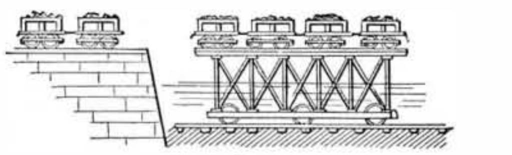
LOCOMOTIVES AND RAILWAYS.

Our selections this week from Knight's "Mechanical Dictionary" (published in numbers by Messrs. Hurd & Houghton, New York city) include a number of interesting engravings of locomotives, among which will be found represented the early machines of Stephenson and others, now carefully preserved as historical relics. We also give illustrations of two railways of curious construction. The

FERRY RAILWAY,

Fig. 1, has its track on the bottom of a water course, and

Fig. 1.



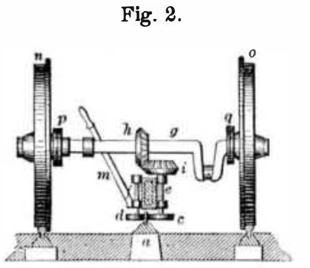
Ferry-Railway.

the carriage which runs thereon has an elevated deck which supports the train. Chains are attached to the carriage and connected to engines on each side of the stream, and in this way the huge vehicle is pulled from shore to shore. A ferry of this kind is in existence at St. Malo, France, and there are others in various parts of Holland. It is a cheap substitute for a railway bridge. Fig. 2 represents Vignolles and Ericsson's

CENTRAL FRICTION RAIL,

which is grasped by apparatus from the locomotive, so that the latter is thus assisted in ascending grades. The rail consists of a flat piece of iron fixed in a vertical position in chairs, *a*. *c*, *d* are horizontal friction rollers, *c* being fixed and *d* movable on their respective shafts. To the driving axle, *g*, is attached bevel gear, *h i*, which rotates the shaft, *e*, of the driving roller, *c*. The friction roller, *d*, may be pressed against the rail by the lever, *m*, which is so connected as to be easily operated by the engineer. The driving wheels, *n o*, may be released from the power of the engine by disengaging the clutches, *p q*, so as to throw the whole force of the engine upon the griping rollers, *c d*, when ascending a grade. In Fig. 3 are represented

Fig. 2.

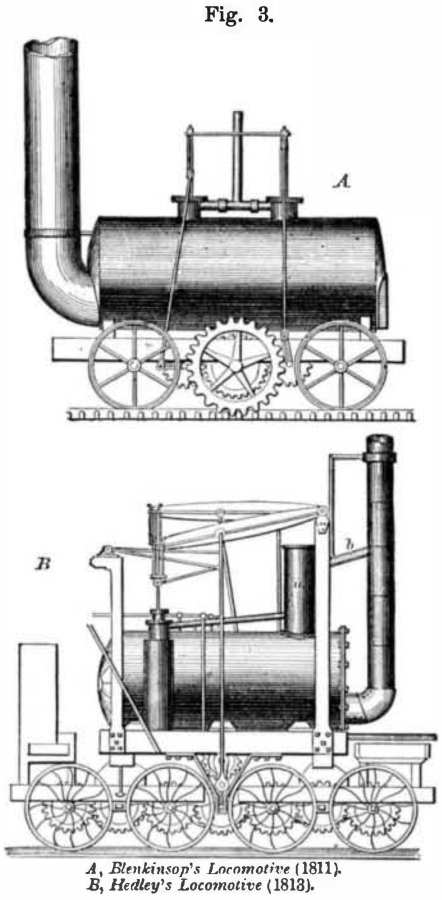


Vignoles and Ericsson's Central Rail.

