THE

Scientific American.

MUNN & COMPANY, Editors & Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

O. D. MUNN, S. H. WALES, A. E. BEACH.

VOL. X. NO. 12. [NEW SERIES.] .....*Twentieth Year.*

NEW YORK, SATURDAY, MARCH 19, 1864.

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(Illustrations are indicated by an Asterisk.)

WHAT IS MEANT BY THE CONSERVATION OF FORCE.

If a boy snaps one marble against another of the same weight with such precision of aim that the two come in contact exactly in line of their centers, the marble that is snapped will stop in place of the other, while the one that is hit will move forward with the same velocity as the first and in the same direction. The marble first set in motion loses its force, but this force is not destroyed, it is transferred to the other marble, and is thus preserved—or conserved. As action and reaction are equal, it is held as a self-evident truth, that matter once in motion can be stopped only by setting some other matter in motion, and this principle is called the conservation of force.

This doctrine is now generally associated with that of the mechanical theory of heat. It is supposed that the universe is filled with an extremely subtle fluid, imperceptible except through its vibrations to any of our senses. The theory further imagines that the minute particles of this fluid have vibrating motions of various kinds. If we fasten one end of a clothes-line to a post, and take hold of the other end and shake it up and down, we shall see undulations or waves run along the line. The several particles of which the cord is composed do not move in the direction in which the waves move, but while each wave starts at one end of the rope and runs to the other, any given inch of the rope simply vibrates up and down. If we shake the end of the cord horizontally, we shall produce vibrations in a different direction; and if we whirl the end around in a circle, we shall produce those of a still different character, the waves will be apparently spiral, though each particle of the rope will be revolving in a small orbit. There are other kinds of waves conceivable in the particles of fluid which cannot be represented by a rope.

Now, the theory is, that one kind of vibration in the etherial fluid produces the effects and the phenomena which we call heat; another kind light; another electricity, another magnetism; and another chemical affinity. It is supposed that when heat is converted into electricity, the peculiar vibrations which affect our senses as heat are stopped, and that in stopping they start those vibrations which we recognize as electricity.

It is also supposed that when a body is heated, the heat vibrations of the etherial fluid are imparted to the several atoms or molecules of the heated body. And, as all the substances with which we are acquainted are more or less warmed, it would follow that all of their particles are in continual motion. In the same way, when a body is electrified, its particles are presumed to receive the electric vibrations.

The fact that light, heat, electricity, magnetism, chemical affinity, and mechanical force are all mutually convertible one into another, is one of the strong arguments in favor of the truth of this theory.

This theory is the most comprehensive that has ever been conceived by the mind of man. It proclaims that all of the varied and complex phenomena of the universe, from the revolutions of the nebulæ to the growth of a lily, result from the single fact, that matter has got in motion and cannot stop It recognises but one force in the universe, *vis viva*, or the force of moving bodies. It also suggests the possibility of explaining all phenomena, leaving one circumstance only beyond the pale of human knowledge—what it was that first set matter in motion.

BREECH-LOADING SMALL-ARMS.

There is no subject of more pressing or of more lasting importance to the Government and people of this country than the arming of our infantry with breech-loading rifles. It was the great aim of Napoleon Bonaparte to train his soldiers to very rapid loading and firing; and able military critics attribute to his success in this effort the irresistible power of his armies. Experience, however, has developed the astounding fact that, when soldiers load and fire in such haste, their aim is so careless that they do not hit a whole regiment once in 200 shots!

Now, a breech-loading rifle can be loaded and fired more than 30 times faster than a muzzle-loader, and it can be fired at least five times more frequently with all of the movements made with the utmost deliberation. It is altogether probable that a soldier with a breech-loading rifle will fire 5 times as many shots in an hour as one with a muzzle-loader, and that 10 times as many of the shots will prove effective—thus increasing the offensive power of the soldier 50 fold.

The superiority of breech-loading small-arms, so manifest in theory, has been confirmed by large and varied experience. The Spencer, the Burnside, and other breech-loading rifles have been extensively used in this war, and have everywhere won the warmest approval of both officers and privates.

The nation is making very great efforts, and expending enormous sums of money to send additional hundreds of thousands of men to our armies. Every one of these soldiers, when ready for service, costs very nearly $1,000. By the expenditure of $5 or $10 additional for his gun, one-half or one-third of the number of soldiers would be equally efficient.

We should like to see sufficient judgment and decision at the head of the War Department to stop, at once, the manufacture of muzzle-loading small-arms, and to devote the whole power of our armories to the production of breech-loading rifles.

THE METROPOLITAN FAIR.

