still making, in improving the loom and its products, can only be properly comprehended by personally inspecting the works of the firm. No written description can more than suggest it. The saving of labor is apparent at a glance. One girl can now run ten looms, that is, two looms of five webs each, that is, the work of ten weavers, and on cloth of a width which formerly could not have been made on any loom in the world.

Indeed, the possible width is practically unlimited with a positive motion shuttle. The uniformity and steadiness of its action naturally produces uniformity and perfectness in the fabric.

It further admits of the use of a much larger "cop" of thread for the weft. And here, again, is a very great advantage. Every "stop," for the purpose of renewing the cop, involves a defect in the fabric, for it is impossible to start the machine with a new weft without, for one cause and another, the new thread being noticeable in the cloth.

Hence, the fewer the stops the fewer the defects in the cloth. This machine, carrying a cop six times as long as formerly was possible, calls for only one stop in six of what was formerly necessary. These two advantages, referring to quantity and quality, are alone sufficient to make the fame of any machine.

To understate it, the advantage secured is ten to one in quantity, and six to one in quality.

At the risk of repetition, we will conclude by briefly enumerating the advantages secured by it:

The striking feature of the loom is that the picking stick, heretofore of universal use, is entirely dispensed with. The shuttle being drawn through the warps, is, with all other parts of the machine, held, controlled and acted upon by a direct and continuous connection with the motive power; hence the liability of a "smash" is removed, and no injury can happen the reed. In case of the loom being stopped during the passage of the shuttle, or at any other time, each part is in place for starting again.

The advantages may be briefly enumerated :

1. The unlimited scope of the shuttle : it being drawn, instead of knocked, through the warps, enables the carrying of large quantities of weft any distance; which being kept at a uniform tension until it is beat gives a perfect selvage.

2. The friction of the shuttle on the yarn is perfectly overcome, therefore it does not wear the warps, nor break any threads, even in the finest fabrics of silk, wool, cotton or linen.

3. The weft is not subject to sudden pulls in starting, and may be of the most delicate texture, regardless of the width of the fabric.

4. The loom can easily be arranged to run a number of shuttles, weaving as many widths of cloth as there are shuttles, and with perfect selvage.

5. The width of the fabric may be extended indefinitely.

6. The loom runs with less power, much more quietly than others, and at any speed desirable.

7. The great desideratum is, that it dispenses with the necessity for the skilled labor heretofore required, enables the weaving of very wide goods at no greater cost per square yard than that of narrow, and on ordinary cotton and woolen fabrics gives a large gain.

The looms are now running in a number of the largest and most important mills in this country and giving great satisfaction, and for Jacquard irregular and heavy sleyed fabrics it is indispensable.

Their four-piece loom is arranged with head motion, for from 4 to 12 harnesses for weaving seamless bags, jeans, crash, toweling, ticking, duck, canvas, hose, etc. They build the above loom to weave from 2 to 5 webs in each loom up to 36 inches wide. Using the large cops or bobbins (which are 4 to 10 times larger than those used in other looms), a girl can run two looms 5 webs each, equal to 10 ordinary looms. It has positive take-up for a large roll of cloth 30 inches in diameter; wrought iron crank shaft, tension or friction let-off, geared for any number of picks per inch, and beam heads from 18 to 24 inches in diameter, and stop motion for each web; harness are also arranged to work from cams 2, 3 or 4 harnesses. These looms are used for sheetings, quilts and blankets, 2 webs in each loom, 80 to 100 inches wide, and are arranged for "Jacquard" when required. They also manufacture cop-winding, spool-winding and cop-compressing machines, of similar ingenuity and value.

Electrical Units.

The International Electrical Congress held in Paris decided to make use of the centimeter, gramme and second in all electrical measurements. They will retain the practical units, "ohm" for resistance, and "volt" for electromotive force. The *intensity* of a current produced by one volt, with a resistance of one ohm, will be called one "ampère;" and the quantity of electricity given by one ampère in one second will be called a "coulomb;" the term "farad" indicates the capacity of the condenser which, laden with a volt, holds one coulomb of electricity. The old term "weber," as unit of intensity of current, will not be used.

A LARGE STEEL CONTRACT.—The contract for supplying steel for the new bridge over the Frith of Forth, Scotland, calls for 45,000 tons. This is called one of the largest orders for steel for bridge building.

