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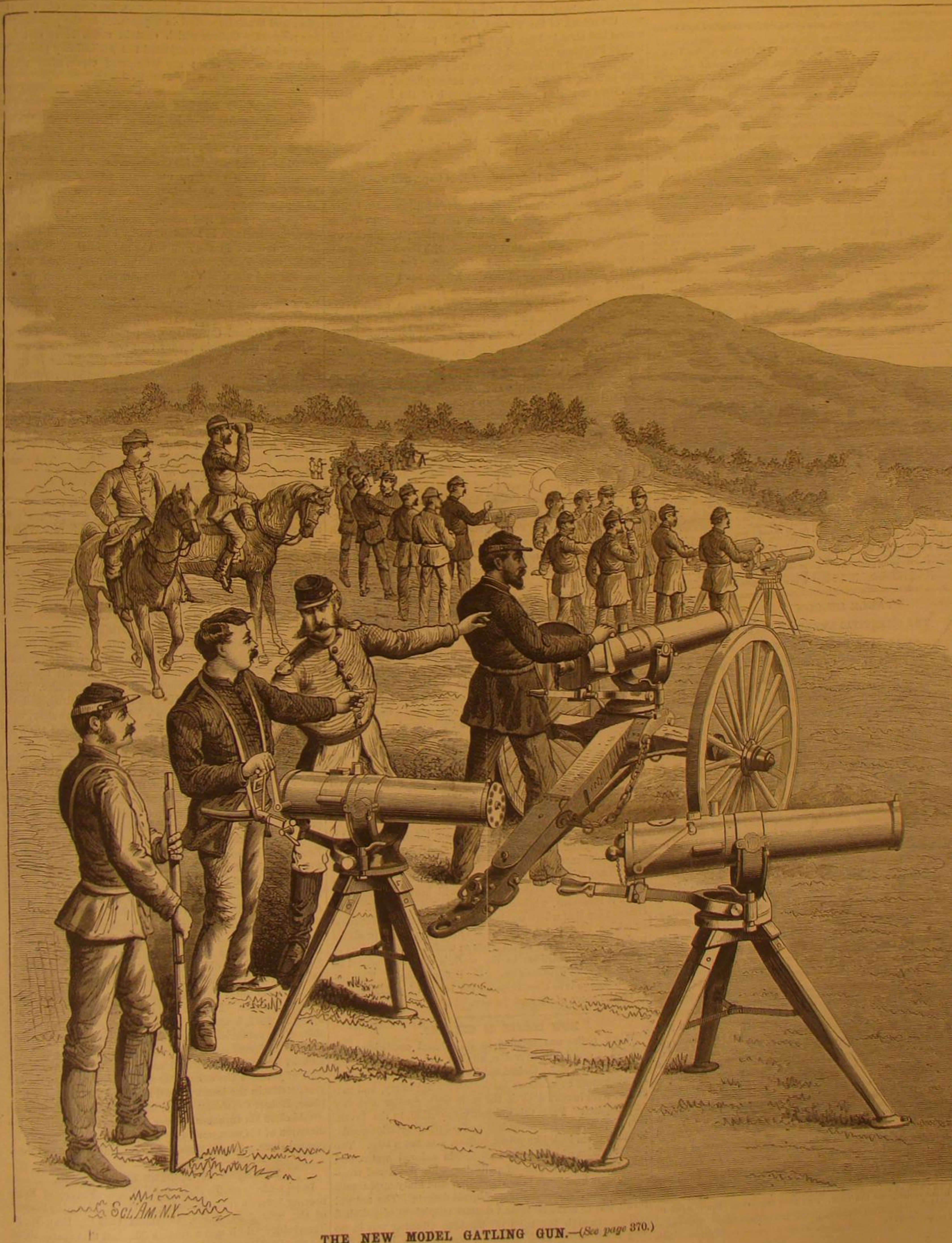

THE NEW MODEL GATLING GUN.—(See page 370.)

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 180,

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OPENING OF THE NORTHEAST PASSAGE.

Another great geographical problem has been settled by the successful passage of Professor Nordenskjold's expedition through the Arctic Sea to the north of Siberia. A telegraphic dispatch from St. Petersburg, dated May 27, states that the Governor of Yakutsk, Eastern Siberia, has received intelligence from the Vega to May 3, and a later dispatch from Irkutsk reports the safe arrival of the vessel in Behring's Straits. All the members of the expedition were well. Before this account reaches the reader the Vega will be on her way to Europe by way of the Suez Canal.

This expedition, which has thus crowned with successful accomplishment the belief of Professor Nordenskjold that a route to Asia might be found to the north of Siberia, sailed from Gothenburg, July 4, 1878, and arrived at Port Dixon, near the mouth of the Yenisei, August 6. This part of the course had already been proved to be passable at midsummer by Professor Nordenskjold's previous expeditions. The next important achievement was the rounding of the north cape of Asia, a feat never before accomplished, and on the 27th the expedition reached the mouth of the Lena. Here the two vessels parted company, the little steamer bearing the name of the Lena ascending that river, the Vega proceeding eastward, hoping to reach Behring's Straits before the autumn ice drifts should bar the passage. In this Professor Nordenskjold was disappointed, for the Vega became ice bound when within forty miles of East Cape, and was obliged to spend the winter there.

It is safe to anticipate a considerable addition to our knowledge of the Siberian seas when the results of Professor Nordenskjold's observations are made public; the plucky explorer has won a name that will rank with those of the greatest navigators; but there are grave reasons for doubting the fulfillment of his hopes of making known a practicable commercial route through the Arctic Sea from Europe to Asia. The season of open water along the Siberian coast is too brief and uncertain, and the risks are too great, to tempt many to undertake the northern passage, notwithstanding the saving in distance.

ANOTHER OBJECTION TO THE LICENSE SYSTEM.

One of the worst features of the recently defeated bill for the destruction of the American patent system was that introducing the compulsory license system or its equivalent. The unconstitutional nature of the proposed invasion of the inventor's exclusive right to control a patented invention was sufficiently exhibited in these columns last winter. The matter might be allowed to rest with the victory gained at that time, did not the opponents of inventors' rights threaten to bring it again before Congress at the earliest opportunity. In view of this fact it will pay to make a note of an objection to the license system recently urged by an English writer against a similar provision in the bill now before an English Parliamentary committee—an objection which we do not remember to have seen before. It may be useful some time.

The bill referred to contains a section which compels the patentee to grant licenses to manufacture or use his invention on such terms as the Lord Chancellor for the time being may consider fair. To this provision there can be urged no constitutional objection, as there might in this country; accordingly it is attacked solely on the score of bad policy. It is shown that it puts it entirely within the power of the Lord Chancellor to fix the value of patents of whose intrinsic value he is likely to know nothing. But worse than that, it puts it within the power of wealthy manufacturers to kill any invention that they may fear. Thus the moment a threatening improvement appears—threatening, that is, to inferior manufactures—the makers of the latter may demand a license to manufacture the new article, which they will proceed to do in the worst possible way, placing the new invention upon the market beside their own better made but intrinsically inferior products.

The public, finding the new invention inferior to the old, will be prejudiced against it, and the poor inventor will be unable to counteract the injustice. The products made in accordance with his invention may be the vilest caricatures of what he would make, yet they will bear his name and make it infamous, while he is unable to help himself. The chances are that where one inventor would willfully suppress or ask an exorbitant price for his invention or its products under the present system, a score of useful improvements or radically new additions to the world's resources would be stamped out of existence under the license system. The proposed change is as obnoxious on the score of public policy as on the score of abstract justice.

HOW COFFEE IS CLEANED.

When coffee was retailed in its natural condition, and roasted in small lots over the kitchen fire, imperfect beans and impurities were picked out by hand. With wholesale roasting more expeditious methods were necessary, and machines were invented to do the work with greater economy and dispatch. From this necessary operation, to the invention of processes for polishing and coloring inferior goods, to make them look like prime coffees, was but a step. The poorer grades of coffee were washed in colored water, and then treated to a course of polishing with powdered soapstone, which gave the beans the glossy and flinty appearance of first rate coffee and covered up all defects. The natural result was to make all honest dealers suspicious of polished coffees, though the need of machine cleaning was in no way diminished. It is possible, however, to have coffee cleaned and polished by machinery and at the same time be honest.

By this process the coffee is put into a large cylinder capable of holding eight or nine hundred pounds, the cylinder being lined with heavy linen and provided with cleats to increase the friction, when the beans are set in motion by the rapid revolution of the cylinder. At one end of the cylinder are a number of holes to admit air, and at the other a suction fan making about two thousand revolutions a minute. The friction loosens the dust and the outer covering of the coffee, which impurities are carried away by the air current set in motion by the fan. After ten or fifteen minutes of this treatment the coffee is wet with pure water and the machine again set in motion. The coffee is thus washed, and after half an hour's scouring comes out entirely clean and much improved in appearance by the polishing it has received. Coffees which contain much loose dirt and many broken beans are subjected to a preliminary process in which the perfect beans are winnowed clean, after which they are treated as already described.

ROBERT CRAWSHAY.

Robert Crawshay, the iron king of Merthyr Tydfil, Wales, died at Cheltenham, England, May 10. The London correspondent of the *Times* tells at great length the story of the foundation and wonderful development of the vast establishment which grew up under the wise management of Robert Crawshay, his father, William Crawshay, and his uncle, Richard Crawshay.

The last named had already acquired a fortune in the hardware business in London, when he purchased the controlling interest in the iron works at Cyfarthfa, in the vale of Merthyr Tydfil. Soon after, by the retirement of one partner and the death of the other, Mr. Crawshay became sole proprietor. This was about the time of the American Revolution and the beginning of England's rapid industrial development.

While Richard Crawshay was pushing his works along, he heard that a certain Henry Cort was working a new process of puddling iron, at some small foundry near Gosport. Crawshay went there, approved of the method, returned to Cyfarthfa, and built works both for puddling and rolling on Cort's plan, paying the patentee 10 shillings for every ton of iron turned out under his process. Among other improvements and extensions of the works, Richard Crawshay erected a water wheel 50 feet in diameter, 80½ feet in breadth, with a weight of gudgeon of 100 tons. The magazines and scientific papers of the time described the wheel as one of the modern wonders of the world. It was made by a local engineer named Watkin George. It used 25 tons of water per minute. The remains of this giant of the past may still be seen on the Taff. Crawshay gave this Watkin George a share in the works—a partnership in those days was more easily managed than it is now, when money is considered more than brains—to extend over a period. When George went out, some dozen years afterward, in addition to salary, he received his share of $500,000 profits. Mr. Crawshay took in other partners at various times, and at his death the disposition of the Cyfarthfa Works was three-eighths to Benjamin Hall, two-eighths to Joseph Bailey. Richard Crawshay died worth £1,500,000, a fortune far short of that made by his nephew, who, besides his Cyfarthfa interests, had vast iron properties in Monmouthshire. When Richard Crawshay died, Hall and Bailey retired, and the works came into the possession of William Crawshay, who, with Sir Joseph Bailey, had practically managed them for several years.

Under this new iron king, who had a genius for invention, Cyfarthfa advanced with gigantic strides. In 1819 it numbered 6 blast furnaces, and in that year produced 11,000 tons of pig iron and 612,000 tons of bars. In 1821 it turned out more of these manufactures than the three kingdoms put together had done between the years 1740 and 1750, and fully half the total yield of all Great Britain so late as 1788. From 1817 to 1840, the Glanmorganshire Canal, which the first Crawshay had started, carried from Cyfarthfa 613,144 tons of puddled iron. The most important of the rolling mills was erected in 1846, designed by William Williams. Attached were 18 boiling furnaces and 20 puddling furnaces, which, in March, 1847, turned out 6,144 tons of rails, and in the same month the largest bar of iron possibly ever made. It measured 27 feet long and 6½ in diameter, and weighed 2,941 tons. In his old age, William Crawshay retired to his seat at Caversham Park, near Reading, on the Thames, having, however, built Cyfarthfa Castle, a magnificent residence near the works. He left his son, Robert, in charge, and dying in 1867, bequeathed him all his property, which, besides other valuables in lands and gold, including Cyfarthfa, with its 11 furnaces—7 at Cyfarthfa proper and 4 at Ynysfach—7 ironstone pits, and 8 coal pits. The estimated fortune of William Crawshay was £35,000,000. When the last great strike in the iron and coal trades of South Wales took place, Robert Crawshay closed his works, declaring that he would close his furnaces forever sooner than submit to the dictation of his men, and they have only been partially reopened since. At one time the works employed 5,000 men.

TRIUMPHS OF MODERN ENGINEERING.

In an address on the Past, Present, and Future of Engineering before a recent meeting of the Engineering Society of the School of Mines, Columbia College, Prof. W. P. Trowbridge said it was a remarkable fact that nearly all of the great achievements in engineering had been accomplished during the present generation, and it made him feel very old when he reflected that the first locomotive was constructed within his own time and memory. He well remembered his first trip from Detroit to Buffalo by steam. At that time there were no railroads beyond Buffalo, but a steamboat made the trip from Detroit to Buffalo in three days, which was considered to be "remarkably fast time."

The first trip by steamboat up the Hudson to Albany was made by the Clermont in 1807, the time being twenty-five hours. Four years later the Comet, a vessel 40 feet long, was built in England for the navigation of the Clyde. At that time the railroad and the locomotive were as much beyond human conjecture as any unknown achievement of the future was beyond our thoughts to-day. It seemed almost impossible that in those recent times tallow candles and whale oil furnished our lights, and that waterworks and other sanitary aids were unknown luxuries. The carpenter, the millwright, the stonemason, and the government surveyor were the engineers of the day. Steam navigation on the ocean was a problem of the future. The changes which had taken place during the past thirty-five years had been as rapid as they were marvelous. In 1830 there were only 23 miles of railway in the United States. In 1874, 69,273 miles had been completed, and including the two continents of Europe and America there had been built, in the same short interval, 125,000 miles of road.

Forty years ago the ocean steamship, with its side lever engines, its jet condenser, and its inefficient boiler, could scarcely carry coal enough for a voyage across the Atlantic. Now the iron hull, the screw propeller, the compound engine, the surface condensers, the high pressure boiler, the steam hoisting engines for loading and unloading freight, had converted the Atlantic navigation from the Eastern to the Western Continent into an extended ferry so far as the certainty and regularity of trips were concerned. Old merchants who began business forty years ago found it almost impossible to keep up with the age and adapt themselves to the wonderful changes which succeeded each other so rapidly. Twenty-five years ago, when Prof. Trowbridge was in California, the people there calculated that by the year 1880 they would have a railroad across the continent. Ten years later one road had been completed and two more were under way, both of which would soon be completed.

A gigantic contest had been and still was going on between man and the elements. With the aid of Ericsson's screw propeller, the iron hull, and the magnificent steam machinery of the present day—the work of men still living—the storms and waves of the ocean had been conquered and no steamship ever altered her course even to avoid a hurricane. There had also been a great contest on land. The railroad engineer had fought manfully and achieved great triumphs, although his battles were not yet ended. In piercing tunnels and ascending mountains he had attempted and accomplished feats unknown before to his art. He had brought to his use new explosives, electricity, the diamond and steam drill, and the strength of iron and steel in place of that of wood and stone.

Prof. Trowbridge then described the advances which have been made in military engineering. The result of the improvements in the art of attack and defense was that the wars of to-day were short and sharp, and fewer men were killed. Krupp's monster steel gun, weighing 50 tons and throwing a shot of 1,200 pounds with a charge of 170 pounds of powder, was the last and most formidable advance on the side of attack, but in the torpedo it found a deadly enemy which had come to the rescue of the side of defense.

Young engineers just starting out in the profession might think that there was nothing left for them to do except to copy the works of their predecessors, but if they allowed themselves to be discouraged by such an idea they made a great mistake. The field was as large as ever, perhaps larger. Sanitary engineering was only in its infancy, and there was no doubt that great changes were to be made in the manner of building railroads. It was a well known fact that under the present conditions a dead weight of about two and a half tons had to be drawn over the road for every passenger carried. This was certainly wrong and must be remedied. Four years ago the matter was very fully discussed in England, and the best engineer there concluded that there was no remedy. But the question was, nevertheless, an open one. Perhaps the elevated railroads which had risen like magic in the streets of New York would be the beginning of a solution of the problem. The demands of the future would be for faster travel at cheaper rates.

If any one said that there was no longer much work for educated engineers they had but to go to the top of the building (the School of Mines) and look about them. From that lookout they would see no less than half a dozen great feats in engineering going on before their eyes. He referred to the Brooklyn Bridge, the works at Hell Gate, the elevated railroads, the Harlem River improvement, the tunnel under the Hudson River, and the projected bridge over the East River at Blackwell's Island, with a span the longest in the world.

New York Steam Fire Engines.

The Fire Department of New York has, in daily use, forty-two steam fire engines, besides the steam fire boat, W. F. Havemeyer. Six of the engines are self propellers. Under favorable circumstances the best steamers can throw a horizontal stream 250 feet. The extreme height to which water has been thrown is 150 feet. The average height to which the stream is thrown on ordinary duty is 60 feet.

Each fire company costs about $14,000 a year, which sum includes the pay of officers and men, repairs to building, apparatus, etc. During 1878, the engines were employed 832 hours, each throwing on an average 16,000 gallons an hour, or over 16,000,000 gallons in all. The number of fires during the year was 1655.

MOLECULAR CHEMISTRY.—NO. III.

From the definition of a molecular volume given in our last paper, it follows directly that the volumes of all gaseous molecules taken at the same temperature and pressure are equal. They must be equally distant from one another, or else they would not expand equally when subjected to the same degree of heat. We may conclude, then, that water vapor is made up of molecules of hydrogen and oxygen, all having the same size.

Now, what happens when this water vapor is condensed to form liquid water, or, still further, to form ice? Are all the molecules condensed equally or unequally? Or does the condensation fall only upon one constituent?

According to Herrmann Kopp, there are temperatures at which liquids and solids are also equally affected by heat, and have therefore the same number of molecules in equal volumes. Calculations are made as follows: Calling the density of a water molecule at 0° C. unity, and its equivalent weight 18, the volume it occupies at that temperature is found by dividing the latter by the former: $\frac{18}{1} = 18$. The weight of a body being the product of its density by its size or volume, or $W = D \times V$, we have also $V = \frac{W}{D}$. Of course its volume will be greater at a higher temperature; hence the first point to be settled was: at what temperature must we make our comparisons? Kopp believed himself warranted in fixing upon the boiling points of liquids as the proper temperatures at which their densities should be compared, because, in the first place, there appears to be a close connection between the chemical composition of many liquids and the temperatures at which they boil. In numerous organic liquids, for example, whose composition differs by CH_2, the boiling points differ by 19°. Thus: alcohol C_2H_6O boils at 78°, propylic alcohol $C_2H_6O + CH_2$ boils at 78° + 19°, etc.

Again, he argued, regarding alcohol as made up of the elements of ether and of water, the volumes of the latter added together at the proper temperatures should be equal to the volume of alcohol computed from its density and equivalent. Selecting density determinations at random without regard to temperature, the results will be found discordant:

Ether $C_4H_{10}O$,	equivalent 74,	density at	12·5° = ·724,	volume	102
Water H_2O	" 18,	"	0° = 1·000	"	1
			Sum		103
Alcohol 2 (C_2H_6O)	" 92,	"	17·8° = ·792,	"	116

When, however, the densities are all taken at temperatures at which the tension of their vapors is the same—one of which is the boiling point—the results agree exactly:

Ether vapor has a tension of	·313 m. at 16°, volume	108 −
Water " " "	·313 m. at 77°, "	19 +
	Sum	127
Alcohol " " "	·313 m. at 57°, "	127

As we cannot accurately determine the density of a boiling liquid, Kopp was obliged to study the rate of expansion of liquids some distance below their boiling points, and calculate what their density would be, if they continued to expand at the same rate. The boiling point of a liquid may be regarded as that temperature at which its vapor has acquired sufficient tension to overcome the pressure of the atmosphere; and of course this tension is the same for all liquids boiling under the same barometric pressure. According to this view, temperatures other than the boiling points might also be chosen for a comparison of densities, provided the tension of the vapors is the same.

In the third place, Kopp found that isomeric liquids, *i. e.*, such as have very different properties, but are of the same chemical composition, and belong to the same group of bodies, have, as a rule, equal volumes at their boiling points.

Having thus, as he believed, sufficient reasons for selecting the boiling points of liquids as the proper temperatures at which to compare their densities, the question presented itself: If the specific volume of the water molecule at 0° is 18, as we have seen above, and this figure represents the sum of the volumes that $H_2 + O$ occupy in water, how much of it belongs to H_2, and how much to O? The answer to this question involved the study of an immense number of bodies, and was finally announced as the result of the following reasoning:

1. Two molecules of hydrogen may be replaced in organic liquids by one of oxygen without sensibly changing the volume. For example:

Ether	$C_4H_{10}O$ has a volume of	105·6 — 106·4
Butyric acid	$C_4H_8O_2$ " "	106·4 — 107·8
Ethyl acetate	$C_4H_8O_2$ " "	107·4 — 107·8
Acetic acid anhydrous	$C_4H_6O_3$ " "	109·9 — 110·1

It should be noticed, however, that there is here a slight increase of volume with each substitution.

