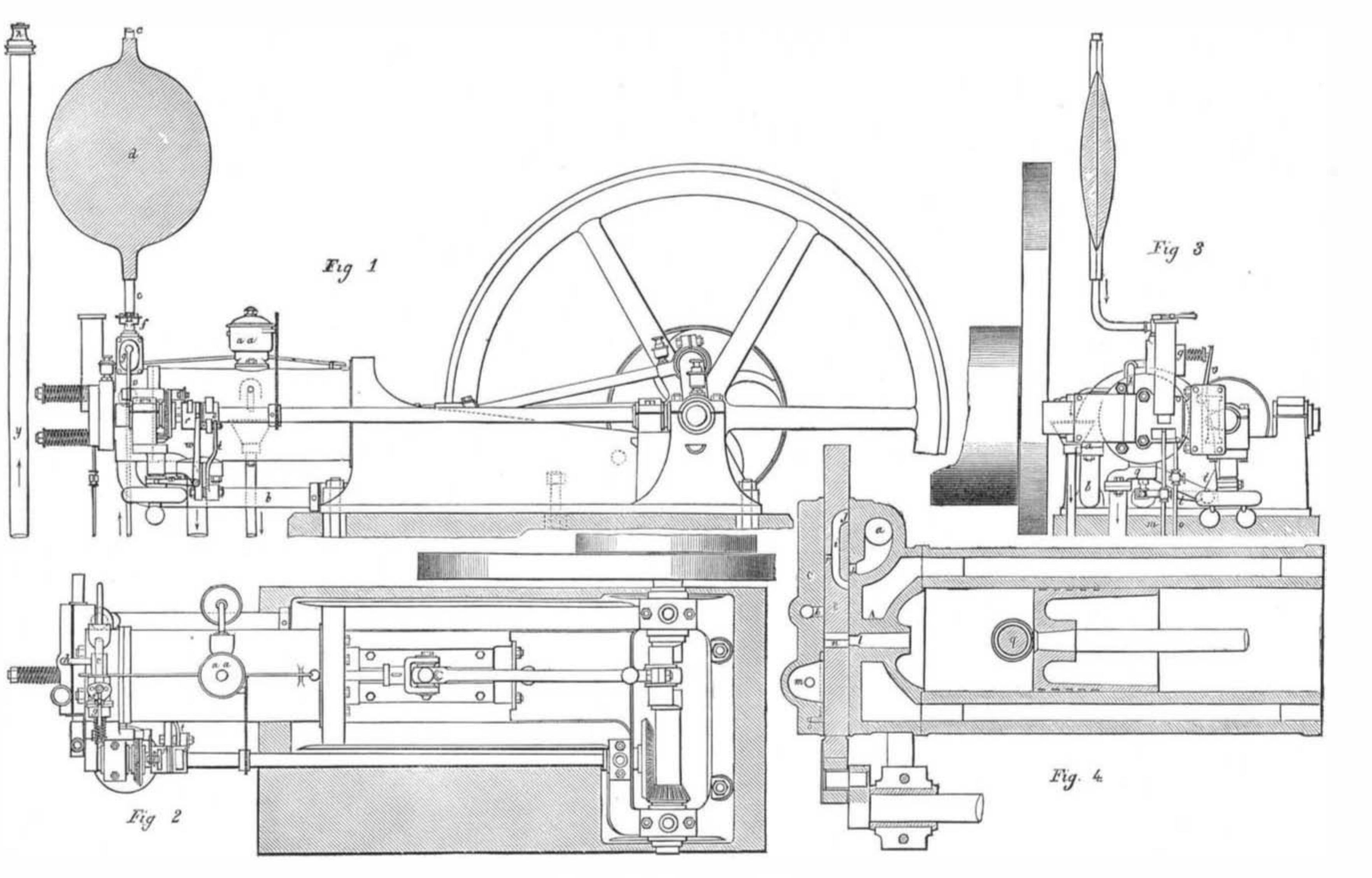
THE NEW OTTO GAS ENGINE.

