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TO OUR FRIENDS.

NOW IS THE TIME TO FORM CLUBS.

With the present number a new volume of this journal commences. We appeal to its friends in all sections of the country where mail facilities exist to endeavor to form clubs for the present year. We feel justified in asserting that no other journal in this country furnishes the same amount of useful reading, and especially at the extraordinarily low price at which it is furnished. The present high price of paper has rendered it necessary that we should somewhat increase the subscription price of the SCIENTIFIC AMERICAN, but by availing themselves of our clubbing rates persons may obtain the journal on very reasonable terms even now. We are obliged to pay more than double the price we did one year ago for the same quality of white paper that the SCIENTIFIC AMERICAN is printed on, while the subscription price to clubs is only a fraction more than formerly.

The long winter evening must be relieved of its dullness, and we must keep reading and thinking, and thus be prepared to overcome temporary difficulties and open new channels of wealth and prosperity. Friends, send in your clubs ; at least renew your own subscriptions promptly.

PROGRESSIVE SCIENCE AND ART.

Every new discovery in science is like an increase of power in the telescope, by which a more extended view into space is obtained. New inventions do not circumscribe, but expand the range of discovery. A new abstract truth is almost apparently valueless to art when first discovered. It is like the seed of a tree or flower, that requires planting and careful cultivation It was observed several centuries ago that light turned certain white metallic salts black, but this abstract truth was like a field of grain long covered by an avalanche in an Alpine valley. The sunshine of genius at last thawed it out, and it has now developed into the wonderful and beautiful art of photography. In 1790, Dr. Galvina noticed that a dissected frog executed a hornpipe when it was attached to a copper wire suspended over an iron ballustrade. This was the germ of chemical electricity, from which have emanated electro-magnetism, electro-telegraphy, and electro-metallurgy. These two cases we have cited out of many as examples of progressive science and art. The pursuit of truth in every form is one of the chief distinctions of the human mind. Every new fact, therefore, in science, however abstract and valueless it may appear at first, should be welcomed as a treasure, for it may become the foundation-stone of a splendid temple of art.

During the past year we cannot point to any remarkable new discovery in science, but there has been a steady progress made in nearly all the arts. Two years ago, by the improved instruments of Professors Kirchoff and Bunsen, it was discovered that the flames of different substances possessed specific properties of color, with bright and dark bands. Already this invention has been applied to analytical chemistry, several new metals have been discovered, and it has opened up a boundless prospect for scientific investigation.

Chemistry and mechanics are intimate companions. The one furnishes the materials, the other the instruments of the arts. Metallurgy may be called both a science and an art. There is such a dependance of one art upon another that any improvement in one benefits all the others. From foreign periodicals we learn that some improvements have been made in Europe during the past year in the manufacture of steel. To these, and to the production of the finer qualities of steel, the attention of our metal manufacturers should be intensely devoted. Coarse steel is now made in considerable quantities at Pittsburg, Pa., but the finest qualities, that are used for making our saws, cutting instruments and wire, are imported from England. All that is wanted for the manufacture of fine steel in America is trained skill. In England, the best steel is made from Russian and Swedish iron. Every variety of iron known is native to America. We have the best materials in profusion for the manufacture of fine steel, and encouraging inducements are now presented, by the increased import duty, for our metallurgists to experiment, and thus acquire that skill which must end in success.

The scarcity of cotton has instituted a demand for new substitutes that may be employed in the manufacture of cloth and paper. Improvements in processes and machinery for treating flax may render this beautiful fibrous substance a cheap substitute. There are thousands of vegetable substances from which fibre can be obtained for spinning and weaving, but the trouble and expense of treating them to remove their gluten and bitumen and obtain the fiber are obstacles to their cheap production. The fibre of some substances is more easily obtained than others, hence attention should be directed to the cultivation, or discovery of those which are the most easily treated. Paper can be made from an endless variety of vegetable substances. The semi-civilized inhabitants of Japan, in several respects, are in advance of the skilled nations of Christendom in the art of paper-making.

Had we space we could allude to quite a number of other subjects connected with science and the arts to which the attention of inventors, manufacturers, scientists and others should be directed in commencing a New Year. Let not small things be overlooked ; observation should be minute and penetrating. There is not a single science or art that can yet be called perfect. By patient thought and industry great improvements may be made in them all. Who knows but that some neglected or obscure truth in science may be developed into a splendid art during the incoming year ? The past is fraught with encouragement, the future is full of hope.

STEAM WAGONS UPON COMMON ROADS.

