knowledge increased, and the more subjects are opened to one's view as he proceeds, he feels his ignorance, and is thus nerved for stronger efforts to gain the upper branches of the tree of knowledge. In the majority of schools, boys are taught geometry before they have chosen a profession, because it teaches them to reason logically, and expands the mind by causing them to use their common sense; and in the same manner algebra shows them how labor is saved and time gained by the use of symbols, and by preserving a method in all their work, so that if they do not require a knowledge of these subjects in after life, they will have improved the mind so as to ever benefit them. In preparing engineers for the British navy, the plan adopted is, to see that they have a thorough knowledge of geometry and algebra, and with this good groundwork to build on, they take trigonometry, mechanics, and chemistry, hand in hand, as they advance taking the higher branches of mathematics, so that in the end, they have often as good a knowledge of all branches of mechanics as those who have studied at the universities. At the same time, they have a complete knowledge of practical engineering, which, together with the theoretical, makes them fully fit for their arduous duties at sea. J. H. RICKARD.

Clifton Springs, N. Y.

Electro-Magnetism as a Motive Power.

MESSRS EDITORS:—I notice in the SCIENTIFIC AMERICAN of July 8th, under the head, "The Impossible in Constructive Science," a well written article from the *Engineer*, in which "Electro-magnetism as a motive power" seems to be very summarily disposed of. Believing that the ideas set forth in said article are calculated to have a tendency to check the ardor of some who are endeavoring to produce a motive power safer and in all respects more desirable than steam power, I propose, with due deference, to offer a few remarks.

Engineer says that "we now know that nothing can be expected from electro-magnetism as a motive power," and that "all the power which an electro-magnetic engine can produce is represented by the oxidation of a given weight of zinc." But what electro-magnetic engine? Henry's, Page's, Vergne's, Wickersham's, or Stewart's? Because each of these will give a different result with a given current. Could the power of steam be definitely ascertained by experimenting with the engines of Hero of Alexandria, Blasco de Garay, the Marquis of Worcester, Denis Papin, Captain Savery, or even of Newcomen? And yet the power of steam was as great 1,000 years ago as to-day. The arrangement of James Watt simply developed a greater percentage of the power of steam than those of his predecessors. Now it is highly probable that the best electro-magnetic engines do not develop one per cent of the electro-motive force, and are in fact mere whirligigs, like the æolopile, showing something of the velocity with but little of the force of the current.

Engineer says it is far more economical to burn coal to store up power in water than to burn it to store up power in zinc. Now the electro-magnetic force is derived from the oxidation of pure zinc, which is obtained from the ore by the combustion of coal. The duty performed by the coal being simply to drive off (not store up) foreign matter, and not oxydize the zinc—a pound of pure zinc giving the maximum of electro-motive force, the combustion of coal being at the minimum (or rather, nothing). So that it is easy, even for an unlettered man, to see that there is no connection or relation whatever between the power represented by the oxidation of a given weight of zinc and the coal necessary to produce the zinc from the ore.

Engineer says "that the discovery of the conservation of energy dashed the hopes of the inventor to the ground. "But why so? What is the amount of coal necessary to oxydize one pound of zinc? Zinc melts at 773° Fah., and at a considerably higher temperature passes off slowly in the form of vapor. More than one hundred pounds of coal would be required to oxydize one pound of zinc, equal to twenty-five horse-power per hour. But again, Miller, in his work on electricity and magnetism, states that, "from the experiments of Weber it may be calculated that if the whole of the positive electricity required to decompose a grain of water were accumulated upon a cloud 1,000 meters (3,281 feet) above the surface of the earth, the attractive force exerted between the cloud and the portion of the earth beneath it would be equal to 1,497 tuns." Now, to decompose one grain of water, 3.63 grains of zinc are required, and the electricity derived from a pound of zinc and situated as above would give an attractive force of 2,384,742 tuns! JOHN CLARK.

Removing Shellac from Watchmakers' Lathes.

MESSRS. EDITORS:—A speedy mode of dissolving shellac upon watchmakers' lathes is needed. The article turned is taken off by the heat of a lamp, and some substance, liquid or solid, which would, with or without heat, soften the shellac, so that it could be quickly removed with the brush, would be a desideratum. Alcohol is used, but it is too slow.

Pa. S. T. S.

[We know of no ready solvent of shellac that will not act chemically upon metals, except alcohol. Shellac dissolves easily in dilute muriatic and acetic acids. By the aid of heat it is also easily dissolved, by a solution of borax If any of our correspondents know of anything better than alcohol, we shall be glad to hear from them.—EDS.

Mode of Dividing Glass.