2. Two molecules of hydrogen may be similarly replaced by one of carbon:

Benzoic acid	$C_7H_6O_2$ has a volume of	126·9
Valerianic acid	$C_5H_{10}O_2$ " "	130·2 — 131·2
Methyl butyrate	$C_5H_{10}O_2$ " "	125·7 — 127·3
Ethyl propionate	$C_5H_{10}O_2$ " "	125·8

3. In series whose composition progresses by increments of CH_2, the volumes increase by about 22:

CH_4O	has a volume of	41·9 — 42·9
C_2H_6O	" "	61·8 — 62·5
$C_6H_{14}O$	" "	123·6 — 124·4

The above are only a few selected out of a large number of examples given by Kopp to illustrate these three fundamental points.

Now, as CH_2 represents an increase in volume of 22, and as $C = H_2$, from the fact that it can replace H_2 without change of volume, it follows that the volume of C is 11, and that of H is 5·5, in the above compounds. $CH_2 = 11 + 2 \times 5·5 = 22$.

With this starting point, we can obtain the volume that oxygen occupies in water. The volume of water H_2O at its boiling point is 18·8. Subtracting the volume of the hydrogen, $H_2 = 2 \times 5·5 = 11$ from 18·8 we have left for oxygen 7·8.

When, however, oxgen is a constituent of a group of elements that enters into combination as a whole, and resembles an element in its characteristics, the volume just found will not fit. For such groups, or radicals as they are called, other values have to be sought, or else the sum of the volumes of the components will be either greater or less than the volume of the compound. Thus, in the case of aldehyde, the oxygen volume is as high as 12·2.

In 45 organic liquids containing only carbon, hydrogen, and oxygen in various proportions, the volumes computed by Kopp, according to the above figures, did not differ from those found experimentally and reduced to their boiling points by more than 4 per cent, which, he remarks, is within the limits of accuracy for such experiments. Considering these figures established, Kopp extended his investigations to substances, in which elements having ascertained volumes are combined with other elements whose volumes he wished to discover. He found the following figures: chlorine, 22·8; bromine, 27·8; iodine, 37·5; sulphur in a radical, 28·6; without, 22·6. Nitrogen assumes three widely differing values: 2·3 in aniline, etc.; 8·6 in nitrous acid; and 17·0 in ammonia. From this he concludes that the same element does not preserve a fixed volume in all its compounds.

Nearly 100 liquid compounds, containing the above elements in different proportions, have been tabulated by Kopp, in which the molecular volumes, computed by adding up the volumes of the constituents, agree closely with the volumes of the compounds found by dividing the molecular weights of the latter by the densities corresponding to their boiling points.

From this list of substances various groups may be selected, the members of which have molecules whose volumes add up to the same figure, notwithstanding great differences of composition. Hence we have in each group liquids which, when compared at their boiling points, follow the same law as gases, for they have the same number of molecules in equal volumes.

In the case of solids the alums are a noteworthy class of compounds, in which similarity of composition and identity of crystalline form are accompanied by a close agreement in molecular volume; but there are, on the other hand, numerous compounds in which, under like conditions, there is a wide dissimilarity of molecular volume, as, for example, in the case of the chlorides of sodium and potassium.

In our next paper we shall examine what other investigators have accomplished in the field opened by the laborious researches of Kopp. C. F. K.

The Advantage of Cheap Patents.

The Philadelphia *Public Ledger* remarks that although the patent right system has been in operation for many years, there is still a strong disposition not to recognize the property rights of individuals in ideas embodied in new inventions, and quite recently an attempt has been made to modify the patent laws in the direction of making patents very costly and difficult to obtain. Without entering into the general question as to what changes in the law, if any, are desirable, it is worth while to remark that *The Machinery Market* and other English trade papers ascribe our successful competition in manufacture to the influence of our patent laws in stimulating inventions. Mr. Thomas Brassey, several years ago, warned the British workman that he had "more to fear from the highly paid labor of America, which brought labor saving machinery and mechanical skill to such a degree of perfection, than from the lower wages of the continent of Europe." It costs fully ten times as much for a patent in England as in this country, and therein we have a great advantage. It is true that many patents are issued for useless or valueless inventions, but even the failures stimulate the invention of better devices, and the general result of encouraging inventors and inventions is that machinery is carried to a higher degree of superiority here than in any nation of Europe, and better machinery enables us to compete even where we are under commercial disadvantages as to the cost of raw materials, wages, etc.

Black Polish on Iron and Steel.

To obtain that beautiful deep black polish on iron or steel which is so much sought after, it is required to boil one part of sulphur in ten parts of oil of turpentine, the product of which is a brown sulphuric oil of disagreeable smell. This should be put on the outside as slightly as possible, and heated over a spirit lamp till the required black polish is obtained.

"Many Mickles Make a Muckle."

According to the calculation of Mr. G. T. C. Bartley, an ounce of bread wasted daily in each household in England and Wales is equal to 25,000,000 quartern loaves, the produce of 30,000 acres of wheat, and enough to feast annually 100,000 people. An ounce of meat wasted is equal to 300,000 sheep.

THE GATLING GUN.

Among the many important and valuable inventions in firearms, of which the present century has been prolific, there is none that equals the Gatling gun in originality of design, rapidity of fire, and effectiveness. The severest tests and trials, and its practical use in warfare, have indisputably established its high reputation as a most formidable death dealing weapon.

The main features of the gun may be summed up as follows: It has usually five or ten barrels, each barrel having its corresponding lock. The barrels and locks revolve together; but in addition to this action, the locks have a forward and backward motion of their own. The forward motion places the cartridges in the chambers of the barrels and closes the breech at the time of each discharge, while the backward motion extracts the empty cartridge cases after firing. The gun can be fired only when the barrels are in motion from left to right; thus as long as the gun is revolved and fed with cartridges, the several operations of loading, firing, and extracting are carried on automatically, uniformly, and continuously. The gun is supplied from feed cases (containing forty cartridges each) which fit into a hopper communicating with the chambers; as soon as one case is emptied another takes its place, and thus continuous firing is kept up at the rate of over one thousand shots per minute.

We believe the Gatling is the only firearm in the world in which the three sets of parts, namely, barrels, locks, and inner breech, all revolve. Having the barrels, locks, and inner breech to revolve simultaneously, enables the gun to be loaded and fired rapidly and continuously, while under revolution, and without producing recoil to destroy its accuracy.

That the gun is simple and durable is evidenced by the fact that one hundred thousand cartridges have been fired from it without injury to any of its parts. The Gatling guns represented in our illustration on first page are supplied with the new elevating and ranging fixture, which enables the operator to instantly elevate, depress, or traverse the gun, so as to keep it pointed at movable objects while being fired. The gun has not only been recently greatly improved, but its ammunition also, so that now its rate of fire is over 1,000 shots per minute. There are a number of these guns with the British forces in South Africa, and in several engagements with the Zulus they have done most efficient service. Lord Chelmsford in his official dispatch, dated Durbau, April 10, says, in speaking of an attack made on the column sent to relieve Colonel Pearson, at Ekowe: "The Gatling gun was of considerable value at this period of the defense." The London *Standard* of May 7th publishes an account of the battle of Gingihlovo, from which we take the following extract: "It was no use offering mercy to the Zulus. The wounded, as our men came up, fought on to the last, firing their rifles, stabbing with their assegais, and even seizing the natives as they passed over them with their teeth, biting like dogs, so, in spite of the efforts of our officers, they were all cut down. When all was over and we counted the dead, there lay, within a radius of 500 yards, 473 Zulus. They lay in groups in some places, of from 14 to 30, dead, mowed down by the fire of the Gatling, which tells upon them more than the fire of the rifles."

The new fixture for mounting Gatling guns can be used on gun carriage, tripod, gunwale, or tops of ships, or in the bow of a small boat.

Fig. 2 of the accompanying engravings shows elevation of top swivel with gun resting thereon, also lever. Fig. 3 is a plan of swivel and lever without gun.

This fixture supplies the place of the elevating screw and oscillator formerly used. It consists of fewer pieces, and is simpler than the screw and oscillator. With it the gunner has better and more instant control of his piece. The gun being well balanced on the fixture, the gunner controls the movement of the piece with his left hand, using his right to turn the crank. The gun rests with its trunnions in the trunnion boxes, *a*, which are supported by the swivel, A. The caps, *a'*, of these trunnion boxes are held by an improved device, *b*, which prevents the accidental opening of the boxes, as in other styles, with keys which may fall out. The lower part of the swivel, A, fits the bed plate of gun carriage, tripod, etc., so that the gun and swivel can be quickly changed from carriage to tripod, or to the gunwale of a ship, or elsewhere, and be held firmly in place by the binder, B. To the lower part of the swivel, A, is pivoted the forked lever, L, which extends under the rear of the breech of the gun, being united with the gun by the sliding box, D, which is held between two lugs on the lower side of the breech by the pivot bolt, *d*. This box fits on the lever, L, so as to slide back when lever and breech of gun are raised, and forward when they are lowered.

Under the lower side of the lever, L, there is a key or wedge, F, which is tapered so that its lower surface is always parallel to the upper side of lever, L, but on sliding it forward the height of the lever, L, is increased, and the sliding box, D, is fastened. The screw, G, working through the side of the box, D, against the lever, L, serves as a second absolute fastening of box, D, on lever, L. On the end of the lever, L, is pivoted, at *e'*, the handle, E, so that when depressed its lower part pushes the key, F, forward and tightens the slide, D. When the lever, E, is raised it pulls the wedge, F, back and loosens the slide, D. The handle, E, clasps a round lug, *f*, on the lower rear end of the wedge, F. The spring, *e*, serves to press the handle, E, downward. In operation the loosening of binder, B, allows the gun when on the carriage a lateral sweep of 90°, by means of lever, L, which is grasped at E with the left hand while the right hand turns the crank. On tripod or gunwale the gun can be swept around the full circle, or 360°. After loosening the screw, G, the gun can be raised or lowered, as a pressure under the handle, E, loosens the box, D. The breech can be raised 30° and lowered 15°, total 45°. By removing the hand at any desired point the spring fastens the gun, or the handle can be pressed down.

For more absolute security when at target shooting, or when a certain aim must be retained, the screw, G, is fastened. Both binder, B, and screw, G, are used to secure the gun when traveling on the carriage. By means of this fixture a man may follow moving objects with an accurate fire, or also shoot from the deck or tops of a vessel when rocking at sea.

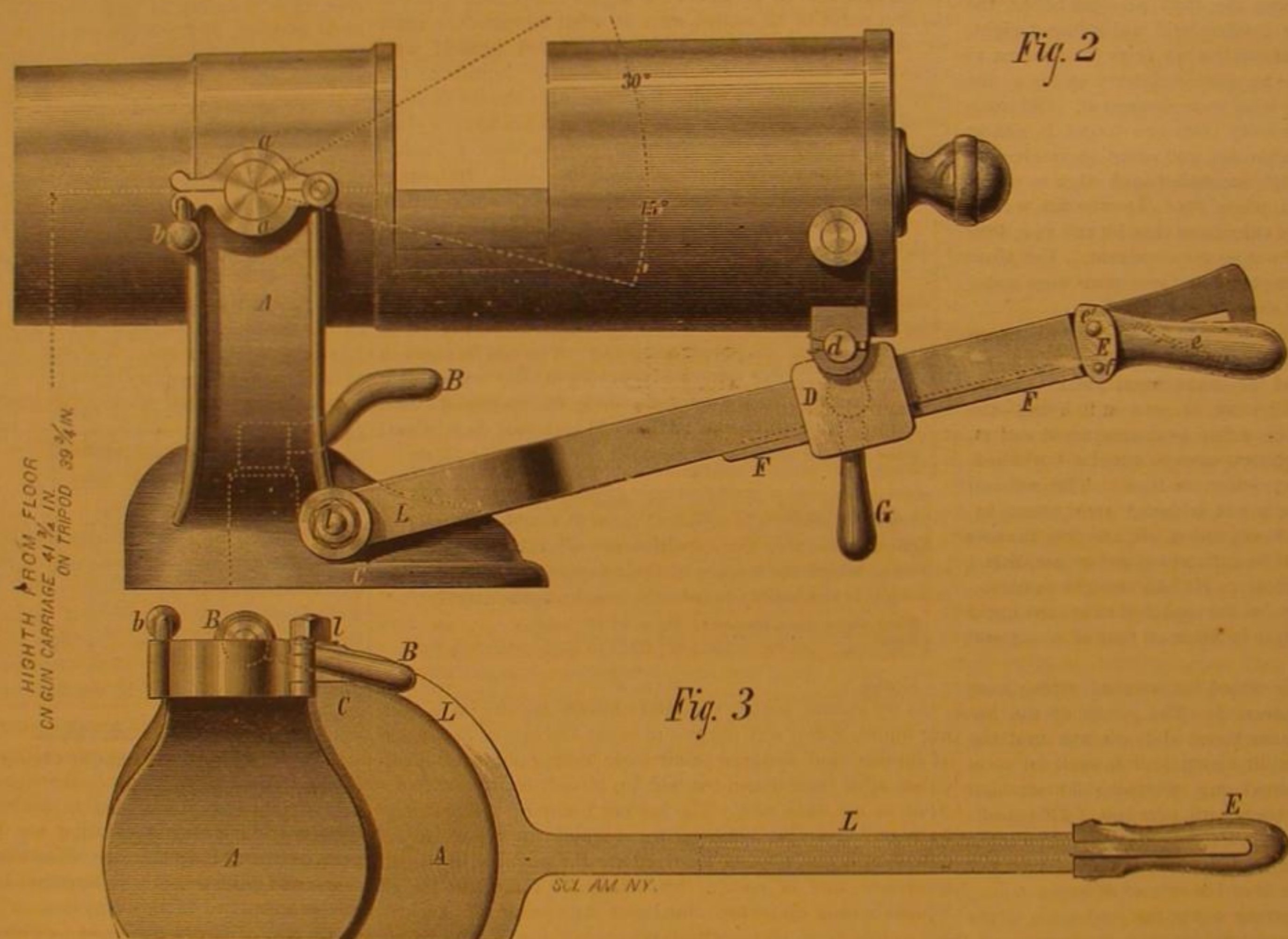
The tripod has been rendered more secure by braces, which prevent the legs from moving in until the center of the braces is raised in folding the legs together.

The elevating and ranging lever, shown on the guns in the front page engraving, are made after the model of 1879.

The gun rests in the swivel in the same manner as in Figs. 2 and 3, and the same binder is employed.

The lever is a plain one, on which slides a box fastened by a pivot bolt to the breech of the gun. Against the side of the lever in slide or box a friction shoe is fitted, which is held in its position in the box by a heel on each end. On the rear end of the lever there is a tapering handle, on which fits the socket of a yoke, which may be easily put in place or removed, and it is fastened by a taper pin. A leather strap which passes under the socket of the yoke is slung over the shoulders of the operator, allowing him to raise or lower the gun, and as his body fits into the yoke any desired lateral motion can be given to the gun by a simple movement of the operator. The binder permits or checks lateral motion, and a screw adjusts the elevation. If in firing the correct elevation has been obtained, the screw is fastened, and the gun can be moved laterally in a horizontal line, so as to cover, at this elevation, any desired lateral distance. The operator's body being in the yoke steadies the gun, even when the binder is loose; he can work the crank with his right hand, resting his left on the yoke.

This gun is manufactured by the Gatling Gun Company, of Hartford, Conn.



THE GATLING GUN.—ELEVATING AND RANGING APPARATUS.

NEW AGRICULTURAL INVENTIONS.

Mr. Jacob Kinstler, of Thomas Hill, Mo., has patented an improvement in plows, which consists in a plow beam pivoted to the plow stock and provided with a flanged and perforated rear end casting, that may be adjusted up or down or right or left.

An improvement in the class of fences whose panel rails are secured to posts by means of wire staples, has been patented by Mr. B. F. McCollister, of California, Mo.

Mr. Joseph W. Temby, of Dallas, Texas, has patented an improved combined wire and picket fence, which consists of two continuous wire rails having bends for receiving the pickets.

An improved device for securing cattle and horses in their stalls, has been patented by Mr. James D. Watters, of Bel Air, Md. It is not only capable of fastening or unfastening a single animal, but it is so constructed that all of the animals in the stalls may be released simultaneously. This is especially valuable in cases of fire.

Mr. Gottlieb Stettler, of North Georgetown, Ohio, has patented an improved apparatus for turning cheese. The invention is more particularly useful in making Swiss cheese, which requires turning daily.

An improved device for connecting the plow beam to the axle and tongue of a cultivator, has been patented by Mr. James M. Mitchell, of Point Peter, Ark. The improvement consists in the combination of simple devices, which cannot be clearly described without an engraving.

An improvement in that class of harrows having spiked cylinders has been patented by Mr. David I. Corker, of Amity, Oregon. The improvement relates to the use of pivoted locking bars, which will engage with or release the spikes of two cylinders simultaneously. The principal object of the invention is to free the spikes from adhering stubble.

Mr. W. V. Russell, of Elwood, Ind., has invented an improved fence, which consists of base blocks having dovetailed notches, to which are fitted uprights which support the rails. The fence also has a brace with a peculiar wire fastening.

An improvement in gate shutters has been patented by Mr. Isaac A. Pool, of Escanaba, Mich. It consists in a rod pivoted at one end to the gate, and running through a sheath or gig is attached to a rope that runs over a pulley and is fixed to a weight.

Fruitfulness of a Grain of Wheat.

If, says a writer in a German contemporary, we reckon that a single grain of wheat produces fifty grains, and that these fifty will each produce fifty grains more, and so on, we find:

In the second year	2,500 grains.
" third "	125,000 "
" sixth "	15,625,000,000 "
" twelfth "	244,140,625,000,000 "

The third year's crop would give 300 men one meal, leaving enough bran to feed eight pigs for one day. The produce of the single grain in the twelfth year would suffice to supply all the inhabitants of the earth with food during their lifetime.

NEW HAY PRESS.

The great volume of hay in its natural state renders it very difficult of transport, so that where vast quantities are required for the forage of armies or the wants of large industrial establishments, it becomes necessary to reduce its bulk very considerably. This, however, must be done judiciously, and above all *uniformly*; for if a certain pressure, determined by experience, be exceeded in any portion of the mass, the nutritious juices are expressed, and the hay rendered comparatively valueless. It is found that hay cannot be compressed like cotton by the application of one direct pressure, but that the consolidation must be effected by two separate operations, one for placing the particles in as close proximity as possible with a slight degree of pressure, and the other to give the final squeeze for reducing the bulk into as small a compass as may be desired. This has generally been effected by tossing the hay into cubical cases, where it is trodden down by men's feet before the final pressure is applied; but this method is open to many objections. The hay is bruised and broken by this rough treatment; no uniformity can be secured in the packing; and the plan enables unscrupulous dealers to fill in the interior of the bale with a damaged or inferior article. Besides this, the form of the bales is very inconvenient, so that they require four men to transport them from place to place.

Fig. 2.

LOADING HAY CYLINDERS.

The hay press exhibited in action by Mr. Th. Pilter, of Paris, at the Cattle and Implement Show under the auspices of the French Minister of Agriculture and Commerce, is improved by him from an American model, and patented in England and France. The hay, thrown on to a platform, is delivered continuously in small quantities up to a circular plate, and passes through two narrow slits, into which it is uniformly fed by two revolving cones, which impart to it a corkscrew motion. The hay is, in fact, roughly spun into a double threaded screw of very fine pitch, and forced onward with gentle pressure until a sufficient quantity has been collected to form a cylindrical bale of the weight desired. A pressure of about 6 cwt. to the cubic yard is then applied, giving the density which is found most desirable; a pressure of 8 cwt. to the square yard may, however, be given if required. The bale is then bound by two steel wires, crossing one another in a longitudinal direction; they are previously looped at each end, and are fastened by simply inserting in the loops a curved link like a small belt hook before it is flattened. On the pressure being relieved the mass slightly expands, stretching the wires; and the bale falls out of the press, a solid uniform cylinder, 2 feet 1½ inches in diameter, which may be rolled along by one man. A bale weighing from 2 to 2¼ cwt. is found most convenient, and for this a power of only three horses is required.

A perspective view, engraved from a photograph of the press exhibited at Paris, is given in Fig. 1. The machine rests upon a pair of wooden carriages, similar to those of a wagon, connected by stout longitudinal frames of angle iron; it is, therefore, easily moved to wherever required for work. The main shaft extends the whole length of the frames, and is supported in bearings, one at each end of the right hand frame or that removed from the point of view in the engraving. A pulley keyed on to the end of this shaft receives motion, by a belt, from a horse gear, portable engine, or any source of power. This shaft carries three spur pinions of equal diameter, arranged quite near the bearings, two at the front end and one, not visible in the engraving, at the back; they all run loose, but are capable of being made fast by friction clutches. When none of the pinions are in gear the main shaft *only revolves*. When the two hindermost pinions are both made fast on the shaft, they cause the two large spur wheels of equal diameter, arranged along the center line of the machine, to revolve together. That nearest the front end is fast on the second shaft, which is hollow, and forms the nut of a screw. The other is merely a ring having a flange cast on to it, which is carried by three friction rollers; it has, however, a couple of ribs, cast on the inside of the ring, which fit into notches in the circular head of the press, so that they revolve as one piece when the hay is fed in at the back end. This head is guided by two T irons bolted to the back plate and attached to a collar carrying arms at the front end. The head is also bolted to a square bar of wrought iron, which slides through the center of the screw, and passes out at the front end. When both the spur wheels are in gear, the second shaft, forming

Fig. 3.