BLENKINSOP'S AND HEDLEY'S LOCOMOTIVES,

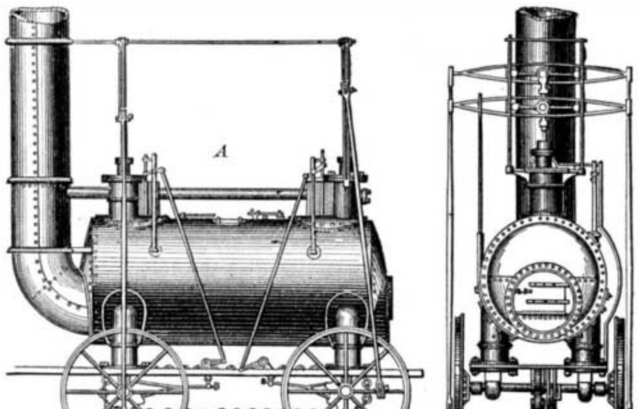
two of the earliest constructed machines. Blenkinsop's locomotive, in 1811, was usefully employed at the Middleton colliery in hauling coals on a tramway, the engine having spur wheels working into a rack on one side of the track. The engine, A, Fig. 3, was otherwise supported on four wheels. The fire was built in a large tube passing through the boiler, and the tube was bent up at the end to form a chimney. Two vertical cylinders were placed above the boiler, and the pistons were connected by crossheads and connecting rods to cranks on the axles of spur pinions, which geared into the main spur wheel, which formed the driver. It was long used on a colliery railway between Leeds and Middletown, $3\frac{1}{2}$ miles distant, and perhaps was the first successful locomotive in regular use. It drew trains of 30 tuns weight at $3\frac{1}{2}$ miles per hour.

Fig. 3.



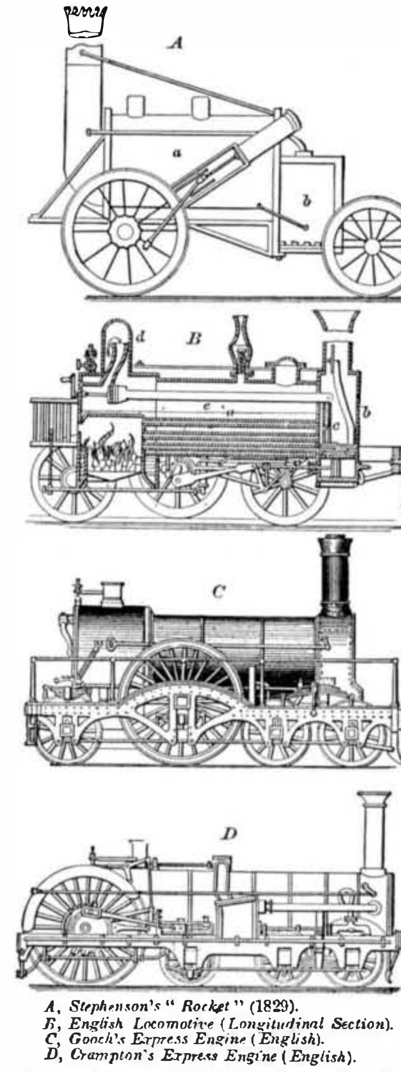
A, Blenkinsop's Locomotive (1811).
B, Hedley's Locomotive (1813).

Fig. 4.



Dodds and Stephenson Locomotive (1815).

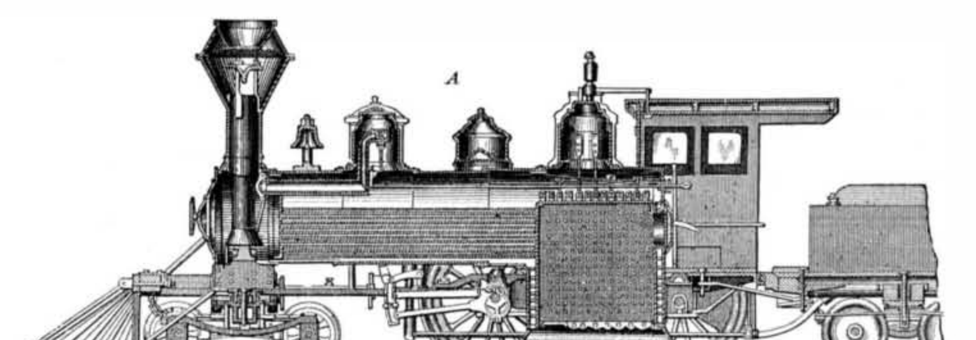
Fig. 5.