The annexed illustrations, for which we are indebted to the Belgian *Bulletin du Musée de l'Industrie*, represent the new Otto horizontal gas engine. In general appearance this machine closely resembles the ordinary horizontal steam engine. A cylinder receives a piston, which on starting draws in air and gas mingled in certain proportions. A flame brought in contact with this mixture produces its rapid combustion. The high temperature thus engendered results in considerable pressure, and the gases act by expansion upon the piston, drive it ahead, and it in turn communicates its motion to connecting rod, crank, etc. There are four distinct phases of operation for every two turns of the flywheel, namely: 1. Aspiration of air and gas; 2. Compression of the mixed gases; 3. Combustion and impulse given to the piston; and 4. Escape of the products of combustion. So that it will be seen that the piston receives but one impulse for every two revolutions.

On the slide, A, Fig. 4, in rear of the cylinder moves the valve, B, which is retained in place by the cover, C, and by spiral springs which allow of some yielding at the moment of ignition. The slide or breech, A, has a tubulure, *a*, which leads air into the cylinder by the tube, *b*, which communicates with the bed block, in which last is the air reservoir. The gas is conducted by a tube, *c*, Fig. 2, in a rubber pocket, *d*, which serves as a pressure regulator, and enters the cover, C, by the stop valve, *f*, and valve, *g*, passing through the tube, *h*. The air and gas penetrate into the cavity, *i*, Fig. 4, in the valve, B, traversing the orifices, *j* and *k*, and thence enter the cylinder by the aperture, *l*. The cover, C, has two small gas tubes provided with cocks. One of these, *m*, terminates in a burner which is constantly lit during the operation of the machine, its object being to ignite at intervals a small quantity of gas carried into the cavity, *n*, of the slide valve by the tube, *o*.



THE NEW OTTO GAS ENGINE.

The valve, B, is moved from the main shaft by bevel gearing and a lateral shaft terminating in a small crank, the velocity of rotation of which is one half that of the motor shaft, so that one stroke of the valve corresponds to two revolutions of the main shaft.

During the first two phases above noted (aspiration and compression), which correspond to the first turn of the motor shaft, the cavity, *n*, in the valve, B, is filled with gas, which is ignited at the passage of the flame fed by the tube, *m*. At the beginning of the third phase, which corresponds to the dead point of the motor crank, and which coincides with the beginning of the second turn of the shaft, the cavity, *n*, of the valve containing the ignited gas uncovers the orifice, *l*, in the breech, A, and thus places the mixture in the cylinder in communication with the flame, producing combustion. The impulse received by the piston is then the motor force.

In order to expel the products of combustion which remain in rear of the piston, the cylinder has a valve, *q*, operated by the lever, *t*. The play of the latter is governed by a small cam fixed on the sleeve, *s*, of the lateral shaft. This cam is regulated so as to push the lever and consequently to lift the valve at the moment the piston begins its back stroke in the second turn of the motor shaft. The cam leaves the lever when the piston is ready to begin a new aspiration—that is, at the commencement of the third turn of the flywheel. The lever then returns to its primitive position, aided by a spring, and the valve closes. The lateral shaft carries a second sleeve, *r*, Figs. 1 and 3, having a cam which governs a lever, *v*, and which in its turn moves the gas valve, *g*, in order to give passage to the gas which produces the explosive mixture. The sleeve, *s*, is connected with the regulator by a lever, *w*. When the motor exceeds its required speed, the regulator lifts, displaces the sleeve, and prevents admission of the gas until normal velocity is regained. The engine meanwhile runs of its own momentum, and the consumption of gas is thus modified according to the work to be done.

The cylinder has a double envelope with water circulation between, in order to prevent overheating of the parts exposed to the hot gases. The heated water is returned to its reservoir and is cooled by contact of the air. To prevent the noise made by the escape of suddenly expanding gases into the atmosphere, the exhaust is led by a pipe first into a reservoir, whence it passes into the atmosphere by the tube, *y*, and ajutage, *z*, Fig. 1. The consumption of gas by this engine varies in some degree according to quality of the former; it averages, however, about 35·3 cubic feet per hour.

◆

Mica Ventilators.

To promote ventilation in rooms, a little wind-rose or wheel with vanes is often used, being inserted in an aperture in a window pane. The draught sets it in rotation. M. Raphael, of Breslau, makes such ventilators of mica, with a narrow metallic outer rim, which is connected with a small metal wheel round the axis by twelve vanes of mica. Among the advantages claimed for these mica wheels over those of metal are the following: Mica is transparent like glass, and so does not darken the room. The variations of temperature and moisture of the air have no effect on it, whereas metal ventilators, through changes of temperature, are apt to be displaced on their axes and have their rotation hindered. The movement is much easier, mica being so very light. Mica is, further, a very bad conductor of heat, so that one side of a plate of it may be too hot to touch while the other can be held quite well.