HAY PRESS.

the nut, and its screw revolve together; but when the back wheel is stationary, the revolution of the nut causes the screw to advance, forcing the head toward the hinder end. For bringing back the screw a smaller spur wheel, the boss of which also forms a nut, is made to revolve in the contrary direction by means of an idle wheel or carrier; and the front spur pinion is thrown into gear by a double clutch at the front end. A bevel wheel cast on to the annular spur wheel at the back end (not seen in the engraving) turns the cones, which are centered in the ribbed plate, and also takes into a bevel pinion, giving motion to a short longitudinal shaft, which, by means of a pair of miter pinions, rotates a transverse crank shaft, actuating the shakers. There are four of these shakers with rake teeth, two on each side of a central division (not shown) for keeping separate the two streams of hay fed in by the two cones. This division is made movable for permitting the wires to be inserted for binding the bales.

Having described the principal parts of the appliance, we will now proceed to give an account of the operation of compressing the hay and forming the bales. Both the large spur wheels are thrown into gear, so that the screw, nut, and head revolve together. The hay is then thrown by forks on to the platform by two men, one on each side, and is carried on by the shakers to the back plate, where it is drawn uniformly through narrow rectangular apertures by the revolving cones. The head is at first close up to the back end; but the pressure exerted by the cones, introducing the hay, forces it gradually forward; and teeth are attached to the head for preventing the hay from slipping round it. In order to cause sufficient resistance of the head on the square bar, the latter is provided with a brake screw, which is turned as tight as experience shows to be desirable. When a sufficient quantity of hay has been fed in to form the weight of bale required, the back pinion, spur wheel, and cones are thrown out of gear, and the large spur wheel at the front end kept in gear; as the boss of this wheel forms a nut to the screw, it causes the latter to advance and drive back the head until it has given the hay the amount of compression desired. The bale is then bound by the two steel wires as described above; the double lever clutch throws out the larger spur wheel, and throws in the smaller, thus bringing back the screw; and the bale falls out, ready to be rolled away wherever required.

The operation of the machine is one of the simplest character, requiring only a power of three horses, the labor of two men, and from three to five minutes of time, according to the size of the bale.

Fig. 2 shows the method of loading the bales into railway cars; and Fig. 3 a plan of the car with the arrangement of the bales as stowed away. It will be evident that this new hay press possesses considerable advantages over those which have preceded it.—*Iron.*

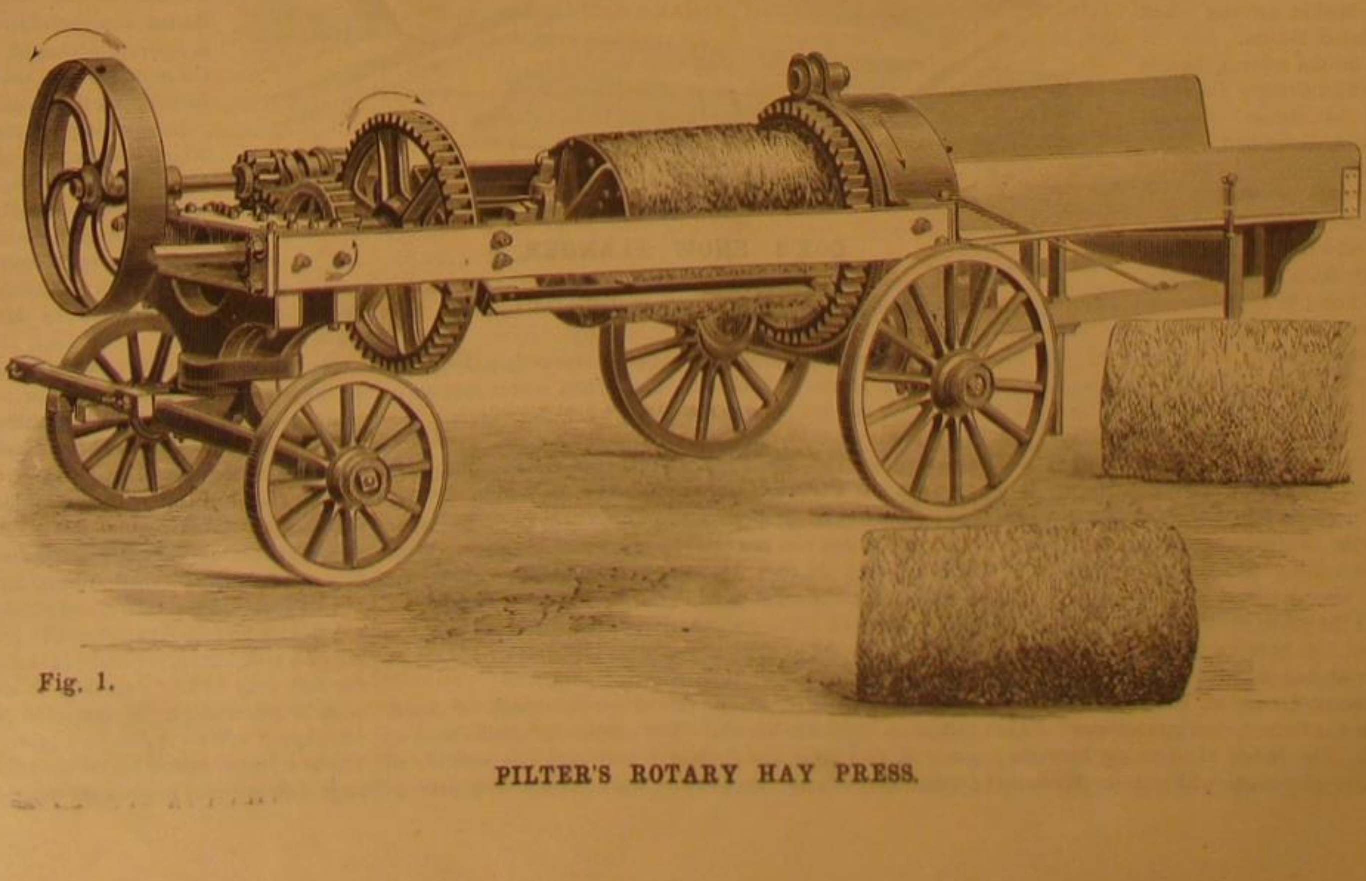


Fig. 1.

PILTER'S ROTARY HAY PRESS.

Beautiful Black Color for Bronze.

A strong concentrated thin solution of nitrate of silver is required for this purpose. It should be mixed with an equal solution of nitrate of copper, and well shaken together. The pieces which require coloring are dipped into this solution and left for a short time. When taken out, they should be equally heated till the required black color makes its appearance.

Economy of Co-operation.

In his report as Commissioner to the Paris Exhibition Ex-Governor Howard, of Rhode Island, speaks of Switzerland as the cheapest cloth-making country in the world. This is due, he says, to the fact that Swiss factories are run largely on the co-operative plan. Mills are family concerns, and owners and operatives live and work together. The hands themselves are very often property owners and have a general interest in the prosperity of the community. As the result, there is a more general spirit of contentment among the Swiss factory workers than any where else in the world. Wages are very low.

New American Industries.

The *Grocer*, in summing up the new sources of wealth in this country, and alluding to the anxiety of foreign producers at our rapid strides in producing nearly all the most important staples formerly imported, says that six years ago cream of tartar was imported from France to the extent of 6,000,000 lb. yearly, but so successfully has the manufacture of it in this country been carried on, that last year not a single pound was imported. Notwithstanding that the crude materials have at present to be imported, the price of the manufactured article has been reduced from 32 cents per pound, the rate for the French article here, to 23 and 24 cents per pound for the American production. France and England formerly sent us annually 500,000 lb. of tartaric acid, while the importation for the last fiscal year was 183 lb. England formerly monopolized our market for citric acid to the extent of 250,000 lb. annually and at the rate of $1.30 per pound, while last year 27,018 lb. were imported and sold at the same price as the American article, 57 cents per pound. At present the lime juice from which citric acid is made has to be imported, but it could easily be produced from fruits grown in Florida, if only sufficient energy were put into the work. If the lemon and lime growers of the South can be induced to prepare the lime juice, the entire production and manufacture of citric acid will be kept in this country, saving hundreds of thousands of dollars annually and developing another great industry. Borax was formerly brought from England at the rate of from 600,000 to 1,000,000 lb. every year. Owing to the development of borax mines in Nevada, this importation has largely fallen off, and the report for the last fiscal year showed only 3,492 lb., and the price of the refined article, which is now prepared in this city, is only 8 to 9 cents per pound, when formerly it was 35 cents per pound, England being now among the buyers where she was the principal seller, both of the crude and refined product.

The production of fruit sirups has heretofore been entirely in the hands of the French. The long time required to transfer these goods from France to South America and the West Indies, where they are largely used, and the natural advantages of the country, induced our New York merchants to enter into competition with the European markets for the production of fruit sirups. The experiment has proved successful, and sirups of a far richer flavor have been produced much cheaper and have met with approval in the tropics. The success of the experiment bids fair to bring to the United States a large trade, and retain in the United States millions of dollars that has previously gone to other nations.

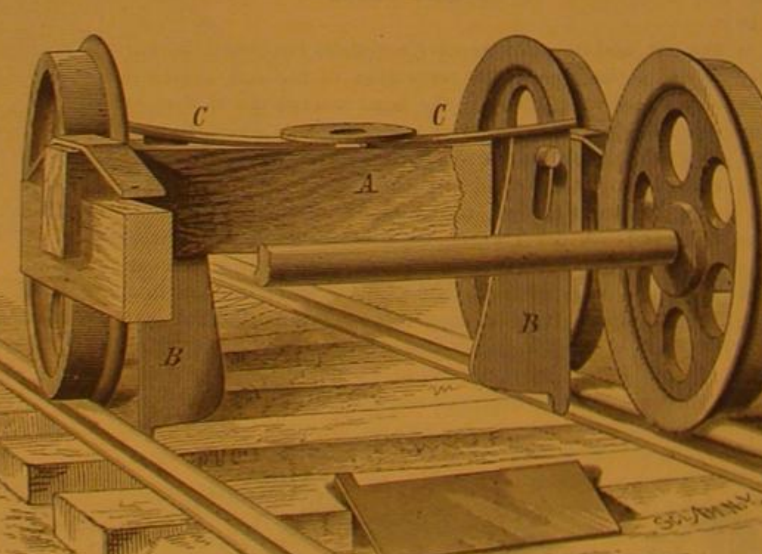
IMPROVED SNOW FLANGER.

We give herewith an engraving of an improved apparatus recently patented by Mr. David A. Cox, of Pine Bush, N.Y., for removing snow from the inner side of the track rail to make way for the flanges of the car wheels. This device, although quite simple, is said to be very effective. We are informed that it has been subjected to a practical test during the past winter, which has demonstrated its utility to the satisfaction of the railroad that has adopted it, as well as to the inventor.

The beam, A, of the car truck is mortised to receive the scrapers, B, which are slotted at their upper ends and held in place by a pin. The upper ends of the scrapers are pressed by the springs, C. The scrapers are flexible, and their lower ends are provided with a projection that extends nearly to the flange of the rail.

As the car progresses the snow is thrown outside of the track, and the path of the wheel flanges is readily cleared. The scraper being flexible yields to any rigid obstruction. The device may be applied to one or more of the trucks on the train, and it operates when the car is drawn in either direction.

Instead of using the slotted scraper the one shown in the foreground having a T-shaped head may be employed, but its action would be the same as that already described.



COX'S SNOW FLANGER.

A Large Meteorite Found.

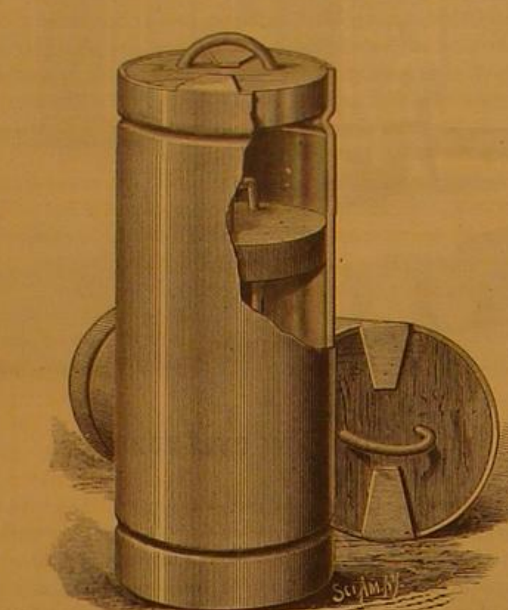
About 5 o'clock in the afternoon of May 10, a large meteor was seen to fall at the edge of a ravine near Estherville, Emmett county, Iowa, making a hole 12 feet in diameter and about 6 feet deep. S. E. Bemis writes to the Chicago *Tribune* that search parties had found numerous pieces, varying in size from 1 to 8 ounces, also four pieces about 4 lb., and one weighing 32 lb. and 2 ounces; but the largest size was found bedded 8 feet in blue clay, and fully 14 feet from the surface. Its weight is 431 lb., and its size 2 feet long by 1½ wide, and one or so foot thick, with ragged or uneven surface. It is composed, apparently, of nearly pure metal, a piece of which has been made into a ring. It makes a very pretty ring, resembling silver somewhat, but a trifle darker in color.

Not Pleuro-Pneumonia.

Professor Williams, of the New Veterinary College, Gayfield, Edinburgh, Scotland, has decided that the American cattle slaughtered at Liverpool were not suffering from contagious pleuro-pneumonia, as the veterinary officers of the Privy Council asserted. The lungs of such cattle having been submitted to him for examination, Professor Williams says that in none of them were there any of the signs of contagious pleuro-pneumonia, but all presented evidences of capillary bronchitis and collapses of certain lobules of the lungs of recent origin. In none of the lungs were there any traces of pneumonia or of pleuritis. He is of the opinion that the disease originated during transit. He adds that the above mentioned portions of lungs have been examined by Dr. Hamilton, Pathologist to the Royal Infirmary and Demonstrator of Morbid Anatomy; Dr. Young, Professor of Physiology; Mr. Vaughan, Professor of Anatomy; Mr. Kitchen, Professor of Materia Medica and Therapeutics, all of the New Veterinary College of Edinburgh, and others, all of whom agree with him as to the nature of the disease and are ready to indorse his opinion.

NEW SAMPLE CASE.

The accompanying engraving shows an improved case for sampling, holding, or conveying goods of various kinds. It seems especially adapted to the use of millers and others dealing in grain or flour.



DAVIS' SAMPLE CASE.

It consists of a sheet metal tube having near each end indented grooves, that in reverse form ribs or shoulders on the inside of the tube, which serve as seats for the stoppers. The stoppers are of sufficient thickness to reach from the rib to the end of the tube, and are retained in place by lips formed at the end of the tube, which are bent down after the package is filled.

The tube is provided with one or more partitions or diaphragms of cork or other suitable material, which divide the package into two or more compartments, so that two or more different samples may be carried. The stoppers at the ends of the package are provided with handles to facilitate their removal.

This improved sample package was recently patented by Mr. M. R. Davis, of Jackson, Mich., from whom further information may be obtained.

Growth of the Petroleum Business in the Pennsylvania Oil Fields from June, 1872, to April, 1879.

The amount of crude petroleum produced in the month of June, 1872, was 506,130 barrels. The amount of crude oil held in stock at that time in the producing regions was 1,010,302 barrels. The number of producing wells in June, 1872, was 4,144. The average daily production per well was 3 9-10 barrels. The sales of crude on board of cars in June, 1872, were from $3.80 to $4.10 per barrel.

The amount of crude produced in the month of April, 1879, was 1,507,950 barrels. The amount of crude held in stock at that time was 6,666,611 barrels. The number of producing wells in April, 1879, was 10,782. The average daily production per well was 4 6-10 barrels. The sales of crude oil certificates in June, 1872, were from 73¾ cents to 83¼ cents per barrel.

From the above exhibit the following results appear:

1. That the production of the Pennsylvania oil fields has increased about 200 per cent. 2. That the stock of crude held in the producing region has increased over 600 per cent. 3. That the number of producing wells has increased about 160 per cent. 4. That the daily average production per well has increased 0·7 per cent. 5. That the average price of crude in April, 1879, was nearly 300 per cent less than in June, 1872.

From the above results the deduction of over production is inevitable.—*Stowell's Petroleum Reporter.*

RECENT AMERICAN PATENTS.

Messrs. D. M. Hurlburt and C. R. Slocum, of Hornellsville, N. Y., have patented an improved umbrella drip cup, which consists in a collar with a flexible rim and having attached to it a flexible bag. The drippings run into the flaring portion of the collar and from thence into the flexible bag.

Messrs. Joseph Conly and Jonas B. Wise, of Sharon, Wis., have patented an improved refrigerating building for the preservation of fresh meat and other substances to be kept cool. It consists in a peculiar arrangement of double walls, partitions, slides, etc., which cannot be clearly described without an engraving.

A horn tobacco box, consisting of two similar sections connected by flanges and rivets, and provided with a sliding cover, has been patented by Mr. Hermann Arnold, of Elizabeth, N. J.

A novel toy windwheel, consisting of a spring hammer, a corrugated bell or gong, and a metallic windwheel, attached to a handle and arranged so that the rotation of the wheel will ring the gong, has been patented by Mr. Joseph L. M. Du Four, of Bound Brook, N. J.

Mr. Frank Donaldson, of New York city, has invented an improved device to be inserted in or attached to house doors for convenience of those supplying and those receiving milk. The device holds the pitcher and the money or ticket, indicates the amount of milk required, and has a small locked door which can be opened only by the milkman, who carries a funnel adapted to the apparatus, which he inserts through the door when he desires to fill the pitcher.

An improved edging tool for lathe working has been patented by Mr. Genas B. Putnam, of Thomaston, Me. The invention consists in a flat cutting blade fitted to a handle and carrying an adjustable gauge arm, to which is attached a gauge plate that acts as a guide for the knife.

An improved means for attaching urns to stoves has been patented by Mr. Cornelius Fuller, of Somerset, Mass. It consists in a horizontally bent arm hinged to one side of the stove by a vertical pin. This arm has an eye through which passes the stem portion of the urn.

Messrs. D. W. and H. Johns and Henry Embs, of New Albany, Ind., have patented an improved machine for making ax-polls. In this machine the ax-polls are made by the rolling process, the iron bar being first bent into a V-shape and the eye formed; the ends or flanges are then closed by stationary dies as the poll comes from the roll.

An improved apparatus for utilizing waste gases of distillation in refining petroleum has been patented by Mr. Henry E. Parson, of New York city. This invention is designed to utilize the gases that are formed in the process of distilling petroleum after the oil leaves the condensing coil.

An improved clothes pounder, patented by Mr. William D. Middleton, of Elkhart, Ind., consists in the combination with a conical dasher of a perforated cylinder, a piston, and a spring, arranged so that air is forced through the clothes and through the water, facilitating the cleansing of the clothes.

In picking cotton long sacks are used, which are dragged on the ground by the pickers. When filled these sacks drag heavily and are worn out rapidly. An improved cotton sack protector, which may be easily attached to or removed from the sack, and which will obviate the difficulty referred to, has been patented by Mr. David W. Bullock, of Tarborough, N. C.

Mr. James S. Brady, of Clintondale, N. Y., has patented an improvement in dampers for stoves and furnaces, by which the draught is controlled automatically. The invention depends for its action on the expansion of the stove and pipe by an increase of heat.

Mr. Theodore Beckerman, of Henry, Ill., has recently patented a windmill which has several novel features. The spokes of the wheel and the rods and stays are made of gas pipe to secure strength, lightness, and durability. The hub is of cast iron and the sails are of sheet iron or wood. It is provided with an effective automatic governing device, consisting of a weighted lever and connections, by means of which the sails may be kept full in a moderate wind and turned more or less under a varying wind pressure, so that a uniform speed will be maintained under all working conditions. The peculiar construction of the mill admits of the use of large sails without necessarily using heavy working parts.

The Hygrometric Properties of Glycerine.

A writer in the *Pharmaceutical Journal* gives the following curious and interesting facts in regard to the behavior of glycerine in a very moist atmosphere: The moisture in the form of water collects and floats on its surface, and taking up, or dissolving, a considerable proportion of the subjacent glycerine (probably more than half its own weight) attracts more moisture, which in turn exercises its solvent power and acquires a capability of still further absorption. Thus the action goes on, not necessarily, as may be thought, in a constantly decreasing ratio as the water increases in amount, but at an almost uniform rate from week to week. The mixture of glycerine and water is not so actively hygrometric as the glycerine alone, but the combination once effected the action continues with singular uniformity.

The author (Mr. W. Willmott) then proceeds to illustrate this by means of a table, from which he shows that although during a period of four weeks there is an increase of weight from week to week, yet there is a diminution of the increase during the second and following weeks as compared with the first; and this is owing to a lessening of the intensity of absorption by the presence of the water. All this goes on without stirring or disturbing the fluids in any way. If, however, the water be kept stirred into the glycerine instead of being allowed to remain on its surface, there will be no appreciable difference in this increase of weight between the first and following weeks. But at what point is there a pause in this process? Where does it end?

