ON FORCE—LAWS OF MOTION.

[Concluded from Page 117.]

The sun, by the act of vaporization, lifts mechanically all the moisture of our air. It condenses and falls in the form of rain, it freezes and falls as snow. In this solid form it is piled upon the Alpine hights, and furnishes materials for the glaciers of the Alps. But the sun again interposes, liberates the solidified liquid, and permits it to roll by gravity to the sea. The mechanical force of every river in the world, as it rolls toward the ocean, is drawn from the heat of the sun. No streamlet glides to a lower level without having been first lifted to the elevation from which it springs by the mighty power of the sun. The energy of winds is also due entirely to the sun; but there is still another work which he performs, and his connection with which is not so obvious. Trees and vegetables grow upon the earth, and when burned they give rise to heat, and hence to mechanical energy. Whence is this power derived? You see this oxide of iron, produced by the falling together of the atoms of iron and oxygen; here also is a transparent gas which you cannot now see—carbonic acid gas—which is formed by the falling together of carbon and oxygen. These atoms thus in close union resemble our lead weight while resting on the earth; but I can wind up the weight and prepare it for another fall, and so these atoms can be wound up, separated from each other, and thus enabled to repeat the process of combination. In the building of plants carbonic acid is the material from which the carbon of the plant is derived; and the solar beam is the agent which tears the atoms asunder, setting the oxygen free, and allowing the carbon to aggregate in woody fiber. Let the solar rays fall upon a surface of sand; the sand is heated, and finally radiates away as much heat as it receives; let the same beams fall upon a forest, the quantity of heat given back is less than the forest receives, for the energy of a portion of the sunbeams is invested in building up the trees in the manner indicated. Without the sun the reduction of the carbonic acid cannot be effected, and an amount of sunlight is consumed exactly equivalent to the molecular work done. Thus trees are formed; thus cotton is formed. I ignite this cotton, and it flames; the oxygen again unites with its beloved carbon; but an amount of heat equal to that which you see produced by its combustion was sacrificed by the sun to form that bit of cotton.

But we cannot stop at vegetable life, for this is the source, mediate or immediate, of all animal life. The sun severs the carbon from its oxygen; the animal consumes the vegetable thus formed, and in its arteries a reunion of the severed elements takes place and produces animal heat. Thus, strictly speaking, the process of building a vegetable is one of winding up; the process of building an animal is one of running down. The warmth of our bodies, and every mechanical energy which we exert, trace their lineage directly to the sun. The fight of a pair of pugilists, the motion of an army, or the lifting of his own body up mountain slopes by an Alpine climber, are all cases of mechanical energy drawn from the sun. Not, therefore, in a poetical, but in a purely mechanical sense, are we children of the sun. Without food we should soon oxidize our own bodies. A man weighing 150 lbs. has 64 lbs. of muscle; but these when dried reduce themselves to 15 lbs.. During an ordinary day's work for eighty days, this mass of muscle would be wholly oxidized. Special organs which do more work would be more quickly oxidized; the heat, for example, if entirely unsustained, would be oxidized in about a week. Take the amount of heat due to the direct oxidation of a given amount of food; a less amount of heat is developed by this food in the working animal frame, and the missing quantity is the exact equivalent of the mechanical work which the body accomplishes.