◆

Microscopical Notes.

Dr. Joseph G. Richardson has directed attention to a method of his own for enumerating the red and white corpuscles of blood, which, he claims, obviates the difficulties which have previously existed to the accomplishment of this important work.

After describing the older methods of Henri Bonne and others, Dr. Richardson suggests the following plan: Take a clean sewing needle (No. 6) and two ordinary glass slides, and having punctured the middle finger of your patient, squeeze out a drop of blood the size of a pin's head, touch the apex of this drop to the surface of your labeled slide near its end, and then immediately spread it out by means of the edge of your other glass slide applied to the portion of the blood drop which adheres to the first slide, and while holding slide No. 2 at an angle of 45°, drawing it rapidly along the flat surface of No. 1, in such a way as to leave a faint reddish film equally distributed over the latter. In half a minute or less your preparation dries, and if protected from dust and moisture, may be examined any time between this and 1978. After writing the name of the patient and date upon the label, inspect as soon as convenient under a power of 200 diameters.

If a comparison is made with a specimen from a healthy person, the presence or absence of any marked change in the ratio of the red and white corpuscles may be observed.

In order, however, to establish the *amount* of alteration, and for the purpose of facilitating the enumeration of the colorless globules, and ascertaining their proportion to the red disks, the following scheme is suggested:

Provide, in the first place, a stage micrometer, ruled in ½ mm. upon glass about half the thickness of an ordinary slide. Lay your blood specimen upon the stage of the microscope, find an area of ½ mm. in width by 5 mm. in length, where the corpuscles are spread so thickly as to almost touch, and yet are in no case superimposed upon each other. Such an area as this can generally be met with quite readily. Lay upon it your ½ mm. micrometer face downward, so that its lines can be seen (somewhat indistinctly perhaps), at the same time the blood globules are in focus.

Secondly, procure an eye piece micrometer with very coarse divisions, the lines of which are $\frac{1}{20}$ of an inch ($\frac{8}{20}$ of a mm.) apart, and place it in your A eye piece, so that its lines divide the field of view into from 8 to 12 transverse bands, each about the width of 5 red blood corpuscles, as seen with a $\frac{1}{4}$ or $\frac{1}{5}$ objective.

These pieces of apparatus are aids to count the red disks, which should be done and recorded as a unit of enumeration for the white corpuscles.

This counting is best done by adjusting the camera lucida, drawing on white paper the outlines of the field of view, with both the transverse lines of the eye piece micrometer and the vertical lines of the stage micrometer, and then counting the individual globules in a band at a time, dotting each corpuscle as counted, so that none may be missed or twice noticed.

For perfect accuracy, the red and the white corpuscles must be counted in each field, but it is not worth while to undertake this. For practical purposes consider the number of red disks in each field of a given lens and eye piece, where these disks nearly touch, but are not piled upon each other, as identical, and the sum of the white corpuscles observed in ten successive fields answering this description, divided into ten times the number of red disks counted in one such field, shows the ratio of the white to the red corpuscles.

For example, with the ¼ inch objective and A eye piece of Power and Leland, I find the field of such a single layer of blood as that above described shows 3,000 red disks, and that in ten fields displays about 100 white globules. Dividing now 100 (the number of the leucocytes) into 30,000 (the number of red disks in ten fields, each ½ a mm. wide), I obtain the fraction $\frac{100}{30000}$, or reduced to its lowest terms $\frac{1}{300}$, as the proportion which the white bear to the red corpuscles.

In doubtful instances the leucocytes may be distinguished from the red disks by turning the fine adjustment so as to raise the lens a little, when the white corpuscles usually display a peculiar fatty luster. Care must be taken to avoid mistaking unusually large aggregations of the fatty (?) molecules of the blood for leucocytes.

Having thus obtained the true ratio of the white globules to the red, it becomes an easy matter to calculate the actual number of the leucocytes in each cubic millimeter of blood, after we have determined by the aid of Hématimètre, of Hayen and Nachet, or of Malassey, the number of the red corpuscles in that quantity of the circulating fluid.

