capacity of railways might have been modified by the knowledge of what is done on the volunteer field days in this country, while his opinions on the uselessness of railways in an enemy's country are apparently inconsistent with the experience of the last American war.

In that war railways and steamboats were found of inestimable advantage. The reports of General Parsons, chief of rail and river transportation for the United States, show that he considered the application of steam to transport had modified the art of war as much as the pursuits of peace; and he stated in 1865, as the result of his experience, that "it is now practicable, on twenty-four hours' notice, to embark by railway, at Boston or Baltimore, a larger army than that with which Napoleon won some of his most decisive victories, and landing it within three days at Cairo, 1,200 miles distant, there embark it on transports, and within four days' more time disembark it at New Orleans, 1,000 miles further." In January, 1865, in the depth of a severe winter, the 23d army corps was wanted for General Grant's operations before Richmond. After four or five days' notice this force, consisting of 20,000 men, with all its artillery, and over 1,000 animals, was started from the Tennessee river, and moved nearly 1,400 miles in an average time not exceeding eleven days. The distance was about equally divided between water and railway transport, along rivers obstructed by fog and ice, and over mountains during violent snow storms, with various interruptions, including thirty hours' detention from fog in the river, and at one point the unexpected delay of transferring the troops to boats of a smaller class, the railroad, meanwhile, being in the bad condition unavoidable in the severe winters of North America. Within seventeen days from the embarkation of the first troops on the Tennessee, General Parsons had the satisfaction of seeing the army quietly encamped on the banks of the Potomac, as fresh as when they started from Tennessee.

During the war, 611 miles of railway in Virginia, Maryland and Pennsylvania, 293 miles in North Carolina, and 1,201 miles in the military division in the Mississippi, giving a total of 2,105 miles, were more or less occupied by the United States authorities as military railways, under the direction of General M'Callum, the government staff carrying on all the working of these lines, and repairs of works and rolling stock, and to some extent the rolling of rails and the construction of new lines. At an early period a number of workmen, under competent engineers and foremen, were formed into a "construction corps," and stationed in detachments along any railway exposed to hostile attack, and stores were established at intervals to furnish the necessary supplies of rails, fittings, sleepers, and bridge timber.

HOW THE YANKEES BUILT BRIDGES.

This corps became at last very experienced in the work of repairing damage. General M'Callum's reports state that the Rappahannock river bridge, 625 ft. long and 35 ft. high, was rebuilt in nineteen working hours; that Potomac creek bridge, 414 ft. long and 82 ft. high, was built in forty working hours; that Chattahoochee bridge, 780 ft. long and 92 ft. high, was completed in four and a half days; that between Tunnel Hill and Resaca twenty-five miles of permanent way and 230 ft. of bridges were constructed in seven and a half days; and near Big Shanty thirty-five and a half miles of permanent way and 455 ft. of bridges in thirteen days. The last of these remarkable operations took place on the line by which General Sherman was connected with his base, in his advance from Chattanooga to Atlanta; and that the Military Railway Department, almost entirely through a hostile country, should have kept pace with the march of General Sherman, constructing and reconstructing the road in his rear, and ultimately have maintained the supplies of an army of 100,000 men and 60,000 animals from a base 360 miles distant, along a single line, exposed at all times to the attacks of an active and resolute enemy, is indeed a wonderful example of forethought, energy, patience, and watchfulness.

EDITORIAL CORRESPONDENCE.

NAPLES, Jan. 28, 1868.

Vesuvius—A Novel Spectacle of Neapolitan Life—Herculaneum and Pompeii.

