SCIENTIFIC AMERICAN

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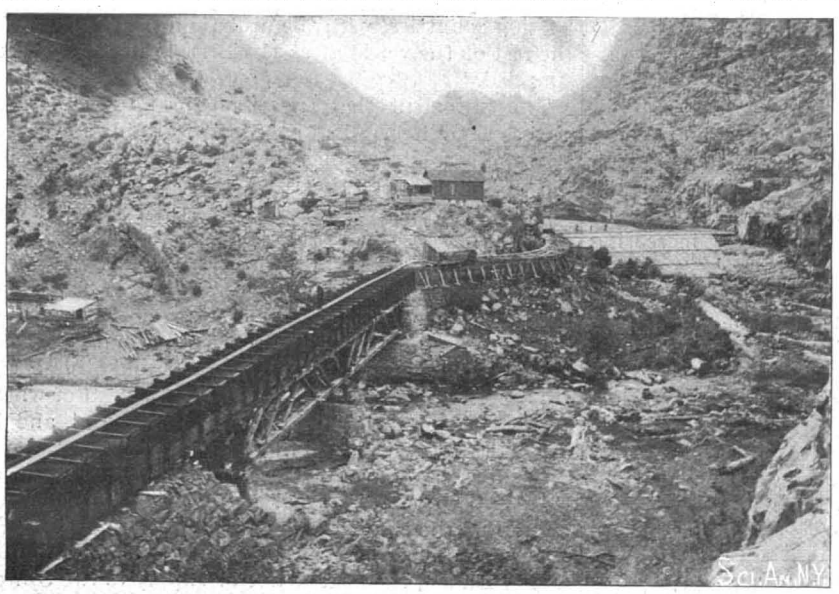
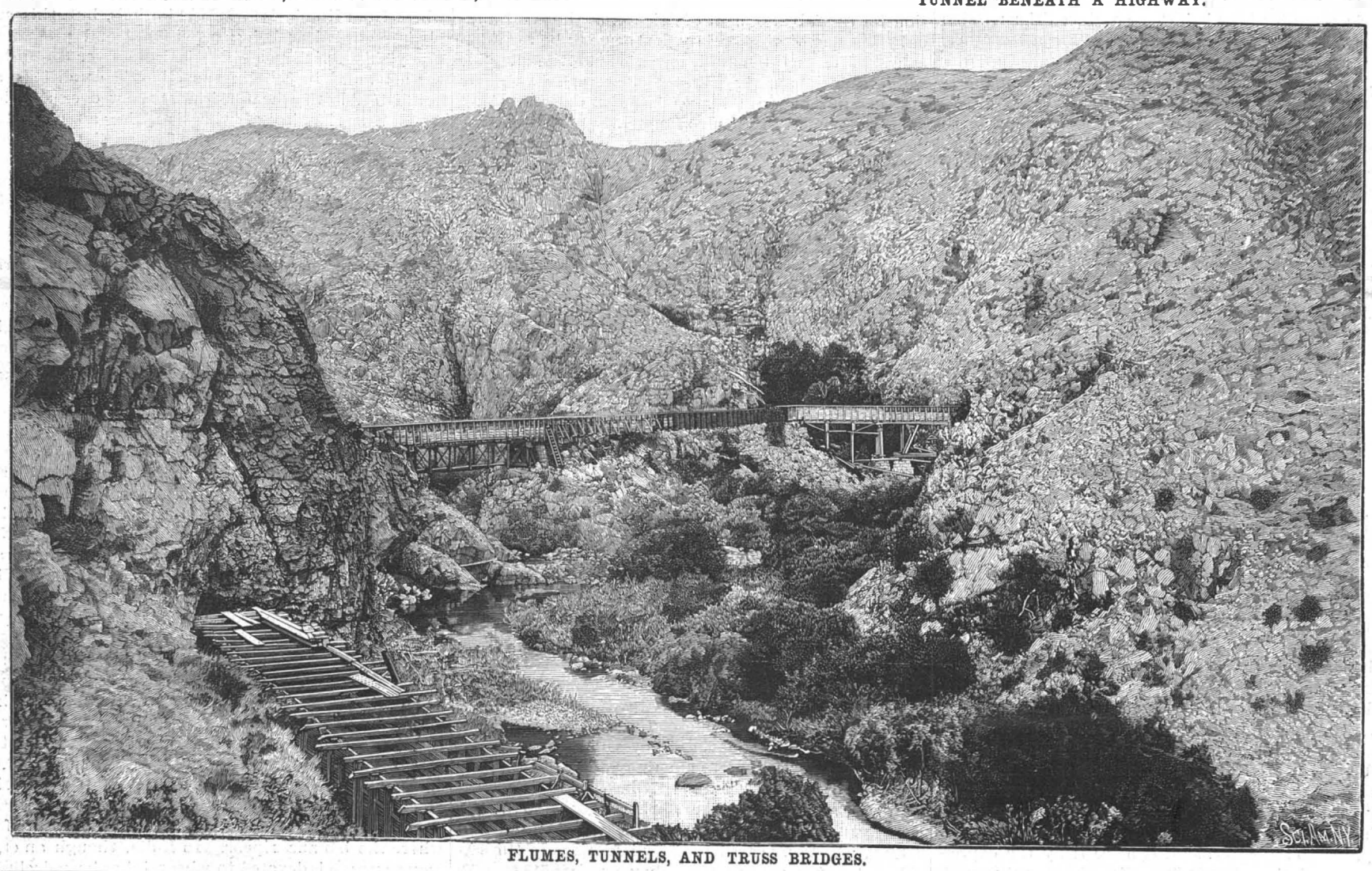
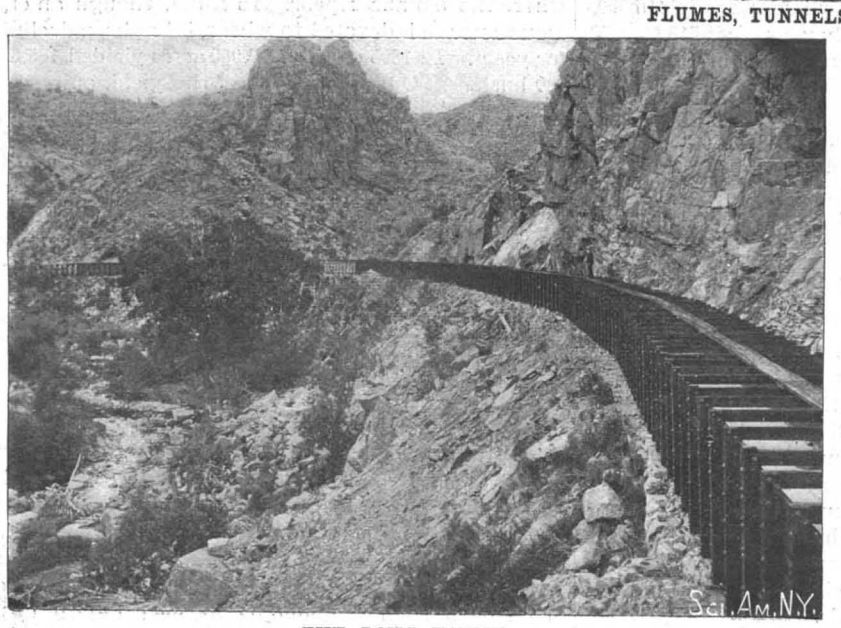


DAM AND HEAD WORKS, NORTH FORK DITCH, COLORADO.

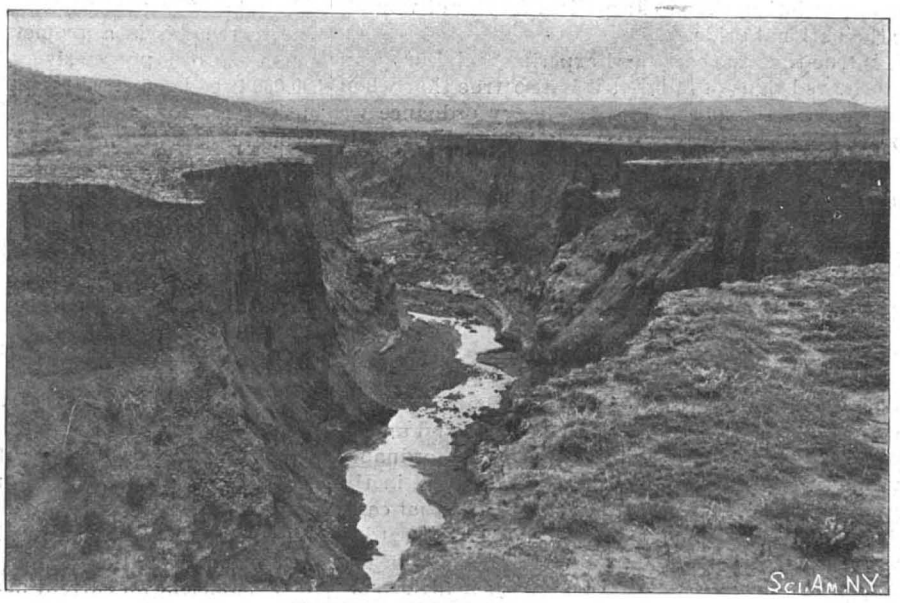
TUNNEL BENEATH A HIGHWAY.



FLUMES, TUNNELS, AND TRUSS BRIDGES.



THE LONG FLUME.



NATURAL CHANNEL DIVISION.

IRRIGATION IN COLORADO—SOME DIFFICULT ENGINEERING PROBLEMS.—[See page 214.]

Total length of main ditch and laterals, 52 miles. Irrigation capacity, 12,000 acres. In actual cultivation, 5,000 acres.

Scientific American.

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PATRIOTIC CRITICISM.

Considerable discussion has been evoked by a letter recently published in The Sun in which the writer made some very just and timely criticisms upon the guns of our navy. Reference was made in this letter to the fact that in energy and rapidity of fire our larger weapons are greatly inferior to guns of the same caliber now being turned out by some of the leading manufacturers of Europe. In proof of this, certain facts, which are well understood by our ordnance experts, were quoted, and the statement was made that, while it is generally known and conceded that our gunners are the best in the world, it is not generally known that the guns they handle are far from being up to the present standard of excellence. The facts, as given, were perfectly correct. They may be found stated at greater length in the special editions which we have recently issued on naval and coast defence, where the pressing necessity for naval guns of greater rapidity and power is shown by a series of comparative tables.

