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THE FLOW OF GOLD.

Gold is now selling in Wall street at 22 per cent premium, and exchange on England at 135 per cent. The premium on gold is simply another term for the depreciation of our paper currency; the quotations might as well be, paper money 22 per cent discount, exchange 13 per cent premium. This makes exchange about 4 per cent above par. An old act of Congress fixed the value of the pound sterling at $4 44, while its actual value is a little more than $4 84, so that exchange when at par, is nominally at about 9 per cent premium. It is now nominally at 13 per cent premium above gold, which is really 4 per cent.

If Mr. Grinnell sends $100,000 worth of corn to England and has it sold there, he wants to get the pay for it to New York. At the same time Mr. Stewart buys $100,000 worth of cloths in England and he mustsend the pay for them from New York to England. In a simple state of society Mr. Stewart would send his gold across the Atlantic in one direction to pay for his cloths, while an equal amount was coming in the opposite direction to pay Mr. Grinnell for his corn; but this expensive, risky, and useless transportation of gold to and fro across the ocean is avoided by a simple arrangement between the exporter and the importer. Mr. Stewart takes his gold to Mr. Grinnell, who gives him in exchange an order on the agent in England for the money obtained by the sale of the corn. This order is called a Bill of Exchange.

When the imports of any country just equal its exports, bills of exchange will find just as many buyers as sellers, and they will be sold at par, but if the exports do not sell for enough to pay for the imports, then some specie must be sent abroad to settle the balance, and importers, sooner than pay the freight and insurance on this specie, will pay a moderate premium on bills of exchange. Four per cent will fully cover the cost of shipping gold, and, consequently, this is as high as exchange can go above the price of gold. By simply looking, therefore, at the money market reports in the papers, we are enabled to know that all the gold which is offered in market is being bought and shipped abroad.

The outward flow of gold from this country at the present time results from two causes, one permanent the other temporary. The permanent cause is the production of gold in California, the temporary cause, the large issue of irredeemable paper by the Government.

When any country is producing more than its share of currency the surplus will be distributed throughout the commercial world. This distribution is effected—like nearly all of the other operations of commerce—through the medium of prices. Currency is the measure of values. When there is a great deal of currency in proportion to other things prices will generally be high. If prices are high in any country, that country is a good place to sell things, and merchandise is consequently imported for sale; at the same time it is a poor place to buy things for export, and there is accordingly an excess of imports over exports, leaving a balance to be settled by the exportation of specie. When it was seen, in 1849, that California would produce annually a large amount of gold, the writer of this told his commercial friends, that as long as we produced more than our share of the specie product of the world the rate of exchange would be generally against this country—enough of the time to carry abroad the surplus over our share. The currency of the world is drawn to its natural level all over the globe by a law as universal and as irresistible as the force of gravitation which levels the water of the sea.

The temporary cause of the outflow of gold is the excessive issue of irredeemable paper by the Government. Our currency is worth nothing to foreigners, while by our own people it is regarded as more valuable than anything which they have to sell. Specie on the other hand is the only portion of our currency with which we can pay our debts or purchase commodities in other countries. Our specie, being worth more for use in foreign commerce than in domestic trade, is appropriated to its most serviceable use; it is shipped abroad. This movement too is effected through the medium of prices. The Canadian who brings a drove of horses for sale to our Government, as he cannot pass our paper money at home, buys gold to take back with him. The puffing up in prices brings a flood of imports from all quarters, making an excess above our exports to be paid in specie.

At the present time we are exporting, not merely the excess above our share of the California product, but we are sending abroad a large part of the specie portion of our currency; this being displaced by the Government paper.

ARMOR PLATES SMASHED WITH SHELLS—REMARKABLE GUN EXPERIMENTS.