Naples, apart from the extraordinary beauty of its situation, its rich museum and splendid churches, does not possess many objects to long detain a tourist; but in the number and variety of its excursions east and west, it offers more attractive features than any other city in Europe. From my youth up I have cherished a desire to visit Vesuvius, Pompeii, and Herculaneun, and to have had that wish gratified fully repays me for all the toils of a journey of four thousand miles. I have seen Vesuvius by dull star light, with its cone all on fire, vomiting streams of red-hot lava, which flowed down its sides like rivers of fire, and casting its dense clouds of smoke and its lurid light upward to the sky; again, on the second night, the appearance still more brilliant and the volume of lava considerably increased, but grander still was the effect of a visit to the mountain by night. Numerous parties go down every afternoon in carriages, as far as the village of Resina, which stands above the spot where Herculaneun lies buried eighty feet below the surface. Here we engaged horses and a guide, and some torch bearers, and thus provided made our way up the mountain near to the crater of the terrible eruption of 1858, which continued nearly three years. The afternoon being clear and still, we were favored with a fine view of the city and bay of Naples, the Castle of St. Elmo high above it, the isles of Capri and Ischia in the bay, and a range of the snow covered Appennines far to the north, while just above our heads rose the awful volcano, with its overflowing streams of liquid fire, and as often as every thirty seconds would a shower of stones be thrown upward hundreds of feet into the air, the shower succeeded by a heavy, rumbling sound, like the distant fire of artillery—certainly a grand and terrifying spectacle. We proceeded on horseback as far as the guide would permit, with sticks in hand, "to try the lava," as the people say when they urge you to buy them. We made our way up one of the principal streams by passing for some distance over the blackening crust of fresh lava, which but three days before was moving down the mountain like molten iron running from a furnace, and was still red hot underneath. At this point, and under cover of the night, we could take at one view not only the eruptions from the crater, but also the several channels through which the lava was working its way down the sides of the mountain, already covered with the blackened masses of former eruptions. We happened to see Vesuvius in one of its most angry moods, and I do not think any of our party will ever forget the sight, and yet no one seems to fear this burning mount. The inhabitants of Naples, and the towns along the base of the volcano, live, eat, and sleep, regardless of the fate of cities that lie buried under its ashes.

The road to Pompeii runs along the eastern bay of Naples, and through a continuous line of villages, whose inhabitants appear to live upon macaroni, if one may judge from the immense quantities of this article hung out to dry. Almost every house has its string of macaroni poles hung out in front, and the people who make it are often so dirty that it is almost impossible to distinguish their features. Pigs are sometimes seen walking around under the pendant links, to say nothing of the dirty urchins who are permitted to handle it. I have heard it said that a lazaroni would keep fat on a daily diet of two cents' worth of grapes and macaroni, but it appears now that the latter article is a luxury which the lazaroni don't enjoy in such abundance.

The roadway from Naples to Pompeii was lined with the strangest assortment of men, beasts, and vehicles, that human eyes ever looked upon. Here is a vehicle or go-cart, resembling a long furniture truck, suspended on a pair of tall wheels, upon the platform of which is fastened what very much resembles an old-fashioned doctor's gig, with covered top thrown back, hung upon double C-springs The seat is occupied by a priest and a fat woman; while behind and underneath the top, sitting on the platform, are two old vegetable women just returning from market. Four men, with red caps, dressed in brown duck trowsers, and short sacks or tunics, are standing up behind, holding on to the gig-top. One is a lazaroni, exposing a pair of legs that might serve for an Apollo. In front, beside the driver, are seven men, who are either sitting or standing upon the platform; the whole load being drawn by one little horse, with a fancy top-knot, and carrying upon his back a huge saddle, provided with three long horns most fantastically ornamented in brass—the center horn carrying a turret of bells and a wind vane. The shafts of the vehicle pass obliquely along the sides of the little animal, and fasten to the saddle a little above his back by a heavily stitched leather band, which slides through openings or grooves cut in the top of the two outer horns. Here is another heavy cart, loaded with cabbages; the skeleton form of a large white ox is yoked between the heavy shafts. On one side of the ox is a little horse, a cow, or a mule; on the other, a small donkey, fastened to the cart by ropes and whiffletrees, to assist in hauling the load. Here is another immense load of carrots, macaroni, or salt cod-fish, drawn by a horse, mule, and donkey, working abreast. Here, again, is a small, open, two-wheeled gig, drawn by a donkey, or a very small horse; the rider is a full-grown man, who jogs along apparently indifferent of the cares and opinions of the world. There is a woman trying to drive a black pig, having a rope tied around his body, and is very nearly being run down by an elegant carriage with fine horses and liveried servants, while all along the sidewalks, fronting the houses, and covering church steps, are to be seen lazaroni sunning themselves; women washing, cooking, spinning from the distaff, examining their childrens' heads, or having their own attended too; half-naked boys running after carriage, pounding their chins to attract our notice; and beggars, plenty, old and young, sick and sore—the whole constituting an actual scene of every day life along the shores of the bay of Naples, and no mere fancy sketch of a letter-writer. Beggary is reduced to a science in Naples, and we witnessed many singular and disgusting forms of it which suggested a most wretched form of society.

