HUMAN MOTOR A MERE MACHINE

ENERGY'S LAWS CONFORM TO THOSE OF MATTER

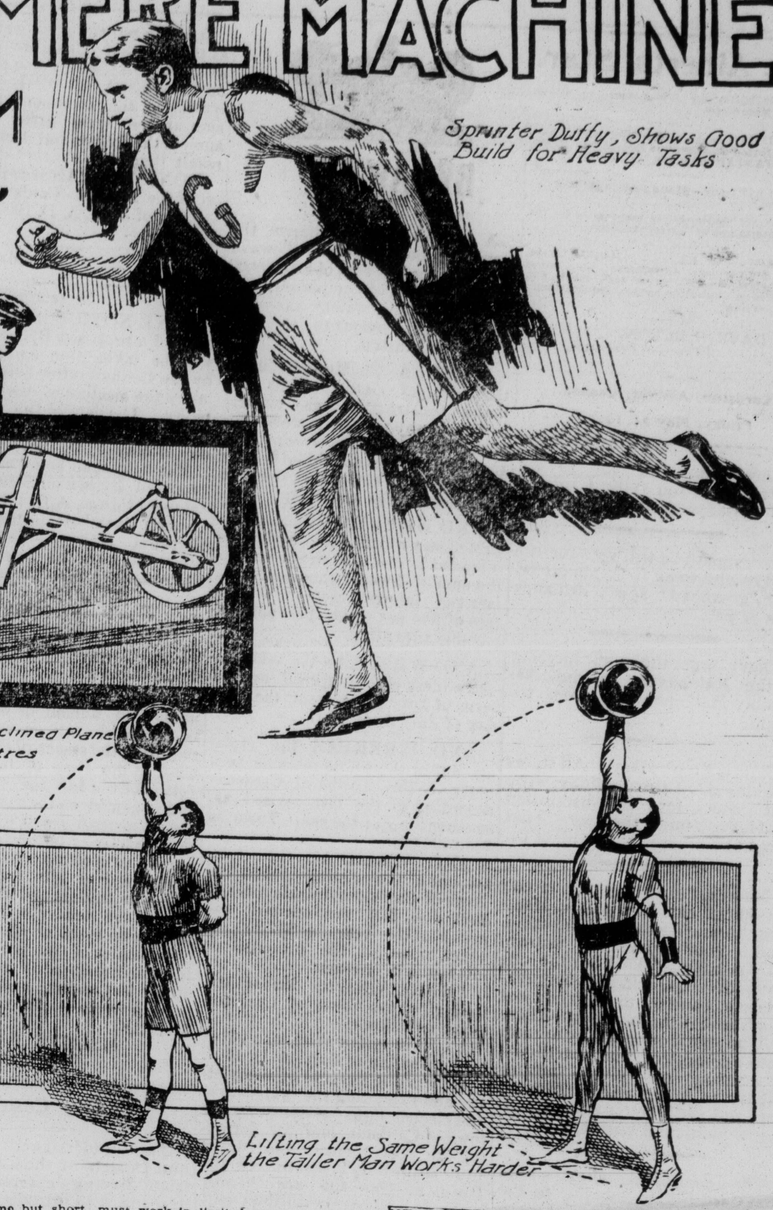
Lifting Dirt With Shovel 38 Kilogrammetres a Day

By Hand Power 73 Kilogrammetres

On Shoulder 66 Kilogrammetres

By Wheelbarrow and Inclined Plane 43 Kilogrammetres

Directly Applied Power Most Effective.



Sprinter Duffy, Shows Good Build for Heavy Tasks

Lifting the Same Weight the Taller Man Works Harder

Man, in looking upon himself as the lord over matter, generally loses sight of the fact that this dominion is a quality of the mind, and that otherwise he is not dissimilar from those things which he operates.

Science, you may have noticed, is never content except when shattering some cherished delusion of man. So some of the leading scientists of France have recently busied themselves with the matter of showing man's relation to machinery.

A human motor—that's all that these scientists have left to us of our anatomy, if we except the more mysterious make-up of the brain.