The publication of this letter, however, drew forth an indignant protest from an ex-officer of the navy, who, after making a series of misstatements, which prove how greatly he and, we fear, many others stand in need of such information as the offending letter furnished, ended with the following statement :

"It is a crying shame that any one who calls himself an American . . . should make invidious comparison with other lands, or try to belittle his own nation."

In a brief but excellent editorial, The Sun makes the comment that, while the navy's guns are the best of their type ever made, and the early European guns were not serviceable, this is not true of them to-day, and the high quality of our weapons is no proof that they cannot and, therefore, should not be improved.

As it has been our intention to take up this extremely important question at an early date, we were gratified to see that a conservative journal like The Sun had lent its columns to the publication of such a strong criticism of what is undoubtedly the weakest point in our navy to-day, and we congratulate our contemporary on the fearless regard for the truth which prompts it to indorse the necessarily unpopular criticisms of its correspondent.

The late achievements of the navy, the deadly execution wrought by its guns upon the Spanish fleets, render the task of criticism an extremely unthankful one. To the lay mind the statement that the very guns that sunk Montojo's and Cervera's fleets are so far behind the latest productions of some European gun shops as to be distinctly in the second class sounds very captious and untimely. Yet the publication of such a fact with a view, not to the belittlement of the navy, but to its betterment, is more truly the expression of patriotism than to keep silent for fear of wounding the national pride.

It is true that the early and experimental European guns showed signs of failure ; it is also true that when we undertook the manufacture of heavy ordnance we profited by their experience—as they did themselves. It is equally true that our guns designed in the late eighties have shown excellent qualities, being in some respects superior to guns of a similar date manufactured abroad. But it is equally true that, while the heavy guns on our ships are chiefly of the 1888 model, foreign powers have gone steadily ahead and are producing weapons which, weight for weight, are from thirty to forty per cent more powerful than our own and possess points of superiority in other points of comparison.

There is no sentiment in statistics. The facts have been demonstrated at the proving grounds and are recorded in the ballistic tables of the various ordnance manufacturers of Europe whose weapons are in the market for purchase by any fifth-rate power that cares to buy them. If Congress had furnished our Board of Ordnance with the necessary funds for experimental work, and if the board itself had been a little more progressive in spirit, the above mentioned criticism would have been uncalled for. As it is, our guns, which were the best of their kind at the beginning of the present decade, can scarcely be expected to hold their own with the improved weapons of to-day, in which are embodied all the results of ten long years of experimental work by the highest ordnance experts of the old world.

An enlightened and thoughtful patriotism will lead us to look the facts squarely in the face and govern ourselves accordingly. The actual facts regarding the heavy guns which are carried on our crack battleships are such as ought to afford the Ordnance Bureau of the Navy Department the gravest concern. Within a year there will be a battleship afloat carrying 12-inch guns, which, if it should encounter one of our crack battleships, would overmatch her 12-inch guns to the following extent: To an energy of 25,985 foot-tons she would oppose 45,000 foot-tons ; to a velocity of 2,100 feet per second she would oppose a velocity of 2,759 feet per second ; and while the enemy's guns could penetrate 46 inches of iron at the muzzle, our 12-inch guns could only get through 31 inches. Moreover, the enemy's shells would be delivered in greater numbers and with a much flatter trajectory, thereby increasing the chances of a hit.

It may be answered that the superior marksmanship of our gunners would more than outweigh the superior ballistic properties of the opposing weapons. Perhaps it would ; but why subject our men to such a handicap ? If our gunners have been trained until they are the best marksmen in the world, the least the nation can do is to furnish them with the best weapon that a modern gunshop can turn out. It is the first duty of patriotism to insist that in all our future warships this shall be done.

THE WORLD'S SUPPLY OF WHEAT.

The address of the President of the British Association for the Advancement of Science, at the great annual gathering of that society, has come to be regarded as one of the most notable occasions in the scientific world, a milestone of progress as it were, by which we may measure off our advance into the unexplored regions of science. It has so frequently been made the medium for the announcement of the more recent and valuable, we had almost said sensational, discoveries of science, that the attention of the scientific world is fixed upon the president of this renowned association with considerable expectancy when he delivers the annual address.

In the recent gathering, held at the ancient city of Bristol, the inaugural address delivered by Sir William Crookes was of an unusually startling and in some respects sensational character. Choosing as his main theme the question of the world's food supply, he produced a formidable array of statistics regarding the present and probable future ratio between the supply and demand of the world's staple article of food—all tending to show that, before many decades are past, the demand for wheat will be far in excess of the earth's capacity to produce it.

Although Sir William disclaims any intention of being pessimistic, we cannot but feel that his statistics, from whatever source they have been gathered, will bear revision, particularly as regards the wheat-growing area and capacity of the United States ; and when one's confidence in the statistics for one country is shaken, a doubt is naturally thrown upon the accuracy and value of the statistics of the other wheat-producing countries of the world.

But while the distinguished lecturer may have been unfortunate in his choice of statistical authorities, there is no questioning the value of the remedy in the way of chemical treatment of the soil by which it is proposed to double the world's wheat supply and stave off the supposed danger for a practically indefinite period.

In 1871, according to the statistics gathered by the lecturer, the bread eaters of the world numbered 371,000,000. Ten years later they had risen to 416,000,000, and at the present time they number 516,500,000. The increase is in a geometrical ratio, for the yearly increase grows progressively larger. To supply 516,500,000 bread eaters will require a total of 2,324,000,000 bushels for seed and food ; but the best authorities estimate the total supplies for 1897-98 to be only 1,921,000,000 bushels, which means a deficit of 403,000,000 bushels, which has not been urgently apparent, owing to a surplus of 300,000,000 bushels carried over from the last harvest. Respecting the present harvest year, we start with a deficit of 103,000,000 bushels, and have 6,500,000 more mouths to feed. It is claimed that the reason scarcity and high prices have not prevailed in recent years is found in the fact that since 1889 we have had seven world crops of wheat and rye abundantly in excess of the average, and these generous crops increased accumulations to such an extent as to obscure the fact that the harvests of 1895 and 1896 were each much below current requirements. Hence it is concluded that bread eaters must be fed from the current harvests, and that even a harvest equal to the fruitful yield of 1894 would not prove sufficient for current needs.

This being the present condition of things, the future prospects are determined by the lecturer in a survey of the various wheat-growing countries of the world. The United States is the chief of the wheat-exporting countries. For thirty years it has been the principal source of the foreign supply, exporting no less than 145,000,000 bushels annually, and the bread-eating world to day depends largely upon the United States for the means of subsistence. Sir William states that practically there remains no uncultivated prairie land in the United States suitable for wheat growing, and within a generation the ever increasing population of the United States will consume all of its own wheat and be obliged to import from other countries. The withdrawal of 145,000,000 bushels will cause a serious gap in the food supply of wheat-importing countries, with the probability of a dearth for the rest of the world after the British Isles have been supplied.

The statement that there remains no uncultivated prairie land in the United States suitable for wheat growing is so at variance with the facts that it raises a natural doubt as to the truth of many of the statements which follow regarding the other wheat-producing countries of the world. As a matter of fact, there are vast areas of land in the Western States that would now be raising excellent wheat crops if the cost of hauling or of railroad transportation did not render such farming unprofitable. There are other and yet vaster areas in Eastern Oregon, Washington, and other Western States, which will yield abundant harvests of wheat as soon as artificial irrigation is introduced, and in many States further to the east there are extensive areas, formerly devoted to wheat, that would at once be given up to this cereal if the price and demand warranted the change.

The lecturer finds even less comfort in an examination of Russia, the next source of supply to the United States in point of importance. The annual export of wheat from Russia is 95,000,000 bushels, but this supply is regarded as being provisional and precarious. The yield in European Russia is not over 8·6 bushels per acre, and in Siberia the climatic conditions are not favorable to wheat raising, except over a limited area. The ripening of wheat requires a temperature of at least 65° Fah , for fifty-five to sixty-five days. As all Siberia lies north of the summer isotherm of 65°, it is ill adapted to wheat culture unless some compensating climatic condition exists. The Russian Minister of Ways and Communications declared in 1896 that Siberia never had produced and never would produce wheat and rye enough to feed the Siberian population.

Canada yields 18,261,950 bushels from 1,290,000 acres of fine wheat-growing land. Performance in this region however has not come up to promise, the wheat-bearing area of all Canada having increased less than 500,000 acres since 1884.

In Australia climatic conditions limit the wheat area to a small portion of the littoral belt. Queensland is stated to have 50,000,000 acres suitable to wheat, but it has never had more than 150,000 acres under cultivation. In South Australia the harvest averaged last year only 3¾ bushels per acre, and in other districts the yield is very unsatisfactory. New Zealand has a climate admirably suited to wheat raising, Denmark and the United Kingdom alone yielding as much per acre. The Zealander, however, finds fruit and dairy farming so profitable that he is not likely to devote his lands to wheat.

Exports of wheat from Austria-Hungary have practically ceased. France imports 14 per cent of her own production and Germany imports 35,000,000 bushels annually. The prospective supply of wheat from Argentina and Uruguay has been greatly overrated. The present wheat area in Argentina is about 6,000,000 acres and there is no prospect of that country ever being able to devote more than 30,000,000 acres to wheat. Of South Africa the lecturer says that wheat culture fails where the banana ripens. In India, though an enormous acreage is devoted to wheat, it has been declining for years. In 1895 over 20,000,000 acres yielded 185,000,000 bushels. One-eighth only of the yield, on an average, is available for export.

Summing up, Sir William Crookes estimates that there is to-day a deficit in the wheat area of 31,000 square miles. When provision shall have been made for feeding the 230,000,000 units likely to be added to the bread-eating population by 1931—by the complete occupancy of the arable areas of the temperate zone now partially occupied—where, asks the lecturer, can be grown the additional 330,000,000 bushels of wheat required ten years later by a hungry world ?

The solution of the problem is to be found in artificial fertilization of the soil. Wheat pre-eminently demands nitrogen, fixed in the form of ammonia or nitric acid. All other necessary constituents exist in the soil, but nitrogen is mainly of atmospheric origin and is rendered "fixed" by a slow and precarious process, which requires a combination of rare meteorological and geographical conditions to render it of commercial value. After examining all the present sources of nitrogen, such as ammonia, formed by the distillation of coal, guano, cropping the soil with clover and plowing in the plant, the drainage of our cities, and the saltpeter of Chile, the lecturer concludes that

some other and vaster source of supply must be found, if the world is to be provided with the 12,000,000 tons of sodium nitrate which must be distributed annually to secure the necessary increase in the crops. Sir William proposes the fixation of atmospheric nitrogen as the best solution of the problem.