Perhaps the most remarkable experiments that have yet taken place with guns of different construction and caliber, firing solid shot and shell, occurred at Shoeburyness, England, on the 16th ult. Members of a Government select committee on iron plates and ordnance, and Lords of the Admiralty were present. The first experiment made was with the Horsfall gun—a wrought-iron smooth-bore piece of ordnance of 13-inch caliber, capable of carrying a ball of 286 lbs., weighing twenty-two tuns and forged at the Mersey Steel and Iron works, Liverpool. A target representing part of the side of the armor-clad frigate *Warrior* was used. It consisted of 4½-inch iron plates backed with 18 inches of solid teak wood. The gun was loaded with a solid spherical shot and a charge of 75 lbs. of powder, and it was placed at the usual distance of two hundred yards from the target The first shot was conclusive. It smashed through the entire target and completely destroyed it for further experiments.

Other trials of a still more important character succeeded. These were made with a Whitworth rifled breech-loading 12-pounder field gun of 4-inch bore, and a 70-pounder rifled naval gun. The object of these trials was principally to test their penetrating power with hardened flat-fronted solid shot and shell. Hitherto the shells which had been fired against armor plates of moderate thickness had been broken in pieces, and it had been held that vessels covered with 2½-inch plates were shell proof. The first trial was with the 12-pounder firing solid flat-fronted steel shot at a distance of 100 yards against plates of 2 and 2½ inches in thickness. In both cases the shot cut their way clear through the plates. The same gun was then loaded with a flat-fronted steel shell, containing six ounces of powder and the charge was 1 lb. 14 ounces of powder. No fuse was employed, as Mr. Whitworth stated that the heat generated in the shell when it struck the target would be sufficient to ignite the bursting charge. One shell passed completely through a plate 2 inches thick and an oak backing one foot thick, and the other pierced through the plate and burst in the backing, shattering it to pieces. This was certainly a most interesting experiment.

The 70-pounder naval gun was next tried against a target of 4-inch armor plates bolted upon an oak frame nine inches thick, attached by a framing of oak four inches thick covered on the back with 2-inch iron plates. The intervening space between the front and back frames was thirty inches, and the entire thickness of iron was six inches. The gun was loaded with a flat-fronted steel shell which weighed 70 lbs., the charge of powder was 12 lbs., and the gun was placed at 200 yards from the target. The first shell pierced clear through the 4-inch plate and the timber backing, and struck against the 2-inch back plate, which it cracked, then it burst and shattered the target.

The results of these trials surprised most persons present. The tremendous destructive power of the Horsfall gun—the largest wrought-iron cannon in England—was astounding. A huge hole, two feet square, was struck out of the plate by the spherical shot, and the surrounding iron was cracked in all directions, and made a complete wreck. On the other hand, the flat-fronted projectiles of Whitworth punched out clean holes in the plate without fracturing any of the surrounding portions. The power of great guns to penetrate armor plates has thus been demonstrated, and those present at the trials, it is said, appeared convinced that this cannon could have pierced through plates six inches in thickness. The London *Times*, which appears to have become the subservient organ of conservative government abuses, asserts that the balance of merit for general purposes lies with the Armstrong gun. But the *Mechanics' Magazine* asserts that the Horsfall gun has "successfully accomplished that which Sir Wm. Armstrong, with the whole resources of the nation at his command, has been after numberless trials unable to accomplish." The Lords of the Admiralty have been expending hundreds of thousands of pounds during the past two years in making experiments to see if iron plates of 4½ inches in thickness could be pierced with the largest Armstrong guns, and from their experiments, it would appear they had become about satisfied that their new iron-clad frigates were invulnerable, and yet this Horsfall gun, which has smashed the *Warrior* target to pieces with a single shot, has been lying at Portsmouth in charge of the Government officials for six years, during which period all trials with it were pertinaciously refused. The *Mechanics' Magazine* asserts that three million pounds (about $15,000,000) have been expended uselessly in the construction of Armstrong guns. The Horsfall gun must be of great strength as the charge of powder used was prodigious. For short distances the penetrating and smashing power of spherical shot fired from smooth-bored guns is greatest; but for great distances rifled guns and elongated shot are superior, because the round shot in its flight meets with so much greater resistance from the atmosphere.

EXPLOSIONS OF BOILERS AND THEIR CAUSES.