In whatever proportionate quantity water may be added to glycerine, from a single drop upward, absorption will take place in a moisture-laden atmosphere until the proportion reaches three parts by measure of the former to one of the latter. At this point the glycerine, so to speak, gives up the contest and succumbs to the influence which the water exerts in the opposite direction. In this mixture, therefore, namely, three fluid ounces of water to one of glycerine, there will be neither attraction nor evaporation, the weight scarcely varying from week to week either in one direction or the other. If now we conduct our experiments in a moderately dry atmosphere—say in the atmosphere of an ordinary room in which a fire is kept burning during the day—the action will be the same, but to obtain similar results the proportions will be widely different, and in fact almost reversed. Instead of three parts of water to one of glycerine, we shall require nearly three parts of glycerine to one of water to reach the neutral point. Where in one case there is absorption and augmentation, in the other there is evaporation and consequent loss.

It is to this hygroscopic character of glycerine and its power to absorb moisture that is due its irritating effect when rubbed on the skin in an undiluted state.

Medical Colleges—Doctors.

Barnes' Educational Monthly takes to task our medical colleges and the medical profession generally, for the imperfect manner in which the former are conducted and the lack of scientific knowledge among the latter.

While we do not indorse the sweeping assertions of the writer, that a large proportion of our doctors are incompetent to prescribe in ordinary diseases, we have no doubt but many reforms might be introduced into our medical colleges, and that our practitioners would become more skillful in their profession if they studied more into the causes of the disease they are called upon to treat; in other words, as the writer says, conduct their practice on more scientific principles.

With the exception of one college in New York, and two in other States, says the above named monthly, any one may become a medical student without preliminary examinations in anything, moral character not excepted. Students are often graduated at the close of two years' study, and in some institutions the course of instruction is even more superficial and imperfect. Examinations for diplomas are not at all rigid, a knowledge even of chemical analysis not being required. There is not a single doctor in one of the counties in Western New York who can conduct a decent chemical analysis, or even tell whether his nitrate of bismuth does or does not contain arsenic. A doctor recently stated on examination that the proper dose of prussic acid for a child two years old was from four to six drops! As a general thing, doctors in rural places, and in some of our cities as well, stick to antiquated remedies and outrageous doses. We think our educational journals ought to stir up the young doctors to more diligent habits as students. Each one of them should have his chemical laboratory, where he daily should conduct such chemical analyses as sickness demands.

If doctors were a little more enterprising and pushing, we should know something more concerning such diseases as typhoid fever, diphtheria, scarlet fever, and measles. Call two doctors in succession to a child attacked with one of these diseases, and the probabilities are they will give you contradictory explanations, and totally different remedies. This is no recommendation to the medical profession. Because doctors are not scientific, the practice of medicine is not conducted on scientific principles, and medicine is not to-day a science. It is a practice, we admit, much to the horror of sensitive tastes. The day will be hailed with joy by a disease-cursed world when this practice is conducted on scientific principles. We laymen would like to know many things our medical advisers will not tell us, simply because they cannot.

Let us have some light on those diseases lurking unsubdued in all parts of our land. It is your duty to enlighten the world, and if you are the students you should be, some of you will bless this humanity of ours by telling exactly what will cure certain diseases, and why it will do so. You should be paid to prevent as well as cure. We would rather give you twenty-five dollars to keep us well, than ten to cure us when sick.

Milk and Lime Water in Nervous Disorders.

In a paper on "Milk with Lime Water as Food and Medicine in Nervous Disorders," presented by E. N. Chapman to the Medical Society of the State of New York, at its recent annual meeting, the author deprecates the warfare of drugs against disease which is now being waged by specialists more vigorously and systematically than ever before. Digestion and assimilation, he asserts, are ignored, and the attention is absorbed by one or more prominent symptoms in a part remote from the primary source of morbid action. Consequently the efforts of the physician to cure his patient are too often unavailing.

He states that having used, the last few years, milk with lime water almost exclusively as the diet of his patients, he has attained a success unknown to him when he depended more on medicine and less on food. To illustrate the ready assimilation, the nutritive quality and the remedial power of milk, when rendered digestible by lime, he presented notes of a number of cases treated by him, embracing a class involving the nerve centers, and that are acknowledged to be little under the command of accepted modes of treatment; such, for instance, as marasmus, anæmia, paralysis, indigestion, neuralgia, chorea, dementia, and alcoholism.

In concluding his paper, Dr. Chapman remarks that the efficacy of milk with lime water in the illustrative cases brought forward by him is equally observable in others whenever, either primarily or secondarily, the nutritive functions are much at fault. The milk (with a pinch of salt) being rendered very acceptable to the stomach by the lime, may almost always with advantage be made the prime article of diet in the sick room, however diverse the conditions. It is the most digestible and at the same time the most nourishing food that can be given. It allays gastric and intestinal irritability, offers a duly prepared chyle to the absorbents, supplies the blood with all the elements of nutrition, institutes healthful tissue changes, stimulates the secreting and excreting glands, and, in a word, provides nature with the material required to sustain herself in her contest with disease. If it be conceded that nature always accomplishes the cure whenever it is secured, and that drugs merely aid, direct, or modify her efforts to this end, it will be self-evident that the food which supplies the vital forces with all the power of resistance they possess is a matter of the first importance, and that milk acted upon by lime, provided it contains all the essential properties of other articles epitomized, and is more friendly than any or all of them, has a range of application almost as extensive as the disease itself, whatever its character and whoever the patient.

Electric Light in Hydraulic Mining.

The first electric light ever introduced in a mining claim was placed on the Deer Creek placer claim of the Excelsior Water Company at Smartsville, on the 10th of last April. A 12,000 candle power Brush machine was put in operation, and three lights of 3,000 candle power each were placed in prominent positions upon the claim. Although the night was very dark the lights shed a brilliant light around and enabled the miners to work as readily as during the day. Until this experiment the mines had to shut down during the night, but now the company expects to work both night and day. Nevada and Yuba counties have many hydraulic mining companies, and several of them have announced their desire to use the new light if the Excelsior company is thoroughly satisfied with their machine. As Mr. Law has received several telegrams from the company which state that it is working well, there can be no doubt that it will be adopted. The three lights cost the company about 10 cents per hour, and with interest, wear and tear, etc., included, the claim is lighted for 16 cents per hour. The company's daily clean-up is from $500 to $1,000, and by running nights also the yield of the mine can be doubled.—*Nevada Transcript.*

Sea Weeds for the Herbarium.

The recipe for pressing sea weeds for preservation used by the Rev. A. B. Hervey, of Troy, N. Y., well known as an expert in that process, is as follows: Float out each specimen by itself in salt water, in a white dish, like a washbowl. Put the paper under the plant in the water, arrange the plant on the paper and carefully draw it out. Lay the paper with the plant upon it on drying paper and spread over it a piece of white muslin. Then spread over this a layer of drying paper, then more plants, and then more cloth, drying paper, etc. Put all under a board, and weight it with forty or fifty pounds of stone or other heavy substances. The next day change the cloths and drying paper, and in one day more the plants will be dry and ready to go into the herbarium or the album for permanent preservation.

Utilization of Hop Stems.

Many attempts have been made to convert hop stems, which, at the present time, are only a nuisance to the hop growers, into some useful product; paper makers have tried to reduce them to a pulp suitable for their purpose, but with only indifferent success. The *Brewers' Guardian* states that M. Jourdeit, of France, has recently patented a process for obtaining from these stems a material suitable for the manufacture of cordage. The stems and runners are collected twenty-four hours after the hops have been picked, tied together in bundles about five feet in length by half a yard in diameter, and steeped in water in the same manner as hemp. Here they are allowed to remain from three to four weeks, after which they are taken out, placed on end to drain for a while, dried for twenty-four hours in the sun, and then stored in dry, well-ventilated sheds. The separation of the fibers from the woody portions of the steeped stems is readily effected by passing these between two cylindrical rollers, though the process is not quite so easy as in the case of hemp or flax, owing to their tougher structure. The fibers, as thus obtained, are of a light brown color, and from 12 to 16 inches long. They are then carded in the same manner as flax, and in this state afford a very valuable material for the manufacture of cordage and similar rough products. Another patent has been taken out in Germany, according to the *Gardener's Chronicle*, and which differs from the above. In the German process the hop stems are boiled in soap, soda, and water, well washed, and reboiled in very dilute acetic acid, again washed, dried, and combed, when they are fit for use, and can be washed like flax.

Another New Metal.

The services the spectroscope is capable of rendering to science become more and more evident daily, the latest proof of the fact being the discovery of a new metal called scandium. In some of the mines in Sweden and Norway small quantities of earthy minerals are found, called gadolinite and euxenite, composed of oxides of very rare metals. The bulk of the substance is of a rose color, arising from the presence of erbium, and is called erbine. At first it was supposed to be simply mixed with some earthy substances which rendered it impure, but not long ago M. Marignac discovered the presence of another metallic substance, which he called ytterbine, the oxide of ytterbium. However, great uncertainty existed as to the composition of these bodies, and M. Nilson undertook a series of experiments on the subject. M. Berthelot, at the last meeting of the Academy of Sciences, gave an account of what had been done so far, the result being the discovery of a new metal to which M. Nilson has given the name of scandium, to indicate that it is of Scandinavian origin. Erbine is, as before mentioned, of a brilliant rose color, while ytterbine is white. But the separation of the two substances can only be effected with extreme difficulty. The earth has to be dissolved in boiling nitric acid, and the ytterbine then precipitated by sulphuric acid; and M. Nilson found that the operation, repeated more than twenty times, did not completely separate the two bodies.

When he had obtained a comparatively pure ytterbine he commenced an examination of it, and then he found that it gave absorption bands in the spectrum unknown to any substance previously examined. After repeated trials he became convinced that he was dealing with a metal never before suspected, and he continued his researches. He is unable to say at present what may be the chemical properties of the new body, as the quantity of material at his disposal was insufficient to allow him to isolate the metal. Nor can he decide as yet as to the place the new metal is to take among the older ones, but he considers that its properties differ materially from those of erbium and ytterbium, and that it should rank between tin and thorium, as the atomic weights of these two are 118 and 234, while he calculates that of scandium at from 160 to 180.

Brain Work and Skull Growth.

The London *Medical Record* sums up as follows the results of some very interesting measurements of heads by two French physicians, Messrs. Lacassagne and Cliquet:

Having the patients, doctors, attendants, and officers of the Val de Grace at their disposal, they measured the heads of 190 doctors of medicine, 133 soldiers who had received an elementary instruction, 90 soldiers who could neither read nor write, and 91 soldiers who were prisoners. The instrument used was the same which hatters employ in measuring the heads of their customers; it is called the conformator, and gives a very correct idea of the proportions and dimensions of the heads in question. The results were in favor of the doctors; the frontal diameter was also much more considerable than that of the soldiers, etc. Nor are both halves of the head symmetrically developed: in students, the left frontal region is more developed than the right; in illiterate individuals, the right occipital region is larger than the left. The authors have derived the following conclusions from their experiments: 1. The heads of students who have worked much with their brains are much more developed than those of illiterate individuals, or such as have allowed their brains to remain inactive. 2. In students the frontal region is more developed than the occipital region, or, if there should be any difference in favor of the latter, it is very small; while in illiterate people the latter region is the largest.

MADEMOISELLE ADELAIDE MONTGOLFIER, a daughter of the inventor of balloons, is still alive, aged eighty-nine years. She is possessed of a large fortune, and presented the Museum of the Aeronautical Academy with a copy of the large medal executed by Houdon, and representing her father and uncle, who was associated with him in the invention of balloons. This medal was executed to commemorate that event. A movement will be got up in France for celebrating the centenary of that memorable event, which took place in June, 1783, in the vicinity of Lyons.

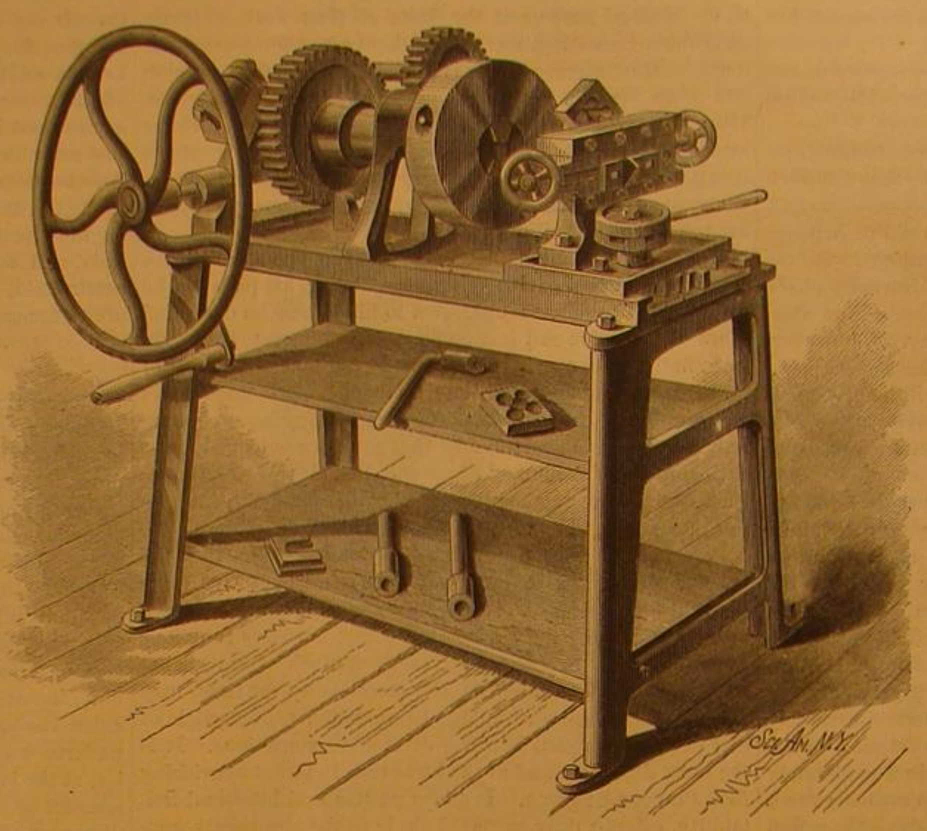
NEW PIPE CUTTING AND THREADING MACHINE.

The annexed engraving represents a compact, portable, and low priced machine more especially designed for cutting and threading pipe, but which may be used to good advantage in jobbing shops for cutting off round iron and for threading bolts and tapping nuts where the attachments for this kind of work are applied. The machine is contrived so that the speed, and consequently the leverage, may be changed to adapt it to light or heavy work. There are three changes of speed: the fast speed cuts one fourth, three eighths, and one half inch; the next three quarters, one, and one and a quarter inch; and the slowest speed one and a half and two inches. These changes in speed are readily made by means of a lever at the front of the machine.

The cutting and threading is done by stationary cutters and dies, while the pipe is held and revolved by a concentric chuck on the hollow mandrel of the machine. We are informed that this chuck is one of the best of its kind for gripping pipe and bars of iron. At the back end of the mandrel there is a universal chuck for centering and supporting the pipe, thus doing away with extra guides or supports. The die head has a cutting-off tool slide and self-centering jaws for steadying the pipe while it is cut off. The die starter consists of a pinion working in a rack at the bottom of the die head; the pinion being provided with a long lever which renders the operation of starting easy.

The manufacturers inform us that as the pipe revolves and the dies remain stationary only straight threads can be cut.

The machine shown in the engraving is arranged for hand power; but it is a very simple matter to apply the pulleys and arrange it to operate by means of a belt when desirable. This machine was recently patented and is manufactured by D. Saunders' Sons, Yonkers, N. Y.



SAUNDER'S SONS' PIPE CUTTING AND THREADING MACHINE.

A NEW CONDENSER.

The condenser, as it was constructed by James Watt, consisted of a closed compartment (the condenser proper) and of the air or condenser pump. It is built in nearly the same manner now, the difference being that the condenser and the air pump are very often not separated but connected as one.

The object of the air pump is to remove air and the water of condensation from the condenser. The warm water that results from the mixture of cold water and steam would soon fill the condenser and stop its operation but for the action of the air pump. A certain quantity of power is necessary for the operation of the pump, and this in the ordinary condenser must be furnished by the engine.

Brossard's condenser, which is shown in the engraving, does not require an air pump, and consequently does not consume any of the power of the engine. It is, in fact, entirely independent of the engine. To operate this condenser, cold water, flowing down a height of from 20 inches to 32 feet, creating a corresponding vacuum, is only necessary.

Fig. 1 is a perspective view of the apparatus. Fig. 2 is a vertical section.

The construction can be seen from the engravings. A is the pipe through which the waste steam from the cylinder passes into the condenser. To set the apparatus in operation the cock, *b*, is opened, then water will flow over the disk, *e*, into the chamber, *f*, of the condenser, whence it flows through the pipe, *g*. In the pipe, *g*, the water tends to attain a velocity proportional to the height through which it falls, but if the cock, *b*, is set so that less water can enter *e* than can flow through *g*, then the water in *g* flows slower. This produces a vacuum in the condenser, *f*. If the steam is allowed to enter the condenser it will be drawn into the vacuum, *f*, and will be condensed there by the cold walls of the condenser funnel, and by being mixed with cold water. The water of condensation also flows off through the pipe, *g*. The water that passes through the pipe, *g*, forms a liquid funnel at *i*, into which the air that may have remained in the condenser is drawn.

As soon as the apparatus is in operation the cock, *b*, is closed, so that the water does not flow from the reservoir, *h*, but is drawn by suction from the reservoir, *k*. The best results are attained if the water is cold and quantity small.

To measure the effect of the apparatus we can assume that 39·37 inches of height through which the water falls, is equal to 2·75 inches of quicksilver. If the vacuum is proportional to 29·8 inches of quicksilver, the rarefaction with this condenser will be proportional to 27·5 of quicksilver if the height is 32 feet. The least effect is produced with a height of 20 inches, and the vacuum is then proportional to 1·37 inch of quicksilver.—*Schweizerisches Gewerbeblatt.*

FIG. 1.

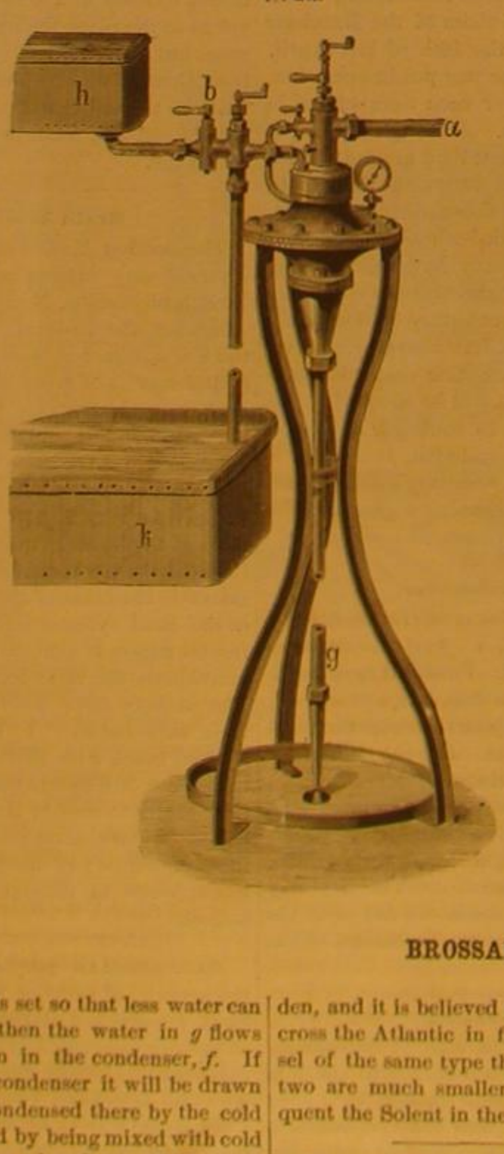
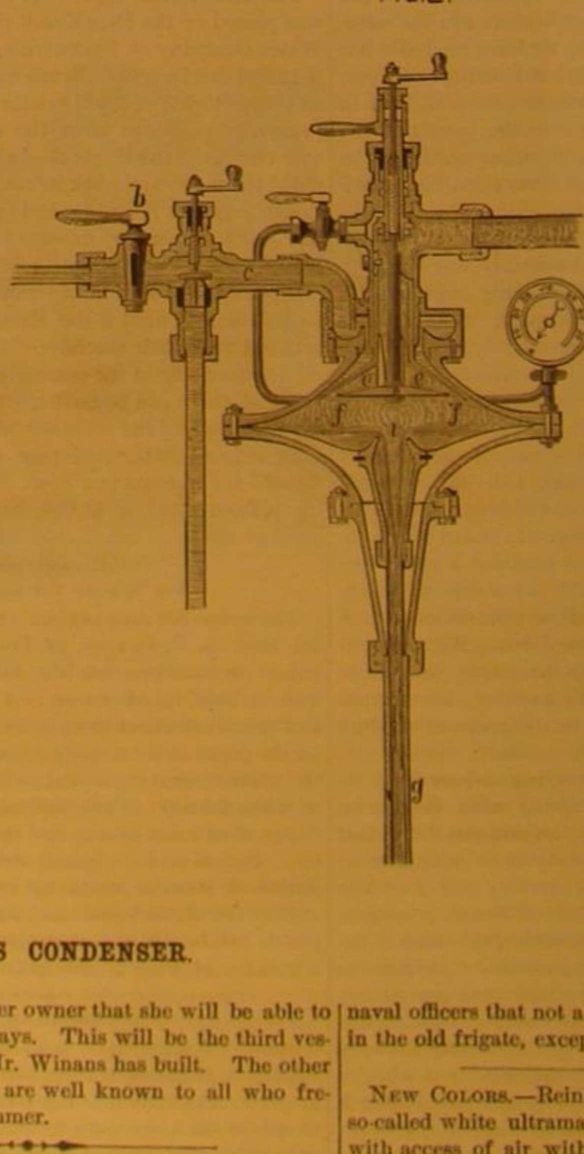


FIG. 2.