Herculaneum is still a buried city, and but little is known of its extent, except what can be conjectured by the discovery and partial excavation of a theater of very solid construction, and capable of seating 8,000 people. This structure was accidentally discovered during the process of digging a well eighty feet below the surface, and some fine marble statues were found which are now at the museum at Naples. All hopes of knowing anything more of this buried city of the dead are forever lost, as a modern city stands above it, and this may some day share the same fate.

Pompeii, of which the world already knows so much, lies buried upon an open plain, and it is estimated that about one fifth of the city has already been uncovered. It is a strange and melancholy sight to walk through its well paved streets, still bearing the marks of vehicles, worn more than two thousand years ago; and amidst ruined heathen temples, amphitheaters, forums, theaters, palaces, houses, mills, tombs, and other structures, which speak of a people who cultivated many of the refined arts and customs of our Christian civilization.

The museum of Naples contains a very extensive collection of objects of art and utility, dug out of this overwhelmed city; and the work is still going on, though slowly, under direction of the government. As I wandered about through the ruins of Pompeii, I could not resist the conviction that all the objects which have been dug up ought to have been kept where they were found, thus forming the grandest and most interesting museum in the world. S. H. W.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents.

Canal Navigation---Steam Power and Enlargement of Locks.

MESSRS. EDITORS:—Having had some experience in building canals in this country and in Canada, and seeing considerable discussion going on in your State Convention respecting the New York canals, with your leave I will venture to make a few suggestions respecting them, not that I am silly enough to suppose I can effect any particular change in their management; but if I should happen to let fall even *one* idea that will benefit the people of your Empire State, I shall feel amply rewarded.

One great obstacle to the expeditious navigation of the Erie Canal is the numerous locks and the great length of time required to pass the boats through them. To obviate this difficulty, I would suggest the lengthening of the locks to eight hundred or one thousand feet by removing the gate at the upper end of the lock, and then extend the lower level by excavating the 800 or 1000 feet, at which point let the upper part of the lock and gate be put in as it was before. It will readily be seen that instead of locking one boat at a time, six, eight, ten, or more, could pass at the same time. Of course the sluices could be correspondingly increased, to give the water the same free passage it now has in the short locks. Wherever the fall is too precipitous, in order to carry out the foregoing, it will only be necessary to extend the length of the canal by a more circuitous route, thus lengthening the grade also.

Another obstacle to expeditious navigation by the canal, is the present method of towing the boats, which is not only slow but expensive. To obviate this, I would suggest the laying of a railway track on the present "tow path," and tow with locomotive engines. If a double track should be thought too expensive, double switch "turnouts" could be put in at each mile, or as often as necessary, which would be short, as only the engine and tender would require to occupy them. It is estimated that a forty-ton engine, with small drivers, will tow thirty boats at the rate of two and a half miles the hour. Suppose one-sixth of the time should be occupied in locking, the engine would take the thirty boats from Buffalo to Albany in about seven days—no small saving of time, to say nothing about expense. At this slow rate of speed, the wear on the track and engine would be scarcely perceptible.

At the present high prices for labor and running such an engine would not be over thirty-two dollars per day. For the seven days it would be $224, or a little less than eight dollars to tow each boat from Buffalo to Albany, and *vice versa*. The expense of towing, in such a case, would be added to the canal tolls; and the freighter would only have to furnish and man his boat.