A, Stephenson's "Rocket" (1829).
B, English Locomotive (Longitudinal Section).
C, Gooch's Express Engine (English).
D, Crampton's Express Engine (English).

In the spring of 1813, William Hedley built a locomotive with four smooth drive wheels, to run on a smooth rail. The machine failed to accomplish much, on account of its small boiler. Hedley thereupon, the same year, built another engine (shown at B, Fig. 3), having a return-flue boiler, and mounted on eight driving wheels, which were coupled together by intermediate gear wheels on the axles, and all propelled by a gear in the center, driven by a pitman from the walking beam. Hedley's locomotive was objected to by residents of Newcastle, on account of the smoke. He therefore passed the smoke into a large receiver, *n*, and turned the exhaust steam upon it. From the receiver the steam and smoke were conveyed by a pipe, *b*, to the chimney, which device soon developed into the steam blast. "Puffing Billy" was at work more or less until 1862, when it was laid up as a memorial in the British Patent Office Museum. Hedley died in 1842.

Fig. 6.



Baldwin Locomotive (Central Longitudinal Section).

DODDS AND STEPHENSON'S LOCOMOTIVE.

In 1815, Dodds and Stephenson patented an engine (shown by side and end views, Fig. 4), in which the power might be applied either through wrists, at angles of 90° to each other on the driving wheel, or an endless chain working in gearing on the axles.

In 1829, the Liverpool and Manchester railway, then the most extensive and finished work of the kind ever undertaken, was completed, and the directors offered a reward of $2,500 for the best locomotive which should fulfill certain imposed conditions. Among these were that it was to consume its own smoke, and draw three times its own weight at a rate of not less than 10 miles an hour, and the boiler pressure was not to exceed 50 lbs. per square inch. The weight was not to exceed 6 tuns, nor the cost $2,750.

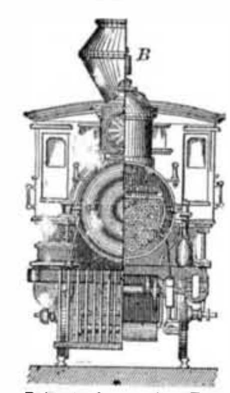
THE "ROCKET."

Three engines competed for the prize: the Rocket, constructed by George Stephenson; the Sanspareil, by Thomas Hackworth; the Novelty, by Messrs. Braithwaite and Ericsson. The Rocket weighed 4 tuns 5 cwt., and its tender, with water and coke, 3 tuns 4 cwt. It had two loaded carriages attached, weighing a little over 9 tuns and 10 cwt. The greatest velocity attained was $24\frac{1}{6}$ miles per hour, and the average consumption of coke per hour 217 lbs. See A, Fig. 5. The Sanspareil attained a speed of $22\frac{2}{3}$ miles per hour, but with an expenditure of fuel per hour of 692 lbs. The Novelty carried its own water and fuel. In consequence of successive accidents to the working arrangements, this engine was withdrawn from competition. A fourth engine, the Perseverance, by Burstall, not being adapted to the track, was withdrawn.

The Rocket engine was superseded in 1837, being condemned for life to the collieries. Here it proved itself capable of a rate of 60 miles an hour; but being gain convicted of levity while on duty, it was cashiered and its place filled by heavier machines of 12 tuns. After a few years of inglorious retirement, some one, not totally oblivious of how it would look in history, recalled the old soldier from his limbo, and now he enjoys the company of his elder brother, Hedley's Puffing Billy, in the English Patent Museum.