MESSRS. EDITORS:—The following plan, to break a bottle or jar across its circumference, so as to form a battery cup or vessel for other purposes, may be of some service to your readers. I have performed the operation successfully many times Place the bottle in a vessel of water, to the height where it is designed to break it; also fill the bottle to the same level. Now pour coal oil inside and out on the water; cut a ring of paper, fitting the bottle. Saturate with alcohol or benzine, so that it touches the oil. Pour, also, some inside the bottle. Set on fire; the cold water prevents the glass from heating below its surface, while the expansion caused by the heat will break the vessel on the water line.

J. T. PEET.

PHYSICAL STRENGTH.

The common idea in regard to physical strength is that it depends solely upon the amount and quality of muscle, bone and sinew. In the training of athletes for the performance of physical feats the prominent features are the means for development of the muscular tissue and the inuring of muscles to severe work, so that the soreness which results from the extraordinary exercise of the body not thus inured, shall no longer be a sequence of physical exertion. This is right so far as it goes. Development of muscle, strength of bone, and firm elastic sinews are essential elements of strength as well as endurance, but they are by no means all. Were that the case, strength could be estimated by weight approximately. But the facts are that many small men having no superior training or no better apparent health, have often been more than a match for larger men. The strongest man with whom we were ever acquainted, never weighed over one hundred and fifty pounds. We might tell some large stories of the feats of this remarkable man, but the point which we wish to make will be sufficiently illustrated without any such particulars. The peculiar feature which always forced itself upon our attention when he was powerfully exerting himself was his perfect placidity of countenance, and the want of that turgid congested appearance of the face which often accompanies such exhibitions. Further the muscles not specially employed never exhibited rigidity, as is often seen in feats of strength, but were soft as though he were reclining at his ease. Except he was doing some labor which caused much motion of the muscles of the chest, he never appeared to be "winded," as it is called.

We have often set ourself to the solution of the reason of the different degrees of strength possessed by different individuals, or rather, we have attempted to get at the secret of strength which lies back of bone and muscle, and we have no doubt it is the peculiar exercise of the will: the concentration, so to speak, of the nervous energy upon one muscle or set of muscles, without the distribution of it to muscles not concerned in the act to be accomplished. This was proved in the case alluded to by the fact that in feats which involved the exercise of nearly all the muscles, his power was not so perspicuous. In special feats, as for instance the raising and sustaining a heavy weight at arms length, his great strength, and also the concentration of will to which we have alluded was most conspicuous. This man's strength was undoubtedly to be attributed to his shortness of limb in some degree as, with equal development of muscle increased length of bone is a disadvantage. Each bone in the animal frame is a lever, and the muscles are so attached that the motion they impart to the bones is multiplied through its transmission by them to weights or resistances. Too great length of bone in proportion to amount of muscle is not conducive to superior strength although it adds to fleetness. The differences in the structure of the bulldog and the greyhound are good illustrations of this fact.

The elements of physical strength may then be stated to be in healthy subjects, development of muscle, strength of bone and sinew, small relative length of bone in proportion to muscle, and power to concentrate exclusively upon the muscles employed the nervous energy which produces contraction. There is no doubt that this power can be cultivated, like other powers by proper discipline; and if those who are obliged to lift heavy weights or to make other great exertion at times, would bear this in mind, they would be enabled to accomplish their labor with less exhaustion than is at present the case. The view here taken of the concentration of will seems to be sustained by the opinions of the eminent chemist and physiologist, Liebig, who states that it is just as impossible by the combustion of a piece of dried muscle to calculate its efficiency in the living body (the assumption of some physicists), as it is by the combustion of a dried bee to estimate the work which it accomplishes in its flight of many hours, carrying the weight of its own body several miles.

The muscle in a living body acts like the apparatus in a watch which gradually expends the power stored up in it; a freshly severed frog's leg represents an apparatus of this kind with an escapement, while the newly removed heart of the same animal corresponds to one without any escapement; the frog's heart beating for hours together just as in the living body, while the frog's leg moves as soon as an irritant sets it for a moment free from the escapement, and if small weights are hung on them, it is possible to obtain work from a pair of severed frog's legs; that is, the weights will again and again be alternately raised to a certain hight, without blood or the supply of any kind of nutriment.

It would seem from these statements that the muscles are to be considered merely as vehicles of a force which is imparted to them. This force—the nervous energy, whatever that may be—must of course become sooner exhausted, and also lose in immediate efficiency by being distributed to muscles not required for the performance of any specific work.

The Chicago Savans.