By running the engines at a uniform rate of speed, it will be difficult to estimate the number of "trains of boats" that could be taken through at the same time.

The "tow path" of the canal being ready for the superstructure, or nearly so, the expense of this method of traction would only be the ties, iron, engines, water tanks, and engine houses.

The plan of lengthening the locks here suggested is a very different thing from "enlarging" them; as, after the excavation is made, the same gates, stone, etc., can be used that would be taken from the upper end or half of the short locks.

I am clearly of the opinion that there is no economy in moving freights on a canal, where horse-power is used, by enlarging the boats, and consequent increase in width of the size of the boat; consequently the horse-power must be increased if the boats are enlarged. As for towing by steamboats or tugs, I believe it is an admitted fact, that in our shallow canals it is impracticable.

According to the foregoing estimate one engine would make two round trips from Buffalo to Albany per month, taking thirty boats, each way, each trip. This would be 120 boats taken through the canal per month. For the seven months of navigation it would give 840 boats as the work of one engine. At this rate 100 engines would move eighty-four thousand boats through the canal once during each season of navigation. Supposing each boat were to carry two hundred tuns of freight, it would amount to sixteen million eight hundred thousand tuns per season.

I am entirely convinced, if this plan of working the Erie Canal were adopted, there would be no necessity for building a ship canal around the Falls of Niagara, on the American side, or the adoption of any other expedient to move the heavy freights from the West to your city as rapidly as they may accumulate. ENGINEER.

The Mysteries of Boiler Explosions and Railroad Accidents.

MESSRS. EDITORS:—"Cause unknown." This is a favorite verdict for a coroner's jury on accidents of all kinds. It has in some sort, taken the place of the old-time mortuary verdict, "died by the visitation of God," and is an easy escape from responsibility and a soothing salve to conscious incapacity or willful negligence. "Nobody to blame" is another comfortable and accommodating verdict in case of accident. These set terms are well enough for whitewashing purposes, but will they forever satisfy the public? When on one single railroad eighteen broken rails are taken up in one day; and on another the train stops four times in less than ninety miles to have broken rails replaced by whole ones; and when it is found that a boiler which exploded had ten out of fourteen head stays broken off for weeks before it blew up, it is about time that either intelligent mechanics and engineers be placed on these juries of inquest or the farce itself be omitted. Your paper has always denied the necessity of attributing boiler explosions to mysterious causes, and I sincerely hope you will continue as heretofore to expose the pretensions of self-sufficient charlatans. B. F. G.

New York city.

Onions and Epidemics.

MESSRS. EDITORS:—In the spring of 1849 I was in charge of one hundred men on shipboard, with the cholera among the men. We had onions, which a number of the men ate freely. Those who did so were soon attacked, and nearly all died. As soon as I made this discovery their use was forbidden. After mature reflection I came to the conclusion that onions should never be eaten during the prevalence of epidemics, for the reason that they absorb the virus and communicate the disease, and that the proper use for them is sliced and placed in the sick room, and replaced with fresh ones every few hours.

It is a well established fact that onions will extract the poison of snakes; this I personally know. Some kinds of mud will do the same.

After maintaining the foregoing opinion for eighteen years, I have found the following well attested: Onions placed in the room where there is small-pox will blister, and decompose with great rapidity; not only so, but will prevent the spread of the disease. I think as a disinfectant they have no equal, when properly used; but keep them out of the stomach.

If need be, the foregoing (which I have greatly abbreviated) can be attested on oath. Let us have all the facts bearing upon the subject. JOHN B. WOLFF.

BEMENT & DOUGHERTY'S STEAM HAMMERS.

The illustrations in this article represent three of the different styles of steam hammers built by Messrs. Bement & Dougherty, of Philadelphia. The hammers are rated or classified according to the effective weight of the piston and hammer head or drop, and range from 100 pounds up to 10 tuns.