Dr. Richardson gives 5,000,000 as the average number of red disks to the cubic millimeter in the blood of a healthy subject.

PRESERVATIVE FLUIDS FOR MICROSCOPIC SPECIMENS.—The following formulæ are by F. Meyer:

(*a.*) For larvæ, hydræ, and nematodæ: Glycerin, chemically pure at 124, 1 part; distilled water, 2 parts. To ten parts of this mixture add one part of the following solution: Pyroligneous acid at 1040, 100 parts; salicylic acid, 1 part.

(*b.*) For infusoria: Glycerin, 1 part; distilled water, 4 parts. To ten parts of this add one part of the above solution of salicylic acid.

(*c.*) For algæ: Glycerin, 1 part; solution salicylic acid, 1 part; distilled water, 20 parts.

TROY SCIENTIFIC ASSOCIATION.—The annual soirée of the Microscopical Section was held on the 4th inst., at the house of Dr. R. H. Ward. The plan adopted was most excellent. Fifty-eight objects were shown by eleven gentlemen, each of whom exhibited specialties in some particular field of microscopy. Twenty-nine microscopes were employed. Those arranging similar soirées would do well to obtain a copy of the printed programme from Dr. R. H. Ward, of Troy, by which they will notice the general arrangements.

Communications.

Locomotive Strokes.

To the Editor of the Scientific American :

In the SCIENTIFIC AMERICAN of March 9, 1878, it is suggested by Mr. F. G. Woodward that our locomotives might be made more efficient and serviceable for freight work by giving them just one half of their present piston area and doubling the length of their stroke. I cannot agree with Mr. Woodward that there is any gain whatever. From my standpoint I will say that the proposed change has no practical or theoretical advantage.

For example, let us take two locomotives of the same weight, boiler capacity, and tractile force, one, as at present constructed, with a 12 inch crank and cylinders of 16 inches diameter by 24 inches stroke; the other (as proposed) with a 24 inch crank and cylinders of 8 inches diameter by 48 inches stroke.

As the cylinder is where the power is applied, we must commence there. The area of our 16x24 inch cylinder, we find, is 201·0624 inches, and it has a cubic capacity of 4,825·4976 inches contents of one cylinder, while we have another on the other side of the same dimensions. To ascertain the full area and cubic contents, we simply multiply by 2, which gives us 402·1248 inches area, and 9,650·9952 cubic inches. Let us pursue the same course with Mr. Woodward's proposed cylinder, one half of the above diameter and twice the stroke. We have a cylinder of 8 inches in diameter and 48 inches stroke, of an area of 50·2656 inches and 2,412·7488 cubic inches. Both cylinders represent an area of 100·5312 inches and 4,825·4976 cubic inches. The difference found in total areas in favor of the standard engine is as 4 to 1, while the cubic capacity is just 4 times that of Mr. Woodward's plan.

Suppose we use a little steam in our 16x24 inch cylinder, at a pressure of 125 lbs. per square inch, and cut off at 8 inches. We have 1,608·4992 cubic inches of steam to expand into 16 inches before exhausted in one cylinder, and twice that in both cylinders, namely, 3,216·9984 cubic inches. The same with Mr. Woodward's plan would represent 402·1248 cubic inches in one cylinder and 804·2496 cubic inches in both cylinders, with 40 inches to expand before exhaustion.

We find the ratio of expansion in the former to be 1 to 2, the latter 1 to 5, provided there is nothing lost by condensing in either case; in other words, our cubic inch of steam would be exhausted at one half of its pressure in the former and one fifth in the latter case, assuming that there is none consumed to overcome the friction in either cylinder.

The suggestion presents itself to me in the following light: We have a 16x24 inch cylinder with 1,608·4992 cubic inches of steam exerting its force on 201·0624 inches area of surface (cut off at 8 inches), and forcing that surface through a space of 16 inches and exhausting itself in the air at one half of its pressure; on the other hand, we have 402·1248 cubic inches of steam exerting its force on 50·2656 inches area of surface (cut off at 8 inches), and forcing that surface through a space of 40 inches, exhausting into the air at one fifth its pressure. This result presents itself: The more inches of area there are, and the less space to travel through, the greater the power; while the less area and greater distance to travel, the less power we have. The difference in favor of the 16x24 cylinder will be readily seen by the following:

16"x24" cylinder	*versus*	8"x48" cylinder.
201·0624 area	"	50·2656 area.
1,608·4992 cubic in.	(cut off at 8"),	402·1248 cubic in.