BREAK IN THE HUDSON RIVER TUNNEL.

An accident occurred at the New York end of the Hudson River Tunnel, Aug. 20, which may delay the work there for ten days or more.

Men were employed laying up the brick-work lining of a 15-foot section, the iron shell of which had been completed, when a plate of the temporary bulkhead gave way and

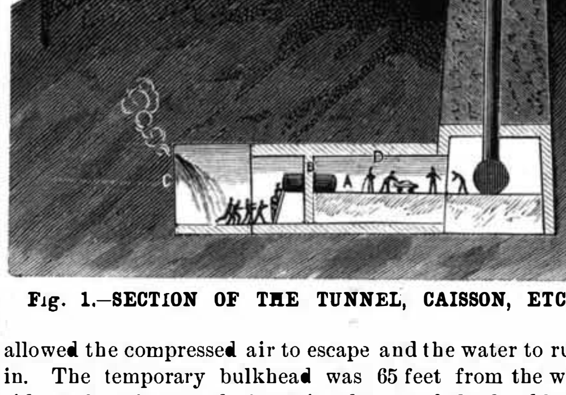

Fig. 1.—SECTION OF THE TUNNEL, CAISSON, ETC.

allowed the compressed air to escape and the water to rush in. The temporary bulkhead was 65 feet from the west side of the caisson and 20 feet in advance of the fixed bulkhead carrying the air-lock. The men had ample time to take refuge in the air-lock, and no one was hurt.

The process of working and the nature of the accident

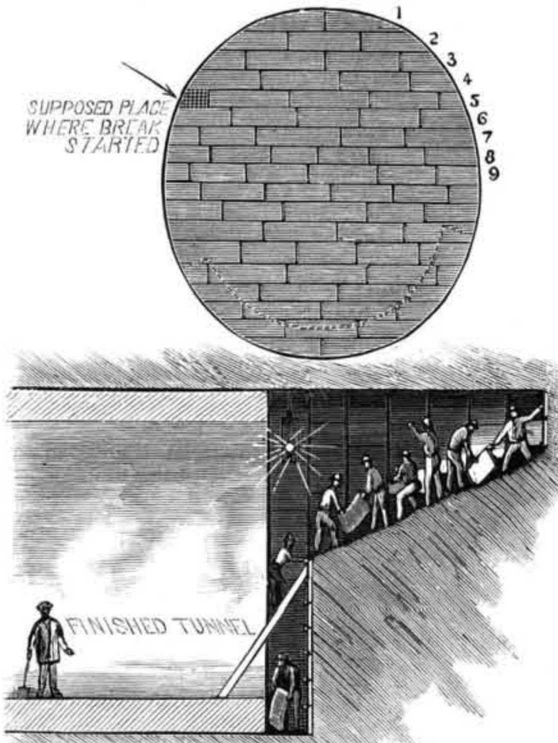

Fig. 2.—THE TEMPORARY BULKHEAD.—METHOD OF ADVANCING THE WORK.

will be clearly understood from the illustrations herewith. Owing to the loose character of the soil on this side of the river, special precautions have been taken to protect the workmen against accident, and the value of these precautions has now been amply demonstrated.

Fig. 1 shows the situation of affairs in the tunnel at the moment of the accident: B is the fixed bulkhead; A the air-lock; C the temporary bulkhead; D the finished portion of the tunnel.

The novel feature is the temporary bulkhead, a plan of which is shown in Fig. 2, the dark spot indicating the plate supposed to have first given way. This bulkhead is built up of eighteen courses of boiler plates, bolted together, and is alternately taken down and reconstructed from the top as the iron shell of the tunnel is advanced, and the earth removed. The method of proceeding is shown in Fig. 2.

The tunnel is advanced in sections of fifteen feet. A new section is entered upon by removing one of the topmost pair of plates of the forward bulkhead. The earth before it is dug out, and one plate of the iron shell of the tunnel is inserted. Then the second plate of the bulkhead is removed and a second plate of the shell is put in. The second course of bulkhead plates is then taken out plate by plate, the earth excavated, and the construction of the shell continued, both at the sides and in front, until the forward progress of the shell at the top has reached a distance of fifteen feet. Then the first course of a new bulkhead is inserted. After that, as fast as the earth is removed, the iron shell and the forward bulkhead are constructed simultaneously, until both are complete, substantially protecting the workmen against large or sudden escapes of air and inrushes of water. As the work goes on in each section, the air-pressure is gradually reduced. The highest pressure is 26½ pounds.