But they haven't stopped with that. Just like the mechanical engine and motor, this human motor must be fed with fuel and in the quality and quantity of fuel depends much of its capacity for work.

They are engaged in trying to discover how to feed our motor in order that we may get the most work out of it, and have even gone into the matter of utilizing waste just as machinists have shown how steam which escapes from the cylinder of a locomotive may be caught and used again.

NOT simply a fad must this work of the French scientists be considered. There is a practical side to it. The discoveries are intended to show how, if we apply the principles of mechanics to a man, we may get more work out of him with less fatigue than at present.

Take a soldier, for instance. In one country he is loaded down with incumbrances; in another he is permitted to carry nothing, on the ground that he can thus do more work.

By means of a system of tests, it will be possible to learn exactly which method is better, and to what degree, as expressed in a unit of measurement suited to the purpose.

You may as well get acquainted with this unit at the start, for it must be used occasionally in this article. It is called the kilogrammeter.

The meaning is simple. Suppose you wish to lift an object weighing one kilogram (two and two-tenths pounds) a meter from the floor. (A meter is equal to 39.37 inches.)

Now, it was desired to get a unit of measurement which would take into consideration both the weight and the height it was to be lifted, and so the words kilogram and meter were combined to form the word kilogrammeter. The term is equivalent to seven and two-tenths foot-pounds. It means the force required to lift one kilogram one meter from the floor.

To return to the soldier. How can the working capacity of this human motor be described in kilogrammeters? Some experiments reported from France explain just how it may be done.

It was desired to know how the human machine could work to best advantage in moving a quantity of dirt from one elevation to another higher one. Why should he take two days to it if he could do it in one? Or why tire himself so with doing it in one day that he would be unfit next day? Since he was on the payroll of the government, the questions were practical.

It was simple enough. Just let him try lifting the load in the various ways, have him examined by a physician each day and compute in each instance the kilogrammeters of work which he was able to do in a day by each method.

Eight methods were tried—raising the dirt with a shovel; wheeling it up an inclined plane with a barrow; carrying it up a plane on his back; raising it with a bucket with a rope by hand; using a pulley with a drum and lever; lifting it by a capstan operated horizontally; lifting it by means of an endless chain and buckets operated by a crank, and lastly, lifting it simply by his own weight, that is, by riding down in an empty bucket while the full one went up at the opposite side of the pulley.

It was found that this last method—using his own weight as the motive power—was far and away the best.

While in a day he could produce but 38,880 kilogrammeters of work by tossing the dirt up with a shovel, he could by other means do 280 kilogrammeters—more than seven times as much as with shovel!

Next in the order of precedence to lifting by the worker's weight came the endless chain; then, in turn, the capstan, the crank and drum, the pulley and rope, the inclined plane with the load on the worker's back, the plane and barrow, and the shovel.

DETERMINING WORKING POWER

It is unnecessary to go into an explanation of these methods. One can, for instance, easily see how a bag of earth, well balanced on one's back, could be carried up an inclined plane more easily than it could be pushed ahead of one in a barrow. The other differences should be as apparent; although it is significant that in many, if not most, modern operations the shovel method is clung to.

So it seems perfectly possible to determine man's working power when he uses his body after the manner of a mechanical device, just as it is possible by means of a gauge to determine the horsepower of a locomotive.

In preparing the analogy of the human motor to the mechanical motor, one must begin with what might be called "firing up the furnace," which is nothing less than placing food in the stomach to be converted into power.

How this power is transmitted to the blood has been not inaptly likened to the conversion of water, by means of heating, into steam.

But it is in the action of the heart in taking care of this steam that the strangest mechanical principle of all may be noted. The heart is the chief cylinder of the body.

Here, too, is seen a system of safety valves more wonderful than that of the cylinder—valves which open and shut with clock-like regularity as the blood passes from one chamber to the other—and which sends the blood shooting through the manifold arteries, vessels and veins to supply the power for every member.

This, to be sure, is neither a new truth nor an accidental discovery; indeed, it is undoubtedly the knowledge of the truth that furnished the idea for the invention of the valves.

Another mechanical analogy is found in the eye—the action of the light on the retina and its transmission to the brain by the optic nerve is almost identical with the catching of an object by a lens and recording it on a photographic plate.

