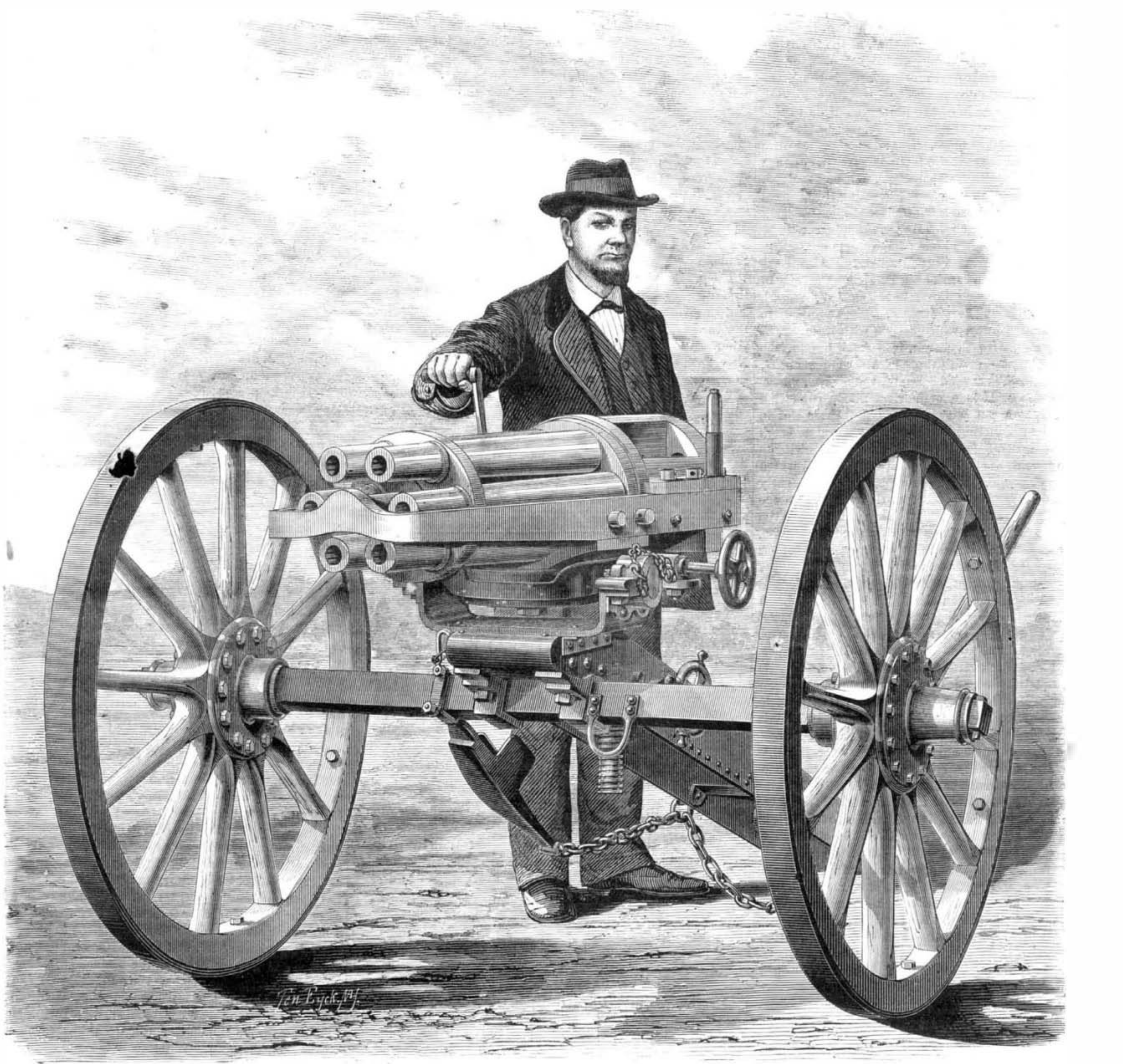
SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. XXX.—No. 2.
[NEW SERIES.]

NEW YORK, JANUARY 10, 1874.