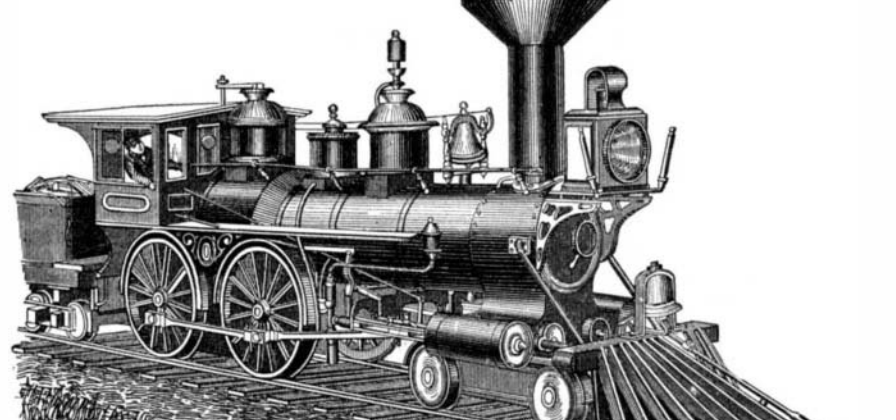
In Fig. 5, A is an elevation of the Rocket. The boiler, *a*, is a cylinder 6 feet long, and has 25 tubes. The fire box, *b*, has two tubes, communicating with the boiler below and above, and is surrounded by an exterior casing, into which the water from the boiler flows and is maintained at the same level as that in the boiler. B is a longitudinal vertical section of a modern English locomotive, which may serve as a contrast to Stephenson's first crude effort. The boiler is surrounded by two casings, one within the other, united by stays. The tubes, *a*, are of brass, 124 in number, and the boiler has longitudinal stays connecting the ends. *b* is the smoke box, into which the blast pipe, *c*, discharges. *d* is the

Fig. 7.



Baldwin Locomotive (End Elevation and Transverse Section).

Fig. 8.



American Locomotive (Perspective View).

steam dome, into which the steam from the upper part of the boiler enters, its amount being governed by a regulator controlled by a winch. This serves to obviate in great de gree the effects of priming. The steam pipe, *e*, has two branches, each entering one of the boxes containing the valves by which the flow of steam to the cylinders is controlled. C is an express engine designed by Gooch for the Great Western Railway, where an unusual rate of speed is maintained. The boiler has 305 tubes, 2 inches in diameter. The cylinders are 18 inches diameter and 24 inches stroke, the driving wheels 8 feet in diameter, the heating surface of the fire box 153 square feet. D is an express engine designed by Crampton. It is adapted for the usual gage.

Fig. 6 is a central longitudinal section of an approved form of American locomotive as made at the Baldwin Locomotive Works, Philadelphia. Fig. 7 is a perspective view. Fig. 8 is a front elevation, one half of which shows a transverse section through the boiler. The engine has four drivers, 60½ inches in diameter, and a four-wheeled swing bolster truck, and weighs, with water and fuel, about 65,000 lbs. The flues, 144 in number, are 2 inches in diameter, and 11 feet 5 inches in length. The fire box, of cast steel, is 66 inches long, 34½ inches wide, and 63 inches deep. Water space 3 inches sides and back, 4 inches front. Grates, cast iron. The cylinders are horizontal. Valve motion graduated to cut off at any point of the stroke. The tires are cast steel, and the wheel centers of cast iron with hollow spokes and rims, the wrist pins of cast steel, the connecting rods of hammered iron. The truck wheels are 28 inches in diameter. All the principal parts of such engines are interchangeable.

Attempts are being made, by adaptation of the furnace and boiler, to run locomotives by means of liquid fuel. Differences also occur in the construction of the heating parts, according to the character of the fuel—coal, coke, wood, peat, etc.

The ordinary speed attained on English railways is greater than that usual in this country. The Great Western express from London to Exeter travels at the rate of 57 miles an hour including stoppages, or 55 miles an hour while actually running. Midway between some of the stations a speed of 65 miles an hour has been reached. A speed of 75 miles is equivalent to 35 yards per second, so that if a row of stakes one yard apart were driven at the side of the road, they would, at this velocity, appear undistinguishable one from another. Were the driving wheels of the locomotive 7 feet in diameter, they would revolve 5 times in a second, each piston would traverse the cylinder 10 times per second, while there would be 20 discharges of waste steam per second, causing a continuous sound instead of the cough which is heard when the engine is moving slowly.