To whom, then, are we indebted for the striking generalizations of this evening's discourse? All that I have laid before you is the work of a man of whom you have scarcely ever heard. All that I have brought before you has been taken from the labors of a German physician, named Mayer. Without external stimulus, and pursuing his profession as town physician in Heilbronn, this man was the first to raise the conception of the interaction of natural forces to clearness in his own mind. And yet he is scarcely ever heard of in scientific lectures, and even to scientific men his merits are but partially known. Led by his own beautiful researches, and quite independent of Mayer, Mr. Joule published his first paper on the "Mechanical Value of Heat," in 1843; but in 1842 Mayer had actually calculated the mechanical equivalent of heat from data which a man of rare originality alone could turn to account. From the velocity of sound in air Mayer determined the mechanical equivalent of heat. In 1845 he published his memoir on "Organic Motion," and applied the mechanical theory of heat in the most fearless and precise manner to vital processes. He also embraced the other natural agents in his chain of conservation. In 1853 Mr. Waterston proposed, independently, the meteoric theory of the sun's heat, and in 1854 Professor William Thomson applied his admirable mathematical powers to the development of the theory; but six years previously the subject had been handled in a masterly manner by Mayer, and all that I have said on this subject has been derived from him. When we consider the circumstances of Mayer's life, and the period at which he wrote, we cannot fail to be struck with astonishment at what he has accomplished. Here was a man of genius working in silence, animated solely by a love of his subject, and arriving at the most important results some time in advance of those whose lives were entirely devoted to Natural Philosophy. It was the accident of bleeding a feverish patient at Java in 1840 that led Mayer to speculate on these subjects. He noticed that the venous blood in the tropics was of a much brighter red than in colder latitudes, and his reasoning on this fact led him into the laboratory of natural forces, where he has worked with such signal ability and success. Well, you will desire to know what has become of this man. His mind gave way; he became insane, and he was sent to a lunatic asylum. In a biographical dictionary of his country it is stated that he died there; but this is incorrect. He recovered, and I believe, is at this moment a cultivator of vineyards in Heilbronn.

Correspondence

The Steam Wagon of the Western Prairies.

The following communication on the subject which formed a leading topic of discussion in the Scientific American of last week, has been received since our remarks were published:—

Messrs. Editors:—I noticed, some time since, an article in your paper in regard to J. A. Reed's Prairie Motor, in which it was stated that it would run from Omaha to Denver City. I also observed, a few weeks ago, a letter from some party in Iowa to the Scientific American, in regard to the impracticability of the route from Omaha City westward for a machine of such size and weight.

Gen. Brown, proprietor of the "steam wagon," arrived here a week or two since, and having obtained all the information in regard to the various routes which could be derived from parties who have been freighting across the plains for several years, he finally determined to run the motor from this point, and it was accordingly landed here. In getting from the levee up into town, they took a circuitous route over a new and rough road, to avoid a bridge, which, it was feared, would not bear the weight of the machine, and ran over a road which would have been impassable for one of the usual-sized Government freight wagons, with six yoke of cattle attached. The steam wagon moved over the road with ease and safety, to the great surprise of two or three hundred of our citizens who witnessed its performance, and many of whom had predicted that it would not work at all.

Gen. Brown and his associates, Messrs. Slote and Osborn, were here several days making their preparations for starting across the plains, and, in the meantime, making several trial trips for the purpose of testing the power and utility of their machine, all of which were entirely satisfactory. On one occasion they took out quite a long train of wagons, carrying not less than one hundred persons, and with this load they moved with ease over a grade of 500 feet per mile. On Tuesday of last week they completed their arrangements and started westward, with about ten tuns of freight; but, unfortunately, after they had gone about twelve miles, having passed safely over all the rough road and got on to the high divide which runs from this point through to New Fort Kearney, they broke a shaft and were unable to proceed farther until they could procure a new one. This accident will detain them here for some time yet. Gen. B. has returned to New York to obtain the necessary machinery, which he will forward immediately. The balance of his party are here yet, and will go ahead as soon as they make the necessary repairs.

Mr. Brown assured the Board of Trade, of this city, that he will have two more motors built and placed on the line from here to Denver by the time the freighting season opens next year; in consideration of which assurance, and the great benefit that it will be to our place, the Board of Trade have agreed to make all necessary repairs on the road as far as New Fort Kearney, so that the grade at no point shall exceed 400 feet per mile.

Fort Kearney is precisely 168 miles from this place, in a line due west, and the road follows the high level divide between the waters of the Platte and Nemaha and Blue rivers. A better natural road I am satisfied cannot be found, and with a little grading at a few places, within ten or twelve miles of this place, it will be as level as some of our western railroads.

Our citizens are quite jubilant over the passage of the Pacific Railroad Bill, in its present form, as it almost insures this as the point from which it will start westward.

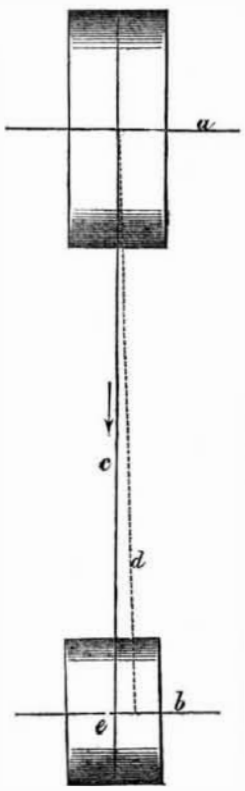
I observed recently a paragraph in several eastern papers, stating that "a conflagration had again visited our city, and that the principal business portion was entirely destroyed." This is a mistake—there has been no fire in our city for the last two years.