The iron shell of a fifteen-foot section had been completed, with the temporary bulkhead in place, two days before the accident. The bricklayers had built up the brick lining or inclosing wall of the new section of the tunnel as far as shown by the dotted lines of Fig. 2, when a hissing sound warned them of escaping air. As the air-pressure lessened water came in, and the workmen fled to the air-lock leading to the completed portion of the tunnel, closed the door, and were safe. The manner of their escape is shown in Fig. 3. It is supposed that by some neglect the marked plate in the fifth course of bulkhead plates, as shown in the plan, had been imperfectly bolted, and the defect precipitated the accident. The flooded portion of the tunnel has since been entered from the air-lock by a diver, who found the bottom of the broken section covered with sand and stones. The iron shell of the section, in front and on top, had been broken in several places, leaving considerable gaps. These breaks have been stopped by a filling of sawdust, sandbags, and other material, and the work of pumping out is now going on. New plates will be substituted for the broken ones, and the work will then go on as before.

It may be added that the New Jersey end of the tunnel is being advanced from twenty to twenty-five feet a week.


Fig. 3.—ESCAPE OF THE WORKMEN.

Earthquake in Mexico.

The severest earthquake felt in Mexico since 1864 was experienced July 19, at 2:35 P.M. The shock lasted two minutes and thirty seconds, making it one of the longest earthquakes on record. The *World's* correspondent at the City of Mexico says that the shock was felt at Cuernavaca, Iguala, Tlaxcala, Toluca, Puebla, Orizaba, Vera Cruz, Queretaro, Oaxaca, Cuautitlan, and Yautepec, so it is estimated that the shock extended over an area of 1,688 leagues.

In the capital it caused much mischief. The walls of several houses fell, a great many edifices were badly cracked, and the churches suffered greatly. In the Cathedral are several fissures in the principal vaults and a wide opening in the north wall near the entrance. The parochial church, El Sagrario, was very much cracked, as also those of San Fernando and San Salvador. In the National Palace and City Hall, and in the rooms occupied by the public archives, the walls are very badly cracked. The Mexican Railway Station also suffered. It is estimated that at least 80 per cent of the buildings in the city were more or less injured.

The water in the city fountains and that of Lake Texcoco overflowed in all directions. The earth opened in some places, and the ground sank in in others. The water pipes were broken and there was a great scarcity of water during the next forty-eight hours.

The monumental arches of the aqueduct of San Cosme and of the Salto del Agua suffered a great many fissures, from which the water flowed freely.

In Puebla nearly all the buildings were badly damaged. The inhabitants of Vera Cruz were fearfully alarmed; the shock was very strong there, and the sea roared furiously all the time. In the town of Yautepec the church and several houses fell. In Oaxaca it was accompanied by loud subterranean rumblings and caused much damage. The City of Huajuapam, in the State of Oaxaca, has nearly disappeared, as all the principal buildings, the churches, and the greater part of the private residences are in ruins; and in the thriving town of Huamantla, on the railway, very large rocks have fallen from that grand mountain, the "Malinche," causing great damage.

Fighting Field Fires with Steamers.

A threatening field fire which had been fought by a large part of the population of South Lewiston, Maine, without staying it, was subdued by a steam fire engine sent down from Lewiston. Three thousand feet of hose was used, water being taken from a brook. By saturating the mossy ground the fire was speedily stopped, though a large timbering had been burned over.

Railway Improvements Needed.

American railway practice has changed in many particulars since the last decade, and one of the results is that certain classes of accidents are more frequent than formerly. Some of these, as has been before mentioned in these columns, are the result of higher velocities and heavier trains. The increased weight of locomotives and train loads, with 20 and even 30 tons of paying load to the car, will scarcely call for any new inventions. All that is required on that account is stronger bridges and permanent way and fixtures.

But the higher velocities increase the number of collisions, and here is work for the inventor. The number of collisions of passenger trains have not increased in proportion to the increase in speed, for the reason that atmospheric and other brakes were opportunely invented; but as these brakes were not adapted to freight cars, collisions between freight and passenger and freight trains are on the increase.

