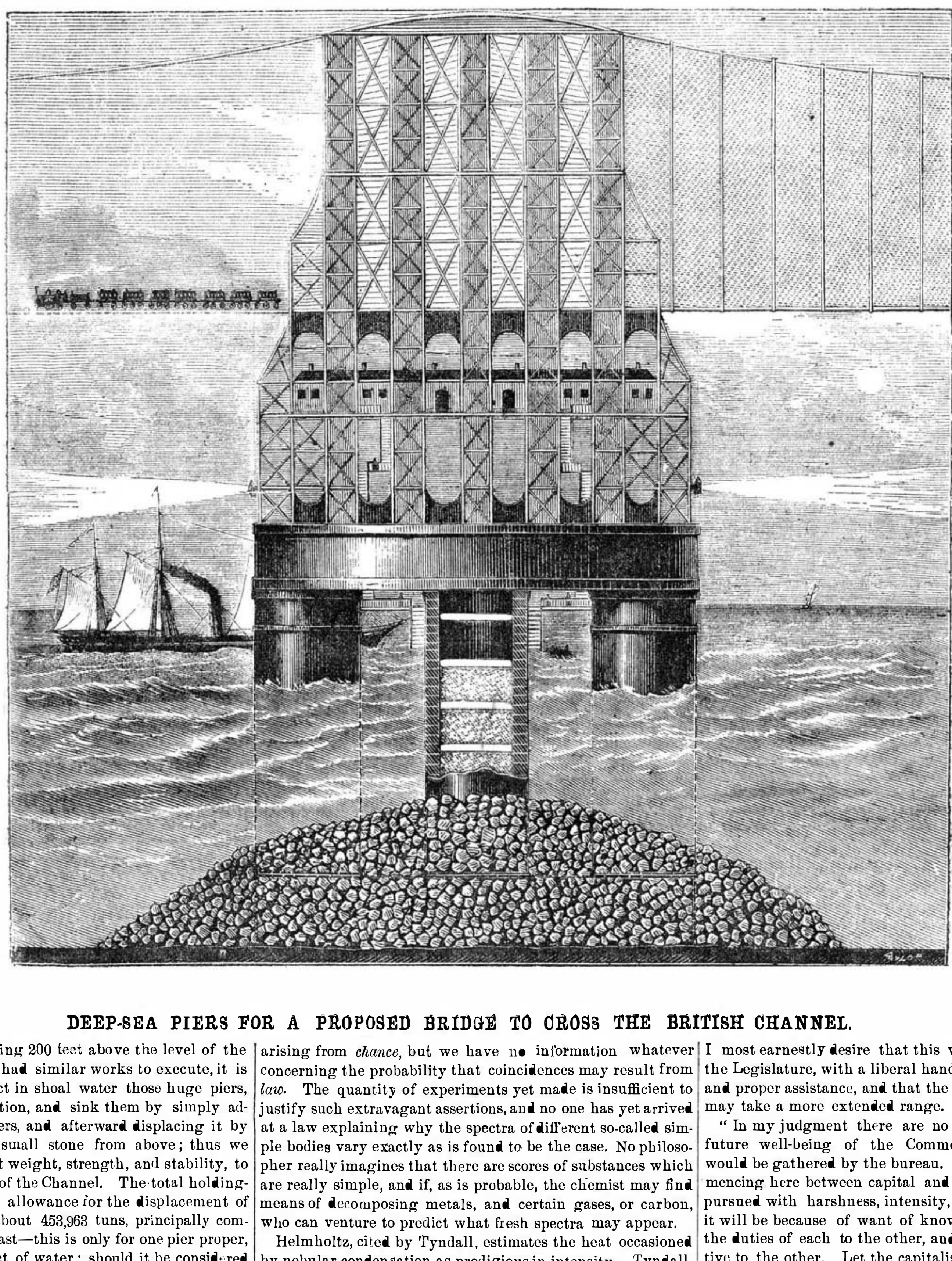
Deep-Sea Railroad Bridges Crossing the English Channel.