Nebraska City, August 2, 1862. A. J. H.

Why a Belt Works from off its Pulleys.

Our correspondent A. B. L. sends us the following explanation in answer to his own question:—

Messrs. Editors:—You ask me to give the cause why a belt works off its pulley when the shafts are not parallel, or diverging in position with each other? I find, when a plain surface (as a stick of timber for instance) moves over a roller of uniform diameter, that every part of that surface moves in straight lines, at right angles with the axis of the roller, no matter what the position of the whole mass may be in reference to that axis. In the inclosed diagram the belt is placed in its proper position on the centers of the pulleys. The belt forms a right angle with the shaft, *a*, but not a right angle with the shaft, *b*, owing to the angle of divergence in the position of the two shafts. Now the belt, following the above law, will move bodily in a line parallel with the dotted line, *d*, at right angles to *b*; one-half of a revolution of the belt will correct the angle at *b*, but will destroy the angle at *a*, consequently the belt will work off both pulleys, toward the ends of the shafts nearest each other. Therefore this rule may be given, that in all cases the belt should run on the pulleys at right angles to the axis of rotation, no matter at with angle it may leave the pulley (as in case of a quarter-twist belt).



I have asked a great many mechanics about this, and the almost invariable answer has been: "The belt runs to the high part of the pulley," practical demonstration being needed to convince them of their

error. With all deference to our intelligent mechanics, I believe this thing, simple as it is, is yet not generally understood. A. B. L.

Stonington, Conn., July 21, 1861.

THE RAM ARKANSAS.

The following is a private letter received at this office from an officer in the fleet at Vicksburg, dated "U. S. S. *Richmond* (just below Vicksburg), July 18, 1862 :—

I have written you, I believe, full details of our passing above the batteries at Vicksburg and our junction with Davis's fleet. On the morning of the 15th the combined fleets lay at anchor quietly, some five or six miles above the city, and very few of the vessels had steam up. All the lower fleet had let their fires go out and few of the others had steam enough to move instantly. A general feeling of security prevailed, as much as though we were in New York harbor. Yazoo river enters the Mississippi a few miles above where we lay--a narrow stream extending a long way up into the country—and it was supposed to be the retreat of most of the river steamers left in the rebels' hands after the capture of Memphis. An unfinished rebel gunboat and ram, called the *Arkansas*, was supposed to have been towed from Memphis up the river. A few week since a vessel or two of the Ellet ram fleet made a reconnoissance up this river ; but on getting about forty miles up were stopped by a heavy raft of logsprotected by batteries. Nothing more was done, not even to place guard boats at the river's mouth. The general impression was that the *Arkansas* was a myth, a failure, or that she drew too much water to get out of the river again at this season. About five days ago a couple of deserters reported that the raft across the Yazoo was removed and that the *Arkansas* was coming down soon. The powers that be did not seem at all alarmed, but on the morning of the 15th, just at daylight, the *Carondelet*, *Tyler* and a ram were sent up the Yazoo to reconnoiter, the rest of the fleet remaining as quiet as before.

The *Carondelet* is the one of Foote's iron-clads that ran by the batteries at Island No. 10. These boats, on account of gross miscalculation, are only partly iron plated, and heavy shot easily reach their steam drums, exposing the crews to a danger far worse than the missiles of the enemy. The *Tyler* is one of the wooden gunboats that did such good service at Pittsburg Landing. Ellet's rams, which first appeared at the engagement at Memphis, are simply fast river boats with their bows strengthened. Their only protection from shot are heavy timbers placed about the boilers and machinery.