The "butting" collisions average about twelve per month. Some of these are caused by bad management or disobedience of orders, and some by reason of the trains not being under control of the train men. This latter evil can be remedied by the use of a new style of brake, or perhaps the improvement of some that are now in use. "Rear" collisions are at the rate of twenty-five to forty per month, and from five to seven of these are caused by trains breaking in two, and the detached cars being in the way of trains following closely. These accidents may be prevented by safety-couplings when they are brought out. The remaining portions of these collisions, or many of them, may be avoided by obedience to orders and a better system of signals than is now in general use. We also have from one to three crossing collisions per month. The only *sure way* to prevent these disasters is for *all trains to stop* within, say, one hundred feet of the crossing, but as this rule will not be established or enforced on all roads, inventors are called upon to produce an *effective* signal for crossings.

Then we have from sixty-five to eighty derailments monthly. Many of these are caused by defect or failure of track or equipment, but from sixteen to thirty of these accidents are unexplained, that is, no cause can be assigned. Many of these derailments are of a serious nature, by reason of the locomotive and cars being upset, and here is where the inventor is wanted.

It is not expected that anything will be produced that will prevent wheels occasionally leaving the track, but something can be contrived that will act as a guard to prevent trucks straying down embankments and overturning.

The check chains in common use are a partial protection, but they are either too light to stand the shock, and break, or pull out their fastenings. It would seem that a kind of "shoe" or "runner" might be so arranged that, when the wheels drop from the rail, the runner would catch the rail and keep the wheels in line and close to the rail, and also act as a brake by friction on the rails, thereby preventing serious accidents. Something of the kind was brought out years ago, but it was poorly contrived and did not come into use. This is a matter well worth the attention of inventors.

Another class of accidents that is becoming quite frequent is "runaway locomotives." In May, of this year, three collisions and one derailment were caused by "runaways." A locomotive is standing on the track with steam up and no one aboard of her. Some car or engine collides with her and gives her a slight shock which opens the throttle, and away she goes, destroying life and property. Of course there are thumb screws and other devices for securing throttles, but they are neglected, and the results are frequently serious. What is wanted is an automatic locking arrangement that will secure the throttle when closed, and at the same time not interfere with rapid handling when doing yard work or switching.

Accidents from brake beams falling on the track are becoming quite frequent, and an improvement in the manner of hanging brakes is in order. Several accidents occur every month, except in the winter, caused by cattle on the track, the barbed wire fence being an insufficient barrier to keep them off. We want an improved pilot, one that will throw live stock to one side, and not roll them under the wheels, and the trains in the ditch.

In these sweltering days it may be refreshing to consider the fact, that snow and ice cause from twenty-five to forty serious derailments and numerous collisions every ordinary winter in the United States. We can hardly expect inventors will produce anything that will prevent collisions in time of snow blockades or blinding snow storms, but there is yet room for improvement in machinery for clearing snow and ice from railway tracks. One of the most important items connected with this work is keeping the flange-ways clear. If these are kept clear of hard snow and ice, locomotives have good footing (so to speak), and can force the big plows through almost any depth of snow. What is wanted is scrapers attached to the front of locomotive truck wheels, so that the flange-ways may be kept clear at all times. It is not forgotten that several devices for the purpose are in use, but the best of them are far from being perfect. Derailments frequently occur on roads using the best appliances for clearing tracks, by reason of packed snow or ice. Even the monster plows are often derailed, and all the rolling stock behind it. In severe winters the expense of clearing tracks is enormous, as much of it is done with pick and shovel, and the inventor who will reduce this expense will be rewarded therefor.

The open draw still continues to swallow victims from time to time, notwithstanding all that has been done to prevent these horrors. Within the last nine years twenty-eight of these accidents have been reported by the *Railroad Gazette*, and in some instances the draws were provided with the most approved signals in use. Let us have something better—an audible signal that can be relied on. In April last a freight train ran into an open draw at Peekskill, N. Y. The usual signals were displayed, but were not noticed. Had there been gongs or torpedoes placed at intervals along the track, the outer one a thousand feet or more from the draw, the engineer would have been forcibly reminded of his immediate danger, and a few dollars' worth of signals would have saved thousands of dollars' worth of property.