THE introduction of steam carriages on common roads has been a pet project of inventors for many years. The advantages arising from their use are many, but the objections to them must also have due weight when their employment is proposed. The progress of the street locomotive, practically considered, has been very slow in this country, few comparatively having been built which can be noticed at all. Of those lately in operation, the Lee & Larned steam fire-engine is, perhaps, the most successful one, viewed either in point of speed or capacity for carrying moderately heavy loads—both of these features are comprised in this engine. The British Society of Engineers have discussed the subject of steam carriages at great length in one of their recent meetings, and we cull from their report some accounts of what previous inventors have achieved, so that if our own people should take the matter in hand, they may not be ignorant of what has been heretofore attempted.

In 1824, W. H. James, of England, took out a patent for improvements in steam carriages, and several were constructed on his plan. He employed four cylinders, each pair coupled on to one driving wheel, the axle of which was divided in the middle ; the object of this was to render each wheel independent of the other, and to avoid the necessity of throwing the inner one out of gear when turning curves, at the same time to allow both engines to be in motion. The motion of the springs was allowed for, by making the engines, and the frame in connection with them, vibrate upon hollow axles provided with stuffing-boxes, constituting the steam and exhaust passages. A few experiments were tried with these engines, during which, it is said, they at[illegible] a speed of twenty miles an hour. They we[illegible] complicated, however, and were soon abandoned.

In 1826, Mr. F. Andrew patented a carriage, the steering apparatus of which is worthy of special mention ; this consisted of a simple wheel placed in front of the carriage, revolving between two lateral bars of a framing ; by guiding this wheel with a lever, the direction of the two fore wheels could be altered, thus turning the wagon in every direction. This carriage had oscillating engines, acting directly on the main axle, but the invention was a failure through a defective boiler.

The next candidate for fortune and renown was a Mr. Gurney, who, after repeated trials and failures, at last succeeded in establishing a line between Cheltenham and Gloucester, England. Mr. Gurney, like many others, commenced his experiments with a machine having a series of legs, which struck out behind in order to obtain the necessary adhesion ; this plan was abandoned in favor of direct-acting engines, coupled on to the cranked axle of the after-drivers. There was also an upper and under framing, the engines being attached to the under one, while the boiler, passengers, &c., were carried by the upper one, the object of this arrangement being to keep the body of the carriage well suspended, while the engines always maintained their relative position with the axle. The proprietors ran these steam coaches for four months, four times a-day, between Cheltenham and Gloucester, during which time they carried 3,000 persons, and ran 3,500 miles at the rate of a little over nine miles per hour. They were, however, driven off by opposition, and the project was finally abandoned by Mr. Gurney.

We now come to Mr. Walter Hancock, of Stratford, who commenced his career in 1827. His carriages were much superior to any others hitherto constructed, both in point of workmanship and plan. The cause of failure in most of his predecessors lay with the boiler, and the one he adopted is said to have been remarkably ingenious, considering the state of the mechanic arts at that period. One of his coaches, called the *Infant*, had a boiler with six square feet of grate surface, and one hundred feet of upright surface. This supplied vapor to engines of 9-inch cylinder, and 12-inch stroke. The weight of the whole carriage was about six tons. He used an artificial draft, and, it is said, raised steam from cold water in twenty minutes. The following is a description of his invention :—In order to avoid twisting the main shaft, which was always breaking in other inventions, an endless chain was adopted in preference to direct action, and a vibrating link was placed between the engine shaft and the axle, to take the strain caused by the transmission of power, as also to preserve a uniform distance between the two parts. The driving-wheels were outside of the frame, ran loose on the axle, and connected with clutches, so that the stoker could throw them out of gear when desirable. The piston worked downwards, and the driving-axle and crank shaft were geared to the same speed. Hancock constructed nine engines of this pattern, which ran several months in public service, but he also was obliged to discontinue them through popular prejudice.

Coming down to later years (1859) we find that a Mr. Rickett, of Stony Stratford, England, has been quite successful, in a mechanical point of view, with his inventions. The main features of his carriage are the framing and the boiler ; the former is hollow, and contains the supply of water for the boiler in addition to supporting the working parts ; the boiler is very short, is made of steel, is nineteen inches in diameter, and affords an area of thirty-one square feet of heating surface. The cylinders are three inches diameter and nine inches stroke, and work at an average pressure of one hundred pounds. This carriage has run upwards of twelve miles an hour on common roads.

With these extracts we conclude. The meeting discussed at great length many other forms of steam carriages, among which was a plan for a street omnibus, which would carry thirteen persons besides the fireman and steerer. The objections to its use were novel, the principal one being that horses were unable to understand or rather comprehend the nature of a wagon that moved without any apparent means of propulsion. The exhaust steam was also a source of [illegible]noyance to horses which it was desirable to [illegible]. This it was thought could be overcome by working the steam at a high pressure, and cutting it off short, thus diminishing its volume. The cost of working street carriages by steam, as compared with horse power, was also considered in balancing the merits of the two systems, and resulted by a small amount in favor of steam. The English roads and streets are so much better than ours, generally, that inventors in that country have not the same disadvantages to contend with as we have. Whether the steam wagon will ever supersede, to any extent, the employment of cattle is a question that remains to be solved. Years ago, he would have been a rash man who predicted the universal system of railroads that now twine almost every country on the globe as with a net. Who shall say, then, that when the difficulties and prejudices which now exist are overcome, what new schemes and inventions may not be inaugurated?