As far back as 1892 he exhibited at one of the soirées of the Royal Society an experiment on "The Flame of Burning Nitrogen," which showed that nitrogen is a combustible gas, and the reason why, when once ignited, the flame does not spread through the atmosphere and deluge the world in a sea of nitric acid is that its igniting point is higher than the temperature of its flame. By passing a strong induction current between terminals, the air takes fire and continues to burn with a powerful flame, producing nitrous and nitric acids. The lecturer, basing his estimate on an experiment of Lord Rayleigh, estimates that one ton of sodium nitrate could be produced by this process at a cost of $130. Electricity from coal and steam engines would be too costly; but, by utilizing water power, the product might be turned out at a cost of not more than $25 per ton. In reply to the question how to produce by the combustion of the atmosphere the enormous annual total of 12,000,000 tons of nitrate of soda, the lecturer states that Niagara alone is capable of supplying the required electrical energy without much lessening its mighty flow.

THE HEAVENS IN OCTOBER.

BY GARRETT P. SERVISS.

Those who begin their acquaintance with the constellations in the month of October are quite likely to become enthusiastic star gazers. It is in this month that the splendid group called "The Royal Family," including Andromeda, Cassiopeia, Perseus, and Cepheus, becomes conspicuous. Nearly overhead at about 10 P. M., on October 1, will be seen the great square of Pegasus, about 15° on a side. The star at the northeastern corner of this square belongs in reality to the constellation Andromeda. It is nearly of the second magnitude, and, with two other stars of equal brightness, forms a line extending toward the northeast from Andromeda's head to her feet. North of the middle star in this line are two fainter stars, constituting the girdle of the imaginary chained figure. Not far from the uppermost of these fainter stars the naked eye, on a clear night, detects a hazy speck. It is the Great Nebula of Andromeda, and its central condensation can be glimpsed with an opera glass.

North of Andromeda the eye is caught by a zigzag row of stars resembling the letter "W;" these mark the constellation Cassiopeia. The western part of the "W" forms, it will be observed, a more perfect triangle than the other part. Beginning at this end, the stars are named, in their order, Beta, Alpha, Gamma, Delta and Epsilon. Less than half way from Alpha to Gamma is a fainter, yet fairly conspicuous, star named Eta. This is a very beautiful double, and a splendid object for those who have telescopes of three inches or more in aperture. The components are of magnitudes 4 and 7·5 and their distance apart is about 5″. The larger star is yellow and the smaller purple, a peculiar combination.

A test for a more powerful glass, say not less than 4 inches aperture, is furnished by the star Iota. This will be found next beyond Epsilon in extension of a line drawn from Delta through Epsilon. It is a triple, the largest star being of the fourth magnitude. Its nearest companion, distant only 1·5″, is of the seventh magnitude. At a distance of 9″ is another companion of the eighth magnitude.

Following Cassiopeia and Andromeda from the east appears Perseus, the hero armed with diamond sword and flying sandals who, in the old classic story, rescues Andromeda from the sea monster. Perseus is a striking constellation marked by a bow-shaped row of stars, the middle one of which is the brightest of the group. With an opera glass or a telescope the background of the sky on which Perseus appears flying is a wonder of starry beauty. The principal star of Perseus, in particular, has an amazing double loop of small stars apparently attached to it as if they were gems strung upon a swinging whip lash. Interposed between Perseus and Cassiopeia appears the glowing starry mass of the Sword Handle, plainly visible to the naked eye, and a glorious object for a modern binocular glass.

Between Perseus and the last star in Andromeda is the marvelous Algol. Although this star's changes have been noticed for centuries, it is only within recent years that their cause has been known. It seems certain that the remarkable loss of light which Algol experiences every two days, twenty hours, and forty-nine minutes is due to an eclipse caused by the passage across the star of a huge black companion revolving close around it. The fading of Algol and its subsequent recovery are very interesting to watch. The process occupies several hours. There will be a minimum at about ten minutes before 10 P. M. on the 22d of October.

The possessor of a telescope should not leave the constellation Andromeda without looking at the celebrated double Gamma, the last in the row of three bright stars first described.

West of Cassiopeia, and between the zenith and the Pole Star, will be found Cepheus, who was the father of Andromeda and the husband of Cassiopeia. His constellation is not very conspicuous. Four of its brightest stars form a diamond-shaped figure. Lyra, the Northern Cross, and Aquila will be seen descending the western sky, while Hercules is setting, Aquarius is on the meridian, the bright star Fomalhaut shines alone in the south, and Taurus and Auriga are rising in the northeast.

THE PLANETS.

Mercury is a morning star in October, being found in the constellation Virgo at the beginning and in Libra at the end of the month. On the 19th it passes superior conjunction to become an evening star. There is a very close conjunction of Mercury and Jupiter in the forenoon of the 16th, when the planets, unfortunately, will be hidden by daylight.

Venus is still the glory of the evening twilight, becoming brighter and brighter until the 27th, when it attains its greatest brilliancy. It is continually drawing nearer the earth, and in the telescope its crescent figure becomes noticeably narrower and more elongated from week to week. In the course of the month Venus moves from the constellation Libra into Scorpio, and on the 18th it will be near the red star Antares.

Mars is becoming more conspicuous, as it rises earlier and approaches the earth. At the beginning of the month it rises about 11 P. M. It passes from Gemini into Cancer and grows rapidly brighter. Its polar snow-cap should be looked for with the telescope.

Jupiter, which is too near the sun to be observed, passes three or four degrees north of the star Spica in Virgo, and comes into conjunction with the sun on the 13th, after which it emerges in the morning sky.

Saturn remains on the borders of Scorpio and Ophiuchus, and its brilliancy, too, is diminished by the twilight. It is in conjunction with Venus on the morning of the 22d.

Uranus, just west of Beta, in Scorpio, is in conjunction with Venus on the 10th.

Neptune still rides on the "golden horns" of Taurus.

THE MOON.

Like September, October this year opens with a waning moon. The new moon of the month occurs on the 15th, the first quarter on the 22d, full moon on the 29th, and last quarter on the 7th. The moon is nearest to the earth on October 19th and farthest from it on October 7th.

The lunar conjunctions with the planets occur as follows: Neptune, 5th; Mars, 8th; Mercury, 15th; Jupiter, 15th; Uranus, 18th; Venus, 18th; Saturn, 18th.

Out of the ninety annual meteoric showers enumerated by Mr. Denning, nine are noted as of more than usual brilliancy, and one of these falls on the night of October 18th, the radiant being in the eastern part of Orion.

NEW TROOPSHIPS FOR THE ARMY.

It is announced that the War Department will retain some of the vessels bought at the beginning of the war and fit them up for hospital troopships. The former Atlantic transport liner "Mobile" will be the first ship to be fitted up, and the Cramps, of Philadelphia, have been given the work. Plans and specifications were prepared by well-known naval architects, and they have been inspected and passed upon by the army authorities and experts whose services they secured.

According to the plans, the ship will be overhauled from stem to stern. The quarters of the officers will be on the spar deck, which will have stateroom accommodations for eighty-four. Each stateroom will accommodate two officers, and there will be one bathtub for every twenty officers. On the aft promenade deck there will be a hospital with a capacity for seventy-six cots. It will have a complete dispensary and operating room and bathroom. On this deck, forward, there will be a promenade where the men will take exercise. It will be covered with dark blue awning as on the hospital ships, so that invalid soldiers will be protected from sun and rain. The quarters for the men will be between decks. The framework of the bunks will be of tubular cast iron, and each bunk will be so fixed that it may be folded back against the side of the ship when not in use, so that when they are folded up, the men will have practically the entire space between decks, from one end of the ship to the other, to move about in. There will be two or three berths, one above the other, depending upon the part of the boat. Each berth will be provided with a mattress and blankets. Amidships, on the main deck, will be the galleys. Forward of them will be what will be known as the armory and mess hall for the men. From the ceiling of the room gymnasium apparatus will be hung, so that the men will have indoor exercise and be able to practice at sea the army "setting-up" exercises. The mess tables will be so arranged that, when the room is to be used as a gymnasium, the tables will be folded back against the wall. Aft of the galleys on the main deck will be the lavatories and bathrooms for the men. Each bathroom will be supplied with hot and cold water and a shower bath. The entire ship will be lighted with electricity and the space between decks supplied with cooled air from a large ventilating plant. A distilling apparatus will be provided having a capacity of 3,000 gallons a day, as well as a refrigerating plant large enough to keep an ample supply of fresh beef and vegetables.

The next ship to be refitted will be the "Mohawk." Other ships to be refitted are the "Mississippi," "Michigan," "Massachusetts," "Manitoba," Minnewaska," "Roumanian," "Obdam," and "Panama." The War Department desires to make these vessels the finest troopships afloat, and it is particularly desired to make the men as comfortable as possible. The discomfort and downright hardships which our soldiers suffered in going to Cuba and Porto Rico and returning from these islands in a sick and enfeebled condition certainly warrants the expenditure of a large sum of money in the equipping of proper troopships. We should at all times have vessels, ready at a moment's notice, which could transport an army of 10,000 or more troops.

END OF AN ELECTRICAL WAR.

It is announced that two of the largest electrical manufacturing concerns in the country are about to unite. We refer to the Westinghouse Company and the Walker Company. It is probable that the plants of the latter company at Cleveland and New Haven will continue their operation as in the past. This company has been extremely successful of late in securing contracts for work, and at the present time there is about $1,300,000 worth of work going through its shops. Among the recent orders taken by them was one for a 5,000 horse power dynamo, for the West End Railroad in Boston, the equipment of the Brooklyn Elevated Railroad system, besides several orders from abroad; one for 600 street car motors to be distributed over the Continent of Europe by French syndicates.

The work of the Westinghouse Company is well known. The growth of the Walker Company marks a peculiar development in the manufacture of machinery in this country. At one time the shops in Cleveland were devoted to the manufacture of heavy machinery required by the operation of the street cable system. For a time the cable appeared to be the governing factor in traction systems for city use, but suddenly it was found electricity was destined to displace the cable, and the huge business built up by the company began to fade away. At this juncture the Walker Company leased the shops on advantageous terms and began manufacturing electrical machinery, and they were soon able to rival the older concerns. Naturally a young company pushing its way into the electrical field was sure to meet obstacles in the way of patents. The result is that the Walker Company has been in almost constant litigation with other electrical concerns. Of course, the new combination will end the costly and unfruitful litigation, which will result alone in the saving of a large sum each year. It will be remembered that, some time ago, the General Electric Company and the Westinghouse Company made an arrangement for operating on a pool basis as to the business done and as to the enjoyment of the patent rights, each licensing the other.