This truly noble project is, we are happy to say, in a healthy state of progress; the brilliancy of the opening ceremonies will, no doubt, exceed anything of the kind ever seen in this city, not excepting those of the Crystal Palace. Contributions of all kinds are rapidly coming into the hands of the Committee. The workmen of the Novelty Works (and doubtless of other shops also) have set apart the proceeds of one days' labor as a free-will gift to their suffering comrades-in-arms; and as the number of workmen is large, the sum collected in this way will be no insignificant item. It is the intention to make the Machinery Department as extensive and attractive as possible; and it is hoped that every one concerned in this branch of trade, whether as a dealer or producer, will forward a creditable specimen of his wares. Those who have machines of a novel character will bear in mind that the machinery is to be shown *in motion*, which will very much enhance its appearance. The Committee on Machinery consists of the following gentlemen, and if any of them are notified, they will send for the articles intended to be contributed:—Wm. Sewell, 64 Courtland street; Joseph Crampton, 226 West 18th street; W. E. Everett, Novelty Works; J. B. Root, at J. L. Jackson's Iron Works, 28th street and 2nd avenue; W. D. Andrews, 414 Water street; W. E. Worthen, 137 McDougal street; C. Roome, 4 Irving Place; J. R. Floyd, 744 Greenwich street; Horatio Allen, Novelty Works; T. F. Secor, Allaire Works; A. S. Cameron, 22d street and 2d avenue.

THE WAY INVENTORS, MANUFACTURERS AND CONSUMERS ARE MUTUALLY BENEFITED.

It is not the inventor alone who is benefited by the introduction of new and useful machines, but the manufacturer who employs and the communities who enjoy the fruits of ingenuity. It would be a task to enumerate the vast number of articles in daily use which have not only lightened the labor of men but changed the entire social system; we shall not attempt it, but merely call the attention of those directly interested to some significant transactions which have lately been made public through the columns of the SCIENTIFIC AMERICAN. We allude to the incentives held out to ingenious men to accomplish certain tasks under the spur of pecuniary advantage. Messrs. Phelan & Collender, billiard-table manufacturers of this city, offer the sum of $10,000 as a reward for the discovery of a substitute for ivory to be used as a material for billiard-balls [see pages 135 and 166]; and a gentleman in New Hampshire, who modestly conceals himself under the style and title of "the editor of the *National Eagle*," offers a handsome reward for the discovery of a steel horse-shoe which can be taken off and put on readily without nails [see pages 88 and 166]. We have no doubt but that both parties will obtain the objects of their desires; if we may judge by the quantity of models and drawings of horse-shoes which have recently appeared at this office, one of them must already be in as great a quandary which to select as Paris was on Mount Ida, when called on to bestow the golden apple on the fairest of three goddesses, all of whom were equally beautiful.

The course alluded to is undoubtedly most wise. In no other way could such results be obtained. Manufacturers who are now delayed in their operations by reason of imperfect machines, methods or costly materials, should set forth their wants to the inventing world, and they will be satisfied. It is a positive and a palpable advantage. What manner of manufacturing concern or incorporated body is there in existence who would refuse to purchase a process if they knew by so doing they could outstrip all competition by employing it? Not one.

Too many people regard invention as a ticket in a lottery. To inventors of perpetual motions and balloons to go to the moon in five days it unquestionably is; but the sober, sensible, practical men of business know the advantages of using patented improvements, and show their sagacity by stimulating inventors to bring forth machines for special purposes. Let the great business world make known its wants; the choice rests with itself. If it approves of the machines offered to it, make the best bargain possible with the inventor and obtain them. If the designs provided for will not answer, refuse them; no compulsion exists, and the reward can be withheld until the object is attained.

INDIA-RUBBER ONCE MORE.

We have before us the petition of Charles Goodyear, Jr., for the second extension of Letters Patent granted to his father, Charles Goodyear, deceased, for the invention of vulcanized india-rubber. It sets out with a brief account of the early struggles and efforts of Mr. Goodyear to discover and perfect his india-rubber inventions, and depicts, with considerable pathos, the sufferings of himself and family before he realized the ideal which engaged his attention. His family were very destitute of food and fuel—they had no money to buy their bread from one day to another—they did not know what they should do for food—they dug their potatoes before they were half grown, for the sake of having something to eat—Charles, the petitioner for the second extension, when only eight years old, was thankful that they had potatoes—some one sent them a barrel of flour unexpectedly—a child only three years old died, and the family walked to the grave; the remains were carried in a wagon, as the parents could not afford to hire carriages—and, somehow, in spite of all the kindness of neighbors, Goodyear was thrust into a debtor's prison. He began his investigations in the years 1831 and 1832, but did not obtain patents until 1844. Litigation sprung up, and thousands of dollars were expended in the defence of his rights; his