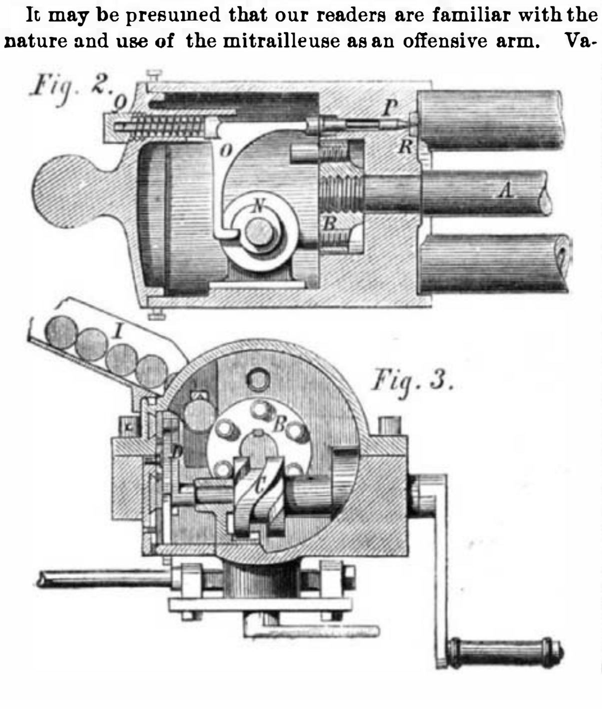
$3 per Annum,
IN ADVANCE.



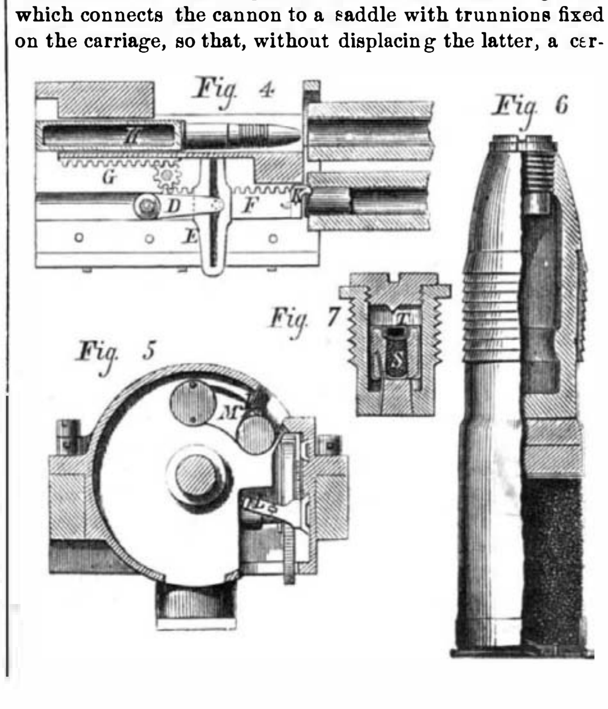
THE HOTCHKISS MITRAILLEUSE.

THE HOTCHKISS CANNON REVOLVER.

It may be presumed that our readers are familiar with the nature and use of the mitrailleuse as an offensive arm. Various forms of the weapon have already been represented in these columns, and the respective merits of the Gatling, the Taylor, the Sigl, and other kindred guns have been fully described. While all of these deadly arms will doubtless bear their full share in the determination of future wars, few, we believe, will prove more formidable than the weapon illustrated in the engravings hereto annexed. It is not a battery of musket barrels, but, as its name indicates, a bundle of rifled cannons which throw explosive shells, or other projectiles, weighing 23·5 ounces, and this at the rate, as experiment has shown, of sixty shots in forty-eight seconds. No demonstration is needed to point out the fearful execution of which such an arm is capable



The cannon, in exterior form, resembles the Gatling gun, but its mechanism, as will be seen as we progress, is essentially different. The working portions may be divided into two distinct parts: First, the barrels with their shaft and frame; and, second, the breech with the firing and charging apparatus. Fig. 1 affords a general perspective view of the gun, from which it will be seen that the barrels are six in number. These are made of cast steel, and are mounted between two disks which are rigidly secured to a central shaft (A in the sectional view, Fig. 2), which goes through the front of the breech. To the latter is attached the frame, which extends alongside the barrels and supports the shaft, A, at its outer end. It is clear that, if the central shaft be suitably rotated, it will carry the barrels around with it. Attached to the interior part of the frame is a turning table which connects the cannon to a saddle with trunnions fixed on the carriage, so that, without displacing the latter, a cer-



tain amount of lateral motion, as well as of elevation, may be given to the gun. The breech is composed of a block, containing the mechanism and closed at the rear end by a cover, shown in Fig 2, which is fixed by two set screws, so that it may be easily removed and ready access thus afforded to the interior portions.