BROSSARD'S CONDENSER.

A New Cigar Ship.

A London paper reports that Mr. Winans, of Baltimore, is building in the Clyde a monster cigar ship at a cost of close on $1,000,000. She is to be of 4,000 or 5,000 tons burden, and it is believed by her owner that she will be able to cross the Atlantic in five days. This will be the third vessel of the same type that Mr. Winans has built. The other two are much smaller and are well known to all who frequent the Solent in the summer.

BABBITT METAL.—By weight 4 parts copper, 8 parts antimony, 96 parts tin.

The Lesson of Asa Packer's Life.

Between the young mechanic from Connecticut who wandered into the Susquehanna Valley on a winter morning fifty-six years ago, with his knapsack and kit of tools, seeking work, and the distinguished citizen whose death the whole commonwealth mourns to-day, there is more than the space of half a century—there is the whole span of American possibilities; there is the whole story of an American fortune, and of the success which was due to thrift, patience, foresight, and, above all, character. The story of Judge Packer's life is better than a romance. Opportunity of no common order was his, it is true; but how many other striplings of Yankee or Pennsylvania growth who were on the road he traveled by, had the discernment to see the opportunity in the first place, the frugality and hard endurance to grasp and hold it, and the rugged truth of character that induced men to hold fast by him when disasters were threatened that overthrew lesser or less steadfast men? There is a practical value in this career, ending as it did in the possession and dispensing of a colossal fortune, that ought to send all doctrinaire theorists on the labor question to the right about. Here was a young fellow, unfriended, except by the skill of his hands as a workman, who came into the Lehigh Valley and conquered it; subdued its rugged mountain sides and its narrow river bed; laid bare its wedged in and countless wealth, and dispensed prosperity to his fellow citizens. More than this, the opposition and narrowness which he encountered in dealing with other men who stood on the level of labor he started from, was the means of turning his attention to his great educational work. The problem of the "strike," which confronts the best minds of capitalists and laboring men to-day with its costly and menacing possibilities, was the corner stone of Lehigh University. Long shall the story be remembered of that scene on the river when the striking boatmen of the Lehigh canal with their boats were collected on the pool of the Lehigh river, above the dam at Easton, with all the uncontrolled passion and disorderly excesses that accompanied the "strike" in the coal regions. Judge Packer, himself a boatman of a few years back, in the full confidence of his kindly feelings and his knowledge of their thoughts and needs, went to them for a friendly talk on the situation. He had no fear of his life in meeting this excited crowd, although from personal experience he knew the temper of these turbulent men. They would not listen to him, but seized him and flung him into the river. Some men would have accounted it a lifelong grudge and an added reason for severity in pursuing the mob leaders to punishment for this outrage. But the perfect temper of Judge Packer viewed this "mob baptism" differently. It was an outburst of passionate ignorance, he reasoned, and his answer to the outrage was a great Free School. It would take a generation to disperse the ignorance, but the rising generation should have the benefit of all that free tuition and the wise disposal of his wealth should give it.—*Philadelphia Public Ledger May* 19.

The Ship Constitution.

The old frigate Constitution, now at Brooklyn, unloading exhibits returned from the Paris Exhibition, had her keel laid in 1794, and was launched three years later. She bombarded Tripoli in 1804, and in 1812 she captured the Guerriere, Wasp, and other vessels. It is said by naval officers that not a particle of the original wood is now in the old frigate, except the mizzentopsail bits.

NEW COLORS.—Reinhold Hoffmann treats blue, green, or so-called white ultramarine at an elevated temperature, and with access of air with acids, or with salts which give off acids when heated. He thus obtains purple-red or violet color, which, on treatment in the same manner, become red.

THE CHAMELEON.

This singular reptile has long been famous for its power of changing color, a property, however, which has been greatly exaggerated, as will be presently seen. Nearly all the lizards are constitutionally torpid, though some of them are gifted with great rapidity of movement during certain seasons of the year. The chameleon, however, carries this sluggishness to an extreme, its only change being from total immobility to the slightest imaginable degree of activity. No one ever saw a chameleon even walk, as we understand that word, while running is a feat that no chameleon ever dreamed of.

When it moves along the branch upon which it is clinging the reptile first raises one foot very slowly indeed, and will sometimes remain foot in air for a considerable time, as if it had gone to sleep in the interim. It then puts the foot as slowly forward, and takes a good grasp of the branch. Having satisfied itself that it is firmly secured, it leisurely unwinds its tail, which has been tightly twisted round the branch, shifts it a little forward, coils it round again, and then rests for a while. With the same elaborate precaution, each foot is successively lifted and advanced, so that the forward movements seem but little faster than the hour hand of a watch.

The food of the chameleon consists of insects, mostly flies, but, like many other reptiles, the chameleon is able to live for some months without taking food at all. This capacity for fasting, together with the singular manner in which the reptile takes its prey, gave rise to the absurd fable that the chameleon lived only upon air. To judge by external appearance, there never was an animal less fitted than the chameleon for capturing the winged and active flies. But when we come to examine its structure, we find that it is even better fitted for this purpose than many of the more active insect-eating lizards.

The tongue is the instrument by which the fly is captured, being darted out with such singular velocity that it is hardly perceptible, and a fly seems to leap into the mouth of the reptile as if attracted by magnetism. This member is very muscular, and is furnished at the tip with a kind of viscid secretion which causes the fly to adhere to it. A lady who kept a chameleon for some time, told me that her pet died, and when they came to examine it they found that its tongue had in some strange way got down its throat, an accident which they took to be the cause of its death. Its mouth is well furnished with teeth, which are set firmly into its jaw, and enable it to bruise the insects after getting them into its mouth by means of the tongue.

The eyes have a most singular appearance, and are worked quite independently of each other, one rolling backward while the other is directed forward or upward. There is not the least spark of expression in the eye of the chameleon, which looks about as intellectual as a green pea with a dot of ink upon it.

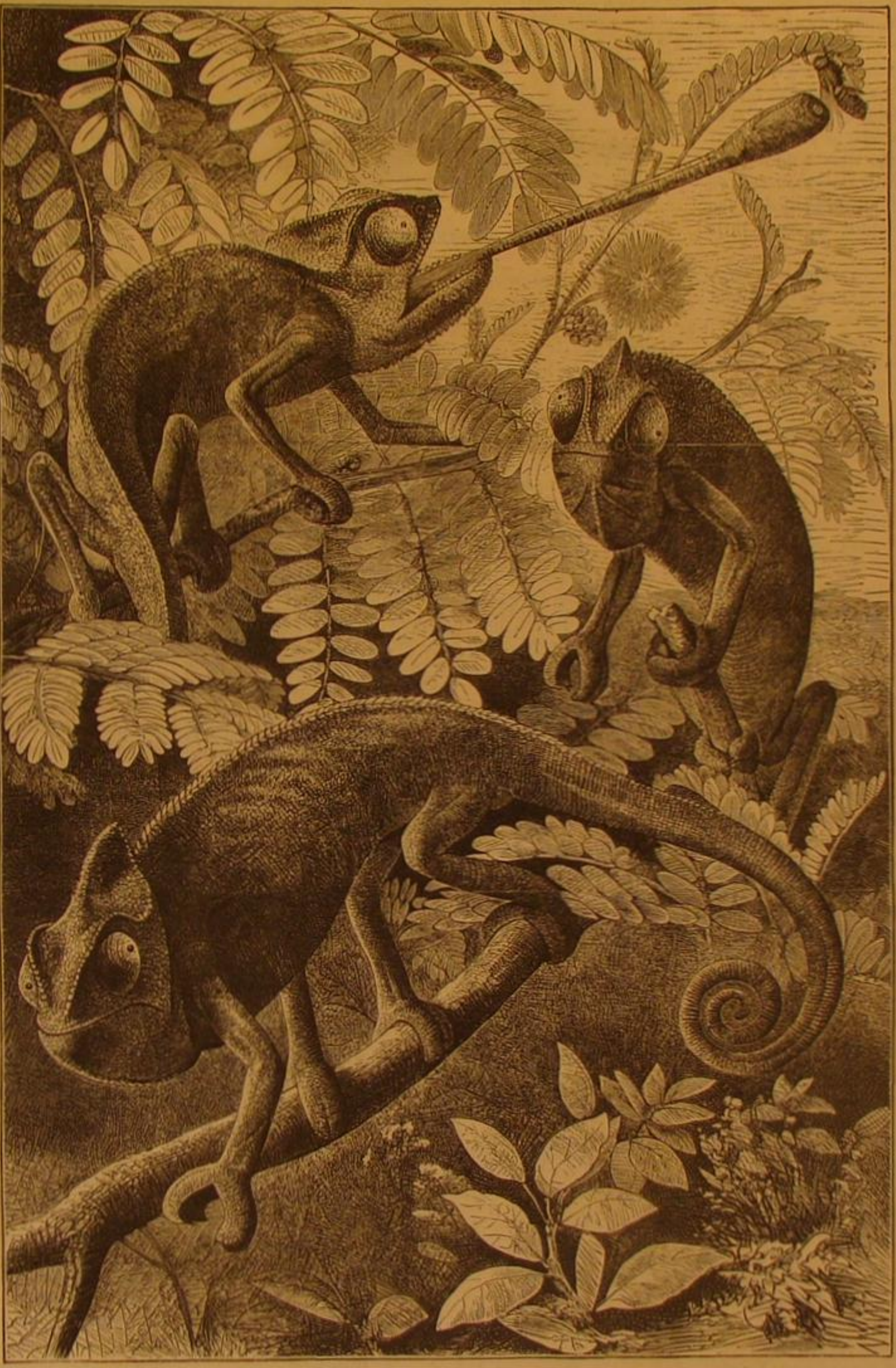
Owing to the exceeding slowness of its movements, it has no way of escaping when once discovered. Great numbers of these creatures fall victims to enemies of every kind, and were it not that their color assimilates so well with the foliage on which they dwell, and their movements are so slow as to give no aid to the searching eye of their foes, the race would soon be extinct. The chameleon has an odd habit of puffing out its body for some unexplained reason, and inflating itself until it swells to nearly twice its usual size. In this curious state it will remain for several hours, sometimes allowing itself to collapse a little, and then reinflating its skin until it becomes as tense as a drum and looks as hollow as a balloon.

The chameleon is readily tamed, if such a word can be applied to the imperturbable nonchalance with which it behaves under every change of circumstance. It can be handled without danger, and although its teeth are strong, will not attempt to bite the hand that holds it. It is, however, rather quarrelsome with its own kind, and the only excitement under which it has been seen to labor is when it takes to fighting with a neighbor. Not that even then it hurries itself particularly or does much harm to its opponent, the combatants contenting themselves with knocking their tails together in a grave and systematic manner.

A few words on the change of color will not be out of place. The usual color of the chameleon when in its wild state is green, from which it passes through the shades of violet, blue, and yellow, of which the green consists. In this country, however, it rarely retains the bright green hue, the color fading into yellowish gray, or the kind of tint which is known as *feuille-morte*. One of the best and most philosophical disquisitions on this phenomenon is that of Dr. Weissenbaum, published in the "Magazine of Natural History" for 1838, which, however, is too long for quotation.

It seems probable that the change of color may be directly owing to the greater or less rapidity of the circulation, which may turn the chameleon from green to yellow, just as in ourselves an emotion of the mind can tinge the cheek with scarlet, or leave it pallid and death-like. Mr. Milne Edwards thinks that it is due to two layers of pigment cells in the skin, arranged so as to be movable upon each other, and so produce the different effects. The young of the chameleon are produced from eggs, which are very spherical, white in color, and covered with a chalky and very porous shell. They are placed on the ground under leaves, and there left to hatch by the heat of the sun and the warmth produced by the decomposition of the leaves. The two sexes can be distinguished from each other by the shape of the tail, which in the male is thick and swollen at the base.

There are nearly twenty species of chameleons known to zoologists at the present day, all presenting some peculiarity of form or structure.



THE CHAMELEON.

Hibernation of the Cotton Worm Moth.

After reviewing all the facts and evidence on the subject of the hibernation of the cotton worm, and showing that it cannot and does not survive in either the egg, larva, or the chrysalis state, Prof. C. V. Riley, in the paper recently read by him before the National Academy of Science, considers its hibernation in the parent moth state. The power of migration is proved and admitted, and the Professor has known of large fields of melons being ruined by the moth, whose proboscis enables it to puncture the rind, as far north as Racine, Wisconsin. "It is but natural, therefore," he continues, "to conclude that the insect comes each year from some country where the cotton plant is perennial, and there are other facts which lead to this view, first put forth in 1854 by Dr. W. J. Burnett, in the Proceedings of the Boston Society of Natural History, and subsequently repeated by Prof. A. R. Grote, before the American Association for the Advancement of Science, in 1874." Prof. Riley goes on to show, however, that the conclusion is probably erroneous, and ends his paper as follows:

"My own belief now, is that the moth really survives the winter in the more southern portions of the cotton belt, as on the Sea Islands of Georgia, and in parts of Florida and Texas, and that it is from this more southern portion that it spreads this year.

"This belief, which yet lacks full confirmation, does not preclude the occasional coming of the moth from foreign, more tropical countries, or the possibility of its being brought by favorable winds from such exterior regions; though the fact is established that it could not have come from the Bahamas since 1866.

"The question has an important practical bearing, for, on the theory of the insect's ability to remain with us, much important fall and winter work of a preventive nature may be done in destroying the moths; whereas, on the theory of its annual perishing and necessarily coming from foreign countries, no such preventive measures are left to the planter. The time employed in baiting and destroying the last brood of moths in autumn will be wasted and he must helplessly await the coming of the parent the ensuing spring, and deal as best he can with the progeny."

Sharks, Sucker Fish, and Pilot Fish.

Professor H. N. Moseley, in his "Notes by a Naturalist on the Challenger," says:

While dredging was proceeding off the Island of Sombrero, on the approach to St. Thomas, two sharks (*Carcharias brachiurus*) were caught with a hook and line. One of these had the greater portion of one of its pectoral fins bitten off, there being a clean semicircular cut surface where the jaws of another shark had closed and nipped it through.

Attached to the sharks were several "sucker fish" (*Echineis remora*), as commonly is the case. Sometimes these "suckers" drop off as the shark is hauled on board. Sometimes they remain adherent and are secured with their companion. In this case four out of six "suckers" were obtained with the two sharks. They were seen to shift their position on the sharks frequently as these struggled in the water fast hooked. The remora is a fish provided, as a means of attachment, with an oval sucker divided into a series of vacuum chambers by transverse plaits. The sucker is placed on the back of the fish's head. The animal thus constantly applies its back to the surfaces to which it attaches itself, such as the shark's skin. Hence the back being always less exposed to light is light colored, whereas the belly, which is constantly undermost and exposed, is of a dark chocolate color. The familiar distribution of color existing in most other fish is thus reversed. No doubt the object of this arrangement is to render the fish less conspicuous on the brown back of the shark. Were its belly light-colored as usual, the adherent fish would be visible from a great distance against the dark background. The result is that when the fish is seen alive it is difficult to persuade one's self at first that the sucker is not on the animal's belly, and that the dark exposed surface is not its back. The form of the fish, which has the back flattened and the belly raised and rounded, strengthens the illusion.

When the fish is preserved in spirits the color becomes of a uniform chocolate, and this curious effect is lost.

When one of these fish, a foot in length, has it wet sucker appled to a table and is allowed time to lay hold, it adheres so tightly that it is impossible to pull it off by a fair vertical strain.

Fishing for sharks was a constant sport on board the ship when a halt was made to dredge anywhere within a hundred miles or so of land, in the tropics. Sharks were not met with in mid ocean.

Mr. Murray examined these sharks thus caught, and reports that they all, whether obtained in the Atlantic or Pacific Ocean, belonged to one widely distributed species, excepting one other kind obtained off the coasts of Japan. The hammer-headed shark (*Zygæna malleus*) was taken by us only with a net on the coasts.

The sharks were often seen attended by one or more pilot fish (*Naucrates sp.*), as well as bearing the "suckers" attached to them.

I often watched with astonishment from the deck this curious association of three so widely different fish as it glided round the ship like a single compound organism. The sharks, as a rule, were not by any means so easily caught as I had expected. Frequently they were shy and would not take a bait near the ship, though they never failed to bite if it was floated some distance astern by means of a wooden float. It is always worth while for naturalists to take what sharks they can at sea, since their stomachs may contain rare cuttle fish which may not be procured by any other means.

The sharks caught were always suspended over the screw well of the ship. It was amusing, on the first occasion on which one was got on board, sprawling and lashing about on the deck, to see two spaniels belonging to officers on board, put their bristles up and growl, ready to fly at the fish. The dogs would probably have lost their heads in its mouth if not driven back. Sometimes the sharks were bold enough and would bite at a bit of pork hung over the ship's side on the regulation shark hook, which is supplied to ships in the navy, and which is an iron crook as thick as one's little finger, and mounted on a heavy chain.

No shark was hooked during the voyage which was large enough to require such a hook. Nearly all the sharks caught and seen were very small, from five to seven feet in length. The largest obtained was, I think, one netted at San Jago, Cape Verde Island, which was four feet in length. Large sharks seem scarce. I was disappointed, and had expected to meet with much larger ones on so long a voyage. The largest shark known seems to be *Carcharodon rondelettii*, of Australia. There are in the British Museum the jaws of a specimen of this species which was thirty-six feet and a half in length (Gunther's "Catalogue of Fishes.") The Challenger dredged in the Pacific Ocean in deep water numerous teeth of what must be an immensely large species of this genus.

The great basking shark (*Selache maxima*), a harmless beast with very minute teeth, ranging from the Arctic seas to the coast of Portugal, has been known to attain a length of more than thirty feet. Sharks occasionally seize the patent logs, which, being of bright brass and constantly towed, twirling behind ships, no doubt appear to them like spinning baits intended for their use.

The pilot fish often mistakes a ship for a large shark, and swims for days just before the bows, which it takes for the shark's snout. After a time the fish becomes wiser and departs, no doubt thinking it has got hold of a very stupid shark, and hungrily wondering why its large companion does not seize some food and drop it some morsels. The "suckers" often make the same mistake and cling to a ship for days when they have lost their shark. I fancy that porpoises and whales, when they accompany a ship for several days, think they are attending a large whale. A humpback whale followed the Challenger for several days in the South Pacific.

RECENT MECHANICAL INVENTIONS.

Messrs. Michael Furst and William Chadwick, of Brooklyn, N. Y., have patented an improved machine for spinning hemp yarn. The improvement relates more particularly to the condenser of hemp spinning machinery, and to devices for rubbing the sliver and polishing the yarn.

An improved lathe dog, provided with a movable or adjustable arm or carrier to adapt it to hold objects at points more or less remote from the center, has been patented by Mr. B. F. Cloud, of Philadelphia, Pa.

Mr. J. D. Russell, of Lebanon, Mo., has patented an improvement in tire tighteners, which is operated by means of a cam and lifting bar, so as to expand the felly and make room for leather washers at the end of the spoke.

An improvement in bench vises has been patented by Mr. Thomas Gremmit, of Rockford, Ill. It is constructed so that it may be readily adjusted for different kinds of work, and for holding work of different shapes.

A Life Saving Bow.

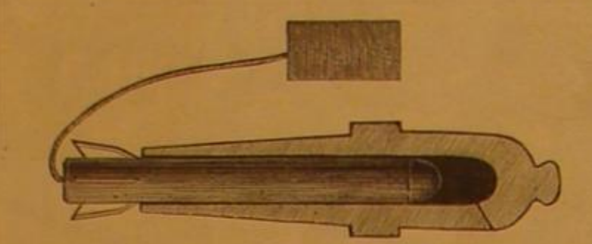
Seeing that wrecks very frequently occur within two or three hundred yards of shore, a correspondent suggests that an efficient aid to the life saving service in such cases might be found in a bow light enough to be carried in the hand and strong enough to throw an arrow with a light line to a ship in distress, or from a ship to the shore. A cord 3-16 of an inch in diameter would suffice to haul off a line strong enough to carry a cable, and much valuable time might thus be saved. To drag a heavy gun a mile or two along a sandy beach, with other heavy apparatus, involves more labor and loss of time than can well be afforded by the short crews of our life saving stations, especially when the wreck is near the shore and in danger of breaking up.

A bow carrying a light life line might be useful also at bathing stations, as at Long Branch, where accidents happen very near the shore. The cost would be small, and there would be no expense attending the practice required to make the beach attendants familiar with the use of the bow and line.

A NEW WINGED PROJECTILE.

The accompanying cut represents a new winged projectile designed by Mr. E. S. Hunt, of Boston. The Massachusetts Humane Society have recently adopted it, and have such faith in its efficiency that they have presented a gun and projectile to the Royal National Life Boat Institution, England, hoping that the authorities will consider its merits.