Then, the principle of the telephone is found in the action of sound waves on the ear drum.

The bendings of the arm and leg are clearly nothing more than applications of the lever principle.

Some of the figures given in connection with the tests made in France recently admit of a very amusing calculation. Every one recalls from his school books the queer challenge of Archimedes, the discoverer of the lever principle—"Give me a fulcrum for my lever and I will move the world."

He meant it, theoretically, if not literally. Indeed, we are left to believe that the old mathematician died grumbling because Mars or Jupiter or some other planet didn't come near enough so that he could use it as a support for his lever while he should pry down on the handle and send the earth bobbing out of her orbit.

Let Archimedes now—if he be susceptible to mundane impressions—be assured that he could never fulfil his boast. The science of the human motor explains why.

The French scientists say that a man can do 172.8 kilogrammeters of work in a day with a lever.

Using this as a basis, it is calculated that for Archimedes—or any one else—to have moved the earth one millimeter (one-thousandth of a meter) would require more than 900,000,000,000 centuries.

In other words, if the learned Syracusan were still living, and had worked constantly during the 2000 years since his declaration, he would have moved the earth only the forty-fifth million part of a millionth of a millimeter—an inconceivably small distance.

All engineers know that machines should be built with special reference to the resistance they must offer to the work they have to do.

For instance, if the piston of a steam engine should, by a direct application of power, be used in an effort to raise 200 pounds of dirt a small fraction of an inch from the ground, the cylinder would have to be made very large.

If it were desired to lift but one pound, the cylinder section might be 200 times smaller than in the other case, but the movement of the piston would have to be 200 times faster. In each instance, the volume of steam would be the same if the same pressure be assumed.

A MUSCLE AS A PISTON

How does this affect the human motor? Suppose a muscle be considered instead of a piston rod.

Then the application of the rule means that the larger the muscle the larger the effort it is capable of.

If large and short, it should produce a great effort multiplied by a short line in which to exercise itself; if long and thin, it works in a longer range, but with less expenditure of energy.

The sterno-mastoid and sartorius muscles, for instance, have a long sweep and proportion of brawn; while the pectoral muscle and the gluteus, be-

volume but short, must work in limited range, but have a large capacity.

When the human motor is used in walking and running it in some degree is an application of the piston idea. And in this connection the scientists have found that the energy expended by the muscles when they contract is compensated for when they relax, although some original effort must be added at every exertion.

Regarding the piston-rod principle in the leg, theoretically the long-legged man should be the swiftest runner for a short distance, while the short-legged man would be the better distance runner.

It is found, though, that if two sprinters of the same figure, weight, muscular power and having the same length of leg be chosen, the faster will be the one whose thigh is longer but whose leg is shorter in the lower part. The anatomy of Kraenzlein and that of Duffey, the American hurdler and sprinter, was studied in coming to this decision.

By an identical method of reasoning, it is declared that the horses called "flyers," such as Eclipse, Gladiator, Holocaust and Flying Fox, are large and powerfully constructed, while the "stayers" are generally small, sometimes even bony, as Arabian and Syrian steeds.

How the lever theory enters into the use of the arms has recently been shown by experiments with dumbbells. Contrary to common belief, something more than mere strength must be considered in lifting heavy dumbbells.

Suppose two men of different builds lift the same weights above their heads. They may rank equally as to strength, and yet the larger man must do more work against greater resistance, because the leverage of his arm is longer.

This accounts for the fact that in athletic contests, where the classification is made according to the total of weight lifted, the short, muscular athletes are generally favored.

It is simply a demonstration of man's wonderful adaptation to mechanical principles when using himself as a human motor.

Men and Feminine Pursuits

IT IS generally supposed that each line of work falls by a natural law of selection to those who can do it best—that women sew, cook, scrub and nurse the sick because of their superior fitness for these activities.

While it may be true that women do these things better than they could do those which long custom has assigned to men, it is nevertheless a fact that some men can do them better than their sisters.

As a general thing, when men undertake the occupations usually pursued by women they excel in them.