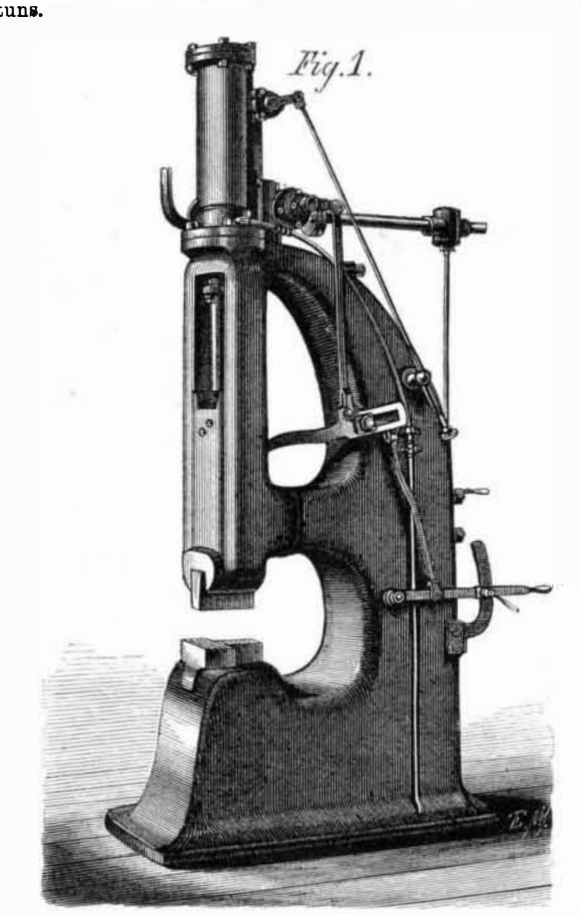
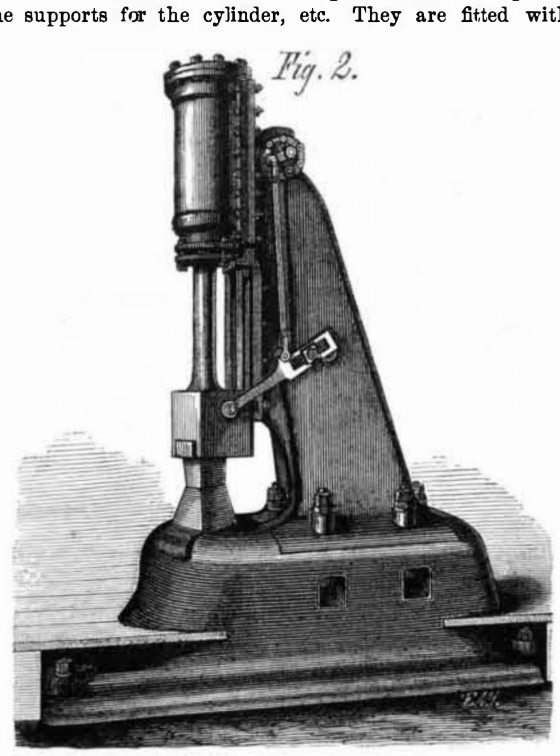
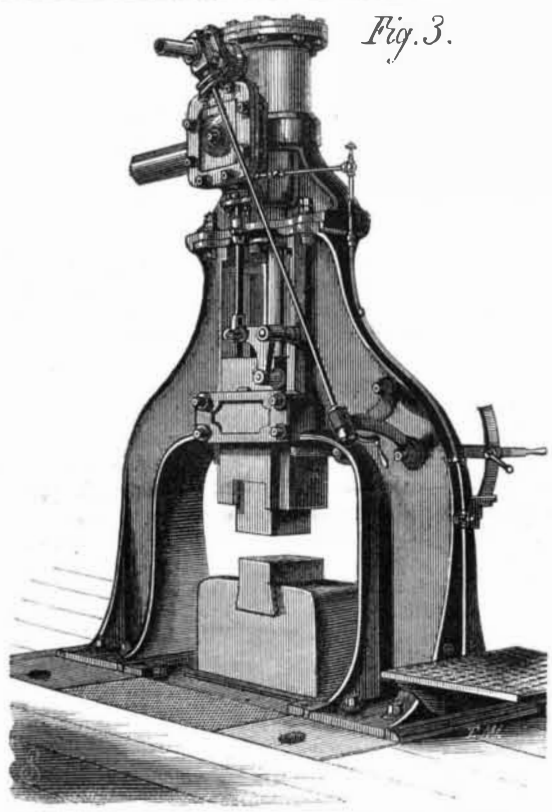