Very high speeds have been attained, on special occasions, on American roads, probably fully equaling any time ever made in England. For instance, it is stated that a train, conveying some officials of the New York Central Railroad, made the distance from Rochester to Syracuse, 81 miles, in 61 minutes, said to be the fastest time ever made in America.

The life of a locomotive engine is stated, in a paper read before the British Association, at thirty years. Some of the small parts require renewal every six months. The boiler tubes last five years, and the crank axles six years; tires, boilers, and fire boxes, seven to ten years. The side frames, axles, and other parts, thirty years. During this period, the total cost of repairs is estimated at $24,450 in American money, the original cost of the engine being $8,490. It therefore requires for repairs, in eleven years, a sum equal to its original cost. In this time it is estimated that an engine in average use has run 220,000 miles.

Correspondence.

The Sun's Retrograde Motion and the Weather.

To the Editor of the Scientific American:

Some time ago, I showed, in your columns, that both lunar acceleration and retardation in the earth are pure results or outgrowths of increase in the sun's motion; and still later, I showed, through the same channel, that inequality in the moon's mean motion is a result of solar retrograde motion; and now, with your permission, I will show that solar retrograde motion, or the sun's velocity, has much to do with our terrestrial winds and weather.

It is recorded in Harper's *Monthly Magazine* for November, 1876, that Mr. Charles A. Schott, of the Coast Survey Office, has, by great labor and investigation, discovered that there is what we may call an oscillation of the winds and weather in about every seventy years. Says the magazine: "All the stations agree in showing a rapid rise in the temperature about February 20. There are also indications that the hottest and coldest epochs change somewhat from year to year, making a complete circuit in seventy years through a range of about six weeks. On comparing the average direction of the wind with the average temperature, it appears evident that for years of northerly winds the temperature is lower, and for southerly winds it is higher So that secular changes in local temperature are attributable to corresponding changes in the direction of the winds. These latter changes, on the other hand, must be a part of a system of oscillation in the general currents of the atmosphere, which may be ultimately due to slight variation in solar radiation." Here I wish to note three things: first, that the wind and weather are supposed to circulate round the earth in some 70 years; second, that change in the winds may possibly be due to slight variation in solar radiation; and third, that I see, from another printed source, that a certain "German philosopher, Professor Prestel," ascribes weather changes "to the moon." Allow me to present my views.

The sun retrogrades in the plane proper of the ecliptic 50¼ seconds, annually; and so of course does the earth, in her own orbit, as it were; and it takes her 20 minutes and 20 seconds, in other words, 1 year, 20 minutes, and 20 seconds, to reach the same point in the heavens that she was at, say, on December 31 last at 12 o'clock at night. Twenty minutes and twenty seconds amounts to one day, or one rotation of the earth, in 70⅔ years. In 70 years and 8 months, therefore, the earth loses one day on the stars; and it will be seen in a moment or two that she loses the same amount, in the same space of time, on the winds and the weather; for the winds do not circulate round the earth, as supposed, but the earth turns—retrogrades round—to receive the winds, supposing them to blow from the same quarter.

To give a proper idea of what we mean, suppose the sun to be moving retrogressively at great velocity, and the earth in consequence to be ever meeting and stemming an etheric current: suppose too that the earth's rotary motion is stopped, and that nothing but her orbital motion and the sun's is going on. In such a case, the etheric current would ever strike the earth on one point of her surface; that would be the point or side of her that is ever lying next to the current. Now suppose that she retrogrades round her axis in a year, an amount equal to the 1-365¼ of a rotation—an amount equal to 20 minutes and 20 seconds—the point on her surface that directly breasted, so to speak, the etheric breeze last year would not breast it this year; but one, a little more than 5° east from it, would. Thus, by the earth's westerly or retrograde motion, as it were round her axis, the ever parallel current of storm seems, to all appearance and to meteorological evidence, to circulate easterly round the earth, while in reality it is the earth that is turning round to receive the ever parallel-flowing etheric breeze: a current that must ever flow directly from the sun as radiance, or be the result of the earth's being drawn, as it were, through ether by virtue of the sun's velocity, as a vessel propelled through water meets the still water as if it were flowing in a current against it. This, I say, would give the winds and weather an apparent easterly motion round the earth in some seventy years: and that is exactly as Mr. Schott finds it. I cite again from Harper's *Magazine*:

"Mr. Schott finds no perceptible secular change in the temperature of the country, nor any decided connection between our temperature and the variations in solar spots. For ten stations the mean temperature has been commuted for every day of the year, and it appears from these that changes in the normal temperature of any day extend over large tracks of country, and progress in an easterly direction." Thus I connect even the winds and the weather with solar retrograde motion, and I think that the moon has nothing to do with the weather. She, in every 18 years, and all along through the 19th year, so conjoins with the sun and earth that the four—sun, earth, moon, and storm current—are in line, or parallel with each other, and so a sort of periodic 19 years storm occurs. But the moon has no more to do with raising it than the surface of the earth has with the so-called seventy years oscillation, that is, the seventy years and eight months oscillation.

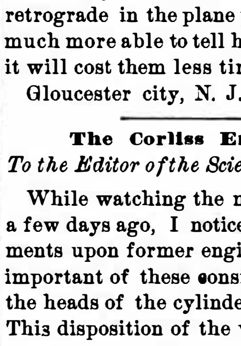
When astronomers, meteorologists, and other scientists, can clearly see the sun and the whole solar system moving retrograde in the plane proper of the ecliptic, they will be much more able to tell how and why phenomena occur; and it will cost them less time and labor too, I think.

Gloucester city, N. J. JOHN HEPBURN.

The Corliss Engine at the Centennial.

To the Editor of the Scientific American:

While watching the movements of this celebrated engine a few days ago, I noticed among its details two improvements upon former engines of the Corliss style. The most important of these consists in the placing of the valves in the heads of the cylinder instead of in the cylinder casting. This disposition of the valves does away with the eight triangular cavities in each cylinder which form the steam ports, namely, A, the inlet, B, the exhaust ports. The diagram shows a cross section at one end of a cylinder through the center of the ports, the aggregate capacity of these ports being equal to from two to four per cent of the steam used in working the engine. By placing the valves in the heads of the cylinder, they are brought almost in contact with the piston (when at the end of its stroke) from end to end of the ports, thus effecting a saving of the two or four per cent of steam usually wasted, and of course enhancing the economy of the engine in like proportion.



Could a like improvement be made in the valve gear of locomotives, the consequent saving of fuel ought to give the inventor a fortune in a short time. In locomotives, from five to ten per cent of the steam used is wasted in the huge passages between the valve and piston: and more, another benefit (aside from the direct saving of from five to ten per cent of steam, owing to the more perfect appropriation of the steam used, consequent upon the close proximity of the valves to the piston) is lost. Some engineers argue that short steam ports are of but little benefit in any case, especially in engines working under a high degree of expansion. By what line of sophistry they arrive at such a conclusion, I know not. They might, by the same reasoning, say that an engine would work just as economically with steam passages long enough to contain half of the steam used. It makes no difference whether the steam is exhausted from the cylinder at 90 or at 5 lbs. pressure to the inch; the percentage of waste will be precisely the same. The cubic capacity of the steam passages between the valve and the bore of the cylinder represents exactly the cubic quantity of steam used over and above what is needed to work the engine; and the sooner locomotive builders realize this, the sooner they will be prepared to reduce the length of these wasteful passages.

Another improvement noted in this engine consists in the interposition of a short link between the rocker arm and the arm upon the valve stem, in such a way as to cause the valve to open and close quickly, and to remain open and almost stationary for a considerable interval, thus giving a very free exhaust and a timely and rapid opening and closing of the valves. F. G. WOODWARD.

Worcester, Mass.