A 35·2-KNOT TORPEDO BOAT.

A cable dispatch says that the extraordinary record 40·8 miles an hour was made at the second trials of the torpedo boat destroyer "Hai Lung," just built at Elbing, Germany, by the Schichau works for the Chinese government. The runs were made in the open sea between the lighthouses at Pillau and Brüsterort, which are 19 knots apart. The wind was fresh (five by the scale) and there was considerable sea on. The "Hai Lung," according to the Kölnische Zeitung, traversed the course several times, the average time for the runs being 32 minutes 28 seconds, which gives a speed of 35·2 knots, or 68 kilometers, or 40·8 statute miles. This exceeds by far any speed heretofore made on the water, surpassing even the best performance of the "Turbinia."

A STATUE OF CHAMPLAIN.

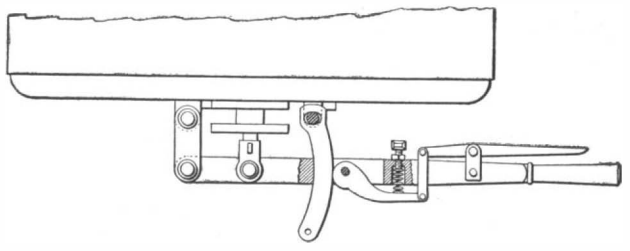
The British and American Commissioners assisted, with the Governor-General, Lady Aberdeen, the Lieutenant-Governor of Quebec, officers of the U. S. S. "Marblehead," and officers of the British fleet and Canadian garrisons, at an interesting celebration at Quebec, on September 21. This was the unveiling of a beautiful monument to the memory of Samuel de Champlain, discoverer of Lake Champlain and founder, in 1608, of the city of Quebec. The monument is fifty feet high and cost $30,000. It is by the architect La Cardonnel, of Paris, and the heroic sized bronze of the navigator which surmounts it is by M. Chevre. The monument is on Dufferin Terrace overlooking the St. Lawrence River, and is a prominent object for miles around.

A NEW LOCOMOTIVE THROTTLE-LEVER.

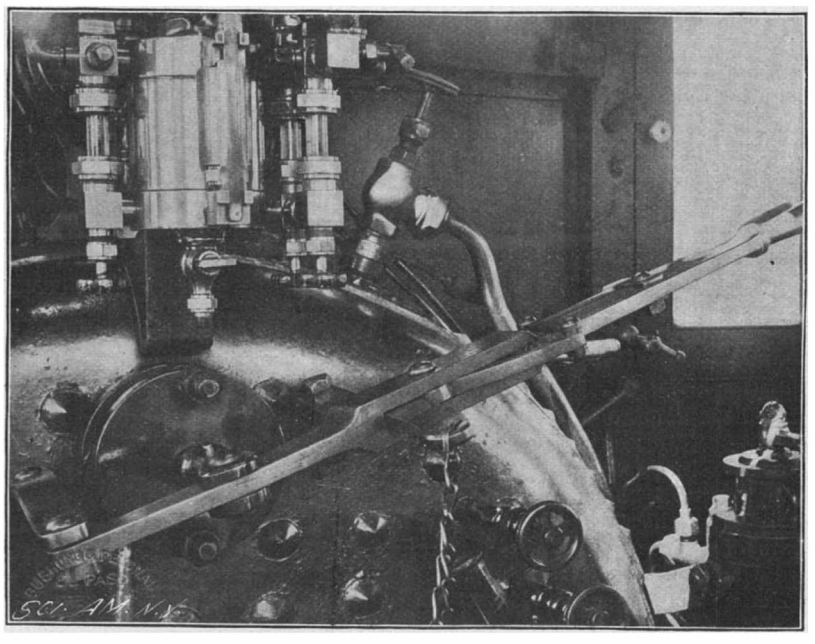
The throttle-levers ordinarily in use on locomotive engines are usually held in place by means of a dog engaging the teeth of a rack. In this form of lever the throttle can be locked in position only at those intervals which are provided by the teeth. In a throttle patented by Lorin W. Canady, of El Paso, Texas, means are provided for locking the lever in any desired position. Referring to our plan view of this new device, it will be observed that the throttle is fulcrumed to an arm projecting from the boiler. The throttle-stem is pivoted to the lever and slides in a gland rigid with the boiler. Extending through a slot in the throttle lever and connected with the boiler is an arc-shaped arm formed with an elongated aperture at its fast end. This elongated aperture permits the lateral movement essential to evenness of operation in connection with the lever. Mounted on a pivot in the slot of the lever is a cam which works against the arc-shaped arm and which is formed with an extension extending parallel with the lever. Connected with the cam extension, as shown in both our illustrations, is a rod pivoted to a hand-piece mounted on the lever. A strong expansive spiral spring adjusted in tension by a set screw and locked in place by a jam-nut, abuts against the cam-extension and causes the cam to bind firmly against the arc-shaped arm. By these means the throttle-lever is held at the proper adjustment.

By pressing the hand-piece, the cam-extension is drawn against the tension of the spring, thus releasing the cam from engagement with the arm and permitting the lever to be moved. Upon relaxing the pressure on the hand piece, the spring expands and causes the cam to lock the lever firmly in place.

With this throttle-lever the engine driver is enabled to regulate the speed of his engine with a nicety that cannot be obtained by means of the ordinary rack and dog device.



PLAN VIEW OF THE THROTTLE-LEVER.



CANADY'S IMPROVED LOCOMOTIVE THROTTLE-LEVER.

An Astronomical Discovery.

The European Union of Astronomers cabled on September 20 to Messrs. Chandler and Richie, of Boston, Mass., the discovery of a star-like condensation in the center of the Andromeda nebula by Dr. Seraphinioff, of the Russian observatory at Pulkowa. If the present supposition turns out to be true that a development is taking place in this notable nebula, Dr. Seraphinioff's discovery will be of considerable importance to astronomers.

A LILLIPUTIAN LOCOMOTIVE AND TRAIN.

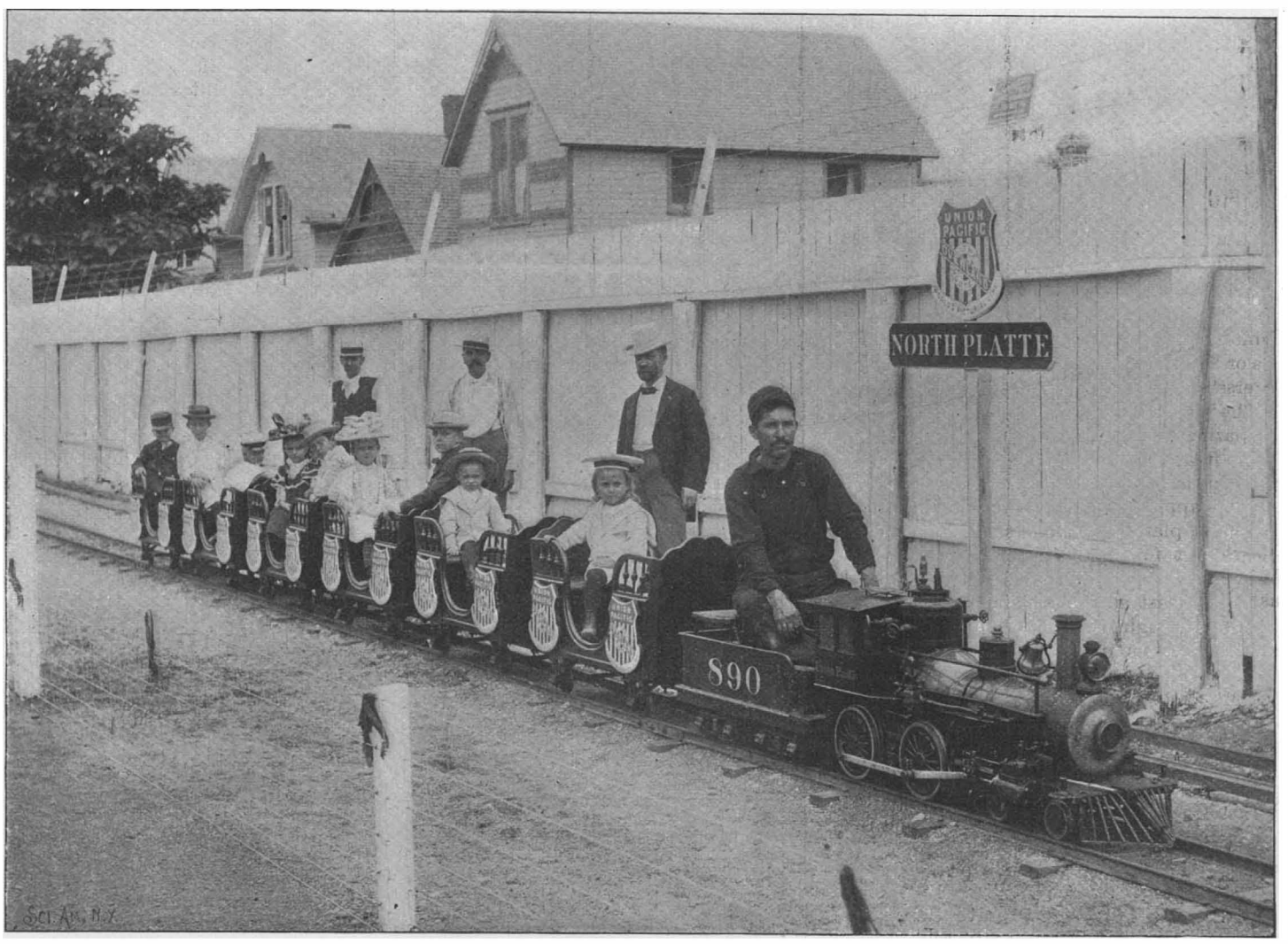
The diminutive train which forms the subject of this illustration was constructed by Thomas E. McGarigle, of Niagara Falls, who claims that it is the smallest train ever built for the conveyance of passengers in seated cars. It was built for use in the grounds of the Trans-Mississippi and International Exposition at Omaha, the space devoted to the miniature railroad being located in the main thoroughfare, where it extends for over 1,000 feet.

The greatest interest naturally centers in the locomotive, which is in every respect a faithful reproduction of the parts and working of a full-sized passenger locomotive. It is of the standard eight-wheeled American type, with a leading truck, four coupled drivers, and a tender carried on two trucks. The gage of the track is 12½ inches, the top of the smokestack is 25 inches above the rails, and the total length from the point of the pilot to the end of the tender is 7 feet 3 inches.