Soon after the expedition left, on the morning of the 15th, rapid firing was heard, but little notice was taken of it. It was thought they were shelling the sharpshooters out of the woods. A few minutes before 7 A. M. our ram came down the river at full speed and spread the news that "the ram *Arkansas* was coming." All was bustle. Fires were lighted, and the thick smoke rolled of out the pipes of every boat in the fleet. But just a minute too late. The *Tyler* immediately appeared at full speed coming around the point fighting with her stern guns the ugly-looking *Arkansas* herself, which, without any hesitation, kept right down upon the whole fleet. First, it fired a broadside at the ram fleet, which lay furthest up the river ; the advance gunboat, the *Wissahickon*, receiving two or three shots at about the same time. I thought the *Arkansas* would strike the next gunboat, the *Pinola*, with her iron prow, but she still kept on, evidently intending to ram this ship, the furthest in advance of the large ones. But she still kept on —now evidently bent merely on passing us. She had already received the compliments of the advarce gunboats, and a shot from our rifle gun on the forecastle, and as she passed the gunboat in advance of us, the men could be seen in her ports loading her guns. But when she passed this ship, and received of course our broadside, not a man dared come in sight, and we were consequently uninjured. She passed within less than a hundred yards of this ship, and I distinctly saw several of our 9-inch solid shot strike, two of which at least hit her just at the water line ; yet she passed on apparently uninjured.

A short time before this, one of the most venturesome of our ram fleet slipped her anchor and bravely stood out into the stream directly in the path of her iron antagonist. But it was only a sacrifice. A single shot fired at her passed through her boilers and disabled her, and, more sad to relate, we had reënacted under our very eyes the *Mound City* disaster—scalded men rushing out of the boat into the water. Just after passing this ship the *Arkansas* overtook our ram which she had disabled, drifting helplessly down the stream, and poured into her a full broadside. She soon passed the flag ship *Hartford*, the iron-clad flagship *Benton*, the *Essex*, and, in fact, all the other vessels in the squadron under a tremendous fire at close quarters and yet kept coolly on, turned the point and stopped under the batteries at Vicksburg. The *Benton* and another gunboat went down when they got up steam enough, and exchanged a few shots with the batteries at long range. The rebel, as he passed, fired at will from either of the four sides of his casemated chamber, and it seemed to be his principal aim to destroy our rams—his only objects of dread.

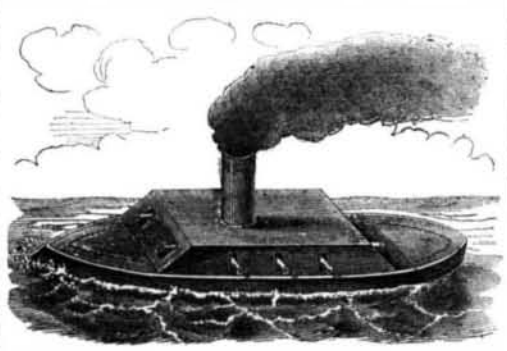
The feat took us completely by surprise, and was as daring as it was successful. It was more dangerous than the exploit of the *Merrimac*, and although perhaps the immediate loss to us in life and property was not quite as great in this case, the movement, in a military point of view, is a very disastrous one. The loss of life was greatest on the boats that were first attacked. The *Carondelet* was raked fore-and-aft with the rebel shots, and lost nine killed and a large number wounded. The *Tyler* fared still worse, as while she retired she made a stubborn resistance to her mailed antagonist.

To give you some idea of what a gauntlet the *Arkansas* ran, I will state that she was exposed to the fire of sixteen vessels, two of them, the *Hartford* and *Richmond*, heavy ships—the former having 20 nine-inch guns and 2 heavy rifles, and the latter 24 nine-inch guns and similar rifles ; two sloops of war—the *Iroquois* and *Oneida*, and four gunboats belonging to the same squadron, beside Davis's fleet of five iron-clad boats, two gunboat rams captured at Memphis, and the wooden gunboat. If we had had steam up we could have rammed the thing, run her ashore or captured her in some way.

Soon after the ram passed all the vessels were ready for action ! Just at dark that evening the whole fleet moved down and attacked the batteries, Farrigut's portion running by to its first position. The fire from the batteries was not as severe as when we went up. The attacking force was larger, which divided the fire more, and we came down of course much faster than we went up. Fortunately no one was injured on board this ship, though the others suffered as much as when we went up. The ram gunboat *Sumter* (captured at Memphis and belonging to Davis's squadron) accompanied us to practice on the *Arkansas* as we passed her, but the darkness and smoke prevented her being seen, as she lay close into the bluff under the batteries.