An occurrence similar to the above was what happened to the pay-train on the Chicago and Northwestern Road, which went through the open draw of the bridge over the North Branch of the Chicago River, in Chicago, on the morning of December 21 last. The engine went into the river, but the draw was just closing and stopped the pay-car. The conductor was drowned and the engineer badly hurt. The usual signal was displayed, but was obscured by fog and smoke. Instances are not wanting to prove that no system of signals trusting to vision alone is safe.

Even when they are not obscured by smoke or fog, and are plainly visible, engineers are liable to get confused and mistake the danger for the safety signal, as has happened on many occasions. An automatic audible signal should be placed far enough from the draw to give ample time to stop, and one placed at intervals up to the draw, for the reason that the draw might be opened after the train passed the distant signal which was at safety, and gave no warning of dangers. It is hardly worth while to mention the fact, that we have an average of seventeen locomotive boiler explosions per annum, for inventors can do but little to prevent this class of accidents under the reckless management the boilers too often receive. Similar remarks will apply to the forty-four failures of bridges and trestles that occurred in 1881. However, if inventors cannot prevent all of these accidents, if they can diminish their number by some improved method of strengthening boilers and bridges, they will be deserving of both thanks and liberal compensation.

Some Uses of Paraffin.

There is no substance of organic origin which displays such an indifference toward chemical reagents as paraffin, as at ordinary temperatures it is quite unaffected by strong nitric acid, sulphuric acid, or chlorine. Paraffin is a name applied by chemists to an extensive series of hydrocarbons, each one possessing a chemical composition corresponding to the general formula C_nH_{2n+2}, and ranging in physical condition from the gaseous state to the harder kind of paraffin wax, which melts at about 140° F.

The solid paraffin, or paraffin-wax, is, however, the form of this substance which is likely to do most service to the photographer or the photographic experimentalist. This substance is found ready formed in nature to a considerable extent, either occurring as crystalline granules, interspersed through earthy matters, as in the case of the so-called fossil wax or ozokerit; while Rangoon tar and analogous bituminous exudations contain abundance of paraffin wax. The principal commercial source, however, of solid paraffin is mineral ore, the distillate being subsequently fractionated, and the heavy portions refined by treatment with sulphuric acid and crystallization from exceedingly light paraffin or benzoline oil.

The best qualities of commercial paraffin wax melt at about 140° F., and consist principally of a hydrocarbon containing $C_{30}H_{62}$, and such a product is excellently well adapted as a waterproofing material for wood-work, paper, and textile fabrics, as no trace of oily exudation tends to separate from it. A well-made wooden box, if soaked for half an hour in such paraffin heated to about 300° F., becomes so thoroughly saturated as to become a tank fitted for any photographic purpose not involving the use of hot liquids, and we have long had such a box in use to contain an electrotyping bath. It is well not to use nails in putting such a bath together, but either to dovetail or dowel the work. Paraffined wooden boxes made in a similar way are excellently well adapted for containing the nitrate of silver bath and other solutions which are easily injured by foreign matter.

A friend of ours, who had to send some dry plates to the Antipodes, wrapped the boxes carefully in paper which was well gummed at the folds, and, when the gum was dry, he dipped each package for an instant in a bath of paraffin maintained near its point of solidification. The plates thus protected arrived in better condition than others which were wrapped in lead-foil. This reminds us of the way in which ingots of sodium are sent into the market. Each ingot is dipped into melted paraffin wax, and this so far protects the metal from oxidation that the coated ingots may be kept in an ordinary tin canister. Something of the same kind was attempted a few years ago with joints of meat; but it was found that the covering of paraffin was liable to become broken during the voyage from Australia.

The use of paraffin as a substitute for wax in rendering prints transparent was referred to in our columns some weeks ago, and our readers were cautioned against employing samples containing oily or viscous constituents. We have found that paraffin may replace white wax in the so-called encaustic paste used for facing albumen prints, and it is quite possible that it may prove a more effectual protective against damp than ordinary beeswax.