The Bude Canal in Cornwall, England.

To the Editor of the Scientific American:

The Bude Canal, from Bude to Launceston, is said to have been working for fifty years. It was intended to transport ore from Launceston to Bude, but is now principally used to carry coal, and sand from the coast for manure for the farms. In order to carry the canal over the highest points of the land, a very simple and wonderfully effective plan has been carried out. The canal is made in sections, each on a level; and each two sections are joined by an inclined plane, on which are laid grooved rails. The barges, which are built for the purpose, are hauled bodily out of the canal laden with, say, 4 tuns of coal or sand, and drawn up the tramway with a chain, and launched again in the next section of canal, which starts from the top of the hill. There are in the entire length of the canal six of these planes, three between Bude to the highest point, and three down into Launceston. At Marham, about 1½ miles up the canal from Bude, is the first ascent. I judged the length of the incline to be 800 feet, and the gradient 1 in 6; the total ascent, therefore, is about 130 feet. The barges are small, of about 5 feet beam, and 15 feet in length, and are loaded with 4 tuns, total weight being 5 tuns each when loaded. Fitted on the flat bottoms are four wheels, which run in the grooved rails, laid like an ordinary tramway, in two lines up the incline. An endless cable passes between the rails, up one and down the other, and round large wheels at either end. These wheels are fixed horizontally. The wheel of the upper end has a strong shaft or axis, which descends into a chamber below, where, by means of cogged wheels, it is connected with an enormous water wheel, the moving power. This water wheel is overshot, and has a diameter of 60 feet. The barge to be hauled up having been placed in position and fastened to the endless cable chain, the water wheel is set in motion, and the barge is rapidly drawn to the top of the incline and floated again in the upper canal. About two miles further up I came to Hobbacott, where is the second incline. This is longer and steeper, and is worked in a different manner. This incline is 900 feet long; total rise, 275 feet. At the top are two wells, 20 feet in diameter and 225 feet deep. At the bottom of each is an escape for water to flow out into the lower canal. Suspended in these wells, by massive cables from a horizontal roller, are two huge iron buckets, capable of holding 60 hogsheads of water each, and weighing, when full, 16 tuns. These are so arranged that, when one bucket is at the top of one well, the other bucket is at the bottom of the other. The bucket which is at the top of the well is filled with water from a sluice, and is allowed to descend; and in doing so, it raises the bucket in the other well, which comes up empty, the water having escaped through a valve which opened mechanically when the bucket reached the bottom. The alternate rising and falling of these buckets sets in motion the endless chain cable on the incline; and by means of cogged wheels, the power is so mul iplied that the descent of the bucket, weighing 16 tuns, into the well 225 feet deep, suffices to haul a barge weighing 5 tuns up the entire length of the incline, 900 feet, in the space of 4½ minutes. The whole of this machinery is worked by two men and a boy, with no further expense than the oil for the machine.

About nine miles further up the canal, at its highest point, is a vast reservoir measuring 60 acres, which supplies the water for working the canal.

London, England. B. R. PLANTE.

The Supposed Planet Vulcan.

To the Editor of the Scientific American:

Please to add my testimony to that of others regarding the intra-mercurial planet. Unfortunately, when I saw the planet, supposing it to be known to astronomers, I did not attach such importance to the subject as to induce me to make memoranda, and at this distance of time can only think that it was about the year 1860. I was residing then in Washington Territory, and was superintending some work on a prairie, a few miles from Fort Vancouver, on the Columbia River. A range of mountains was in the distance, from behind which the sun had reached an altitude of about 30° above the horizon, when a small boy asked me what was the matter with the sun. On looking at it I saw a planet, not as your correspondent saw it, but as a perfectly rounded, well defined dark spot, having with the disk a smaller relative proportion than that you have illustrated, and situated nearer the disk's diameter. I watched its progress till its completion without a telescope, merely glancing with partially closed eyes, at very short intervals. It was in the hight of summer, and the hour was so early that no one but our party, that I have heard of, saw it. I am