The best cooks, the best cleaners, house-servants, washers and ironers, the best nurses, are of the stronger sex.

Asked if his sex ever indulged in sewing, a young man flippantly replied that he had only heard of them doing so in connection with wild oats.

Men—many of them—do sew, both by hand and by machine, and they sew much better than women. Who has not heard from an irritated husband or brother: "If you want a button to stick, sew it on yourself, or get a man to do it"?

Even in the matter of making women's dress females are said to be much excelled by males in every branch of the work.

Sailors are conspicuous as clever needlemen, and in some parts of Europe, particularly in Hungary, shepherds embroider upon unbleached calico with remarkable skill, as they tend their flocks.

Many Scotchmen are good knitters, and fancy needlework is now a vogue among men of the leisure class in Europe. They pursue it precisely as others pursue painting or other branches of the fine arts.

Men embroiderers do not play at their work; they are too much engrossed in it. They do not, like women, hem a piece in hand as they sit gossiping in the drawing room or in the exchange or porch of a hotel. They throw their soul into their work, and hence they excel in it.

In royal circles of Europe the Grand Duke of Hesse is well known as a most skilful embroiderer. His grand ducal highness is a good shot, but the pleasures of the chase are less alluring to him than the pursuit of music, of which he is a devotee, and that of the needle.

It often happens that when he has an interesting piece of work on hand he will remain in his room at his tapestry frame hard at work by the hour. A favorite time for him with his embroidery is the early morning, and when he is engrossed in this pursuit he will even begin work before he dresses.

Victor Bowring-Hanbury, of England, who recently married Mrs. Hanbury, widow of the Minister of Agriculture, and took her name in addition to his own, is a most famous example of the exquisite skill men may attain in the gentle craft.

Before he was married Mr. Bowring-Hanbury made beautiful embroidered covers for his mother's drawing room.

Difficulties of the Cuban Lover

MANY difficulties confront the Cuban lover on wooing bent. He deserves the sympathy of mankind.

In the first place, he can never see the object of his affections alone, and love-making under the cold, observant eye of a third party is not conducive to an overflow of warm sentiment.

Even before he is permitted to call upon her he must submit his intentions to a rigid family examination and come to an understanding with the girl's parents.

He may be entirely acceptable, and regarded as a man of most exemplary character, but all his courting must be done under the eye of the girl's mother, or some other member of the family.

Recently, a high-spirited Cuban girl committed suicide because she permitted her lover to kiss her, and her indiscretion was harshly commented upon.

After marriage the bridal pair must be invisible for a period—he for five days, the bride for a week.

Very exacting are the regulations of Cupid. The accepted lover must visit his lady daily, otherwise the hot Latin jealousy would make things unpleasant; at any rate, the girl's relatives might become cantankerous.

This condition of affairs is apt to go on for some time, as Cuban courtships are usually of long duration. Wealth is not common among the young men of the island, and there is generally the chance that the happy bridegroom will find himself compelled to support a number of his wife's relatives.

In Cuba the old Roman idea of a home prevails; the husband is undisputed lord and master, and, unless she has had forethought enough to provide legally against it, he coolly appropriates whatever property the wife may have.

The Cuban married woman retains her maiden name. She usually writes it entire, placing after it the word de (of) and the surname of her husband.

A lot of red tape surrounds the religious marriage. First, the banns must be posted in a conspicuous place two weeks before the wedding. This makes elopements almost impossible.

Next, a statement is signed by the man and woman, and then, if the parties are under age—23 years for both man and woman—the written consent of the parents must be filed.

Another document contains a full description of both parties and their parents, with a lot of family information incorporated. Then comes an extensive document declaring that the marriage has taken place, and, finally, a regular marriage certificate is issued.

Especial tribulations assail the widow or widower who may wish to marry again. It is essential that a doctor's certificate telling of the death of the former partner be filed.

Not long ago a widower was unable to marry again because he had failed to obtain the necessary certificate from his deceased wife's physician, and the doctor himself had passed to another world.

As a consequence of all this, many couples are now being married by the civil authorities, who do not require so much formality.

Others slip away to the nearest American city, Key West, six hours from Havana, and are married there.