Or four times the power in favor of 16"x24", with the 12 inch crank. Assuming that Mr. Woodward would gain twice the power on the crank, we have yet twice the power in favor of the present locomotive.

JOHN A. HOLMES.

East Buffalo, N. Y., March 8, 1878.

◆

The Prevention of Explosions in Mines.—An Invention Needed.

To the Editor of the Scientific American :

Permit me through the columns of your journal to call the attention of inventors in general to a matter of vital importance to thousands of our laborers, and which will amply reward the successful inventor who turns his attention thereto. I refer to the discovery of some method or plan by which the explosions of inflammable gases in coal mines may be prevented. Accidents, nearly always fatal, are of almost daily occurrence in the anthracite coal regions of Pennsylvania, and aside from the loss of life and mutilation of the miners, the damage done to the property of the mine owners is almost beyond computation. The inventor who succeeds in effectually preventing these disastrous explosions will not only prove a public benefactor, but the fruits of his invention will enrich him to an extent greater than the profits of any average business could reward him for a lifetime of labor. To those who will turn their attention toward this matter I would say that the most perfect system of ventilation alone will not effect the object sought, and most mines are so constructed that it is next to impossible to force more pure air into them than is barely necessary for the support of the miners' existence. The proper ventilation of mines is provided for by law in this State, and nearly all mine owners comply with the law to the extent of their ability; but there are natural obstructions to thorough ventilation. In such cases the miners are compelled to work in the gas, using the safety lamp, which in many cases has unfortunately proved to be a safety lamp in name only. Old practical miners, men who have spent their whole lifetime in the mines, assert that the most destructive explosions always occur in dry mines, while wet workings are to a great extent free from such dangers. They explain this by saying that in all dry workings the atmosphere is charged with finely powdered coal dust, which alone is dangerous, but when mixed with the explosive gases forms a matter tenfold more dangerous in case the gas is fired. I quote below Section 7 of the mine ventilation law for the guidance of those who may wish to pursue the investigation of this subject:

"SECTION 7. The owners or agents of every coal mine or colliery shall provide and establish for every such coal mine or colliery an adequate amount of ventilation, and not less than fifty-five cubic feet per second of pure air, or thirty-three hundred cubic feet per minute, for every fifty men at work in such mine, and as much more as circumstances may require, which shall be circulated through to the face of each and every working place throughout the entire mine, to dilute and render harmless and expel therefrom the noxious, poisonous gases to such an extent that the entire mine shall be in a fit state for men to work therein, and be free from danger to the health and lives of the men by reason of said noxious and poisonous gases, and all workings shall be kept clear of standing gas. The ventilation may be produced by using blowing engines, air pumps, forcing or suction fans, of sufficient capacity and power, or other suitable appliances, so as to produce and insure constantly an abundant supply of fresh air throughout the entire mine, but in no case shall a furnace be used in the mine, where the coal breaker and chute buildings are built directly over and covering the top of the shaft, for the purpose of producing a hot up-cast of air; and there shall be an in-take air way, of not less than twenty square feet area, and the return air way shall not be less than twenty-five square feet."

Now it has always been considered impossible to free a mine entirely of explosive gas by trying to expel the gas with the force of a current of pure air, and yet we have never heard of any plan of preventing danger and explosions excepting the ventilation method. In some mines (a very few) it works well enough to answer all practical purposes, but in a large majority of cases, and in all large mines, it fails to be effectual simply because as the mine is worked gas is being constantly freed, and miners are liable at any time to strike a "feeder" or current of gas which the air is powerless to expel. It may be that some one of our inventors will devise a plan of ventilation that will prove more perfect than those now in use, but the chances are that no such system will ever prove a perfect safeguard against explosions. What is needed and what we think is the key to the whole subject is the discovery and application of some neutralizer which will destroy the explosive nature of the gases. To dilute the gases with air and allow them to become impregnated with the atoms of coal floating in the mine atmosphere renders the gases more dangerous than when in a pure state, and the knowledge that the gases are diluted renders ignorant miners much more careless at a time when they are in imminent danger. A substance or method that will abate the destructive power of mine gases will enrich the discoverer beyond the most sanguine expectations, will make him a public benefactor, and will enroll his name on the scroll of Honor and Fame in letters that will endure for centuries to come.