Steam to drive the little fellow is raised in a wagon-top boiler 10 inches in diameter, in which are 11 one-inch tubes 24 inches in length. The grate-surface is 54 square inches and the steam pressure is 125 pounds. The boiler is built of steel and was tested to 300 pounds pressure to the square inch. It is equipped with two injectors and holds 12 gallons of water.

The driving wheels are 10 inches and the wheels of the truck 5 inches in diameter. The cylinders are 2 inches in diameter, with a stroke of 4 inches. The weight of the engine is 600 pounds. The fire box is 10 inches in depth and 10 inches in width, and hard coal is used as fuel. The fittings of the locomotive are all complete, and include sand box, bell, whistle, and even a steam brake between the drivers. The engineer has to utilize the whole tender as a foot plate, and he must, perforce, remain at all times seated in order to get at the throttle, reversing lever, etc. The tender is of the two-truck type. Its wheels are 5 inches in diameter and its capacity is 15 gallons of water.

Passengers are carried in two-seated cars of the design shown in the illustration, and the hauling capacity of the locomotive is ten such cars, conveying twenty passengers, a total load of about 4,000 pounds. The scale on which the locomotive is built is about one-seventh of the size of one of the largest engines of the New York Central Railroad.



A LILLIPUTIAN LOCOMOTIVE.

Cylinders, 2×4 inches; drivers, 10 inches; steam pressure, 125 pounds; diameter of boiler, 10 inches; height of smokestack from rail, 25 inches; gage, 12½ inches; total length, 7 feet 3 inches.

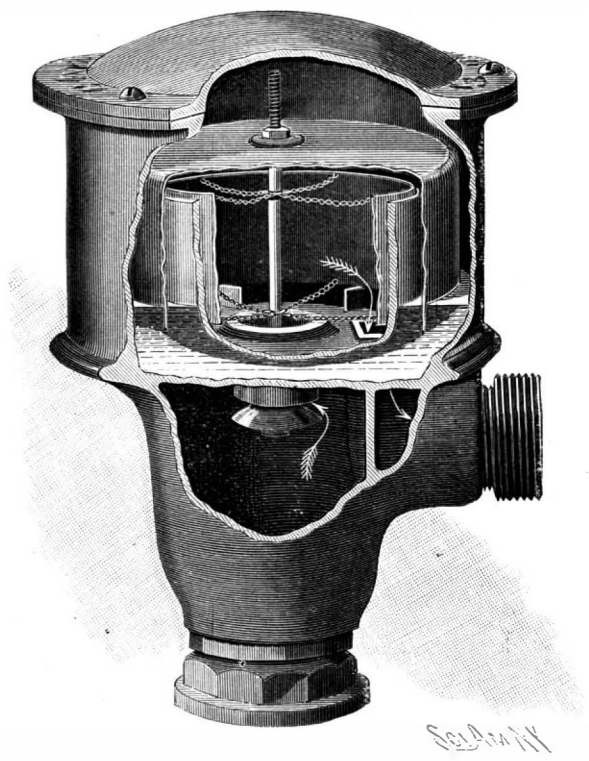
The Value of Fresh Air.

The admitted advantage of an outdoor life in many morbid conditions, and notably in consumption, seems to point to the conclusion that there is something definitely injurious in the indoor life which is now the common mode of existence among civilized people. It is a striking and startling thing that the mere removal of a patient into the open air should lower his fever, should remove his night sweats, and take away his hectic flush, and it is difficult to avoid the conclusion that if these symptoms are removed by the purity of the air outside, they must have been largely caused by the impurity of the air within the house. Nor have we any right to assume that it is the consumptive only who suffers. Doubtless the healthy struggle against and overcome evil influences before which those who are tuberculous succumb, but that is not to say that in the struggle we do not suffer, and, indeed, the facts recently brought forward are sufficient to show that the stuffy life of warmth and comfort which civilized man now "enjoys" is bad for the health even of the healthiest. We make our windows fit, we pad our doors, we shiver at a draught, we surround ourselves with woolen curtains, dusty carpets, and fluffy, luxurious upholstery; we breathe the same air over and over again, and then we wonder that we are not strong and vigorous. The fact is we are daily using up the exuberant vitality with which nature has provided us in struggling against artificial conditions. How powerful for evil, how deteriorating these conditions are, is shown by the fact that their mere removal gives back to the consumptive that vitality which enables him to overcome the seeds of disease within him. Fresh air is not a thing to be taken in little doses once a day, but a thing to live on.—London Hospital.

A FIRE CAUSED BY THE DROPPING OF A TOOL.—The Street Railway Review states that on May 26 a workman on the South Side Elevated, Chicago. dropped a tool, which made electrical connection between the third rail and a large gas pipe carried on the structure. A hole was burned in the pipe, and the gas ignited. The fire department was called out, and traffic between the down town terminus and Thirty-third Street was blocked for over two hours. The wiring in several cars was burned out and the cars set on fire. A few days previous to this another one of the cars was set on fire by arcing in a portion of the electrical equipment.

A NEW GAS-GOVERNOR.

In the gas mains of our large cities, the pressure in most districts is found to vary, depending upon various natural conditions and upon the size of the mains. The gas-companies, moreover, in order to supply the



THE HAYWARD AUTOMATIC GAS-GOVERNOR.

consumers at the ends of their lines, are compelled to force the gas through the street mains at a much higher pressure than is required for best service and most light. The higher the pressure in the mains, the smaller will be the light-value of the gas and the greater the waste. Since every meter relentlessly measures each foot of gas that passes through it, it is very natural that various governors should have been invented to regulate the gas supply in accordance with the specific requirements of any location, and thus avoid the expense caused by an unnecessary pressure.

Much difficulty has been experienced with the governors in use, owing to the fact that their valve-stems become coated with foreign matter and clogged within the bearings through which they are journaled. The Hayward automatic gas governor, manufactured by the Connelly Iron Sponge and Governor Company, of 3 Wooster Street, New York, avoids these difficulties by various peculiarities of construction.

Referring to our illustration, it will be observed that the governor comprises a casing containing a float, a valve-stem connected with the float, a mercury-reservoir, and passageways for the gas. Unlike the valve-stem in most governors, the stem is here supported by loose chains, the flexibility of which presents no opposition to the movements of the float and stem. By making the seat of the valve a knife-edge, clogging is prevented.

In operation, the gas takes the course indicated by the arrows, first entering the governor at the bottom opening, then passing through the valve and finally acting on the float, which is balanced to maintain the desired pressure. As the gas in each burner is ignited, the float sinks and the valve is further opened to permit the passage of more gas. Should the pressure become excessive, the float rises and, partially closing the valve, permits only an amount of gas to pass through, which is sufficient for the needs of the burners in operation.

AN IMPROVED TREAD-SANDING MACHINE.

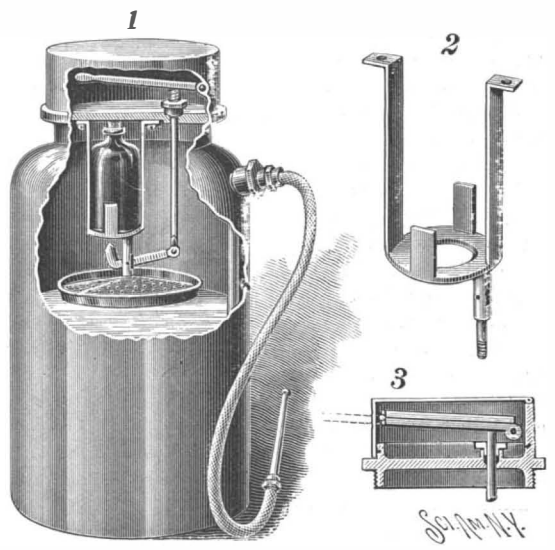
The accompanying illustration represents a new machine made by the Defiance Machine Works, of Defiance, Ohio, which automatically smooths the tread of a vehicle-wheel. Mounted upon a suitable bed-plate and stand are two head-stocks sliding in longitudinal guideways. On shafts extending through the head-stocks spindles are fitted carrying sandpaper disks. The spindles are driven by the pulleys and belts shown in the illustration. The wheel to be finished is placed between the disks with its hub resting on a spring-supported cone held on a spindle. Secured to this last spindle is an arm provided with pins extending upwardly between the spokes of the wheel. The wheel-spindle is driven by a system of gearing connected by pulleys and belts with the countershaft. The head-stocks are adjustable relatively to the sandpaper disks by means of screw rods having hand-wheels at their outer ends. The inner ends of the screw rods are provided with collars, between which are loosely held blocks pivotally connected with the ends of a lever. One end of the lever has a handle carrying a hand-lever for operating a spring-pressed catch and locking the handle in position. When the hand-lever is pressed, the handle and lever are unlocked, thus enabling the operator to swing aside the lever and cause the screw rods to move the head-stocks in opposite directions and force the sandpaper disks apart. While the parts are in this position, a wheel is placed on the proper spindle and the lever swung back to its initial position and locked in place. The rotary motion now given to all the spindles causes the wheel and the sandpaper disks to revolve rapidly. When the tread of the wheel has been sufficiently smoothed, the hand-lever is again operated, the disks moved apart, and the wheel removed.

A MOVEMENT is on foot, says The Medical Record, in Allegheny, Pa., to establish an association for the loaning of pictures to be hung on the walls of the hospitals, the pictures to make the tour of the hospitals and then to be returned to their owners. One of the originators of the movement has offered sixty of the pictures from his home. In a letter accompanying his offer he said that many persons spend a part of the year out of the city, and during that time the pictures would do much good in the hospitals, without in the least depriving their owners of the enjoyment of them.

A NEW FIRE-EXTINGUISHER.

The fire-extinguisher which we illustrate belongs to that class in which a tank or reservoir is partially filled with a solution of sodium bicarbonate, into which is precipitated the contents of a bottle containing sulfuric acid, the resulting gas being used to extinguish the fire. Fig. 1 shows the tank provided with the usual discharge pipe, having a nozzle of any desired construction. The tank is provided with a screw-closure having a circular wall covered by a screw-cap. Secured to the lower side of the closure and projecting into the tank is a yoke, shown in detail in Fig. 2. A glass bottle containing sulfuric acid is held by this yoke so that the cork presses against the cover. Within the cover a lever is fulcrumed and connected by means of a rod with a lever having at its free end a hammer-like formation adapted to bear against the bottom of the bottle. The latter lever is fulcrumed on an arm carrying a pan, the perforated bottom of which lies just above the solution of sodium bicarbonate.