The illustration and description of the explosion of the locomotive on another page, together with the very valuable scientific information on the water explosive hypothesis, will be appreciated by all who are interested in steam engineering and the chemistry of iron and water. Our opinion respecting the cause of steam boiler explosions is that they are due to an overpressure of steam. On page 89, Vol. I. (new series) SCIENTIFIC AMERICAN we said upon this subject, "We have taken the position that an excess of steam pressure in proportion to the strength of boilers is the cause of explosions." This opinion we have reiterated on several occasions. We admit that from accounts received of various explosions it is scarcely possible to account for them upon this theory, but in nine cases out of every ten they may be traced to an overpressure of steam in the boilers. Two new theories of boiler explosions have been published within four years. The one by Mr. Zerah Colburn; the other by D. K. Clark—both railway engineers and writers on machinery. A contributor to the New York *Times* claims Mr. Clark's theory for Mr. Colburn. He says: "Just after the *Great Eastern's* funnel-casing exploded a party of engineers in London were attempting, with little success, to reconcile any old theory with the phenomena here exhibited, when a new theory was proposed, which, after running the gauntlet of professional criticism, assumed such importance that Mr. Zerah Colburn, an American, and the probable author of the theory, wrote a book about it, and Mr. D. K. Clark explained it in the *Encyclopœdia Britannica*." Quite recently, while experimenting for a very different purpose, Mr. Edwin Stevens, of Hoboken, developed the great fact upon which its probability depends. Water cannot exist as water under the atmospheric pressure at a higher temperature than 212°. Now the temperature of the water in a boiler under steam pressure of 100 pounds is 330°. If then the steam pressing on the water can instantly escape as through a rupture caused by mere weakness of the metal or by over-

pressure, a great part of this water at 330° will instantly flash into steam carrying the rest with it at about the velocity of a cannon ball. So far we know. The theory is that this flying body of inelastic water-particles operates like so many projectiles—like a broadside of grape—tearing into pieces everything within reach."

We alluded to the statements of this writer on page 137 of our present volume, and would not now refer to them but for the purpose of further exposing their erroneous character occasioned by a recalcitrant article in the New York *Times* of the 25th ult. In the above extract the impression is conveyed that Mr. Clark has indorsed Colburn's theory and amplified it in the *Encyclopœdia Britannica*. This is not so, for Mr. Clark has repudiated the steam percussive theory of Mr. Colburn in two letters to the *Mechanics' Magazine* of May 3 and 10, 1861.

The experiment of Mr. Stevens is of no consequence for or against these theories. The statement above, that water will fly with the velocity of a cannon shot, is so unscientific that no person acquainted with mechanical philosophy, upon reflection, would have made it. The velocity of water flowing into a vacuum under a pressure of 100 pounds on the inch is but 116.72 feet per second, whereas the initial velocity of a spherical cannon shot is over 1,700 feet per second. The heated water that evaporates into steam in a boiler relieved of pressure by the escape of steam through a rupture is necessarily of low pressure and not very destructive. This is according to a well known law.

At the period of the explosion on the *Great Eastern* the correspondents of the New York *Times* and the *Engineer* were on board, but for want of a proper consideration of the case they mystified it amazingly. The most profound of living engineers has cleared up the subject in a very few lines. In Fairbairn's "Information for Engineer's," pages 305 and 306, he says: "In the disastrous accident which attended the first trial trip of the *Great Eastern* the funnel of the boiler, which was surrounded by a water jacket, gave way by a collapse at what was probably low pressure. This might easily have been prevented had the maker been aware of the extreme weakness of such flues when of large diameter and great length. The funnel, six feet in diameter, is in this case (which he illustrates with a diagram) exposed to the pressure of steam together with that of a column of water nearly forty feet in depth, and these two forces were quite sufficient to collapse the funnel and cause the frightful explosion which occurred."