The American Association for the Advancement of Science, out of gratitude for the hospitality shown them by the citizens of Chicago, admitted to membership some two hundred prominent business men, lawyers, hotel keepers, pork packers, and so forth. A writer in the Chicago *Tribune* makes this a subject of sport in a very humorous "take off," in which these gentlemen are regarded as professors, reading papers upon the subjects peculiar to their several occupations. We extract the following, which show the satirical humor of the article:

"In looking over the list of the Chicago *savans*, who can help being proud of the contributions they will make to the scientific knowledge of the world at their first meeting, the record of which will undoubtedly appear in the daily press somewhat after the following fashion:

"The session of the American Scientific Association was one of peculiar interest, from the large number of essays which were read. Professor Jerome Beecher read a paper on the relations between gas and dividends, showing that the pre-historic man never received any profits from its illuminating properties and that Solomon was quite irregular in paying the gas bills of the Temple.

"Professor Edward Ely then occupied the attention of the association with a paper upon coats and neck-ties, illustrated with diagrams, in which he proved conclusively that the automicity of the torso of a coat (that is, a coat without a tail or sleeves), was equivalent to one atom of an element in a coat with a tail, united to one or more atoms of a second hand coat; and that the moral influence of the fluctuations of a neck-tie upon a well regulated mind could hardly be computed.

"Dr. Clinton Briggs gave the algebraic formula, starting on the basis of x, which keeps Merchants' Union stock at 24. This view was also corroborated by an able paper read by Professor C. B. Farwell. Professor C. M. Cady delivered an oral argument proving that a Steck piano had been dug up underneath the skeleton of a mastodon in an alluvial formation, and that the skeleton of an aborigine was seated at it From the position of the petrified fingers on the keys, he had discovered a chord in the touching song 'Let me kiss him for his mother,' thus proving the immense age of this ballad.

"Dr. George H. Dunlap, N. W. R. R., read an essay on the coming railroad from Chicago to the moon. He stated that Professor Perry H. Smith would probably locate himself at the moon terminus, to see that its perturbations did not affect the stock, and he had no doubt, moreover, that as soon as they settled the uncertainty relative to the moon's semi-diameter the stock would be at a premium. Telegraph stations would be under the control of the man in the moon—not Professor Smith, but the other man—and the stockholders would be given a free annual ride to the octants in the orbit, corner lots in which were now for sale.

"A recess was then granted, and the association lunched at the residence of Professor Dr. Dyer. During the informal conversation reference was made to the old slow coach days when Chicago had but one *savant*—the late Colonel Graham—and the famous Dyer story was revived. At a dinner party Dr. Dyer sat next to Colonel Graham. In response to a toast the Colonel arose and after paying his respects to the company, said he had an important discovery to make known. He had labored upon it for years, and had now arrived at the conclusion, after long scientific explorations and many anxious nights of study, that there was a tidal wave in Lake Michigan of at least one third of an inch. Dr. Dyer, who was sitting next to the Colonel, sprang to his feet and exclaimed, in utter amazement, 'Good God! Colonel, you don't say so. I always thought there was something the matter with that cursed lake.'"

OXYHYDROGEN LIGHT.—The experiments commenced last year on the Place de l'Hotel de Ville, in Paris, on the oxyhydrogen light, are about to be continued by order of the Emporer, in the court of the Tuileries. The magnesia cylinders having been found to corrode and waste away too rapidly for the purpose of a continuous light, an artillery officer, M. Caron, after experimenting with a variety of substances, has adopted zircon, a substance which Berzelius pointed out as infusible, and giving forth a very brilliant light under the blowpipe. It is said that M. Caron has had a cylinder of this substance in use with the oxyhydrogen light for a month without the slightest trace of volatilization. The luminous power of zircon, under the oxyhydrogen jet, is about one-fifth more than that of magnesia. The zircon employed is an oxide of zirconium; it is found principally near Miask, at the foot of the Ural Mountains. M. Caron economizes the zircon by mounting a point of it on a small stick of magnesia or fire-clay, the zircon being made to adhere by compression and afterwards baking.—*Journal of Society of Arts.*

MILK.—The milk supply of this city comes chiefly over the Erie and Harlem Railroads. The Erie, however, brings the largest quantity. The milk train on this road runs out as far as Portersville, a distance of seventy-six miles from the city, and gathers up on each trip at the various stations about 3,800 ten gallon cans, the transportation of which yields a revenue to the road of nearly $2,000 per day, and is probably the most profitable of all the fifty odd trains which daily pass over the eastern division of the Erie.

The milk train arrives at Jersey City a little past midnight, and from that hour until morning a string of milk carts are engaged in carting the milk away for distribution to the families in the city. The conductor assured us that the milk was delivered to the train perfectly pure, and if reduced at all by water it must be done by the milkmen after its delivery to them. Thus, while the denizens of the city are snoring in bed, the agencies employed in supplying their wants are going on with ceaseless energy, reaching to the furthest bounds of the continent.