When it is desired to use the extinguisher, the screw-cap is removed and the lever pressed downwardly. This operation causes the hammer to be forcibly driven against the bottom of the bottle, thus breaking the glass and causing the sulfuric acid to fall upon the

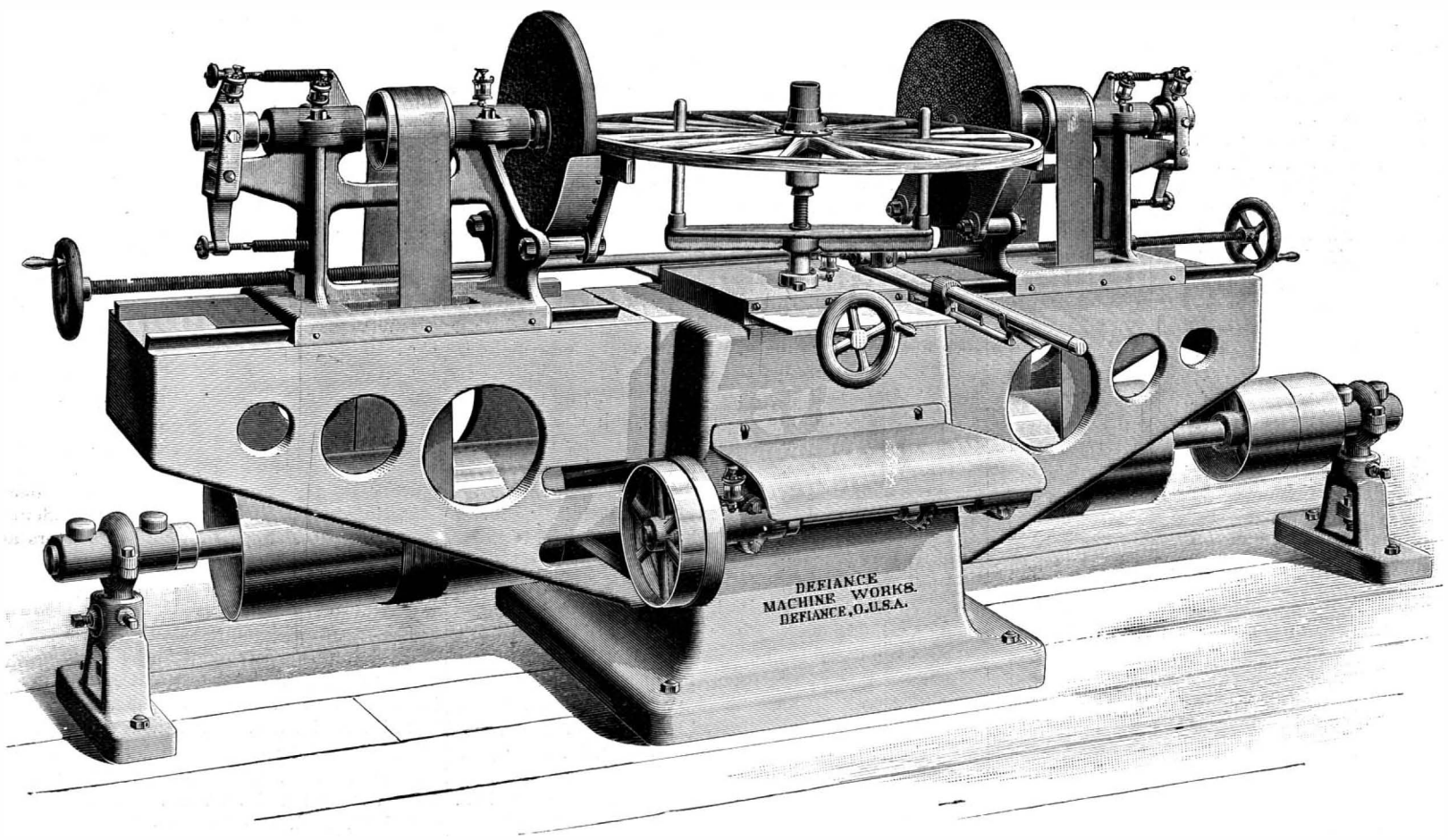


RING'S FIRE-EXTINGUISHER.

pan, whereby the acid is sprayed into the soda solution. The resulting gas is then used to extinguish the fire.

In Fig. 3 we have shown a modification, in which the operating lever inclosed within the cover is formed of two sections. These sections may be doubled on each other or they may be extended to the position shown by dotted lines. Instead of being screwed in place, the cover is hinged to a lug. By means of this construction, the cover may be quickly displaced and the lever extended for operation.

The extinguisher is the invention of Dr. Allan Mott Ring, of Arlington Heights, Mass.



DOUBLE AUTOMATIC TREAD-SANDING MACHINE.

DIFFICULTIES OF MOUNTAIN IRRIGATION ENGINEERING.

BY H. A. CRAFTS.

In the early days of irrigation engineering in Colorado the question of locating a canal was of easy solution. Numerous streams were found flowing out of the rocky gulches and cañons on to the broad plains. The pioneer irrigator appropriated to his use the rich alluvial soils along the borders of the streams and laughed at the man who suggested the possible utility of the table lands that stretched on all sides, producing little save buffalo grass and sage brush. The soil was supposed to be poor even if it were possible to get water upon it. But it was not long before bolder spirits ventured upon the occupation of these lands. And when they were broken by the expenditure of not a little animal force (for the soil in many places was baked as hard as a brick), and the water from the artificial irrigation ditches was turned upon them, they produced wonderful crops, so that in time the bottom lands, which had for so long been considered the only ones available for cultivation, fell into disfavor and in many cases were given up to the herdsman.

The value of the table lands for farming purposes having been demonstrated, there followed a scramble for all such as were favorably situated for irrigation. So that it was not long before not only was the water supply of the various streams appropriated, but all the most favorable sites for ditches were taken up. The first land-holders had, of course, the choice of location, both for lands and ditches. Provided the lands were within reach of water, their lay and quality of soil were the first questions for consideration. Topography was of course considered to some extent, but difficult engineering was not necessarily encountered in the prosecution of these early enterprises. Everything was planned with a view to avoiding mountain construction, so that the location of main ditches was a very simple thing.

The first care was the location of the head gate or the point of tapping the stream from which the water supply was to be obtained. The bank of the stream merely had to be cut to a sufficient depth to permit the water to flow into the proposed canal at the desired head. In some cases a dam or jetty was extended from the lower side of the head gate at an angle, out into the bed of the steam, in order to facilitate the diversion of water. These were usually constructed of cobble stone from the bed of the stream, supplemented by logs, brush, and sometimes straw weighted down with stone. From the bank of the stream the construction of the canal was a matter of mere plowing and scraping.

Our illustrations show the various features of an interesting piece of mountain construction known as the North Fork ditch. In order to cover the land which was designed to be irrigated, the promoters of this work were compelled to follow up the North Fork of the Cache la Poudre for a distance of eleven miles from its confluence with the main stream. The dam and head gate were established in the midst of a rocky gorge, five miles from the base of the outer range of foothills. Intervening was a perfect labyrinth of granite hills, and beyond these a series of limestone and sandstone ridges.

In order to raise the water in the stream to the requisite height, a dam of rock and cribwork was constructed in the bed of the stream. The dam was 50 feet high and 300 feet long at its crest. The thickness of the dam at the bottom is 75 feet and at the top 12 feet. The top of the dam was floored over with three-inch planking, forming a spillway for the entire length of the crest. The dam is set in solid granite, the sills of the cribs being fastened to the rocks by long drift bolts set in lead. From the head gate the water is conducted in a flume ten feet wide and sufficiently high to carry water to a depth of five feet. The flume is set on a grade of 10½ inches to the mile. It is constructed of 6×10 sills, 6×6 posts and 3×6 stringers and lined with 2½-inch planks. The planks before being put in place were dipped in boiling tar and each year are painted on the inside with hot tar, just before the water is turned in. This is done to preserve the wood, which is severely tried by the water, the hot suns, and the dry atmosphere of Colorado.

The flume, after leaving the head gate and crossing a small point of land, is carried across the North Fork itself upon a truss bridge, supported by stone piers. Next was encountered the craggy side of a granite hill. This granite is known in technical terms as "gray whacke" and is one of the hardest kinds of material to work in. Four of these granite hills were tunneled in the progress of this work. The largest of these tunnels is 630 feet in length. The tunnel section is 10 feet wide on the bottom and 6 feet high, the roof being struck on a 4-foot radius. These tunnels were all drilled out by hand and cost $70 per lineal foot.

From hill to hill the ditch was carried in flumes across cañons and gulches, the flumes being supported by bridges, one of which is a steel Fink truss, the others being wooden Howe truss. The total length of flumes is 4,000 feet and of tunnels 1,000 feet. The flumes and tunnels were joined by quarrying the rock down to grade and then cementing the fluming to the sides of the tunnel with Dykenhoff cement. The joints were also caulked to render them thoroughly watertight.

After getting out of the granite hills, ridges of stratified sandstone were encountered, some of which had to be tunneled, while the ditch was quarried out of the sides of others. In fact, one-third of the work to the plains was solid rock work. The original cost of the first five miles of this ditch was $154,000, or more than $30,000 to the mile. The cost of the fluming was $6 per lineal foot, or $35,000 per mile, approximately. With good care it is estimated that the flume will have to be renewed but once in eighteen years.

The principal features of the ditch as it traverses the outer foothills are the short tangents and sharp curves, which are necessitated by the fact that the waterline has to be kept as near as possible below the original ground line. The sharp curves necessitate the protecting of the bank of the ditch, especially in running a full head of water, because of the erosion near the waterline. This action is checked by riprapping, dry rubble walls, or masonry set in cement. The banks also require constant attention during the time of running water to guard against the work of gophers.

At the end of the mountain division of the North Fork ditch, which is 8 miles from the head gate, the canal enters what is known as the "natural channel division," which from a scientific standpoint must be regarded as a failure, the result of a mistake made by the engineer of the original construction. At this point the water was turned into a natural "draw," but not a natural water course. There is a sharp fall here of some 500 feet. The engineer supposed that the water would soon cut a channel down to bed rock and there stop. But contrary to expectation the total length of the division lies through a series of strata consisting of a mass of soft shale and friable soils. The consequence is that the canal has dug its way for the entire length of the division into a chasm in many places from 75 to 100 feet deep. This has had the effect of clogging the first mile of the division with immense quantities of sand, which has to be cleaned out yearly. Large quantities of this sand have also been washed out upon the adjacent land, for which the company has been compelled to pay heavy damages.