SINKING OF IRON CYLINDERS FOR PIERS.

The employment of cast iron cylinders for foundations in water, such as bridge and dock piers, has been tried in America to a limited extent, but with such satisfaction that in all likelihood their future use will be upon an extensive scale. They constitute an improved development of foundations laid by the diving-bell system. In 1779 the celebrated Smeaton first used the diving-bell for repairing the foundations of Hexham Bridge, in England, instead of making coffer-dams. The next good improvement was D. Potts's pneumatic process of sinking iron cylinders, which was illustrated on page 1, Vol. VIII, (old series) of the Scientific American. The principle of this method may be briefly stated as follows:—An iron cylinder to be sunk as one of the piles of the foundation is covered with an air-tight cap, placed in position, and allowed to sink through the water and soil; it is then connected by a flexible hose to a receiver, which is furnished with a trap valve in the bottom, opening downwards, and put in communication with a three-barreled air-pump. The pump is put in motion, and the air is exhausted from within the cylinder and receiver, the silt or sand is forced up in the reservoir by the external pressure of the atmosphere, and, as soon as the reservoir is filled, a valve at the bottom is opened and the contents allowed to flow out, after which the valve is closed and the operation repeated until the pile is sunk to the required depth. The cylinder sinks by its own weight and the external pressure of the atmosphere. The method is not available when applied to stony ground, as water would flow in under the edges of the cylinder and vitiate the external vacuum.

A plan the reverse of this, called Hughes's pneumatic system, has been employed for sinking the cast-iron cylinders of the new bridge at Harlem, near this city. This method consists in filling the cylinder with compressed air by which means the water is expelled from below the tube, and men excavate and work inside. In both of these methods, the cylinders used are plain castings; an air-tight trap hood being used on the top of each cylinder during the operations of excavating. Another method consists in forming each cylinder with a screw on its lower extremity, and giving it a rotary motion by which it is forced into the ground. In many situations this plan has been very successful. Another plan consists in forming each screw cylinder with a disc at its lower end, leaving a hole in the center through which a wrought-iron pipe is carried down through the pile, projecting some inches below its bottom. Water is forced down this pipe under pressure, and a rotary motion is given to the cylinder at the same time. This method has been found very successful in sinking such cylinders in very hard river bottoms.

The number of applications for pensions made at the Pension Bureau at Washington, up to December 12th, this year, was 7,911.

WHAT A UNIT OF HEAT CAN DO.

In talking and writing about heat, physicists have felt the need of some mode of expressing a definite quantity, and the idea was suggested of calling that quantity which is sufficient to raise the temperature of one pound of water one degree of Fahrenheit's scale a *unit*. Having thus exactly defined a given quantity of heat, it is surprising to find how many truths in relation to the action of caloric may be briefly and clearly expressed, which before, it was difficult to comprehend and convey. It is an impressive illustration of the value of accurately defined terms in scientific discussions.

Specific heat, for instance, may be explained in a very few words by the medium of units. A unit of heat will raise the temperature of a pound of water one degree, but it will raise the temperature of a pound of mercury 33°, and of a pound of tin 20°. Or, it takes one thirty-third of a unit of heat to raise the temperature of a pound of mercury one degree. We accordingly say, that the capacity of mercury for heat or its specific heat is one thirty-third, or three one hundredths, expressed decimally 0.03, and that of tin is 0.05.

A clear idea of *latent heat*, also, may be very briefly conveyed by means of units. To raise the temperature of a pound of water from 60° Fah. to 212° the water must absorb 152 units of heat; then it will absorb 1,000 units more without raising its temperature at all, but these 1,000 units convert it into steam. As this heat which changes the water from the liquid state to that of vapor does not show itself either to the touch or when tried by the thermometer, it is called hidden or latent heat.

A unit of heat applied to *mechanical effort* will raise 772 pounds of matter one foot; in other words, it will perform 772 foot-pounds of work.

As it takes more heat to raise the temperature of water one degree at some temperatures than it does at others, it was necessary to fix some temperature at which the measure should be taken, and 60° Fah. has been agreed upon; water at that temperature being easily obtained.

THE CHANGES OF A PIECE OF SILVER.

If we place a piece of pure silver in nitric acid and add a proper quantity of water, the silver is dissolved as completely as sugar is in water, and wholly disappears; the solution looking exactly like pure water.