Mr. Fairbairn believes that explosions are due simply to an overpressure of steam in boilers, in proportion to their strength, and no man living has made so many accurate experiments with steam boilers. In the report of May 7, 1862, of Mr. L. E. Fletcher, Chief Engineer of the Manchester Association for the Prevention of Boiler Explosions, he presents similar views respecting the cause of explosions. He says, in alluding to several cases, "It will be seen that all the above explosions occurred from the most simple causes, and that no mystery can be attached to any one of them. By suitable construction of the boilers in the first place, and due attention to their state of repair in the second, these explosions could in every case be prevented. * * * I find by far the most frequent cause of explosion is the insufficiency of the boiler for its working pressure, either on account of its original construction or want of repair." These remarks of Mr. Fletcher should "be written in letters of gold." They are of the greatest importance to every person who makes or uses a steam boiler.

A FRENCH SAVANT ON THE MANUFACTURE OF STEEL.

At the regular meeting of the French Academy of Sciences, held in Paris on the 18th of August last, M. Fremy, who is well known among scientific men for his researches into the nature of steel, read another memoir on the subject. He gave it as his opinion that steel would yet take the place of other metals in the manufacture of guns, and that it would yet supplant heavy wrought-iron plating in armor ships. "Those nations" he said, "which do not strive to keep up with the march of science, will very soon be left in a position of inferiority." The English method of making steel he held to be excellent, but as it is made in crucibles not holding over 44 lbs. it could not be obtained in very large masses. This method of making steel is also very costly, as it requires the use of the best malleable iron, and about seven times the weight of the iron, for fuel, during the process. France could not compete with England in making steel by such an expensive system. M. Fremy has therefore made experiments, and investigations to make good steel by another method. When he commenced operations, it was generally thought necessary to get Swedish or Russian iron to obtain a proper quality of steel, because it was believed that only a peculiar quality of iron ore possessed "a steeling propensity." He desired to clear up this metallurgical mystery, and he asserts that he has succeeded. When in England he had an opportunity of witnessing Bessemer's process in operation, and although much impressed with the magnificence of the system it left serious doubts in his mind respecting the quality of the steel. He left England with the impression that the cast iron of France, reduced by coke, contained too much sulphur and phosphorus, to be converted into steel; but experiments made by him at the works of St. Seurin have dissipated his fears. The Bessemer process converts French pig iron in about twenty minutes into a kind of burnt azotized malleable iron which is very "red short," but when to this is added some cast iron of the specular quality in the proportion of 1 ounce to 40 lbs. good steel is produced. Experiments were made on a large scale, and it was found that good steel could be obtained from any pig iron which could be refined. English workmen have examined the specimens of steel there obtained, and they pronounce it equal to English steel. It has been made into chisels, knives, gravers and other cutting tools. M. Fremy believes that a great revolution is about to take place in the metallurgy of iron. We judge from his experiments, that good cast steel may be manufactured in America from most of our pig iron. Several tuns of steel have been made by M. Fremy, from pig iron which he had supposed was totally incapable of being employed in the manufacture of steel.

MISCELLANEOUS SUMMARY.

Wrecks of British Vessels.—From the statistics, recently published, of disasters that occurred on the coasts of Great Britain in 1861, we learn that there were 1,494 wrecks, embracing a registered tunnage of 253,238 tuns. The number of persons employed upon them was 11,040. Respecting the classes of vessels lost, there were 487 engaged in carrying coal. These vessels make numerous and short voyages; they run close along shore and are not provided with modern improvements for shortening sail and braving heavy gales. Of the lotal number lost, only 42 were steamers. The number of lives lost was 884.

The Preparation of Flax.—A corespondent of the Montreal *Herald* mentions a discovery in the mode of preparing flax, which seems equally applicable to the Northern and elevated portions of the United States and Canada. He observes:—It has been discovered that in Lower Canada we can prepare our flax for the mill with very little trouble or expense, by a mode which answers as well as steeping, and that is, to spread the flax on a meadow in December, and allow it to remain on the ground till April. The winter snow rots it effectually, and when the snow goes off in April, you will find your flax clean and dry, ready for carting to the scutch mill, without any expense worth mentioning.

