A. S. LYMAN'S PATENT ACCELERATING RIFLE.

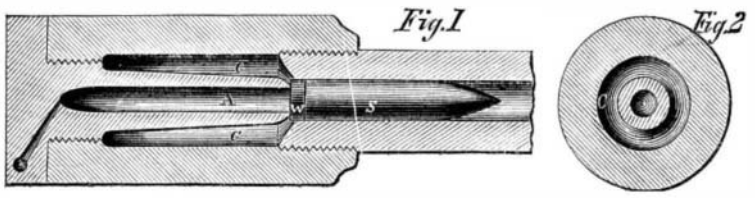
Fig. 1 is a longitudinal section of the breech of an accelerating hunting or target rifle.

Fig. 2 is a cross section through the accelerator.

A is the initial charge chamber; C C is the accelerating chamber; S is the shot.

This rifle is loaded at the muzzle when standing nearly vertical. The powder first fills the center tube, A, which holds twenty grains, then runs over into the accelerating chamber, C C, which surrounds it, and is upward of ten times as large as the center or initial charge chamber. A wad, W, of leather (made by cutting a piece from sole or harness leather with a punch) is next pushed down upon the end of the initial charge chamber. This cuts off all connection between it and the accelerating chamber. The barrel may then be wiped out if desirable, and the shot sent home.

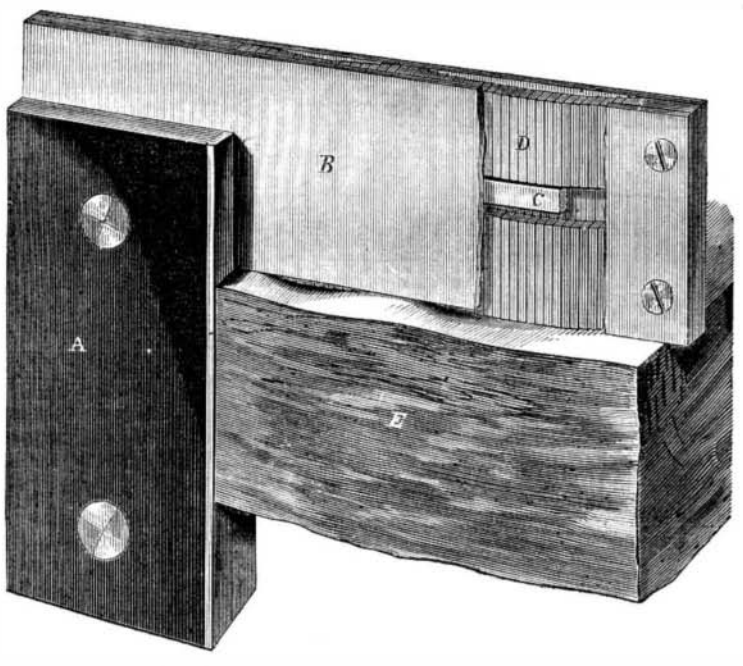
The range of this little rifle but ⅝ inch diameter of bore, and weighing, with its telescope, less than 15 pounds, using half an ounce of powder and one ounce shot 2¼ inches or six calibers long, is 1,000 yards with 1° 28′ elevation, and 1,300 yards with 1° 58′ elevation. It will be seen that this is a greater range than is obtained by any known cannon at the same elevation except the Accelerator, and more than twice as great as that of the Whitworth or any other rifle known of the same caliber.



This great range and horizontality gives it a vast advantage for hunting and other purposes where the exact distance is not known, as explained in description of Accelerating Cannon in SCIENTIFIC AMERICAN of Aug. 3d.

Improvement in Try-Squares.

In the use of the ordinary try-square for trueing up stock it is necessary either to stoop repeatedly in order to look under the blade of the square, or to raise the piece being operated upon to permit the light to show between the blade's edge and the work. Of course, this, if long continued, is a wearisome labor, especially if the piece being trued is heavy or bulky. The object of the improvement in the square shown in the engraving is to obviate this necessity by permitting the eye to note the progress of the work by a glance at the top of the blade. How this is effected may be seen by the following description:—A is the handle or stock of the try-square and B, the blade. This latter is hollow or double, composed of two longitudinal blades secured, as seen, a little distance apart. Running lengthwise through the center of the space between these blades is a square bar, C, on which hang cross pieces, D, with a mortise in each sufficiently long to permit a slight vertical movement on the central bar. These drops are about one-sixteenth of an inch in width, made of steel, and fitting nicely one to another. The central bar permits these uprights to drop below the level of the lower edge of the blade but only flush with the top edge. Thus it will be seen that when the piece which is being planed becomes true, all those uprights which bear on its surface will be exactly level with the top edge of the blade. The block of wood, E, is purposely shown to be very uneven to exhibit the working of the square, a portion of one side of the blade and a part of the central bar being broken away to expose the parts.



BURGUM'S IMPROVED TRY-SQUARES.