Stenhouse's method of waterproofing paper, cloth, and other textile fabrics with paraffin is of great practical value, and, as Dr. Nicol pointed out in our Year Book for 1876, admirable temporary dishes may be made from paraffined paper, the edges of the sheet being folded up, or kept in position either by pins or a light frame of wood. Dr. Nicol also mentions that friction with paraffin wax is an excellent preliminary to coating a plate with collodion for the wet process. The plate is warmed so as to be a few degrees above the melting point of paraffin, after which it is rubbed over with a lump of the solid material, and the excess is polished off with a warm flannel. We have tried this, and found it to yield excellent results, the collodion adhering well during the development and washing; but when dry it can readily be stripped from the glass should a reversed negative be desired. The paraffin forms a chemically clean substratum, and covers up many impurities on the plate, rendering these impurities harmless. Paraffin has one decided advantage over albumen as a substratum; namely, that of not working the slightest mischief to the nitrate of silver bath.

Instead of employing a lump of solid paraffin and warming the glass, a twenty-grain solution in benzole may be used, this being merely poured on the cold plate, and all excess polished off, as in the previous case.—*Photo. News.*

Curious Habits of Ants.

Sir John Lubbock's extraordinary book on "Ants, Bees, and Wasps" will amaze readers. Fancy ants having slaves! Fancy these proverbial examples to the sluggard keeping certain insects as we keep cows, and building sheds over them, and keeping others as pets! The aristocracy of ants seem to have all the vices which brought antique monarchies to destruction. Sir John writes soberly, as a philosopher should, and weighs his words no doubt, which makes his conclusions the more astonishing. The author quotes some of Huber's experiments, the value of which he has himself tested. The bloated ant aristocrats, it is said, "have lost the greater part of their instincts; their art, that is, the power of building; their domestic habits, for they show no care for their young, all this being done by the slaves; their industry, for they take no part in providing the daily supplies; if the colony changes the situation of its nest, the masters are all carried by the slaves on their backs to the new one; nay, they have even lost the habit of feeding. Huber placed thirty of them with some larvæ and pupæ and a supply of honey in a box. 'At first,' he says, 'they appeared to pay some little attention to the larvæ; they carried them here and there, but presently replaced them. More than one-half of the Amazons died of hunger in less than two days. They had not even traced out a dwelling; and the few ants still in existence were languid and without strength. I commiserated their condition, and gave them one of their black companions. This individual, unassisted, established order, formed a chamber in the earth, gathered together the larvæ, extricated several young ants that were ready to quit the condition of pupæ, and preserved the life of the remaining Amazons.' This observation has been fully confirmed by other naturalists. However small the prison, however large the quantity of food, these stupid creatures will starve in the midst of plenty rather than feed themselves. . . . I have, however, kept isolated specimens for three months by giving them a slave for an hour or two a day to clean and feed them; under these circumstances they remained in perfect health, while, but for the slaves, they would have perished in two or three days."

Some Large Lenses.

The thirty-inch objective for the great telescope of the Russian Observatory at Pulkova was lately tested at the establishment of the grinders, the Clarks, of Cambridgeport, Mass., and found to be fairly perfect. The flaw discovered before the grinding, due to imperfect cooling, has no effect on the definition, but lessens slightly the amount of light transmitted. The flaw is too slight to injure materially the efficiency of the lens, yet another block of glass, of the same size, has been ordered to be placed at the disposal of Professor Struve. For testing, the lens is mounted in a temporary telescope, forty-five feet long, and weighing, with its fittings, about seven tons. The lens weighs 450 pounds, will cost when finished $60,000, and will be for a little while the largest in the world.

The largest object-glass in use is the 26-inch lens at Washington, with a focal length of 33 feet. Its light-gathering power is 16,000 times that of the unaided eye.

The Pulkova glass will soon be excelled by that of the Lick telescope, the disk of glass for which is now in the establishment of the Clarks. It is 38 inches in diameter and 2 inches thick. When ground and polished it will be reduced to 36 inches. This glass is optically perfect. It was cast at Paris, France, where the Pulkova glass was, and weighs a little over 374 pounds. The casting occupied four days and the cooling thirty days.

A Large Tunnel.

The famous antique tunnel of Posilipo has a rival in a railway tunnel under Posilipo, between Naples and Puteoli, completed August 5. The new tunnel which brings into direct connection the modern representatives of the ancient cities of Neapolis and Puteoli, is over 30 feet wide by 36 feet high, and is said to be the largest modern tunnel in Europe.