Ammunition.—Some idea of the amount of ammunition required to supply an army, such as Gen. McClellan's, during a heavy fight like that of the battle of Antietam, may be gained from the fact that thirty-eight tuns of ammunition were forwarded to Gen. McClellan from Washington, via Baltimore, Harrisburg and Hagerstown. An eye witness of the battle states that he counted, at four different times during the day, the number of discharges from the Union artillery, and found that they were made at the rate of seventy-eight to the minute.

The Philadelphia steam fire engine *Hibernia* has been taken to Washington, accompanied by ten skillful firemen. It is in the quartermaster's department, and has been secured as a measure of safety from fire, for the enormous quantity of Government stores in the city.

The Vitality of the North.—The population of the loyal States is about 23,000,000, or 5,000,000 more than that of Great Britain and Ireland in 1813, and about 5,000,000 less than that of France in 1813. Our wealth and natural resources are superior to either of these nations in 1813, and, instead of being twenty years at war, this is only the fifteenth month of our war; whereas France and Great Britain, in 1813, were both exhausted by twenty years of war, when they placed the vast armies of a million men in the field, armed and equipped.

A balloon for scientific purposes has been built in England by Mr. Coxwell. It is fifty-five feet in diameter and sixty-nine feet in length. The builder proposes to ascend five miles, for the purpose of making observations on the temperature and humidity of the air at different hights. He will use Professor Thomson's electrometer for electrical experiments. Trigonometrical observations are also to be made.

Petroleum for Europe.—The Portland *Price Current* says, the large whale ship *Omega* is about to load petroleum at that city for Europe. There has been exported from that port since January 1st, to the 20th of September, 87,200 gallons of petroleum, and from the United States during the same time, 6,242,912 gallons.

It is a common notion with many people that the morning air is the purest, most healthful and bracing; but the contrary is the fact. The air is then more full of dampness, fog and miasm at about sunrise which the heat of the sun gradually dissipates. Before engaging in anything like work or exercise out-doors it is conducive to take a cup of warm coffee and milk if breakfast cannot be prepared beforehand.

A Nice Flower for a Button Hole.—There is a plant in the island of Sumatra, the circumference of whose fully expanded flower is nine feet; its nectarium is calculated to hold nine pints; the pistils are as large as cow horns, and the whole weight of the blossom is computed to be fifteen pounds.

How to get ahead of Time.—The Alta *California*, of August 24, has this paragraph:—"The telegraph worked bravely last night. Our latest dispatches are dated Washington and New York, twelve o'clock, midnight. They reached us at ten P. M., two hours before they were transmitted."

Baked Quinces.—This fruit may be baked like apples, adding sirup, or sugar and water, while baking. Certainly every one who likes a sour baked apple will relish a baked quince. They are very good simply baked, and eaten with powdered sugar.

Heroism of an Engineer.

The express train from the West, on the Central road, due at Albany at half-past three P. M., Oct. 6th, ran off the track four miles west of Little Falls, through the displacement of a switch, throwing the locomotive, baggage, smoking and five passenger cars off the track. The accident occurred on a part of the track where the embankment on one side was six feet deep. When the engineer, whose name is Wemple, saw the danger, he applied the patent brake, communicating from the locomotive to all the cars, and, resolving to save the passengers, stuck to the engine till it was pitched down the embankment, and a total wreck. The brave fellow miraculously escaped with slight injuries. The fireman was seriously injured. The baggage car was also thrown down the embankment. Owing to the application of the brake the speed of the cars was so far checked that although five cars went off the track not a single passenger was injured in any degree. Sanford E. Church and family, State Engineer Taylor and Secretary of State Ballard, were on the train. The escape is wonderful, as the train was going at full speed.

Proportion of Males and Females in the United States.

According to the United States census of 1860 there were at that time about 730,000 more males than females in the United States, a fact unprecedented in the census of any other civilized nation. In most of the older States there is an excess of females; in Massachusetts 37,600 more females than males, while in Illinois there is an excess of 92,000 males; in Michigan 40,000 excess of males; in Texas 37,000; in Wisconsin 43,000: in California 67,000; and in Colorado there are twenty males to one female.