If all the plans and projects for crossing the English Channel, which have been published, were engrossed upon suitable paper, rolled up, and cast into that famous passage, they would nearly bridge the space between Dover and Calais, and would form as practicable a structure as many that have been seriously mooted.

We illustrate this week from the English *Mechanic* a plan proposed by John S. Winton, an English engineer, which is, to say the least, as feasible as many others put forth by men of wider celebrity.

Mr. Winton writes to the above-named journal as follows:

"The great difficulty in laying down deep sea bridges is, undoubtedly, the piers; for in the Channel the depth of water varies from 75 feet to 175 feet. The bed, we will presume, is gravel. Some prefer piling, screwing long piles into the sand or gravel, as the case may be. I would lay before you a very different mode of sinking deep sea piers—the accompaning sketch almost explains the plan I would adopt. Three hollow piers are constructed of metal, filled in with concrete, securely joined together at the bottom, as well as having distance pieces uniting them, a little below the surface of the sea, as shown. The length of each would be 390 feet, the breadth of each 60 feet, and the total breadth 260 feet. The piers would have an inner and outer skin, strongly trussed together, the space between the skins being filled up with concrete, as well as the bottom part that rests on the bed of the Channel. Such I consider is the size that would be required for the piers at mid-channel, as the total hight of the structure at that part would be little less than 550 feet, the track being 200 feet above the level of the sea. To those who have had similar works to execute, it is an easy matter to construct in shoal water those huge piers, tow them to their destination, and sink them by simply admitting water into the piers, and afterward displacing it by precipitating puddle and small stone from above; thus we would have piers of great weight, strength, and stability, to resist the troubled waters of the Channel. The total holding-down weight, making due allowance for the displacement of the structure, would be about 453,963 tuns, principally composed of concrete and ballast—this is only for one pier proper, sunk in a depth of 175 feet of water; should it be considered necessary, hydraulic, or pile piers, could be sunk into the bed of the Channel to secure a better foundation. These piles being contained within the piers, could easily be working from the platform, with suitable pipes, valves, etc. Thus, having laid down all the piers, the superstructure could be proceeded with. I consider the suspension principle far before the horizontal wire-rope bridge of M. Bratch, and would certainly recommend a suspension bridge, embodying the ideas of the French engineer, by the system of interlacing all the wire ropes. I consider, when the main suspension ropes were laid on to the depth of the bridge or lattice-work at the center of the spans, a platform could then be laid for finishing the structure, requiring no scaffolding, as in the Boutet Viaduct. I will not trespass on your valuable space much further; suffice it to say, that when both countries agree to a bridge, that bridge can be easily constructed, and although my tunnel project does not interfere with the navigation, I think all must allow, and more especially the fair sex, that railway communication per bridge would be a delightful way of visiting our Continental friends. The inclosed sketch is drawn accurately to scale; the railway train seems a mere toy, and it is this fact that renders the whole structure not only safe, but practical. Of course the electric light would guide navigation at night."



DEEP-SEA PIERS FOR A PROPOSED BRIDGE TO CROSS THE BRITISH CHANNEL.

ALL exact knowledge depends upon exact measurement.

Heat from Nebular Condensation.

Professor Tyndall, in his "Heat as a Mode of Motion," affirms that the chances that iron is in the sun are 1,000,000,000,000,000,000 to 1, on account of the coincidence of certain dark lines in its spectrum with certain bright lines yielded when incandescent vapor of iron is employed as the source of light. This is put forth as an *actual* calculation. It may be *actual* in the sense that Professor Tyndall actually made it, but purely imaginary at the same time. The elements for a *real* calculation of the probabilities are not known. Very likely the professor is right if he thinks only of coincidence arising from *chance*, but we have no information whatever concerning the probability that coincidences may result from *law*. The quantity of experiments yet made is insufficient to justify such extravagant assertions, and no one has yet arrived at a law explaining why the spectra of different so-called simple bodies vary exactly as is found to be the case. No philosopher really imagines that there are scores of substances which are really simple, and if, as is probable, the chemist may find means of decomposing metals, and certain gases, or carbon, who can venture to predict what fresh spectra may appear.