This sand is also discharged in large quantities through a series of trap floodgates, located on this section of the ditch. The flood gates are badly planned, being hinged at the bottom and opened by the automatic action of high water. Being thus constructed, it is a very difficult task to close them when once open, without shutting the water entirely out of the ditch. They have to be lifted against the combined weight of the gates themselves and the water flowing over them. It is probable that they will be abandoned and automatic spillways constructed in the shape of a series of long level flush boards, calculated to relieve the ditch of all flood water without disturbing the natural flow of water in the canal below high water mark.

The North Fork, which is in successful operation, including the main ditch and laterals, has a total length of 52 miles. The main ditch is 23 miles in length. It has a carrying capacity of 200 cubic feet per second. The storage capacity of its reservoir system is 600,000,000 cubic feet of water. Five thousand acres of land below it are in actual cultivation. Its present irrigating capacity is 12,000 acres. Whether it will ever be brought to a condition that will compensate for the large amount of money expended upon the mountain division is a question for the future to determine.

A Hotel Silver-plating Plant.

It is a common thing for hotels to have their own laundries, their own electric lighting plant, and their own bottling machinery, but the Hôtel Métropole, in New York, is probably the only one that does its own electro-plating for the purpose of renovating its spoons and forks and other articles from which the silver has been worn off. The plant, which has been in operation for some time, says The Electrical Engineer, of New York, has fully justified the first cost of the outfit, and has shown the economy and feasibility of this novel scheme. The United Electric Light and Power Company, which supplies current to the hotel, leads its high potential circuit into the sub-cellar, where it is transformed to 220 volts by means of two 1,000 light converters. In close proximity to this place the hotel management has installed the silver-plating plant, which consists of the following apparatus: A 2 horse power 200-volt 2-phase Tesla motor running at 1,800 revolutions per minute, belted by means of a countershaft to a buffer running at 3,000 revolutions per minute, and a plating dynamo delivering 75 amperes at a pressure of 5 volts; the necessary fuses, an overload circuit breaker, and the conductors, which in this case are hollow copper tubes, leading to the various vats. There are, in all, four of these vats, each holding 25 gallons of liquid, and containing respectively the nickel, copper, silver, and striking solutions. As the operator of this plant is not kept busy constantly, the guests not eating the silver off with sufficient rapidity, he devotes the remainder of his time to the buffing of the silverware.

Science Notes.

An interesting experiment has just been started on the Philadelphia, Wilmington, and Baltimore Railroad in order to find out which is the best wood for telegraph poles. Some forty-two have been set up in order to test the life of the various woods employed. There are six chestnut poles, creosoted; six pine poles, creosoted; six chestnut poles, woodiline; six set in broken rock, six in clay, six in the ordinary manner, and six to have a hole bored near the ground so that they can be saturated with oil.

There are now about 350 public libraries in Great Britain, says Science. These libraries contain over 5,000,000 volumes and isssue about 27,000,000 books each year. The annual attendance of readers is about 60,000,000. In comparison with these figures the following, recently published, will be interesting: There are 844 public libraries in Australia, with 1,400,000 volumes; 298, with 330,000 volumes, in New Zealand; 100, with 300,000 volumes, in South Africa. In Canada the public libraries contain over 1,500,000 volumes. In 1896 the United States, according to government statistics, possessed 4,026 public and school libraries, containing 33,051,872 volumes.

A national astronomical society is about to be organized in this country. Heretofore the astronomers have been in the habit of meeting together once a year at the annual meetings of the American Association for the Advancement of Science, they constituting a large part of the membership of Section A, Mathematics and Astronomy. The number of observatories and the number of men now devoting themselves to astronomical research make the formation of a separate astronomical society advisable. It is probable that the new society will be one of the "affiliated societies" of the American Association for the Advancement of Science, which hold their annual meetings at the same time and place.

Mr. McNicholl, the general traffic manager of the Canadian Pacific Railway, estimates that fifty thousand people have gone to the Klondike this season, and that twenty thousand of them will return to their homes without reaching the gold fields. Each man carried with him an outfit costing several hundred dollars, and his traveling expenses were not less than $250 or $300, making a total average expenditure of not less than $600, or a total investment of $30,000,000 in pursuit of the phantom. Thus far less than one-fifth as much has been brought away, taking the miners' own statements as correct; and the total output of the Klondike country this year is not expected by the most sanguine to exceed $10,000,000. In other words, the gold hunters will get back about one-third of their investment.

An extended study of the phenomena of insomnia by De Menaceine, a Russian authority in medicine, brings him to the conclusion that it is characteristic of persons who blush, laugh, weep readily, and whose pulse is apt to quicken upon the slightest provocation. Loss of sleep, however, he admits, most frequently results from overwork of either mind or body; overstrain of either kind dilates the bloodvessels of the brain and eventually paralyzes them, extreme cold producing the same results. Experiments also show that exercise of the emotions causes a rush of blood to the brain, and sleeplessness, if occurring near bedtime. There is a common theory that sleep is required in proportion to the scarcity of red corpuscles in the blood, and thus all persons do not correspond in their need of sleep, and many authorities agree that the need of sleep depends upon the strength of consciousness.

Mr. Kempster B. Miller, one of the best known telephone experts, is the instructor at the International Correspondence Schools, of Scranton, Pa., on the subject of telephony. The course is a remarkable one, and, like the other courses of this school, it is taught by mail. The telephony course is intended for electrical engineers, switchboard designers, inspectors and employés of telephone manufacturers, promoters and officers of telephone companies, members of construction boards, telephone superintendents, those in charge of interior systems, chief operators and operators, electricians in the navy and merchant marine, members of the Signal Corps of the army, street railway superintendents, etc. Few of the technical schools in this country give instruction relating to telephony, and the importance of the subject has not been sufficiently appreciated by electrical engineers. The course is intended not only to give the theory of telephony, but also to give an excellent idea of the practical work of the installation of the complete systems. The course commences at the beginning, which is acoustics, and takes the student from the fundamental principles of sound through the theory of the multiple system; from the construction of the simplest private line through the complexities of the great multiple switchboard, the construction of which involves the use of thousands of miles of wire and hundreds of thousands of soldered joints. The instruction papers are most valuable, and we are sure that those who take this course will obtain a competent knowledge of the subject.

Correspondence.

LEAKAGE OF BICYCLE TIRES.

To the Editor of the SCIENTIFIC AMERICAN:

In view of the extensive use of the bicycle, it may be of interest to some of your readers to know how the porosity of the rubber in the pneumatic tire may be easily demonstrated. This porosity, rendering the rubber pervious to air, accounts for the necessity of frequently pumping up the tire, which labor, unavoidably associated with the use of pneumatic tires, is very often attributed to a leaky or an imperfect valve; whereas, in fact, there is a perfect stream of air continually passing through every tire throughout its length in the shape of exceedingly fine bubbles, so long as the pressure of air inside the tube is much in excess of the atmospheric pressure on the outside, as it always is when the tire is properly inflated.

This flow of air can be easily shown by stretching a sheet of rubber, such as is used in the inside tube of the bicycle tire, over the slightly flanged end of a glass tube and winding a stout twine tightly about the rubber in several turns, as shown in Fig. 2. By filling the tube with any transparent oil and connecting the top of the glass tube to a vacuum pump capable of producing a fairly good vacuum, a continuous stream of bubbles will be seen to rise through the oil, which will continue so long as the vacuum is maintained above the oil. With a vacuum of about 28 inches by the mercury gage, the bubbles will be from $\frac{1}{32}$ to $\frac{1}{16}$ inch in diameter, and even larger as they near the surface of the oil. This large size of the bubbles—enabling them to be seen so distinctly—is due to their being relieved from atmospheric pressure, and therefore greatly expanding as soon as they reach the inside of the rubber wall, the only pressure at that point being that due to the weight of the oil and the slight remnant of air remaining above the oil. If the top of the tube is suddenly opened to admit atmospheric pressure, the bubbles are seen to suddenly disappear, being compressed into the finest specks, and, owing to their diminutive size, they remain practically stationary in the oil. When the vacuum is again produced, they suddenly expand to their former size and continue their journey toward the top of the oil.

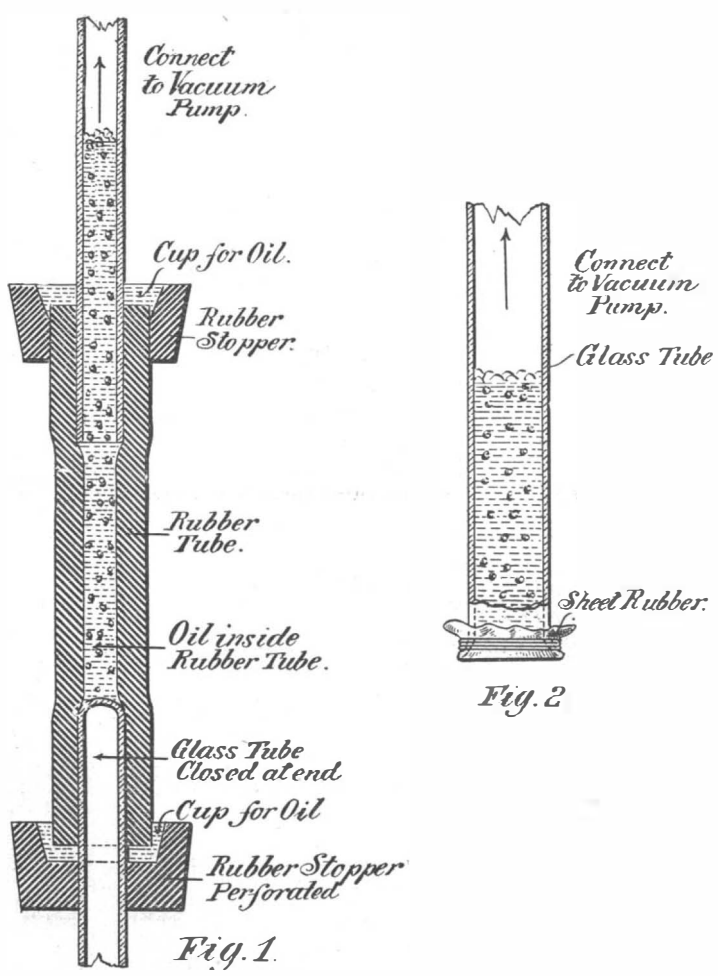
By means of the arrangement shown in Fig. 1, the writer has tested samples of several different qualities and makes of rubber tube up to ¼ inch thickness of wall, and has been unable to find any that would not allow the air to pass through it freely.