HORACE B. MCCOOL.

Pottsville, Pa., March 7, 1878.

◆

Power Required to Run a Velocipede.

To the Editor of the Scientific American :

In your issue of February 9, G. O. A. asks: "Is there a practical velocipede, that is, one which would enable a man of ordinary muscular development to travel a distance of 20 miles on a good country road in less time and with less fatigue than he could do it on foot?"

In your issue of 16th inst., a correspondent, Jno. B., replies in the negative, and though it would appear from his communication that his experience ought to be considerable, yet I am (from experience also) compelled to differ with him, and before giving my experience, I may state that I am not the possessor of any extraordinary amount of muscular development; on the contrary, I am rather under the average in that respect, my weight being about 140 lbs.; yet I have ridden a velocipede on "a good country road" in one day, a distance of 52 miles, the actual running time, or the time deducting stoppages, being 7½ hours, a feat which I could not have performed on foot under any circumstances, yet I accomplished this without feeling any unusual fatigue. This is the greatest distance that I ever had occasion to make in one day, but have frequently ridden a distance of 30 miles for amusement.

Your correspondent, Jno. B., says that it "is impossible, under any circumstances, to run a velocipede through a given distance with the same expenditure of power as that required to walk the given distance;" but let us look at it for a moment, and it will be evident that in walking the whole weight of the body must be supported on each foot alternately, which, in my case, would mean a force of 140 lbs. expended every step, besides that required to propel the body forward a distance of about 33 inches. Now let it be remembered that in riding the velocipede, the whole weight of the body is borne by the vehicle, and allows the rider to exert all the power employed for the purpose of propelling himself forward; and it must also be remembered that in riding the velocipede with, say, a 42 inch wheel, the rider at each step can propel himself forward a distance of 126 inches, or $3\frac{27}{33}$ times the distance that he would move in walking at an ordinary gait.

I have never actually tried the force required to be exerted on the pedals of a velocipede to propel myself forward, but I am satisfied that it does not require more than that which is required to sustain the weight of the body and propel it forward in walking.

I might draw your correspondent's attention to the fact that one man can move a loaded car on a level railway track, yet no one would expect him to carry it.

Your correspondent's idea of a man going on a journey and drawing a velocipede after him is simply ridiculous, and reminds one of a person who, in attempting to draw a saw log lying on the ground, would refuse to attempt to draw it on a truck on account of the additional weight.

I am perfectly satisfied that a man of "ordinary muscular development" can travel a distance of 20 miles on a properly constructed velocipede with a less expenditure of power than he could walk the same distance.

Hoping some of your correspondents will give a more scientific exposition of the reasons why than I am able to give, I remain yours, VELOCIPEDE.

Chatham, March 11, 1878.

◆

[For the Scientific American.]

PLANT MIND.

I.

THE SOUL OF PLANTS AND MODERN SCIENCE.

Vegetable physiology has made but slow progress. Although its beginning may be traced to the period when Malpighi aided it with the microscope, its real origin does not date earlier than the last century, when, by his beautiful experiments on the nutrition and transpiration of plants, Hales explained some curious phenomena in the vegetable world.

From that time naturalists began to study attentively the phenomena of vegetation.

The observations of Linnæus and Holff, the numerous experiments of Bonnet and Senebier, the works of Duhamel, Ludwig, and Mustel, the investigations of H. de Saussure and Hedwig—all these efforts tended toward the same end, namely, reuniting scattered materials and forming a regular whole. Some of these in studying the life of plants examined more particularly the form, structure, and development of their organs; while others attempted to explain their play and functions. The result of these labors was the birth of two new sciences—vegetable physiology and organography.

Modern physiologists have observed some extraordinary phenomena in plants, with which they have been differently impressed. They all, it is true, recognize a sensible analogy between these facts and certain animal instincts; but some see in these only isolated phenomena of secondary importance, and propose to explain them by altogether mechanical or physical theories; while others, on the contrary, attracted by the singularity of these facts, have studied them with close attention, and as the result of their observations have come to the conclusion that a plant is an animated being. This is substantially admitted by Vrolik, Hedwig, Bonnet,