This invention was made at the suggestion of a correspondent in the SCIENTIFIC AMERICAN a few weeks ago and it appears to meet a want long experienced. For further particulars address John Burgum, Concord, N. H. Patent pending through this office.

A QUARTETTE OF MATHEMATICAL GYMNASTS.

The errors which have lately been made in calculating the power of projectiles, the resistance of armor plates, and the force of steam vessels when used as rams, seem to indicate that a knowledge of first principles is more necessary for a correct appreciation of mechanical problems than any amount of abstract mathematical skill.

The scientific gentlemen whose errors on the subjects alluded to, it is intended at this time to point out, are Captain Noble; Professor Daniel Treadwell, late of Harvard University; one of the Shoeyburyness scientific reporters, and Rear Admiral Louis M. Goldsborough, of the U. S. Navy.

The curious blunder of Captain Noble, of her Britannic Majesty's Service, the famous artillery calculator, in computing the dynamic force of the fifteen-inch shot, has a parallel, in point of inaccuracy, in a late error (which will presently be referred to) of another Shoeburyness mathematician in calculating the resistance of a certain iron-clad target, and also in the blunders committed by Professor Treadwell in his calculation on the fifteen-inch gun. Captain Noble, it will be remembered, made the following error in his calculation of the power of the fifteen-inch shot. Referring to page 30 of his report, the result of his calculations is stated as follows, viz.: That with a "50-pound charge and a 484-pound shot an initial velocity of 1,070 feet per second will be the result." This is equivalent to a force represented by 8,658,760 pounds raised one foot high, which divided by 50 gives only 173,175 foot-pounds as the energy exerted by each pound of powder.

On June 27, 1867, Captain Noble fired the fifteen-inch gun at Shoeburyness with the following result: Charge 50 pounds, weight of shot 450 pounds, velocity 1,214 feet per second, dynamic force of the shot 10,328,400 foot-pounds, or divided by 50 gives 206,570 foot-pounds for each pound of powder. Thus Captain Noble was no less than 1,569,634 foot-pounds out of the way, and he himself practically demonstrated the fallacy of his calculations, together with his want of knowledge of the weapon he had condemned on the results of blundering computation. And more unfortunate still for the reputation of this officer, he asserted that 50 pounds "is as heavy a charge as it will stand." Now these guns have been fired frequently, some of them for 100 rounds, with 100-pound charges of mammoth powder=83 pounds of such powder as Noble's calculations are based upon. Consequently the energy produced represented by 83×206,570 (the force of one pound)= 17,145,310 foot-pounds, or about double the power this ordnance officer asserted it was possible for the fifteen-inch gun to exert!

We are sorry to say that Professor Treadwell has blundered still more than Captain Noble in his speculations on the capacity of the fifteen-inch American gun. In Vol. VII. of the Proceedings of the American Academy of Arts and Sciences, we find the following statement in a communication from Professor Treadwell, read by Professor Winlock, viz., that the fifteen-inch gun with a projectile of "315 pounds" weight and a charge of "50 pounds" of powder an "initial velocity of 1,118 feet per second" is obtained, which is equal to a "force in pounds raised one foot high, 6,057,950."

Referring to the results of trials before alluded to, it will be remembered that 50 pounds of powder projected a 450-pound shot with no less a velocity than 1,214 feet per second, which is equal to 10,328,400 foot-pounds, or 4,276,450 more foot-pounds, or nearly double the *vis viva* stated by the Professor. And in order to show still further to what extent he has underrated the real power of the gun, it is only necessary to repeat that with a proper charge the gun imparts an energy to its shot of no less than 17,145,310 foot-pounds, as tested by more than a hundred discharges from one single gun, as before stated.

In the same communication we find the following put down as the performance of the Armstrong wrought-iron coil gun: "Weight of shot 600 pounds," "charge of powder 100 pounds," "initial velocity 1,400 feet," "force" of shot "in pounds raised one foot high, 18,375,000." According to these statements a pound of powder in the 15-inch only exerts a force of 123,039 foot-pounds, while the late Shoeburyness trials show that this piece actually exerts a force of 206,567 foot-pounds; thus the Professor underrates the American gun to the enormous extent of 83,537 foot-pounds for each pound of powder employed, a degree of blundering quite inexcusable in one who undertakes to teach the American Academy of Arts and Sciences. The enormous friction of the rifle shot and the absence of friction in the 15-inch shot, should have suggested to the Professor that his calculations must be erroneous.

Again, the 100 pounds which he puts as the charge in the Armstrong gun has only been used on one or two occasions; 70 pounds was called the service charge, and even that ruined the gun in a very short time, and the last one tested burst at the sixth fire with but 70 pounds. In a word, the English themselves admit this gun to be a dead failure. But with this charge, *i. e.* 70 pounds, and a 511-pound projectile, an initial velocity of only 1,250 is obtained; hence the force of the shot is equal to 12,500,000 foot-pounds, or only 178,528 foot-pounds against nearly 207,000 for the 15-inch.