Helmholtz, cited by Tyndall, estimates the heat occasioned by nebular condensation as prodigious in intensity. Tyndall, describing his opinions, says, that supposing the nebulous matter to be in the first instance of extreme tenuity, and the specific heat of the condensing mass the same as that of water, then the heat of condensation would be sufficient to raise the temperature 28,000,000° Centigrade, or about 13,000 times the heat of the Drummond light. A question arises whether condensation would take place under such circumstances, or at such a temperature, which we should be inclined to suppose would dissociate all chemical compounds. Nebular condensation, producing suns and planets, must give rise to chemical unions, and if heat were not the cause of the dispersion of the molecules of the nebula into the highly-attenuated form of those bodies, their condensation may not evolve heat as Helmholtz supposed.

The Relations of Labor---Letter from General Butler.

General Butler has written a letter in which he describes the changes that have taken place in the management of the great manufacturing establishments of New England, and in the character of the operatives, and expresses his views of the proper policy to be pursued hereafter in the following terms:

"It seems to me that the time has come for the interference of the Legislature in the investigation at least of the limit of the hours of labor, and the limit of the employment of youth, to determine how far it is best for the State that its children shall be deprived of an opportunity for education and training, by the employment of its young life in accumulating the gains of selfish parents, or adding to the profits of equally selfish capitalists; also, what safeguards ought to be placed around the lives and limbs of the operatives engaged in managing huge and powerful machines, where a false step or a false motion may cost the life or limb. On this very necessary and important subject our statute books are wholly silent, while the laws of England are dotted all over with penal enactments to preserve the persons of the laborers from accident.

"Also, to inquire as to what may be done to insure a fair division of the rewards of labor as against the profits of capital. In a word, that the law may intelligently do in this most important relation of life and business what it ought to do, and does do, in almost every other, step in and restrain the strong from crushing the weak, and protect the needy against the promptings of avarice or the cruelty of selfishness.

"Of course, to do this effectively and justly to both parties requires accurate and careful observation of the conditions and relations of the operative to the employer, and of labor to capital, a full examination and report upon the abuses which require remedy, a full understanding and comprehension of all the facts on the one side and on the other which should guide legislation, to the end that injustice may not be done to the employer, or the citizen when employed shall not be without adequate protection by the laws.

"I was more than gratified at the establishment of the Bureau of Statistics and inquiry into the connection of labor with capital, and I have examined the report of that bureau with the utmost interest and attention I most earnestly desire that this work may go on, and that the Legislature, with a liberal hand, will afford all necessary and proper assistance, and that the objects of its investigation may take a more extended range.

"In my judgment there are no statistics so vital to the future well-being of the Commonwealth as those which would be gathered by the bureau. A struggle is just commencing here between capital and labor. If the contest is pursued with harshness, intensity, and bitterness of feeling, it will be because of want of knowledge by both parties of the duties of each to the other, and the rights of either relative to the other. Let the capitalist remember that, unlike England, here the vote of the laborer controls capital in legislation, and that if capital desires to preserve itself from unjust legislation, it must be because labor wields the ballot with intelligence. Let capital also remember that abuses, if any exist, in its relations with labor, cannot be hidden, and may grow all the more magnificent in their proportions from being partially unknown. A wrong understood only to be felt as a fear, is always the most terrible. The voter uninstructed will act upon exaggerations and erroneous impressions. The capitalist will refuse the amelioration of evils of which he neither knows the extent, nor, perhaps, the existence; and therefore collision with the operative because of them is inevitable. When that collision comes, the history of all governments shows capital goes to the wall."

FRAMING WOODEN BUILDINGS.—A writer in the *Architectural Review* says that in constructing wooden buildings, there is one thing to which particular attention should be paid; namely, the binding the top of the walls well together, and that is accomplished by framing the wall plate all around the house, and spiking the ceiling joists down on the same; then herring-bone, bridging these joists in as many rows as are necessary to make a thoroughly stiff brace for the whole. The roof (no matter whether Gothic or Mansard) cannot exercise any bad influence in pushing out the walls when this system is adopted.