Two smooth bore brass guns, mere toys to look at, weighing 56 lb. and 69 lb. respectively, each 24 in. long, were used to fire the projectile, the charge of powder varying from 3½ oz. to 4½ oz. The projectile, the novel feature of the invention, weighed, when filled ready for firing, 12½ lb. In form it is an elongated shell carrying a line tightly coiled within, which it pays out without the smallest risk of breaking as it travels through the air. It is placed in the gun, as it were, the wrong or heavy shot end first, and on leaving the muzzle, at once reverses, the front end becoming the



HUNT'S WINGED PROJECTILE.

rear end, the projectile, after this reversal, maintaining, in consequence of the four wings, and on the principle of the arrow, an accurate and distant range.

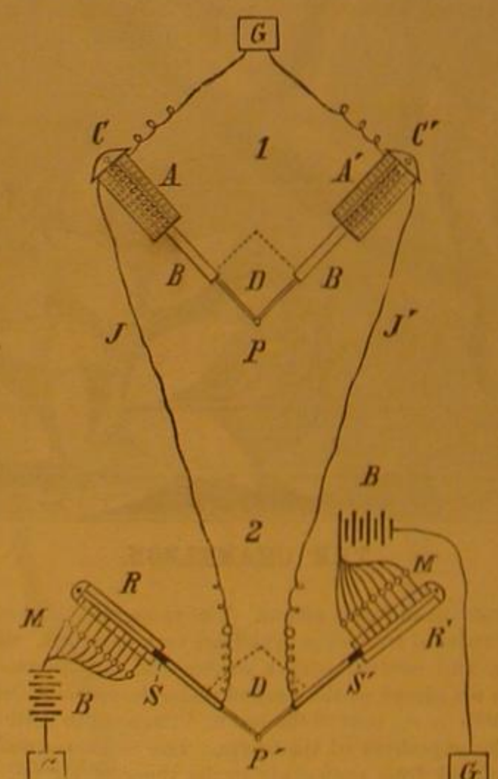
In construction the projectile is a tin tube 20 in. long, 3½ in. in diameter, having fixed or hinged wings at one end, and a leaden shot weighing 6 lb. at the other. Within the tube is a compact coil of line 17½ in. long, and the diameter of the tube. This line is from 200 to 400 yards in length, with a breaking strain of from 250 lb. to 400 lb. The shot is attached to the second or shore coil lying alongside the gun, so arranged that on the shock of the discharge the line runs out freely from both coils.

During a recent trial at Mr. Hunt's range, 22½°, an elevation which has been found by continued practice best suited to throw the line over any wreck with the smallest strain to it and the projectile, the distances obtained and measured on the official range course were 389, 448, and 507 yards, the deviation of the shot and line from the target being 4½, 9, and 8 yards respectively. Three shots fired at 30° and 35° elevation, traversing a line of flight some 400 ft. in the air, ranged 478, 489, and 386 yards, with deviations of the shot and line from the target of 2, 6, and 6 yards respectively.

THE WRITING TELEGRAPH.

Prof. A. E. Dolbear, Tufts College, Mass., communicates the following description of his writing telegraph to the *New England Journal of Education:*

When a current of electricity is sent through a hollow coil



PROF. DOLBEAR'S WRITING TELEGRAPH.

of wire the latter is made a magnet, and will attract into it a short rod of iron. If the helix be held vertical, the rod of iron may be supported in the air without touching anything, through the strength of the attraction. If the iron rod be placed end to end of the coil, it will be attracted into it with a force proportional to the strength of the current of electricity in the coil. I have utilized this in making a galvanometer, the iron rod or core being supported by a spiral spring; the distance the core is drawn into the spiral is the measure in weight of the strength of the electrical current. This same device is also employed in the receiving instrument of the writing telegraph (see 1 in the diagram).

Let *a* be a hollow coil of wire, and *b* the core of soft iron held in place by a spiral spring within the helix. At *p* is a marker attached by a light rod to the end of *b*, so that any movement made by *b* toward *c*, the bottom of the helix, would cause *p* to make a straight line in the same direction. Now let a current of electricity enter the helix by the wire, *l*, and at once *b* will move into the coil a certain distance; a stronger current would make it to move still further in, and a weaker one would allow the spring to push it back again; the marker then would make a straight line. At *a'* and *b'* is another fixture, precisely like the one described; they are at right angles to each other, and their common junction is at *p*, so that any motion made at *b'* will make *p* record the direction. When these two act conjointly, the place that *p* will have will depend solely upon the distance each of the cores, *b* and *b'*, is drawn into its helix, and when the helices can turn upon pivots at *c* and *c'* it is plain that the point, *p*, may take any position inside the space indicated by the dotted lines; that is, any kind of a figure may be drawn by *p* inside those limits. This instrument is called the receiver.

The transmitter (see 2 in diagram) is a separate instrument, and unlike the receiver. At *r* is a narrow strip of wood having a groove in it, in which *s* may slide. On one side of the groove are a series of wire terminals of the battery, B. The end, *s*, of the slide is metallic, and it is in connection with the wire, *l*; and when it is thrust a little way into the groove it touches one of the wire terminals of the battery and permits a current of electricity to flow into the wire, *l*, and so through helix, *a*, drawing *b* in and causing *p* to make a short mark. If *s* is thrust into *r* still further, a stronger current is thrown on the line, *l*, and so on the further it is down the groove. At *p'* is a marker corresponding to the marker in the receiver, so it will be understood that *p* will duplicate the motion of *p'*. In like manner as in the receiver, there is a second part in the transmitter, at right angles to the first, and its slide, *s'*, is in connection with the marker, *p'*, and with the terminals of the battery, B', so a current over the line, *l'*, will move *b'* in the receiver. The other terminals of the batteries, G and G', are in the earth. It is evident that *p'* may be at any point within the limits of movement of *r* and *r'*, and also that any new position will vary the current on one or both lines, *l* and *l'*; hence any movement of *p'* will be duplicated by *p*. For writing a strip of paper moved by clockwork under the point, *p*, will give a facsimile of what is written at *p'*. A profile or portrait, or indeed any kind of marking whatever, at *p'*, will be duplicated by the receiver. The arrangement for varying the current from the battery, B, consists of a series of coils of wire having different resistances, as shown at *m m*.

The main part of this invention was made by me some years ago, and it is alluded to in the book on "The Telephone and Phonograph," by George B. Prescott (p. 261). A device quite similar to this has lately been invented and described by Mr. Cowper, of England. His receiver, however, consists of two electro-magnets at right angles to each other, and the varying current acts so as to twist a light needle very much as in a common galvanometer. This transmitter is identical with mine. My instrument was made and shown to a good many persons when Cowper's was first made public here.

The Regeneration of the Eye.

Galignani's Messenger reports some curious experiments lately undertaken by M. Philipeaux, to discover whether on completely emptying the eyes of young rabbits and guinea-pigs, the vitreous humor would be reorganized, and whether even the crystalline would be reproduced. With this view, he has been conducting his operations, always, of course, taking care not to touch the crystalline capsule, for experience has shown that in order that an organ shall regenerate, a portion of it must be left in its place. It seems that a month after the mutilation was effected, the experimentalist was able to state that the eyes, which had been emptied, were filled afresh, and that the crystalline was reconstituted. He operated on 24 animals, and in each case the mutilated eye revived. This would seem to show that the optic organ has the same capabilities as the bones; the organic process repairs an evil and reconstructs, more or less completely, that portion which has been struck off from the whole. How far similar results are obtainable with the human eye does not appear. If the same regenerating power is found to be general, a decided improvement may be possible in the treatment of certain injuries and diseases of the eye.

Close Work.

A very pretty piece of engineering was successfully completed early in May in connection with the Baltimore Water Works Tunnel, by the resident engineer, Mr. O. C. Swann. It was the union of two headings between shafts 3 and 4, the most of which was done by Thos. McCabe, contractor. Shaft No. 3 was 276 feet deep, and shaft No. 4, 300 feet, being the two deepest on the whole tunnel. The distance apart was 2,100 feet. The center line was so exact, says the Baltimore *Gazette*, that it struck a plumb line. In the level there was no apparent difference whatever, and measurement varied only one inch between the surface and the tunnel measurement. The entire tunnel, to be 6¾ miles in length, will be finished in about a year. The tunnel commences at the Great Gunpowder river and runs perfectly straight, with an internal diameter of 12 feet, to Lake Montebello, the receiving reservoir. There are 15 shafts along the length of it, varying from 2,000 to 3,000 feet apart and from 50 to 300 feet deep.

WILSON'S "HOROGRAPH," OR CLOCKWORK PEN.

Mr. Edison's remarkable electric pen has brought to mind a stillborn effort of like character dating back eighteen years. Mr. Wilson, of the firm of Messrs. Newton, Wilson & Co., London, then conceived and worked out the idea of a pen that was operated like a fretwork machine, for marking designs on work for the sewing machine. For some reason or other, but chiefly, no doubt, because of the requirement that the work had to be passed under the pen, in sewing machine fashion, nothing came of the Wilson pen invention. It passed into oblivion, to be immediately revived, however, on the mention of the discovery of Mr. Edison. Mr. Wilson now set himself to the easy task of importing into his previous pen (which, technically speaking, would be the original patent pen) the portability of the Edison electric pen. The Wilson pen is wound up by a sort of watch movement, and its running down action may be utilized on a sheet of paper anywhere. When it is wound up it does not act at all, unless there is a slight pressure of the thumb on the controlling key. It needs no battery to keep it going. The Wilson and the Edison pen have a similar needle, perforating sheets of paper with minute holes, instead of lines; the holes thus made forming writing, or drawing, or design, at the pleasure of the writer. The perforated sheet is called a stencil, and this is put upon a blank sheet of paper. It now only remains to pass an inked roller over the stencil, when a beautiful impression will be made upon the blank sheet beneath, and upon any number of blank sheets that afterward may be submitted to the process. It is said that as many as 300 perfect impressions may be printed from a single stencil in an hour, and that a single stencil will readily yield 10,000 copies.

The Pneumatic Clock.

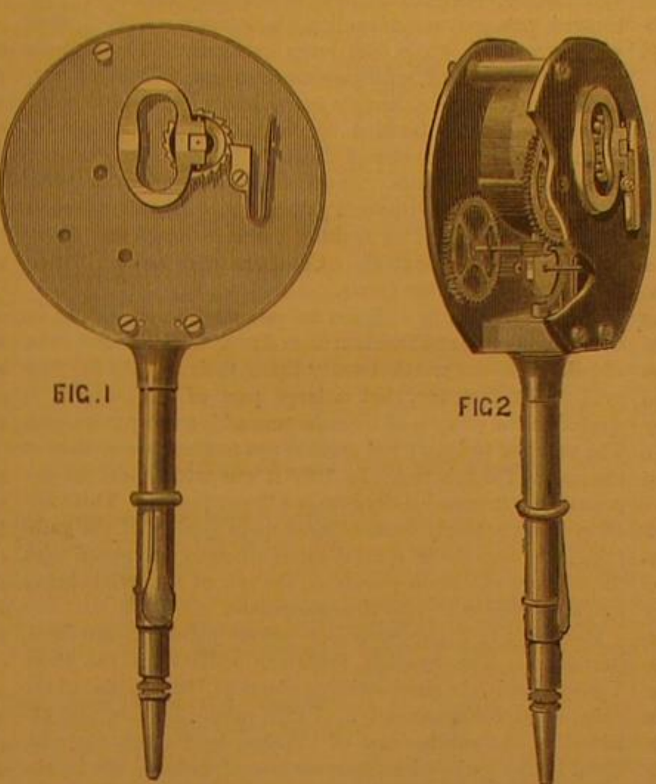
In describing the pneumatic clocks at the Paris Exhibition the SCIENTIFIC AMERICAN gave the credit of their invention to Mr. Mayerhofer, an Austrian engineer, and the merit of perfecting them to Mr. Victor Popp. In a letter, dated March 22, Mr. Mayerhofer begs to have the entire credit restored to himself. He says that the invention was made by him in 1864, but not publicly exhibited until 1875. After many delays and disappointments he succeeded in getting from the City Council of Vienna permission to set up the system in that city, on trial for one year. The cost of this experiment made it necessary for Mr. Mayerhofer to seek financial assistance, which was gained by association with Messrs. Resh & Popp, who undertook the business part of the enterprise. The construction and management of the clocks, however, fell entirely to Mr. Mayerhofer, to whom the perfection of the system is wholly due.

RECENT DISCOVERIES IN ASSYRIA.

In the course of the last summer Mr. Hormud Rassam, a Syrian scholar, made some very interesting discoveries at Balawat (nine miles from Nimroud), on the site of the ancient Nineveh. Mr. Rassam set out last year on the joint expense of the British Museum and the *Daily Telegraph*, and brought back with him most interesting collections.

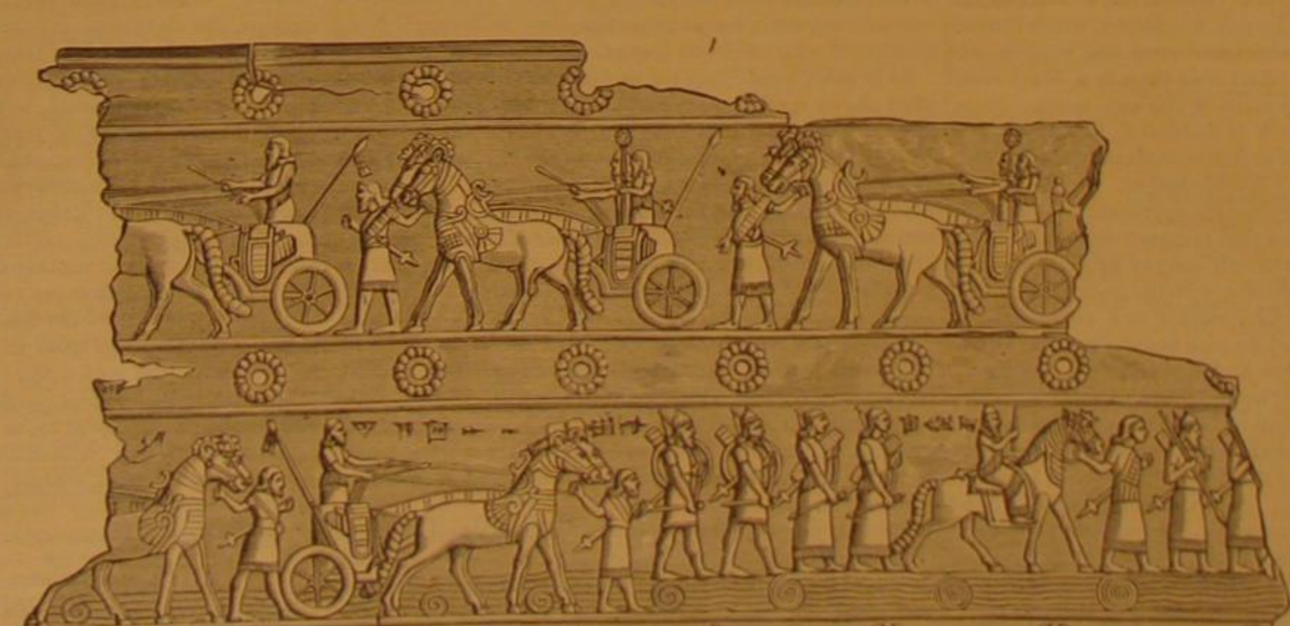
Balawat was formerly a fortified Assyrian town, but now little more than the ruins of the walls remain. This city has had different names during the reign of Assur-nasir-pal, the father of Shalmanezar II. Although situated but a short distance from Nineveh, it was conquered by the Babylonians before the fall of the Syrians. But when Assur-nasir-pal succeeded to the throne he rebuilt the town and called it Inigur-Bell. The great soldier built a temple for the god of war in the town. These facts are inscribed on some alabaster tables found by Mr. Rassam in a chest of like material, near the portico of the destroyed temple. The inscriptions describe some special event of the obscure periods of Assyrian history.

The ruins of the temple are situated in the north of the ancient village near the ramparts. By making excavations on this spot, Mr. Rassam brought to light two large bronze plates which have singular forms engraved on them. These bronzes were immediately sent to London, where they were received with the greatest enthusiasm by the Director of the British Museum. The rust and earth which thickly covered the same were then removed, and a trial was made to discover that which had been well preserved. It was soon found that they were remnants of a rectangular door which turned on pivots. Judging from the nails that have been found, the body of the door must have been of wood, about ten centimeters thick. The designs are in high relief, and represent the combats of Shalmanezar, his victories and his triumphs, the tortures inflicted upon the prisoners, and his adoration of the gods. These new documents relate of his campaign against Babylon, and also his expedition to the Mount Araval and his triumph over Akhuni, King of Borsipa.



FRONT AND SECTIONAL VIEWS OF THE WILSON CLOCK PEN.

Our engraving represents one of these plates. The king is seen on the march with his army. The warriors stand on war chariots similar to those of the Homeric heroes during the siege of Troy. The horses are led by valets, and the king is represented on horseback, and wears a flowing robe and a cape. He is preceded and followed by his eunuchs. The men carrying the bows and arrows are crossing the Tigris. The other panel shows the king sacrificing before an altar. The captain of the guards is standing behind him, and the soldiers carry an ox and a ram which are to be sacrificed. The chest found by Mr. Rassam contains tablets having hieroglyphic engravings, from which the whole history of the reign of Assur-nasir-pal can be read.—*From Le Monde de la Science et de l'Industrie.*



RECENT DISCOVERIES IN ASSYRIA.

The Latest Telephone.

At a recent meeting of the Society of Telegraph Engineers in London, an interesting feature was the disclosure made by Major Webber, R.E., to the effect that he had recently experimented with a remarkable new carbon telephone from America, which owed its power to a diaphragm of animal tissue. With this instrument, which was not further described, Major Webber was able to speak in a low tone over 70 miles of wire with perfect clearness. A part of this line consisted of underground cable, in which from 20 to 30 other circuits were busily at work without interfering with the telephonic message. The voice of this instrument was singularly full and life-like, whereas that of magneto-telephones is peculiarly thin and parroty.

Clarification of Water.

Well waters sometimes contain vegetable substances also of a peculiar kind, which render them unwholesome, even over large tracts of country. In sundry districts the decaying vegetable matters of the surface soil are observed to sink down and form an ochreous pan, or thin yellow layer, in the subsoil, which is impervious to water, and through which, therefore, the rain cannot pass. Being arrested by this pan, the rain water, while it rests upon it, dissolves a certain portion of the vegetable matter, and when collected into wells, is often dark colored, marshy in taste and smell, and unwholesome to drink. When boiled, the organic matter coagulates, and when the water cools, separates in blocks, leaving the water wholesome and nearly free from taste or smell. The same purification takes place when the water is filtered through charcoal, or when chips of oak wood are put into it. These properties of being coagulated by boiling, and by the tannin of oak wood, show that the organic matter contained in the water is of an albuminous character, or resembles white of egg. As it coagulates, it not only falls itself, but it carries other impurities along with it, and thus purifies the water—in the same way as the white of egg clarifies wines and other liquors to which it is added.

Such is the character of the waters in common use in the Landes of the Gironde around Bordeaux, and in many other sandy districts. The waters of rivers and of marshy and swampy places often contain a similar coagulable substance. Hence the waters of the Seine at Paris are clarified by introducing a morsel of alum, and the river and marshy waters of India by the use of the nuts of the *Strychnos potatorum*, of which travelers often carry a supply. One of these nuts, rubbed to powder on the side of the earthen vessel into which the water is to be poured, soon causes the impurities to subside. In Egypt the muddy water of the Nile is clarified by rubbing bitter almonds on the sides of the water vessel in the same way.

In these instances the clarification results from the iron compounds or the albuminous matter being coagulated by what is added to the water, and in coagulating, it embraces the other impurities of the water, and carries them down along with it. Salt and many saline matters have likewise the power of clearing many kinds of thick and muddy water. So long as the water contains but little dissolved matter, all its particles of mud remain a long time suspended. But the addition of almost any soluble salt, even in small proportion, will, as it were, curdle the impurities, causing them to collect together and settle. These cases, and especially that of the sandy Landes of Bordeaux, and elsewhere, throw an interesting light upon the history of the waters of Marah, as given in the fifteenth chapter of Exodus:

"So Moses brought Israel from the Red Sea, and they went out into the wilderness of Shur; and they went three days in the wilderness, and found no water. And when they came to Marah, they could not drink of the waters of Marah, for they were bitter; therefore the name of it was called Marah. And the people murmured against Moses, saying, What shall we drink? And he cried unto the Lord, and the Lord showed him a tree, which when he had cast into the waters, the waters were made sweet."—*Chemistry of Common Life, Church.*

Southern Alaska.

William H. Dall, explorer and naturalist, describes that portion of Alaska lying east and southeast of Mount St. Elias as a region covered with dense forest, canal like arms of the sea penetrating everywhere and teeming with fish as the islands do with game. The mean annual temperature is about that of Central New York, with a wetter and cooler summer and a very mild winter, the thermometer reaching zero only once in ten years. It is a paradise compared with the alkali flats of Utah, the burning sands of Yuma, or the monotonous and dreary prairies of the Rocky Mountain cattle region. Nor are its advantages solely relative. It has long been proved by actual experiment that potatoes and many other vegetables do well there, and grasses (if not grain) come to great perfection. In that region one never need lack food, and a small investment of capital is all that is needed to make a really comfortable home, were communication kept up regularly with the rest of the world, and protection against violence insured. That it is a far better country than nine tenths of Norway and half of Prussia, Mr. Dall knows from personal experience and observation.