Fig. 1 is a perspective view of a 500-pound hammer whose anvil and frame are cast in one piece, to which are bolted the cylinder, guides, etc. It is fitted with an improved valve motion which can be worked at pleasure, single or double acting, adjusting itself to all variations in the thickness of the forging, controlling the admission of steam so as to produce at will a short and quick or a long and slow stroke, and graduating from the light-cushioned blow to the "dead blow," in which no steam is admitted beneath the piston until after the blow is struck, thus utilizing the *vis viva* of the falling weight impelled by the top steam. It can also be used as an ordinary hand-working hammer without altering the setting of the gear.

Fig. 2 shows a 1,000-pound hammer whose frame is keyed and bolted to a massive casting which forms the anvil and base, and expands below the level of the floor to such an extent and mass as to absorb the concussion and thus enables the foundation to be of the least expensive character. The piston rod and drop are of wrought iron forged in one piece. The piston head is of steel and also the guide, which is so arranged behind the drop as to leave the hammer face and dies entirely clear for convenient working. It has the same valve motion as that of Fig. 1, the details, however, not being seen on the side presented, they being sufficiently shown in Fig. 1. Messrs. Bement & Dougherty do not, however, restrict themselves to these designs, but are prepared to build these sizes of hammers with separate anvils if desired.

The 1,500-pound, 2,000-pound, and 3,000-pound hammers being similar in design and differing only in dimensions, are sufficiently illustrated by Fig. 3. They have separate anvils and double frames which form the guides for the drop and the supports for the cylinder, etc. They are fitted with





balanced slide valves of superior construction whose variable and self-acting motion is produced by the well-known expedient of a rock lever operated by an inclined slot or groove planed in the hammer drop.

Owing to the improvements made in many minor features since the photographs were taken from which these engravings were prepared, they can be said to give a correct idea only of the general style or design of these hammers. [See advertisement on another page.]

History of a Rail of Bessemer Steel.

In the early part of the year 1857 a steel bloom was made by melting in crucibles Bessemer metal with spiegeleisen. This bloom was rolled into a double-headed rail, and in the spring of 1857 it was laid down at Derby station. On the 21st of December, 1867, ten years and six months after it had been laid down, it was reported to be apparently little the worse for wear. Now the wear amounted to, on an average, 250 trains passing over it daily, and a like number of transits of engines and tenders. Reckoning now the weight of each train at 100 tuns average, and that of engines and tenders at 20 tuns, we have an amount of 30,000 tuns per diem passing over this rail, and this continued for, say 300 days per annum, 10½ years, gives a total of 94,500,000 tuns. Now on the Canadian railways the iron rails are worn out by a traffic ranging from 4 millions to 30 millions of tuns, according to the quality of the iron rails. The Derby rail, therefore, of Bessemer steel, has already sustained more than three times the amount of traffic which suffices to destroy the best iron rails, and, in spite of this, it is still "apparently little the worse for wear." The opponents of steel rails will argue, no doubt, that this rail is an exception, and was better than other Bessemer steel rails, because the metal was remelted. Such, however, is not the fact, for steel is always more or less deteriorated by remelting; and the rail ends from Bessemer steel rails, made at Crewe, and therefore, of course, the rails themselves, are of as good and as durable a quality of steel as this Derby rail. ROBERT MUSHET.

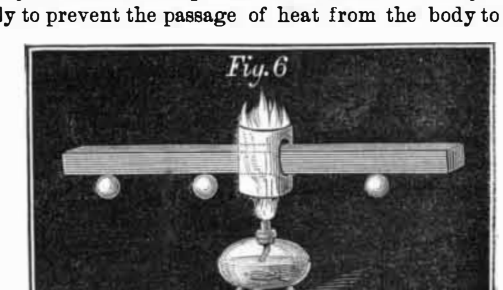
Science Familiarly Illustrated.