While Professor Treadwell has overstated the power of the abortive 13·2-inch English wrought-iron coil gun, he has as we have shown understated the power of the American 15-inch cast-iron gun in the ratio of 6,051,950 foot-pounds to 17,145,-310 foot-pounds, that is, he has underestimated its capacity *nearly three-fold!*

In looking through Professor Treadwell's paper, an explanation which seems to account for these astounding blunders may be found in the fact that the document in question is intended as an argument in favor of the coil system of constructing cannon, his patent system. On this point it will be enough to say that the Armstrong coil system, which the Professor crowns with unearned laurels, is utterly unable to meet the strains put on heavy ordnance; in short, it is a complete failure, and is so acknowledged in England by the fact of its abandonment for a simpler system. The Armstrong system is now admitted to be founded on erroneous mechanical principles.

Much more remains to be said on this point, but we pass on to the next candidate, the Shoeyburyness scientific reporter. And with respect to the blunder made by this official in his calculations on the resisting power of an iron target, we cannot do better than quote from the London *Army and Navy Gazette* of August 24th. The *Gazette*, after giving its views of the self-satisfied air of the Shoeyburyness ordnance and select committee men, says: "There is, we see by the pages of the leading journal, a recent and rather remarkable illustration of the utter fallaciousness of the calculations at Shoeburyness, which the scientific officers would have done better to have kept to themselves. It was considered desirable to test the power of the American system of laminated plates as compared with that of solid plates. One target was composed of a solid 7-inch plate, one of two 3½-inch plates, and one of three 2¼-inch plates, bolted together."

We are told that "the ratios of resistance under the 'empirical rule' ought to have been 49, 24, and 16 respectively. The result was ludicrously at variance with the empirical rule, and is represented in the proportion of 61, 57, and 52 respectively." It is not likely that any comments can add to the force of the teachings of such a result.

The blunder to which we now call attention, in point of ignorance of principles, is entitled to cap the monument of blunders whose base and shaft is formed by the others which we have already mentioned. It is the extraordinary hallucination of no less a mathematician than Admiral Goldsborough with regard to the smashing or punching power of rams. The Admiral's fallacious reasoning deserves to be pointed out at the present time, from the fact that he still clings to an error which, if he has any conception of the subject, he must have seen long since.

In his report to the Secretary of the Navy in 1864, the Admiral strongly advocates the employment of rams for the protection of harbors, unprovided with guns, which he says "are detrimental to unity of purpose." This view he attempts to sustain by the absurd statement that a ram weighing 10,080,000 pounds, moving at the rate of 15 knots an hour or 25 feet per second, "is equal in point of shock" to a ball of iron weighing 252,000 pounds striking with a velocity of 1,000 feet per second. This ball is 10 feet 2¾ inches in diameter. The striking force of the ram is measured by its equivalent of a little over 100,000,000 of foot-pounds, while the striking force of the 10 feet 2¾ inches ball is measured by no less than 3,906,000,000 foot-pounds. In other words, the Admiral, by not understanding the fact that the comparative "shocks" of the impact of moving masses are measured, not directly as their velocities, but as the squares of their velocities, has committed the ludicrous blunder of exaggerating the power of his ram nearly forty fold.

The Admiral's ramming theories appear to have been conceived while he was in command of the naval force in Hampton Roads opposed to the *Merrimac*, and while that iron-clad was nightly haunting his dreams. The official delivery of these theories was formally announced with the ceremony due to a royal birth, in the report to the Secretary referred to.

We have a few other mathematical acrobats on our list, but as their summersaults were turned on another stage, we will not mention them at the present time, but we hope before long to place them before the readers of the SCIENTIFIC AMERICAN. We will briefly observe, however, that one of them is not a thousand miles from the Navy Department, and he is still, we believe, accumulating figures with extraordinary cunning and industry.

GLEANINGS FROM THE POLYTECHNIC ASSOCIATION.

The meetings of this Society were resumed, after the summer intermission, on Thursday evening, Sept. 19th. The attendance was small, and the exercises were of a somewhat miscellaneous character, being chiefly confined to discussions and comments upon a budget of scientific items collected by the Chairman, Prof. Tillman, during the summer months.

FACTS CONCERNING DEAFNESS.

Following the reading of a note upon the causes of deaf-dumbness Dr. Richardson remarked upon some prevalent but false notions, respecting the use of aids to hearing and to sight. Persons having but a slight impairment of their auditory apparatus, are loth to have recourse to speaking trumpets fearing that thereby permanent deafness will ensue. But this is a mistaken idea, for the use of this aid is in effect a kind of invigorator, bringing the organs of hearing into full play, and thereby developing rather than paralyzing them.

In supporting similar views in relation to the organs of hearing and sight, Dr. Richardson recounted the observations made by Dr. H. R. Smith, of Chicago, during a recent visit of scientific research to the Mammoth Cave. The fish of these subterranean lakes are not only without eyes or even traces of an orbit, but so far as he could ascertain by careful and