Beginning our explanation with the revolving mechanism, B, in Fig. 3, is a pin wheel keyed inside the breech to the end of the shaft, A, and carrying six studs upon its rear face, arranged parallel to each other. C is a worm wheel which is mounted on a shaft at right angles to shaft A, that is, transverse the breech. The left hand end of the worm shaft turns in a bearing within the breech, while its other extremity passes through the latter, and is actuated by the crank, the motion of which operates the whole system, as will be seen further on. The worm wheel, C, the grooves in which receive the studs on B and so rotate shaft A, is of peculiar construction, and is so designed that, at the instant of firing, the barrels may be motionless. To this end the directing groove is composed of two inclined parts connected by a straight portion which covers half of the section of the cylinder, so that, while a pin of the pin wheel, B, is in this straight part, no movement of the barrels during half a revolution of the wheel takes place. But as soon as the worm wheel has revolved so far that the inclined part acts upon a pin, the wheel, B, and with it the barrels, will be revolved. Of course, during the time the pin is traversing the straight portion of the groove, the firing takes place.

From Figs. 3, 4, and 5, the loading mechanism will be readily followed. The left hand end of the worm shaft, Fig. 3, I will be noticed, passes through its bearing within the breech, and terminates in a crank arm, D. The extremity of the latter carries a pin which works in the slotted piece, E, Fig. 4, so that, as the crank arm revolves, it gives a to-and-fro motion to said slotted piece, which carries with it a rack, F. Above, and engaging with this rack, is a small pinion, the teeth of which also mesh with those of a second rack, G, so that, as the rack, F, is carried forward, the rack, G, moves back, and *vice versâ*. H is a cylindrical piston connected with the rack, G, by a pin which travels through a slot in the bottom of the conducting trough, so that piston and rack work together. I, Fig. 3 is the feed trough in which the cartridges are placed, as shown, and in the bottom of which is a little door, J, Fig. 5. When the piston is sufficiently retracted, this door falls open and a cartridge drops into the conducting trough by its own gravity. Subsequently, as the piston moves forward, in the manner described further on, to drive the charge into the barrel, a stud upon its upper side pushes the door shut, and thus holds it until the proper time for the reception of another cartridge arrives.

As shown in Fig. 4, the crank arm, D, is horizontal. It arrives at this position just as a pin upon the wheel, B, enters the straight part of the worm; and of course the racks, as depicted in the last mentioned figure, are drawn respectively forward and backward to their fullest extent. As above noted, the little door, J, is now free to open, and hence a cartridge drops in before the piston. The racks also, in the position shown, remain at rest for a moment and this is effected by giving the slot in E, Fig. 4, a circular shape, concentric to the shaft of the crank. The object of this is that at this moment, the barrels arriving at the end of their motion, a spent cartridge in one becomes engaged with the large double hook, K Fig. 4, of the extractor, which is secured to the lower rack, F, and hence, if the motion of the racks were not thus interrupted, time would not be afforded to complete the engagement.

The crank arm, D, we will suppose, continuing its revolution, passes the circular portion of the slotted piece, E, and, consequently moving the latter, starts the racks in opposite directions. Rack, F, pulling on the extractor, drags the cartridge shell out of the lower barrel and to the rear, until it meets an ejector, L, Fig. 5, against which the cylinder strikes, is detached and falls to the ground through the opening shown in the breech block. Rack G, moving forward and carrying with it the piston, during the next half revolution of the worm wheel introduces the cartridge into its barrel; the latter, it will be remembered, necessarily stands still. The cartridge is, however, not driven in all the way, but its head is in view of an inclined plane, M, Fig. 5, which is cut into the metal of the breech, on which it slides when carried around by the movement of the barrels. This completes the introduction of the charge.