HEAT AND COLD.

BY JOHN TYNDALL, ESQ., LL. D., F.R S.

Lecture IV---Continued.

I have now to say a few words upon another subject—the propagation of this thing we call heat—this curious quivering motion of the atoms of bodies; and in order to make this evident to you, I will, first of all, make an experiment or two on liquid bodies, or on gases. I want you to understand the manner in which heat distributes itself in gases, and, for that purpose, I have here placed a little piece of platinum wire—that metal which we raised to a bright white heat in our first lecture. It is a refractory metal, and bears a very large amount of heat. Now, we will have the room made dark, and Mr. Chapman will excite our electric lamp, and I will ask you to look at the shadow caused by this little platinum wire on the screen. I trust that even the most distant young philosopher now sees that shadow. We will heat the platinum wire by an electric current, and you will observe two things. You see, first of all, that the platinum wire gets longer—swags, sinks down—when I heat it. Observe also the air rising up from the surface of the heated wire. That wave-like motion is due to currents of heated air rising from the wire. The air, when heated, rises in that way. The same is true of liquids; I have here a glass cell containing cold water, which will enable you to see this. I will place it in front of the lamp, and cast an image of it upon the screen. There is a means of warming this spiral of platinum wire within the water, and I want you to observe that the same thing occurs in water as you saw taking place with the air just now. Mr. Cottrell will now make the circuit for the electric current to pass; and then the moment the circuit is made you will find that the water will be heated by this spiral of platinum wire and the heated particles of water will rise to the surface of the liquid. There, on the screen, you see the action of the hot wire upon the water, causing the water to rise in these *striæ*. The water goes up from the heated surface, and in time the heated particles will distribute themselves through the entire mass of the water. I make this experiment in order to fix upon your minds the difference between this action and another which resembles it at first sight. The action which I have shown you receives the name of *convection*, which I should like the elder boys to remember, and I want you to distinguish between this and another process, which is a very different one, and which is called *conduction*. In order to illustrate this subject of conduction, I have placed here before you an iron bar and a copper bar (Fig. 6), and I want to ask them which conducts heat best. Mr. Cottrell will now light a lamp, and place it underneath the bars, so as to heat the ends of them at the same time; and as they become hot they will liberate these little balls, which are fixed on with wax; and I think you will find that the heat will travel along the copper better than along the iron. Here is a similar apparatus, with bits of tallow candle fixed to it. The greater the number of these pieces of candle that drop away from either bar, the further and better the heat has traveled through that body. This is almost a better experiment than the more elaborate one, and it is one which you can make at home for yourselves. The copper will be able to melt away all its candles, while the iron will not be able to do so. The whole philosophy of the clothes you wear is, that they are bad conductors of heat. Your bodies are sources of heat. Through the burning up of the food you eat, within your bodies, warmth is produced; and the object of the woolen clothes which you wear at the present cold season of the year, is simply to prevent the passage of heat from the body to the



air. For this reason we clothe the body with woolen cloth, that being one of the worst conductors of heat in nature. But the cloth has no warmth in itself; if I want to keep ice cool, as I did in a former lecture, I wrap my ice in flannel, which prevents the heat from without coming to the ice. Thus the woolen cloth simply prevents the transfer of heat in either direction, and hence the value of these non conductors as articles of clothing.

The experiment with the pieces of candle sufficiently illustrates the fact that different materials differ in their power of conducting heat. I might also show you this in another way. If I warm this piece of iron by putting it into warm water, and then place it upon a cylinder of glass which stands on the face of the thermo-electric pile, that glass does not allow the heat to pass through to the pile, and the needle still remains on the side of cold. It would be a long time before the heat of this iron passed through the glass and reached the face of the pile. I will now remove the glass and place a cylinder of copper on the face of the pile, and then put the warm iron on the copper. I suppose that not more than two or three seconds will elapse before the heat will pass by the conduction of the copper to the face of the pile, and the moment it does so you will see that the needle will come to the other side of the middle line, showing heat. Now, in this