We are now anchored below the city in range of the lower batteries and anxiously awaiting further movements. The *Arkansas* is in plain view smoking and blowing off steam under the heaviest battery.

From what I can judge of the *Arkansas* from seeing



her pass so close to us, and from what I can learn from the pilots who saw her in Memphis before she was completed, I have made the inclosed rough sketch of her, and can describe her as follows ;—

The *Arkansas* was built at Memphis, and after receiving a portion of her machinery and armor, was, some time before that place was captured, towed up the Yazoo river, where she was recently completed She is about 175 feet long, 32 feet beam, and draws about 12 feet of water. Her hull, below water, is shaped much like that of a sea-going steamer ; she is propelled by two screws, one under each quarter. A single high-pressure engine is connected with each of the propellers. She has six of the ordinary 42-inch river boilers (which easily sustain a pressure of 180 lbs. to the square inch). Her boilers and machinery are entirely under water ; she has but one smoke-pipe, a huge affair, passing up nearly in the middle of the vessel. The bow and stern are but little out of the water, and the former is built of solid timber for some distance aft. Amidships is a low casemated chamber with two portholes at each end and three on each side. Her armor consists chiefly of railroad iron backed by timber, like the *Merrimac*. She has no pilot house ; her wheel is in the casemate chamber, which is furnished with a numbar of "peep holes" for the pilots. She carries ten guns, most of which are supposed to be thirty-twos, though we found when she passed us, that she had several very heavy rifled guns, and at least one 8-inch gun. Deserters who reached the flagship reported that the *Arkansas* lost five men, one of them her pilot, while passing the fleet, by shot which entered her ports. They say, too, that when we passed the city on the night of the 15th, an 11-inch shell (supposed to have been fired by the *Iroquois*) penetrated her casemate, and bursting on deck killed five men and wounded her commander. They also report the extravagant story that the *Star of the West*, now in Yazoo river, and the *Arkansas*, mean to run by the fleets in the river here and at New Orleans, then go to sea and put into Mobile. I verily hope they will try to do so. I fear the *Star of the West* will not get out of the Yazoo, much less run by the fleets with her two exposed beam engines. I hope, ere long, to see the flickering star of rebellion set in the West, never to rise again.

JULY 19, 1862.

Some officers, who have been taking a look at the ram, from the bushes on the point opposite, report that they can count eighteen places where shot have struck her, some of which are jagged holes through into the casemate chamber. It does not appear, however, that her machinery can be reached so as to disable her. The loss of a few men at her guns does not necessarily cripple her.

Does the Mississippi Flow up Hill?

MESSRS. EDITORS :—At a late meeting of the Teacher's Association of the town of Johnstown, an opinion was delivered by one of the savans maintaining the affirmative of the above proposition, and embracing the following points :—

First, the terms up and down are used in relation to the distance of places from the center of the earth. Second, the earth being an oblate spheroid, any point north or south of the equator is nearer the center of the earth than any place on the equator. Third, the head of the Mississippi river (Lake Itasca) is situated some 2,000 miles north of its mouth. Therefore, as a conclusion deduced from the first two propositions, the river must in its course flow up hill, and that too a number of miles. The reason assigned for this apparent anomaly is the motion of the earth on its axis, and a consequent continual tendency of matter to flow from the poles to the equator.

On being asked why the course of the St. Lawrence is not similarly affected, the reply was, "Because the banks of that stream held the water in." Will the editor of the SCIENTIFIC AMERICAN please oblige the readers of his valuable paper in this locality by giving his opinion upon this subject? A. B.

[This is a mere dispute about the meaning of words. Up and down are not ordinarily used to express the distance of bodies from the center of the earth, but their relative distance above or below the level of the sea. The level of the sea is determined mainly by the balance between the centrifugal force resulting from the earth's rotation, and the power of the earth's gravitation. These two forces give the earth its form of an oblate spheroid, causing the surface at the equator to be 13 miles farther from the center than the surface at the poles. When water is raised above this surface the balance of the centrifugal force and gravity causes it to descend to the surface. Though the Mississippi at its mouth is some miles farther from the center of the earth than at its source, it does not flow up hill. Still, if any one chooses to say that it does, the assertion raises a question for lexicographers only ; there is no difference of opinion in relation to the facts EDS.