The firing apparatus is omitted in Fig. 3, in order to render other parts more clearly shown, but it is represented very plainly in Fig. 2. N is a cam secured on the worm shaft and to the right of the worm wheel. It will be remembered that we have supposed the cartridge to be inserted and the barrels to be revolving; hence, this cam will now also be turning, and in such a manner as to be in the act of pushing back the long arm, O, which connects with the firing pin, P. The action of the spiral spring, shown at Q, keeps the arm, O, pressed up against the cam so that, as the pin is forced back, it compresses the spring and, in fact, cocks the piece. The barrel, with its charge, now arrives opposite the end of the pin, the head of the cartridge being at this moment in face of a steel plate fixed in the breech block, R, Fig. 2. The shoulder of the cam now slips from under the arm, the pin, P, is driven forward by the spiral spring, strikes the primer of the cartridge, and explodes the charge. The object of the steel plate, R, is to receive the shock, and we are informed that, on becoming worn or deranged by repeated firing, it may be readily changed.

We understand the caliber of the barrels to be 1·57 inches, and their length 38 1 inches. The total length of the gun is about 4 89 feet, and its weight, inclusive of saddle, 968 lbs.

Figs 6 and 7 represent, respectively, the form of fixed ammunition used and the percussion fuse. The total weight of the charged cartridge and shell is 26 3 ounces, and of the charge alone, 2 8 ounces, and the length is 7·2 inches. The fuse, Fig 7, consists of a case which, in its under part, contains a lead plunger, S, with a brass envelope. The plunger holds the fulminate, and has a little powder chamber at T. It is fastened by a safety plug of lead in the under hole of the fuse, and it is closed by a plug which has the point against which the plunger drops at a sudden stop of of the projectile.

The elevating screw of the gun is so made that the head is connected to a bearing, movable on an axis near the trunnions, and so annexed as to provide for a lateral system of pointing. The nut of the screw is a conical gear wheel, and receives the movement from another wheel moved by a crank placed on the right side of the trail. The end of the latter is formed into a large friction plate, and the wheels are placed on shoes so that motion of the carriage by recoil is prevented. Approximate pointing is effected in the same way, by the trail, and nicer range is obtained by the mechanism under the gun.

We notice that a report of recent experiments with the cannon at Garve, France, by the French Marine Department, states that 500 rounds were fired with perfect success. Forty shots were fired in 30 seconds at targets 5,760 feet distant; and from the explosion of the forty projectiles, two hundred hits were obtained. At Turin, further trials are to be made by the Italian Government. We learn that the gun has already been fired sixty shots in 55, and afterwards in 48, seconds.

The weapon is the device of Mr. B. B. Hotchkiss, of 27 Rue de Cooiseul, Paris, France, a gentleman already well known for his rifle projectiles and other military inventions. For further information address, care of C. C. Dawson, office Congress and Empire Spring Company, 94 Chambers street, New York city.

Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year	$3 00
One copy, six months	1 50
CLUB RATES { Ten copies, one year, each $2 50	25 00
CLUB RATES { Over ten copies, same rate, each	2 50

VOLUME XXX, No. 2. [NEW SERIES.] *Twenty ninth Year.*

NEW YORK, SATURDAY, JANUARY 10, 1874.

Contents:

(Illustrated articles are marked with an asterisk.)

NEW PATENT CONVENTIONS.

Messrs. Thacher, Hill, and Blake, Committee of the Vienna International Patent Congress, have, in accordance with their official authority, issued a call, addressed to all who are interested in the effort to secure better patent protection for Americans in foreign countries, for a Convention, to be held in the city of Washington. The Committee say that: "Our friends abroad greatly need the information and aid which we can readily furnish, *for we are the foremost nation in the world in the liberality and success of our patent system*."

This characteristic assemblage of American Patent Saints is called for January 15, 1874, for the purpose of discussing this topic, so says the call, and if thought desirable, of organizing a United States Patent Association. We hope the attendance will be full, the proceedings harmonious, and the results practical. This Convention is to have the aid of an other Convention, recently organized at Boston, called the New England Association of Inventors and Patent Owners. The objects of this association, so far as we can gather from the reports of the proceedings, are to render mutual aid and benefit to the members in the management of their patents, to secure the extension of their several patent monopolies, compel the payment of fair prices for patents by railway companies, and in other ways "to promote the general prosperity of the country."

Among the prominent members of this new association is Mr. Hamilton A. Hill, who also figures as one of the Committee of the Vienna Congress, and as one of the callers of the Washington Convention. He offered a couple of resolutions, one of which was that the association should be represented at Washington by delegates; the other: "That this Convention heartily endorses the action of the Congress lately held at Vienna on the subject of patents." Both resolutions were adopted. We congratulate Mr Hill in having thus succeeded in getting himself endorsed by the New England Association. Possibly he may have equally good luck before the Washington Convention.