The mineral wealth of the region is largely problematical. That gold, silver, iron, and manganese, as well as white marble exist, there is no doubt. How well they may pay for working is to be determined hereafter. If a man knows of a good "lead" he keeps it to himself until the time shall come, if ever, when he can work it in peace of mind because the United States government has decided to protect its citizens in Alaska as well as in New York, notwithstanding the fact that both speculate in mines and form associations for developing different parts of our common country.

Precious Coral.

The precious coral of commerce is, after pearls, the handsomest and most valuable production obtained from the ocean depths. Corals are ranged by naturalists in the animal kingdom at the head of zoophites or "animal plants." They are of two kinds—those deposited within the tissues of the animal (*sclerodermic*), and those secreted by the outer surface at the foot of the polyp (*sclerobasic*). Among the sclerodermic species we find such familiar forms as the "star coral" (*Astræa*); "brain coral," or "brain stone" (*Meandrina*); the "mushroom coral" (*Ctenactis*), differing from other kinds in being the secretion of a single gigantic polyp, and in not being fixed; the "madrepore" (*Madrepora*), a neatly branched kind with pointed extremities, each ending in a small cell; "sponge coral" (*Porites*), also branching, but with blunt ends and smooth surface; "organ-pipe coral" (*Tubipora*), consisting of smooth red tubes lying nearly parallel and connected by cross plates; and many others. Most of these, with other so-called corals, are to be seen in the shop of nearly every dealer in shells and natural history specimens, and are used for ornamenting chimney-pieces, drawing-room tables, cabinets, and for museum purposes. The organ-pipe coral being much cheaper in price than the more costly article, presently to be spoken of, is frequently used as its representative in cabinets of economic products. The majority of the calcareous frameworks that we designate as "coral" are white, or nearly so. At a recent meeting of the New York Academy of Sciences Dr. Newberry exhibited a beautiful specimen of a sclerodermic coral—a species of *Oculina*—which had a pale green tint, a color hitherto unknown in connection with the calcareous skeleton, although common with the animals themselves.

The coral which is alone used for articles of personal adornment and works of art is known as "precious coral" (*Corallium rubrum*), and is an example of the sclerobasic division. A sclerobasic coral is a true exoskeleton, and is distinguished by being smooth and solid. The polyps, having light fringed tentacles, are situated on the outside of this as a common axis, and are connected together by the fleshy *cœnosarc* covering the coral. The precious coral is mostly obtained in the Mediterranean, and occurs of different shades of color, the Barbary coast furnishing the dark red, Sardinia the yellow or salmon color, and the coast of Italy the rose-pink. In Europe the latter color is the most valued, while in the East the dark red is preferred. Occasionally the red coral is found white or without any coloring matter. At the Naples Maritime International Exhibition a magnificent branch of black coral from Trapani was shown, which formed a finish to the trophy of aboriginal arms and weapons exhibited from the Pacific. At Yeddo there is a black coral fishery which extends fifty miles north and south. From taking a fine polish the black is fashioned into beads and mouth-pieces for cigars. The dull white is not quite so hard, and from not polishing well is sold cheaper.

Coral presents to the fisherman the appearance of a branching shrub, of a red or rose color, compact and solid. The material has the hardness and brilliancy of agate; it polishes like gems and shines like garnet, with the tints of the ruby. The large branches are used for carving, and, as the material is durable and is well suited to give definite outlines to the sculptor's work, great labor and ingenuity are frequently expended on objects of art wrought in this material. The Chinese, Hindoos, and Cingalese have all tried their skill in carving coral, but the finest and most artistic work emanates from the Italian workshops of Naples, Genoa, and Leghorn. Much of the manufacturing process, grinding, drilling, and polishing is carried on by women. The working of beads is principally executed by the females of the Val du Bisagno, in Italy. All the operatives employed in cutting belong to about 100 families in the commune of Assio; those in piercing and rounding to about 60 families living in other parts of the valley. Every village works exclusively at beads of a fixed size.

In Genoa each manufacturer employs from ten to twenty or more women, who submit the coral to a preparatory process before it is given to the workers of Bisagno. Thirty or forty men and women are employed in their own homes in cutting coral into facets. There are also about thirty engravers of cameos and coral. In all from 5,000 to 6,000 persons gain their livelihood in the province of Genoa either by fishing for, working on, or selling coral, and this craft produces a revenue of $400,000 per annum. Exports of coral are made from Genoa to Austria, Hungary, Poland, England, America, Aleppo, Madras, and Calcutta. Large, perfect, well-shaped beads are by far the most valuable form of coral, and these have greatly increased in estimation of late years. Many of the finest are sent to China, where they are in demand for the Mandarin's red button of rank worn on the cap. Some of the natives of India have a preference for what may be called worm-eaten beads, and tons of these, which would not find a sale in Europe, go to the East, where they are esteemed from a superstitious belief that gods dwell in the little recesses or cavities of this coral.

Connoisseurs know that of late years coral has risen considerably in the estimation of the fair sex. A somewhat arbitrary standard of beauty has, however, been established in regard to the color. Coral, to be rare and valuable, must now be of a delicate pinkish, flesh-like hue, uniform in tint throughout, and in large pieces. The principal commercial varieties distinguished are red, sub-divided into deep crimson red, pale red, and vermilion (the latter rare), black, clear white, and dull white (the latter common). The delicate rose or flesh-colored, which is most prized, is sold at very high prices, as it is entirely a fancy article. In some countries red coral is classified by dealers into five grades: 1, froth of blood; 2, flower of blood; 3, 4, 5, blood of first, second, and third qualities. Dealers and workers in the material recognize rough tips and polished tips, fragments, roots of branches suitable for making earrings, and coral tulips for shaping into ornaments. Coral branches assume the espalier shape and other forms.

Coral is valued, in addition to its color, according to its bulk, soundness, and freedom from flaws. Certain rare kinds, of pale tints, are worth twenty times their weight in pure gold. The fact, too, that a large part of the material is wasted in the process of manufacture adds greatly to its cost. The value of ordinary red coral is apt to fluctuate greatly at the seat of the fisheries. In 1867 it was worth only $4 per pound, but it occasionally brings $10 per pound. This variation arises not only from differences in quality of the gathering, but also from special circumstances connected with the markets of distant countries, the sale of the article being much smaller in Europe than elsewhere.

Coral fishery is prosecuted at various points in the Mediterranean. The Spanish fishermen collect off the Cape Verde Islands, the product being about 24,760 pounds, of the value of $100,000 annually. Large quantities are also obtained on the south coast of Corsica, by Italians entirely. Coral is also gathered in more or less abundance along the coast of Tunis, Algiers, Morocco, and Barbary. The number of boats engaged in this fishery on the Algerian coast has averaged of late years about 300, more than two thirds of which are Italian. The product is said to amount to about 75,000 pounds. A coral bank of great richness is said to have been discovered on the coast of Japan, but no fishery of any importance has yet been begun there. The largest fisheries are in the vicinity of Sardinia, the exports from there amounting to $300,000 in value. The coral is chiefly found in the shallow waters near Carloforte, Alghero, and the Island of Maddalena. At Alghero about 190 vessels, manned by 1,930 sailors, are employed in the fishery from March to October.

Hitherto the fishing operations have been conducted on the old primitive method of the drag net or rough dredge, formed of a cross of wood with a quantity of hemp attached to tear up the coral. The diving bell has been made use of, but it does not succeed. A few French fishermen use diving apparatus. Torre del Greco, near Naples, is the principal residence of the coral fishers, and the place from which most of the boats are fitted out for the business. The industry is annually acquiring larger importance and the fishing is being prosecuted with increased energy.

As to other corals than the precious kind, madrepores and other showy species are sometimes used for ornamental purposes. The horny axis of black flexible coral (*Plesaura crassa*) is used for canes and whips in the Bermudas, and the axis of fan coral (*Rhipidogorgia*) for skimmers in the same islands. Coral is used for building purposes in the Pacific islands, Mauritius, Seychelles, and other places. Coral rock of recent formation (*Coquina*) is employed in Florida in the manufacture of ornamental vases and earrings.

An Anecdote of Professor Agassiz.

A writer in *Harper's Magazine* tells a characteristic story of Professor Agassiz, cleverly illustrating the difference between the older school of science, which sought simply to discover and record facts, and the modern school, which seeks the law within the law by comparison of observed phenomena.

Some 35 years ago, at a meeting of a literary and scientific club discussion sprang up concerning Dr. Hitchcock's book on "Bird tracks," and plates were exhibited representing his geological discoveries. After much time had been consumed in describing the bird tracks as isolated phenomena, and in lavishing compliments on Dr. Hitchcock, a man suddenly rose who in five minutes dominated the whole assembly. He was, he said, much interested in the specimens before them, and he would add that he thought highly of Dr. Hitchcock's book as far as it accurately described the curious and interesting facts he had unearthed; but, he added, the defect in Dr. Hitchcock's volume "is this: it is dees-creep-teeve, and not com-par-a-teeve." It was evident throughout that the native language of the critic was French, and that he found some difficulty in forcing his thoughts into English words; but the writer never can forget the intense emphasis he put on the words "descriptive" and "comparative," and by this emphasis flashing into the minds of the whole company the difference between an enumeration of strange, unexplained facts, and the same facts as interpreted and put into relation with other facts more generally known. The moment he contrasted "dees-creep-teeve" with "com-par-a-teeve" one felt the vast gulf that yawned between mere scientific observation and scientific intelligence, between eyesight and insight, between minds that doggedly perceive and describe and minds that instinctively compare and combine. The speaker vehemently expressed his astonishment that a scientist could observe such phenomena, yet feel no impulse to bring them into relation to other facts and laws scientifically established. The critic was, of course, Agassiz, then in the full possession of all his exceptional powers of body and mind.

Photography by Gas Light.

Among the various forms of artificial light which, during the past winter season, have been competing for the supremacy in photographic portraiture, common gaslight figured but little until quite recently, when Mr. P. M. Laws, of Newcastle-on-Tyne, commenced to try its capabilities. Mr. Laws' efforts in the direction of portraiture by gaslight have been noticed on more than one occasion in our columns, and his specimens have been exhibited at the meetings of the South London Photographic Society and the conditions under which they were produced explained.

It will be remembered that the light used in producing the earlier specimens was Wigham's twenty-eight jet burner, while the last we received from Mr. Laws was obtained by means of the large sized burner of sixty-eight jets, with an exposure of only twenty-five seconds for a cabinet picture, fifteen seconds having been found sufficient for a carte.

The Wigham light is not on the Argand principle, but is composed of a number of distinct jets of the ordinary description, placed so close to one another that their aggregate light forms a cone of intensely luminous white flame. In order to obviate the smoke, which would otherwise arise from the imperfect combustion of the gas issuing from so large a number of burners in so small a space, a chimney of transparent talc receives the upper part of the flame, and creates such a draught that a full and ample supply of oxygen is obtained, to secure perfect combustion as well as a more intense and whiter light. It is to be noticed that no glass chimney is required—hence there is no risk of breakage. The talc "oxidizer" (as it is called) is not liable to fracture, and, at the same time, by its transparency, possesses the advantage of not wasting any appreciable quantity of light.

The burner is made in five different sizes, ranging from twenty-eight to one hundred and eight jets, the sixty-eight jet burner occupying the midway position between those limits. This burner, by which Mr. Laws has been able to produce results with exposures very little more prolonged than with ordinary daylight, gives a light equal to 1,253 standard sperm candles on a consumption of 146 feet of cannel gas per hour. It may be noted that cannel gas and ordinary gas give very different results; if the later be employed with the sixty-eight jet burner the candle power is estimated at about 1,000. The largest size—one hundred and eight jets—gives, with cannel gas, an illuminating power of 2,923 candles on a consumption of 308 feet of gas per hour.

The manner in which the larger burners are constructed for lighthouse purposes, so as to give lights of varying intensity according to the state of the atmosphere, is most ingenious. Starting from the twenty-eight jet burner as a nucleus, the additional jets may be added at pleasure, in concentric rings, each ring being divided into two segments, and each separate segment being supplied from a special pipe fitted with a stopcock, so that even without "unshipping" the outer circle of jets their light may be shut off. The method of connecting the extra segments is most especially ingenious; instead of any screw arrangement, which would occupy time in fixing, besides other inconveniences, the supply pipe of each segment simply dips into a cup of mercury, fitting on to another tube from which the gas supply is obtained, the mercury rendering the joint air tight.

These burners afford the most intensely illuminating and, as far as we can judge from the color, the most actinic gas light we have ever seen. Mr. Laws' experiments prove that for practical photographic purposes the sixty-eight jet burner enables the photographer to, at any rate, eke out the feeble light of some of our winter days, if not to depend solely upon gaslight as his illuminating power. The total cost of the sixty-eight jet burner, fitted up, is but a few pounds.—*British Journal of Photography.*

A New Source of Heptane.

Abietene, a new hydro-carbon obtained by distilling the exudation of the nut pine or digger's pine of California (*Pinus sabiana*), was described six or seven years ago by W. Wenzell. The tree is notched and guttered in the winter season at a suitable distance from the ground, and the resin which comes from the wound is subsequently distilled. In a crude state the oil is sold in San Francisco under various names, and it is used for removing grease spots, etc. It is aromatic, colorless, and very liquid. Mr. T. E. Thorpe lately made a pretty thorough chemical and physical examination of this abietene, and found it to consist mainly of pure heptane—a substance the other known natural sources of which are petroleum and fossil fish oil. The occurrence of a paraffine playing the part of oil of turpentine in a tree now living is exceedingly interesting. In ordinary turpentines a paraffine-like substance has been found, but only in very small quantities. The composition of the oil of the *Pinus sabiana* probably varies at different seasons, as sometimes the nuts taste strongly of turpentine, and at other times they have hardly any of that flavor.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

NEW BOOKS AND PUBLICATIONS.

BETRIEBS-EINRICHTUNGEN AUF AMERIKANISCHEN EISENBAHNEN. Von H. Bartels. Berlin: Ernst & Korn.

Contains a clear and concise description, illustrated, of the stations, freight depots, cattle yards, oil docks, water powers, coal yards, switches, turntables, signals and signal service of the American railways. The author traveled on the Pennsylvania and Western roads in 1876 and '77. The subject of which the book treats was not well known in Germany, as can be seen from the fact that this book was published upon order from the Secretary for Commerce and Manufacture. We are indebted to the Smithsonian Institution, Washington, for a copy of the work.

TABLES OF THE PRINCIPAL SPEEDS OCCURRING IN MECHANICAL ENGINEERING. By P. Keerayeff. London and New York: E. & F. N. Spon.

This little pamphlet must prove of great use to mechanical engineers and users of machinery, especially as the subject is meagerly treated in pocket engineering books.

THE NEW ENGLAND BUSINESS DIRECTORY for 1879. Boston; Sampson, Davenport & Co. 8vo. pp. 1,576. Price $6.00.

This, the ninth issue of the New England Business Directory, will be of practical value and assistance to every man having business interests in, or connection with, those States. Its classification is such that one can find in a moment the names and post office address of every man or firm, in any business, in any town in New England. The book is well made, and contains a good map of the Eastern States.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) A. McC. asks: 1. What length and sizes of wire for primary and secondary coils would be required for an induction coil to give a ¼ inch spark for the electric pen described in No. 8 of present volume for February 22, 1879, p. 121? A. Wind over a well insulated core of No. 18 annealed wires, ½ inch in diameter and 3½ inches long, two layers of No. 16 silk covered wire for the primary. For the secondary wind over the primary about 15 layers of No. 36 silk covered wire, insulating the separate layers as well as the primary from the secondary with two thicknesses of shellacked writing paper. You will need a condenser. 2. In "Notes and Queries," No. 32, March 22, 1879, you answer a like question from A. L. S., by saying "a coil giving an 8 inch spark will do." This is evidently a misprint; an 8 inch spark is a very powerful one. Do you mean a ⅛ inch spark or an 8 inch coil? A. It was a misprint; it should read—a ⅛ (one eighth) inch spark will do. 3. I have a small coil made for a medico-electric apparatus. It is 2 inches diameter by 5½ inches long and gives powerful shocks, but, though I have made for it a condenser with 350 square inches tin foil (700 in counting both surfaces) it will not give a spark more than one twentieth inch long, when used with the zinc and copper, sulphate of copper battery jar belonging to it. I have used it with a more powerful battery, before attaching the condenser, but could see no spark. The circuit braker is a thin spring about one-fiftieth inch thick, nine-thirty-seconds inch wide, 1¼ inch long. Does it need more wire, a better, *i. e.* lighter spring, or more battery power? A. It is probable that the coil is not made with sufficient care to give a spark of any considerable length. The insulation must be very perfect.

(2) L. writes: 1. In making brass cocks that are used to control the flow of water in hydraulic cotton presses, can they be made solid by using a core in the mould? A. Yes. 2. If a core can be used, what should it be made of? Made of common sand they all come out full of small holes just under the scale. A. River sand 2 parts, loam 1 part, and a very small quantity of wheat flour. Mix well together and moisten preparatory to moulding, with stale beer or with water to which a little molasses has been added.

(3) F. C. J., referring to query (20), page 283, current volume, writes: It seems to me the answer should be four feet instead of three. A. Test the question practically by weighing any uniform bar of iron on two scales, or spring balances. If it was placed at 4 feet the two men would carry two thirds and a part of the other third. See answer to W. P. P. on this page.

(4) W. P. P. writes: On page 283, current volume, query (20), relating to the carrying of a 12 foot shaft by three men, two carrying it by means of a lever and the other by taking one end, you state that to distribute the weight of the shaft equally between the three men, the lever should be placed three feet from the end. Is this right? I think it should be placed 4 feet from the end, because the 4 feet one side of the lever would balance 4 feet on the other side of the lever, leaving 4 feet for the man at the other end. Am I right? A. True, 4 feet on one side of the lever balances 4 feet on the other—but this does not leave 4 feet for the other man to carry, but one end of four feet. See answer to F. C. J. on this page.

(5) H. J. P. asks if the Corliss engine which was at the Centennial was the largest ever built? A. We believe it was the largest Corliss engine which had been built up to that time.

(6) A. D. R. asks if the mercurous sulphate battery gives off poisonous fumes, or fumes that would destroy metallic apparatus. A. If pure sulphate were used the amount of anything given off would be inappreciable under ordinary circumstances. These batteries should not, however, be kept in a warm place.

(7) J. H. G. asks: How can I make an emery wheel out of a cast iron one? A. Cement to the periphery of the wheel a strip of leather, allowing the ends to overlap each other. Coat the leather with rather thick glue, and roll the wheel in emery heated to about 200° Fah.

(8) F. L. R. asks: What causes halos around the sun and moon, and what do they indicate, if anything? A. They are formed by reflection of light from minute crystals of ice floating in the atmosphere or from watery vapor. They generally indicate a change of weather.

(9) C. M. R. writes: 1. I have constructed an induction coil, 1¾ inches by 1½. Nos. 26 and 36 silk covered wire used in its construction, and each layer is insulated with paraffined paper. Also a condenser containing 324 square inches of surface mica insulated. Have proved the insulation with galvanometer. The coil without condenser will yield a spark ⅛ of an inch, but with condenser in primary circuit, as per drawings and description in SCIENTIFIC AMERICAN SUPPLEMENT, No. 160, Fig. 4, the spark will not pass even at half that distance, though the shock which one may receive by completing the circuit with the hand is greatly increased. Are these results such as might be expected, or should the coil yield a spark at greater distance with the condenser in, and if so, where is the fault? A. Your primary wire is too small, and your condenser must be in some way defective. See that the two parts are everywhere well insulated from each other. Possibly less condenser surface would be better; the coil should certainly yield a longer spark with than without a condenser. See reply to A. McC. on this page. 2. How is the Trouve battery constructed? A. See SCIENTIFIC AMERICAN SUPPLEMENT No. 159.

(10) J. W. W. writes: I am making a dynamo-electric machine according to drawings in SUPPLEMENT No. 161, only three times the size instead of twice. What would be a suitable number of wire to wind the magnets and armature? The machine is intended for general experimental purposes, with reference more particularly to the production of a small electric light. A. You would probably obtain good results by winding the magnets with No. 14 wire and filling the armature with No. 16.

(11) C. B. B. asks: How can I polish fancy woods? A. Apply with a woolen rubber a mixture of alcoholic shellac varnish 3 parts, boiled linseed oil 1 part. Rub the work briskly until the shellac is hard.

(12) J. A. D. writes: In No. 162 of the SCIENTIFIC AMERICAN SUPPLEMENT you describe a simple electric light. 1. How many Bunsen cells would be required and how long would the light last? A. It would require about 8 or 10 cells. 2. Would a piece of carbon from a lead pencil answer for the thin carbon rod? A. No. 3. In No. 160 SCIENTIFIC AMERICAN SUPPLEMENT is a description of an induction coil. Is there a simpler way of making a commutator. If so, please describe it, and if possible by diagram. A. See answer to W. G. S. on this page. 4. How long a piece of tin foil is needed for 40 square feet of surface if it is one foot wide? A. 40 feet.