If now we evaporate a portion of the water and set the solution away, we shall find in the course of a few hours that the bottom of the vessel is covered with beautiful, white, flat plates, which are crystals of nitrate of silver, the metallic silver in combination with nitric acid. The nitrate of silver has some very singular properties. If kept free from contact with other substances, it may be exposed to the light for any length of time without any change from its pure white color. Or it may be applied to cotton or the skin or hair in the dark without any change in color. But if it is applied moist to any vegetable or animal substance and exposed to the light, it turns black in a few minutes. It is the coloring agent in indelible ink.

If we place crystals of nitrate of silver in water, they are quickly dissolved, and if we throw a little table salt—the chloride of sodium—into the solution, the silver leaves the nitric acid, and combines with the chlorine in the salt, forming the chloride of silver. This is a white lustreless powder, and gradually turns black when exposed to the action of the light. Metals may be silvered cold by means of the chloride of silver.

If we mix chloride of silver with carbonate of soda, and heat the mixture in a crucible to a very bright red, it is dissolved, and both of the substances are decomposed. The chlorine leaves the silver and combines with the sodium of the soda, forming chloride of sodium—table salt—the carbonic acid escapes as a gas, and the silver is left in the metalic state in the bottom of the crucible.

Thus we have silver first as a white solid metal, then a liquid like water, then in crystals like salt, then as indelible ink, then as a gray or black powder, and finally again as a metal. And these are only a very small part of the forms which it may be made to assume.

GENERAL BURNSIDE'S LETTER.

General Burnside has written a letter to President Lincoln in reference to the late disaster at Fredericksburg, in which he most characteristically and magnanimously assumes the whole responsibility of the occurrence. "The pen is mightier than the sword," and in this respect the General has shown himself the greatest soldier of the war. We cannot recall, at this writing, any other case of a like nature, in which the commanding officer so nobly and generously bared his own forehead, and laid himself open to whatever criticism might be visited upon him. In speaking of the honored dead who fell upon that day, fighting superhumanly, the General conveys to those who mourn, the assurance, at least, that he also, being a man, grieves with them and shares their sorrow. Our losses, says the same authority, have been as usual, greatly overated. They amount to 1,152 killed, with about 7,000 wounded; we also took 700 prisoners, which last have been paroled. The retreat—which seems to have been carried out only after the enemy refused to leave their intrenchments and attack us—was a masterly affair, and was executed without loss. The President, in acknowledging this letter, has issued an address to the army under General Burnside, in which he congratulates them upon their valor and endurance, and assures them that although they were unsuccessful, the attempt was not an error, nor was it anything but a pure accident. Well may Mr. Lincoln thus eulogize our brave men; surely a cause that has such hearty supporters was not born to die. In common with most of the Northern people we were overwhelmed, at first, when the news and extent of our disaster reached us, but we feel like adopting the backwoodman's advice to his comrade when his rifle missed fire, *i. e.* to "pick the flint and try her again." And this is just what the North will do. No lawful means will be left untried to secure those rights and privileges for which we are fighting and which we properly deem inestimable; without these life itself is valueless.

PAPER FOR SHIP-BUILDING.

Much has been said and written about "the wooden walls of old England," meaning thereby the war-ships of that nation; but, from late experiments, we judge they are not quite so good as paper. The special Government committee that was appointed to make experiments with guns and iron-clad targets—the latter representing the side of a ship—deserve credit for developing many new facts connecting with the power of resistance possessed by various materials, and the penetrating powers of others. Thus it has been found that steel and wrought-iron shot will penetrate plates which break cast-iron shot like glass. A target was constructed entirely of iron, under the impression that it would prove superior to one composed of wood and iron combined; but it was found inferior, owing to the greater amount of vibration induced by the shot striking. Hard wood, especially teak, was supposed, until lately, to be the best backing material which could be employed for the iron plates; but, strange to relate, it has been found by experiment to be inferior to paper. Two targets were lately constructed with one-inch plate-iron—the one backed by fourteen inches in thickness of teak-wood, the other backed by the same thickness of paste-board. They were fired at with a Whitworth 6-pounder, using elongated shot 5½ inches in length, and 2½ in diameter, and the penetration was found to be twice as great in the timber-backed target that it was in the paper one. The targets were then fired at with a 12-pounder, and with like results. The resistance of paste-board to shot has attracted so much attention on the other side of the Atlantic that further experiments are to be made with it. A denser and tougher material than wood can be made of straw and cornstalk paper. Who knows but the seas may yet be navigated in paper ships?

Pompeian window-glass, of which panes have been discovered as large as 20 by 28 inches, has proved, on examination, to have been cast in a manner similar to that now followed in making plate-glass, except that it was not rolled flat, as now, by metal cylinders, but pressed out with a wooden mallet, so that its thickness is not uniform.