It is well known to our readers that the resolutions adopted at the Vienna Patent Congress contained hardly a single point or suggestion for change in the existing laws of the leading continental governments, except this, namely: That the laws ought to provide that the inventor shall be compelled to sell his invention and rights under the patent, at such prices as government officers shall dictate. This is not the exact wording of the resolution, which was framed in the German idiom, but we give its real meaning, translated into plain English. Most of the Americans who were present objected to the passage of the resolution and argued against it strongly. Mr. Hill himself spoke against it, and Mr. R. W. Raymond, who was present, has publicly stated that the resolution would have been defeated had the American delegates all continued to protest against it with united voice. But between night and morning a defection in their ranks took place; Mr. Hill and some others went back on their comrades, and next day voted for the resolution, which they had previously opposed. Now if the New England Association or the Washington Convention supposes that the endorsement of Mr. Hill's obnoxious resolution at Vienna is likely to promote the interests of American inventors in foreign countries, we can assure them that they are mistaken. The very thing that our inventors most need, in foreign countries, is to be freed from government interference. What our people want is the right to control their foreign patents, in the same untrammeled manner as their home patents. Nothing less than this will satisfy them. On this point the Convention should take a firm stand, pledging itself to its advocacy, and seeking for its adoption throughout Europe. But to start off the Convention by resolutions approvatory of the absurd project, first opposed and then supported by Mr. Hill, will be likely to impair the usefulness of the Convention, and prevent our countrymen from taking interest in its proceedings.

THE PRIME MOVERS AND THEIR RECENT PROGRESS.

The prime movers are those machines from which we obtain power through their adaptation to the transformation of some available natural force into kind of effort which develops mechanical power. These sources of power are generally classified, according to the form of energy which they yield or which the machines are fitted to utilize, as muscular power, the weight and movement of fluids, electricity, and heat. Thus, men and animals are prime movers, utilizing muscular power; water wheels and wind mills utilize the fluids water and air; electrical engines make useful the power of the voltaic battery; and gas, air, and steam engines —heat engines, as they are collectively called—transform the force of heat motion into mechanical force. All of these prime movers have received a certain degree of development; and some of them, as the heat engines generally, and particularly the steam engine, have occupied the attention of man for many centuries and have afforded a field for the display of his highest scientific attainments, inventive genius, and mechanical skill; and they today are doing by far the greater part of the unintellectual work of civilization. Indeed, they indirectly assist, to a wonderful and inestimable extent, even intellectual progress, by furnishing the material aids essential to its existence and continuance.

Muscular power has its origin in heat developed by combustion, probably, as truly as does the power obtained from the generally termed heat engines; and the animal system is simply a machine or apparatus in which a certain quantity of oxydizable material is consumed and a certain quantity of power is developed by its consumption. The animal system is compelled to furnish heat sufficient to keep its several parts in working order, and to furnish supplies also to that strange and wonderful organ the brain. It is, therefore, impossible to state how efficient the animal system is as a prime mover, simply, but it is supposed to be far more efficient than any machine yet constructed by man. Man can do little to improve the efficiency of the animal mechanism, but he can do something. Whether the organism to be used as a prime mover be that of a man or of a beast, the proper treatment by which to obtain maximum efficiency is that by which the natural strength of *physique* and constitution is cherished and increased. Abundance of plain, wholesome, nutritious food, regular work, never exceeding but always approaching the maximum that can be attained without more than moderate fatigue, comfortable housing and general care will give the animal system its most complete development and its greatest effectiveness. It is generally believed that working one third of a day, at one third the maximum speed attainable without load, and with a load equal to one third the maximum force which can be exerted, gives the best conditions and highest efficiency.

Having effected so much for the prime mover, the next point to which attention should be turned is the simplicity and effectiveness of the machine through which the work is done, whether a wagon, a treadmill, or a so-called horse power. Probably not less than twenty per cent of the power of the animal is generally lost here, in some of the best designs of these forms of apparatus, and usually occurs through friction. Invention and mechanical skill have not deserted this field, however, and we hope yet to be able to chronicle some useful improvements.

The power of falling water and of the winds is utilized by the various forms of water wheels and wind mills. Not many years ago, awkward and costly vertical water wheels, with their slow motion and expensive systems of transmitting machinery, were thought the only proper and economical