(13) W. G. S. asks: 1. Could the commutator described in connection with the induction coil (SCIENTIFIC AMERICAN SUPPLEMENT No. 160) be made like that of Professor Hughes' induction balance (page 244 in current volume of SCIENTIFIC AMERICAN), and if so describe connections and give details of making? A. You may make one on a similar principle by connecting with each binding post a button, and driving three round headed screws into the board, so that either the middle screw or one of the outer ones may be touched by one of the buttons, and the middle and the other outer screw may be touched by the other button. Connect the middle button with one terminal of the primary coil and the two outer buttons with the other terminal and you have it. 2. What would be the price of the induction coil? A. $35 to $40. 3. How can I make a pair of spools suitable for a telegraphic instrument or electric call bell? A. As you do not give the resistance of your proposed line we cannot give you a definite answer. If the bell and instrument are intended for experiment only, probably the following would do: Turn two very thin wooden spools, 1½ inch long, ⅜ inch internal diameter. Wind them with about 8 layers of No. 20 cotton covered wire. 4. Could I make a Trouve battery of a number of zinc and copper plates in the same cell, and would it be of sufficient power to be felt? A. You can make a battery in the way you propose, but you will not be able to feel the current from it without using a great number of pairs or employing an induction coil.

(14) J. A. McC. asks: 1. Is not the office of the line wire in the acoustic telephone to transmit the vibrations of the diaphragm from the transmitting to the receiving instrument? A. Yes. 2. If this be correct, would it not be better to use as light a wire as possible? A. Yes. 3. If this also be correct, would it not be better to use hard drawn wire on account of strength and lightness, instead of soft? A. No, on account of its resonance. 4. What is the durability of the diaphragm in this instrument when made of thin iron, or has it been tested? A. We see no reason why it should ever fail. 5. Is there any more danger of damage from lightning on lines of one mile and less without ground connections than there would be from a badly put up lightning rod to a house or other building? A. More danger to the operator because the line extends over a greater area. You should use a lightning arrester. 6. Can you tell me if there is any foundation in fact for the idea generally prevalent among western hunters that a breech loading shot gun will not shoot as well as a muzzle loader, everything else being equal both as regards closeness and penetration? A. We think a well made breech loader the best.

(15) J. H. W. asks for the best way to keep steam boilers through the summer that are used for heating purposes in winter. A. Fill them entirely full of water and paint the outside well.

(16) D. B. B. asks can power be obtained by air pressure in the cylinder of an engine in the same manner as from steam. A. Yes. See Mr. Haupt's report published in Nos. 176 and 177 of the SCIENTIFIC AMERICAN SUPPLEMENT.

(17) J. L. G. asks: 1. What is meant by saying an engine cuts off at ½ or ¼ stroke? A. Cutting off the steam at the time when ¼ or ½ the stroke is made. 2. How is the valve set when it cuts off at ½ stroke and when it cuts off at ¼ stroke? A. We cannot explain to you the set of the valve, as it depends upon the kind of valve and valve motion. 3. Are the fire sheets of a large flue boiler the same as the other sheets? A. Yes. 4. What is the diagram often mentioned in connection with steam engines? A. By examining the back numbers of this journal you will find descriptions and cuts of engine diagrams.

(18) D. C. H. asks for a receipt for making paste to make paper adhere to tin. A. Soften 4 parts of glue in 15 of cold water, and then moderately heat until the solution becomes quite clear. Then add 65 parts of boiling water, and agitate. In another vessel stir up 30 parts of starch paste with water enough to form a milky liquid without lumps, and into this pour the boiling glue solution with constant stirring. Continue the boiling for a few minutes, and add, after cooling somewhat, a drop or two of carbolic acid to each gallon of paste. Keep the paste in closed vessels.

(19) P. A. L. asks if bismuth is extensively used. What is its value? A. Bismuth is chiefly used for certain alloys, as Newton's and Rosse's fusible alloys, etc. The basic nitrate and the carbonate are used in medicine. *Magisterium bismuthi* or *blanc de fard* is used as a cosmetic. Bismuth is worth about $2.25 per pound.

(20) J. C. asks: 1. Do you know of any locomotive in Wales or England that weighs 120 tons? A. No. 2. What is the weight of the heaviest American locomotive that you know of? A. About 60 tons without tender. 3. When is a locomotive heaviest on the rail, when it is running or when it is standing? A. When running up a concave grade.

(21) B. F. M. asks: 1. Will it materially weaken ¾ inch pipe to bend it cold into coil of 20 inches internal diameter? A. No, if of good iron. 2. Can a pump be made—and how—to work boiling water coming out of boiler at about 150 lbs. pressure? I wish to take the water out at one side and pump it in again at the other. A. Place your pump a distance below the boiler, so that the water will fill the pump by gravity.

(22) J. J. B. writes: A friend of mine has in constant use three return tubular boilers side by side, two of which are connected with one smoke stack, 60 feet high; the third is connected with another smoke stack, same dimensions and height as the one referred to. The smoke stacks are of brick, and stand about seven feet apart. The first smoke stack referred to has not quite sufficient draught for two boilers, the other has more than enough for one. Will connecting the two stacks be of any benefit in running the three boilers, if so, how near the surface of the ground should the connection be made? A. Yes, if properly done. The flues of all the boilers should be brought together and then divided to lead off to the two chimneys.

(23) T. P. H. asks: 1. Will not a keel do as well as a center board in the boat of which plans are given in No. 29 of SUPPLEMENT? A. You will not be able to carry so much sail with the ordinary keel unless the boat is ballasted. 2. If so, what depth and thickness should the keel be made? A. 2 inches thick and 4½ inches deep.

(24) J. H. C. asks: Can you tell me when and where cycloidal teeth were first used for gear wheels? Who is supposed to have invented them? A. Camus, a French mathematician, describes cycloidal gearing in a work published in 1732 and translated into English about 1806. 2. Are the profiles of "involute" teeth approximate involutes, or are they but one of the curves of cycloidal profiles? A. Approximate involutes. 3. Can you refer to any work containing the history of gearing? A. There is no such work that we know of.

(25) W. R. writes: 1. Suppose two side wheel steamers of unequal size run with equal speed in still water, should the larger boat be able to beat the smaller one against a current because the current has more effect on the smaller boat? A. The one having the greatest propelling power in proportion to its weight, should be the most efficient against the current. 2. Can a boat run in shallow water (not touching bottom) as well as in deeper water, other things being equal? A. No. 3. If two unequal but similar boats stop their engines when even and going at the same speed, which will stop first? A. Other things being equal, the lightest boat.

(26) H. B. asks: 1. Through what process is paper passed that it may resist the influence of water and fire? A. For processes of waterproofing paper, consult SCIENTIFIC AMERICAN SUPPLEMENT No. 96. A saturated aqueous solution of sodium tungstate may be used to render paper uninflammable. 2. What chemicals are used in the manufacture of lumber from paper? A. Usually a concentrated aqueous solution (hot) of zinc chloride.

(27) J. T. G. asks how to remove the paper patterns from scroll work. A. Moisten it and scrape it off. It is better to trace the pattern than to paste it on the work. It is a good plan to paste the pattern on a piece of veneer and preserve the whole as a pattern after sawing.

(28) P. B. C. writes: 1. I have a well, 14 rods from house, at 26 feet rise from well to house. I have common force pump, 1¼ inch diameter by 4 inches stroke. Will the pump force water through a ½ inch pipe to the house? A. Do not use less than ¾ inch pipe. 2. Will an air chamber on the pipe help it any? A. Yes. 3. How large a windmill will it take to drive the pump? A. 8 feet.

(29) J. M. H. asks for dimensions for a pleasure skiff twenty feet long. A. 20 feet long, 3 feet 3 inches wide at bottom and 4 feet at top, and 18 inches deep, 7 inches shear forward and 4 inches aft; stern 2 feet 10 inches wide.

(30) G. L. W. asks: 1. What would be the power of an engine 8 inches by 10 inches stroke, with 100 lbs. steam pressure, making 100 revolutions per minute? A. See page 267-(4), current volume of the SCIENTIFIC AMERICAN. 2. What is meant by mean effective pressure? A. Average pressure on the steam side of the piston, greater than the retarding pressure on the exhaust side.

(31) "Subscriber" writes: 1. We have a line of steam pipe, one hundred and twenty-one feet long, and have some difficulty in keeping our union joints tight. Would we gain anything by putting expansion joint in the line, and if so, would one be sufficient? A. Certainly, put in an expansion joint, or else suspend the pipe so that it can expand and contract freely. 2. Will asbestos cement rust steam pipe or a boiler? A. We think not.

(32) H. F. asks: Is there any astronomical reason known why the earth, one of the smaller planets, was selected by the Almighty to be the habitation of man? A. Neither known nor possible to be known. It does not fall within the province of astronomy to discover the motives of the Almighty in ordering things as they are. Science endeavors to discover the conditions of phenomena: it has no business with the infinite *why* of existence.

(33) C. P. M. writes: I have made a phonograph from drawings in SCIENTIFIC AMERICAN SUPPLEMENT No. 133, but fail to make it work. I have followed directions implicitly, and I thought perhaps you might give me some light as to some essential part that I had overlooked. The needle makes the groove all right, but does not seem to make any dots if I speak into it, nor does it reproduce sound when turned back. A. It may be that your diaphragm is too thick or too heavily damped, or it may be that your mouth piece is not tight. You should also bear in mind that it is necessary to speak quite loudly and clearly to the instrument.

(34) J. J. B. H. asks for the meaning of the term "angular aperture" as applied to microscopical objectives. A. The angular breadth of the cone of light which a microscope receives from an object, and transmits to the eye, is called its angular aperture.

(35) T. E. W. writes: If a hole were made through the earth, passing through the center, and a bullet dropped into the hole, would the bullet stop at the center, or pass through nearly to the other side, oscillating to and fro, losing a little distance each time, until it finally settled at the center? I hold that it would not pass the center; that at the center the weight would be nothing, the attraction nothing (or balanced), and the velocity nothing. My friend holds that it would reach the center with enormous velocity, and be carried through to the other side. Please say which is right. A. We think your friend is right. The bullet, upon arriving at the center of the earth, would have an amount of accumulated energy (so to speak) or momentum, that would be expended by passing beyond the center against the action of gravitation, then would return again under the action of gravitation.

(36) "Student" writes: 1. I have an engine, 8 inches diameter and 12 inches stroke. Purchased it for 15 horse power, but with 100 lbs. steam and 100 revolutions per minute, I calculate 21·50 by your rule, allowing 1-5 for friction. 1. Am I correct? A. Yes; but have you sufficient boiler? It is a badly proportioned engine to get that amount of power from. 2. Have I sufficient power to run a 56 inch circular saw in heavy pine timber and 3 wood turning lathes at the same time? A. Not at proper speed. 3. Can I run a 24 inch burr corn mill and 70 saw cotton gin at once? A. We think not, to their full capacity. 4. What rate per minute must I run my saw and grist mill in order to obtain the best results? A. Consult a good millwright, as it depends upon the kind of work your mills are to do. 5. Is a 5 foot driving wheel too large for 12 inch stroke? A. No.

(37) A. B. B. writes: I have a mercurial barometer from which some of the mercury has been spilled. Will it indicate the changes in the weather correctly? A. No, it should be refilled. This you may do by inverting it, pouring in mercury, and jarring it to remove every particle of air.

(38) T. A. S. asks: 1. Would it not increase the power of an electro-magnet if, with a given battery power, I connected ground wires; connecting the — pole directly with the earth by one wire, and running the current from + pole to another ground wire after passing around the magnet? A. No. 2. Would a magnet made of ⅝ inch iron, the poles 3½ inches long, wound with Nos. 20 or 21 wire, and connected with two cells Callaud battery, attract with much force at ¼ inch from the poles? A. No; magnetic attraction is inversely as the square of the distance.

(39) F. A. S. asks: 1. Will several magnets in close proximity, if insulated, retain each their separate power? A. No. The magnets will mutually enfeeble each other. 2. Does pointing a magnet concentrate its power at the points? A. Yes, to some extent. 3. How near the neutral line on a magnet can the coil be placed, and still have its effect in the telephone? A. The coil of a telephone should be near the end of the magnet. We do not think the telephone would work at all with the coil near the mean line of the magnet; that is if the magnet were of any considerable length.

(40) J. M. S. writes: Suppose we place 3 wheels on the axle of a locomotive secure, and let the outside wheels be twice as large as the center one, and then we raise the track for the middle wheel so that they may all have an equal bearing on the tracks. Now in traveling a certain distance of course it does not take as many revolutions of the large wheels as of the small one, but as they are all fast to the same axle, one cannot make more revolutions than the other. How is the distance gained by the small wheel, and does it slip on the track? A. As you have two large wheels and but one small one, and the same weight supposed to be resting on each, the small one must slip.

(41) G. W. E. asks: If you take two cog wheels of the same diameter, the same number of cogs etc., place one of them stationary and revolve the one around the other, how many revolutions will the movable one make passing once around the other? A. Two.

(42) E. F. writes: I would like to know if there is anything made so as to filter the water before entering boiler, and is now in successful operation, and where it can be seen or had; or is there any composition or liquid, when mixed with the water, would precipitate the sediment to the bottom as in a tank. A. If you are troubled with a lime deposit, there are various feed water heaters that will relieve your trouble, as they are arranged so as to deposit most of the lime in the heater. Various materials are used to aid in the removal of deposits, but an analysis of the water should be made before proper advice could be given.

(43) C. C. S. asks (1) whether two lubricated hard substances will wear longer together than one hard and one soft. A. Yes. 2. Would the result be the same where there is no lubricator used? A. Yes, that is, the hard surfaces would wear the longest.

(44) J. O. H. asks: Can you give me a remedy for excitability, while reading or speaking before a school? A. Force of will and practice are the best remedies. It is said that a momentary inhalation of the vapor of ether will quiet the nerves and give a feeling of confidence, but we should greatly prefer the other remedies.

(45) T. S. V. asks: How hard or how soft will cast steel require to be before it is tempered? I claim that it is tempered when it is extremely hard, or when it is annealed very soft. Am I correct? A. Tempering is reducing the hardness of a piece of steel to any degree short of the softness produced by annealing by the application of heat. The operation of hardening does not properly include tempering.

(46) J. R. B. asks: Can you give me any receipt for bending white oak save the ordinary way by steaming? Is there any composition used? A. We do not know of any composition for this purpose. Boiling the wood in water is sometimes preferred to steaming.

(47) F. P. asks how much and what size wire he should use on electro-magnet, with core 7-16 inch diameter and 2¾ inches long, to be operated by one or two cells Grove's battery. A. You do not mention the purpose for which you intend using the magnet. Supposing you intend it merely for experiment, we suggest winding each core with 8 or 10 layers of No. 20 wire.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. C. McL.—It is a fine sample of asbestos.

COMMUNICATIONS RECEIVED.

On a Solution of the Convict Labor Question. By D. D. S.

On Solar Circulation: Heat and Light. By E. F. D.

On Rotary Motion. By H. J. M. M.

[OFFICIAL.]

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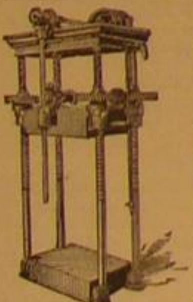

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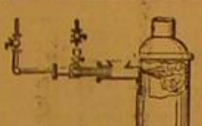
THE AMERICAN GENTLEMAN'S REVOLVER. The most elegant Revolver in design, shape, and finish, ever seen in the United States. The above picture can give but a faint idea of this beautiful weapon. It is made of the finest **English Steel,** *positive stop fluted Cylinder* (using extra long rifle cartridge), and having an **extra long barrel.** *THE BARREL IS 4½ TIMES AS LONG AS THE CYLINDER,* and is rifled as carefully and finely as a Creedmoor Rifle. **The Czar has both front and rear sights,** the front sight being shaped like the famous "*California knife blade sight,*" the finest muzzle sight made. **The Czar** will kill farther than an ordinary Revolver will *shoot;* it will bring down a squirrel from out of the tallest tree; it is a dead shot at 100 yards. The Czar has a similar shaped stock to the Smith & Wesson 38 calibre, which gives the finest "GRIP" obtainable. The stock is hard rubber, finely chased and engraved. The frame and barrel are *triple* nickel silver plated, and the cylinder and base-pin are heavily **gold plated.** It is engraved throughout *by hand* in the most exquisite manner; the work on the frame being so fine as to resemble **frosted silver.** The effect of the gold and nickel plate and the dark engraved rubber stock is beautiful beyond description. **The Czar** is in every respect the most superb revolver that has ever been made; and there is not a gold-mounted revolver in the market for $10 that will in any way compare with it. WE GUARANTEE IT EQUAL TO A COLT OR SMITH & WESSON IN WORKMANSHIP, MATERIAL, AND ACTION. Every one will remember seeing our advertisement of the Alexis Revolver, last fall. The Alexis had the most remarkable sale of any Revolver ever sold in this country—over 30,000 in three months; and at times it was a perfect impossibility to fill our orders on time. The Alexis was a bargain, but the **gold-mounted Czar** is as much finer and better *everyway* than the Alexis as a Winchester Rifle is better than a common Musket. The Alexis was made for a large Russian firm, who were unable to pay for them. The Czar Revolvers were a part of the same order, but were intended for an **officer's pocket Revolver** at a much higher price. The actual retail price of the Czar Revolver was to be over ten dollars, and we offer it for $2.75. **It is the biggest bargain as well as the handsomest Revolver ever seen in America,** and we guarantee *perfect satisfaction* or money refunded.

PRICES. CZAR REVOLVER, rubber stock, full nickel silver plate, GOLD-MOUNTED, **$2.75;** with Ivory stock, **$3.75;** with pearl stock, **$4.50.** *On receipt of cash with order,* we give **FREE** a box of cartridges with each Revolver. The cartridges WILL NOT be given free when the Revolver is sent C. O. D. Uses regular metallic cartridges sold everywhere. To those not living near an express office we will send the Czar Revolver by *registered* mail, prepaid, for 25 cents extra; when sent by mail cash in full must come with order, as we cannot send C. O. D. by mail. We will furnish, for **50 cents extra,** an extra cylinder; one can then have 14 shots ready for use; the cylinders can be changed in an instant. For **$1 extra,** an extra barrel, 8 inches long, elegantly rifled, for target shooting. The barrels can be changed in a few seconds, and with an 8-in. barrel the Czar is almost as good as a Rifle. *The Czar loads and ejects cartridges without removing the cylinder.*

READ THIS CAREFULLY. *With fire-arms, the same as with sewing machines or watches, the price depends,* **1st,** *upon the quantity made (it is obvious that 10,000 can be made at one-half the proportionate cost of 1,000) and* **2nd,** *upon the cost of the machinery necessary to produce them. It is often the case that the producing machinery of a new Revolver costs $10,000; now if only 5,000 of these Revolvers were made, $2 apiece would have to be added to the* **real cost** *of each Revolver to get back the cost of the machinery. There is scarcely a $10 Revolver in the market that really costs over $3, or that couldn't be sold for that sum if the cost of the machinery, patterns, &c., &c., necessary to produce it was not taken into consideration; but this of course must be, and each Revolver is taxed for its proportionate part, which is often much more than all the rest. The machinery used in the manufacture of the* **Czar Revolver cost over $30,000,** *and for the use of this machinery we pay absolutely nothing, the Revolver costing us simply for material and labor. There are about 20,000 of them all made, with the exception of the rubber stock, which we make ourselves, stamped with our own initials. This number will last but a very short time, as it is the most tremendous bargain ever heard of in the Revolver line; a veritable* **$10 Revolver** *gold-mounted, for* **$2.75.** *After this lot is exhausted, we shall continue making them to meet the demand, though the profit will be very small. WE DO NOT ASK ANYONE TO TAKE OUR WORD IN THIS MATTER; we will, when the purchaser requires it, send a Czar Revolver, C. O. D., with privilege of examination at express office, before paying bill,* WITHOUT ANY MONEY IN ADVANCE. *This offer places our statement* **absolutely beyond disbelief.** *If you doubt our assertions* **then we will prove them to you,** *without any risk on your part. This is neither a swindling or deceptive advertisement. If you wish to purchase a Czar Revolver and dislike to send the money in advance then deposit it with your express agent and get him to write us, guaranteeing to return the Revolver to us within three days, if not taken, free of expense to us and in as good condition as when received, and we will forward the Revolver; of course cash orders will always be filled before those sent C. O. D., which may have to wait several days, and the purchaser will have to pay the return charges on the money, which are often very heavy, and he will not get the box of cartridges which we give free when the Revolver is paid for in advance. We offer to send them C. O. D. simply to prove beyond doubt that we claim no more than the Revolver itself will back up. Out of ten thousand sent C. O. D., not one would come back, but the extra trouble to us of a package sent C. O. D. is very great and we try to make it an object to send cash in advance.* IF THE REVOLVER IS NOT AS REPRESENTED WE WILL REFUND THE MONEY EVERY TIME. *Remit by registered letter, Post Office money order, or bank draft, or send your money by your express agent, who will call and get the Revolver and deliver it to you.* Address **G. W. TURNER & ROSS, Importers, M'f'rs, and Dealers in Fire-arms,** 16 & 17 Dock Square, Boston, Mass.



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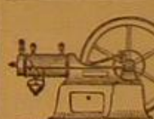

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THE

Hancock Inspirator.

STRONG TESTIMONY.

DUNNELL MANUFACTURING CO.,
PAWTUCKET, R. I., May 12th, 1879.

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Very respectfully,
J. A. MONCRIEF,
Engineer for Dunnell Mfg. Co.

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