Fig. 1 shows in section a rubber tube of nearly pure gum with ¼ inch wall. Near the ends were attached perforated rubber stoppers cupped out to hold castor oil, in which the ends of the rubber tube were kept immersed to prevent any air passing between the glass and the rubber. The lower end of the rubber tube was closed by a sealed glass tube fitting tightly.

The pump was allowed to work sufficiently long in every test to exhaust all gas from the oil and the inside surface of the rubber. The stream of air bubbles would continue to pass after the pump had been working for several hours.

Immersing the entire tube in castor oil would cause the passage of air to cease but as soon as the tube was removed from the oil the flow of air would be resumed, although in smaller quantity. Wiping off the oil from the outer surface or bending the tube would cause the air bubbles to greatly increase in number.

Peterborough, Ontario. HENRY D. BURNETT.



METHOD OF TESTING LEAKAGE IN BICYCLE TIRES.

Long Distance Railroad Runs Without Stop.

To the Editor of the SCIENTIFIC AMERICAN:

I have studied with great interest the valuable article in your issue of September 3 on the subject of the two fastest long distance railroad runs without stop, and congratulate you on the completeness of the engineering data contained therein. I wish, however, in this connection, to call your attention to the ocean express trains on the London & Northwestern Railway, which make the run from London to Liverpool without a stop, the distance being exactly 200 miles, or 6 miles greater than that covered by the Great Western train. These trains also owe their existence to the keen competition between the Liverpool and Southampton steamship routes, and run every Wednesday and Saturday, in connection with the White Star and Cunard boats. The time for the 200 miles is 3¾ hours, giving a booked speed for the entire run of 53⅓ miles per hour, approximately the same as that of the two trains described in your article. I should say that I have no data for these trains more recent than last December, but, as the competition is as keen as ever, I presume the speed is still maintained. An article on these trains would doubtless be very acceptable to your readers. You do not seem to take account, either, of the run from London to Crewe, made twice daily by the same company, without stop. The distance is 158 miles, or 15 miles longer than the New York and Albany run, and the time is 3 hours 5 minutes, giving a booked speed of approximately 51 miles per hour.

In this country, the California Limited (run semi-weekly during the winter months), on the Santa Fé route, is scheduled to run the 202 miles from La Junta, Col., to Dodge City, Kan. (on an average descending grade of about 7½ feet to the mile), without stop, in the very creditable time of 4½ hours, but presumably there are stops not shown on the official time card.

No doubt your attention has already been called to what is presumably a slip in the first paragraph of your article. You state, or imply, that the Empire State Express was inaugurated during the year of the World's Fair, that is, 1893, and that the length of its run is nearly 1,000 miles. Doubtless you refer to the "Exposition Flier," which was run distinctly from the Empire State Express. The run of the latter is, of course, 440 miles, and the date of its inauguration was 1891.

Hoping this long epistle has not exhausted your patience, and that you will publish the same if you think it of general interest, I am,

Santa Cruz, Cal. HUGH S. GORDON.

[The run on the London & Northwestern Railway to which our correspondent calls attention is a good performance, but its exact merit can only be known when the weight of the train is given. It would scarcely come into the comparison instituted in our article of September 3, for the reason that it is not a regular daily train running on schedule time, as is the case with the Empire State Express and the Cornishman. The facts given in the letter are of considerable interest, especially the run on the Santa Fé route, the account of which will, no doubt, be news to a considerable number of our readers.—ED.]

Plants of Hawaii.

Since it has been determined, says The Independent, that the Hawaiian Islands may immediately come under the dominion of the United States, its natural products must deeply interest our people. A tropical flora is always attractive, but that of these islands is peculiarly so.

It is well known that they are very remote from any other land. From our own country the distance is 2,040 geographical miles, to the Marquesas group 1,060, and to Tahiti 2,190. It will thus be seen that it occupies a singularly isolated position, and, from a natural history point of view, has been left to work out its own salvation. Anyone who has given attention to the distribution of animals and plants over the earth knows how profoundly a fauna or flora may be affected by such entire independence of other lands. Once established in such a situation, uninfluenced by continental struggles, the creatures in the course of ages assume peculiar and marked characteristics.

There are reasons for supposing that this group of islands has always been thus separated from the influences of other lands. While in a northwesterly direction, according to Hillebrande, there is a succession of reefs and low uninhabited islets extending for a distance of thirty degrees of longitude about half way to Japan, the depth of water is less than a thousand fathoms, and reveals a narrow band of raised sea bottom. This line of reefs and islets exactly follows the trend of the fissure in the earth's crust on which the Hawaiian volcanoes have been erected. There is, too, abundant evidence to show that the age of the different islands of the group increases from east to west. Hence it is fair to conclude that these islets, rocks, and reefs lie in the same fissure and are only the coral-covered peaks of submerged volcanoes; in other words, that the volcanic action began at the northwest extremity, thirty degrees of longitude northwest from the island of Kauai. Thence it gradually moved on to the island of Hawaii, with subsidence of the older formations while it progressed.

But the western extremity of this varied sea bottom is separated by a great distance and enormous depths of sounding from the nearest high land, Japan, and the circumstance that the present flora of the Hawaiian Islands has less affinity to that of Japan than to any other warm or temperate country on the borders of the Pacific forbids altogether the assumption that this submerged chain of islands can at any time have formed a road for the migration of plants.

The soundings between Hawaii and California reveal one of the profoundest oceanic depressions on the globe. This, considered alone, would prove almost a total bar to the migration of plants from the northern portions of America. But, in considering the problem of distribution, one has to take into account the presence, direction, and force of ocean currents. These may carry on their surface seeds or even parts of living plants. Darwin proved by actual experiment that many seeds will long survive exposure to sea water.

Almost an infinitesimal number of Hawaiian plants, and these mostly on the high mountains, are North American in origin. However, a current deflecting from the coast of Mexico, or even further south, bathes the shores of the Sandwich Islands, and thus gives a marked American character to the Andean regions of the country. Other, and especially equatorial, currents have also had their effect. Long after their establishment in a new region, plants may retain traces of their origin. On the other hand, under new conditions, and disturbance of native systems of check and balance, they may vary widely.

It is said that Hawaii contains, and we would expect this from the circumstances above indicated, more endemic plants than any other known country; i. e., plants peculiar to itself. Great differences of elevation are found in the islands, from the palm-fringed lowlands to the sparsely clad heights of the volcanic peaks.

In one day a traveler may proceed from tropical jungles to a region of perpetual snow, and from a climate with an annual average of 180 inches of rainfall to one of 30 inches, or even less.

It will pay the reader who may be interested in lovely flowers to consult the royal folio of colored plates of Hawaiian plants prepared by Mrs. Francis Sinclair, Jr., and published by Houghton, Mifflin & Company, in 1889. One is impressed especially by the prevalence of elegant types of hibiscus, convolvulus, and pealike flowers. Of course this volume, issued solely for esthetic reasons, neglects many plants that a collector would delight to see. Many of these he will find figured in the superb atlas of the United States Exploring Expedition under Captain Wilson. Miss Isabella Bird, now Mrs. Bishop, in her charming volume, gives us some pleasant pictures. Here is one of them:

"Without exception the men and women wore wreaths and garlands of flowers, carmine, orange, or pure white, twined round their hats and thrown carelessly round their throats—flowers unknown to me, but redolent of the tropics in fragrance and color. Many of the young beauties wore the gorgeous bloom of the red hibiscus among their abundant, unconfined black hair, and many, besides the garlands, wore festoons of a sweet-scented vine, or of an exquisitely beautiful fern, knotted behind and hanging half way down their dresses. Their adornments of natural flowers are most attractive."

It may be said in closing that Hawaii, like all tropical islands, abounds in ferns. They are infinite, varied, and beautiful.

Spontaneous Combustion of Red Lead.

At some works in Germany a caskful of minium or red lead had become hardened, and in order to work up the mass again a commencement was made of breaking it into pieces, the whole being left for the night covered with a few sacks. The oxygen of the air soon acted upon the fresh fractures, raising the temperature of the mass, while reducing and igniting the resinous substances that had served to agglomerate the red lead cement, and a fire was only prevented by the fortunate arrival of the watchman.

PROTECTED CRUISER "PHILADELPHIA," OF THE UNITED STATES NAVY.

The accompanying engraving of the "Philadelphia" will possess special interest for our readers from the fact that it was made from a photograph of the vessel which was taken as she was leaving San Francisco Harbor for Honolulu, with a government commission on board bearing the resolutions of Congress annexing the Hawaiian Islands.

The idea of annexation had been very much in the air for several years when the outbreak of the Spanish-American war brought matters to a crisis. A dispatch from Honolulu, bearing date April 27, stated that President Dole had communicated with President McKinley, offering to transfer the islands to this country, and to furnish supplies to the American warships in the Pacific. This step commended itself to the military and naval authorities and to a strong party in each house of Congress, and the feeling in favor of annexation found expression in the Newlands Joint Resolution, which, on June 15, passed the House by a vote of 209 to 91. The sanction of the Senate was secured on July 6 in a vote of 42 to 21, and the signature of the President on the following day, July 7, 1898, saw these fertile and lovely islands of the North Pacific become a legal part of the great republic of the western hemisphere.

It now remained for the islands to be formally transferred to the United States, a duty which was allotted to Minister Sewall, who accepted the islands in the name of the United States, and Admiral Miller, of the "Philadelphia," who was intrusted with the duty of lowering the flag of the Hawaiian republic and hoisting in its place that of the United States.

To the "Philadelphia" was assigned the honor of carrying the annexation commission to Honolulu, and a detachment of bluejackets from this handsome ship took part in the annexation ceremonies. The formal transfer of the sovereignty of the islands took place on an improvised balcony in front of the Executive building, in Honolulu, on August 12, where Mr. Sewall handed to President Dole a large envelope and said that it contained the joint resolution of annexation. On receiving the document, Presldent Dole replied: "A treaty of peaceful union having been made in the interest of the Hawaiian body politic with full confidence in the honor, justice, and friendship of the American people, we yield up to you as the representative of the American government of the United States the sovereignty and public property of the Hawaiian Islands." Admiral Miller then ordered the Hawaiian flag lowered, the native band meanwhile playing the national anthem. As soon as the colors reached the ground, they were detached and an American flag was made fast and hoisted to the accompaniment of "The Star Spangled Banner," played by the band of the "Philadelphia"

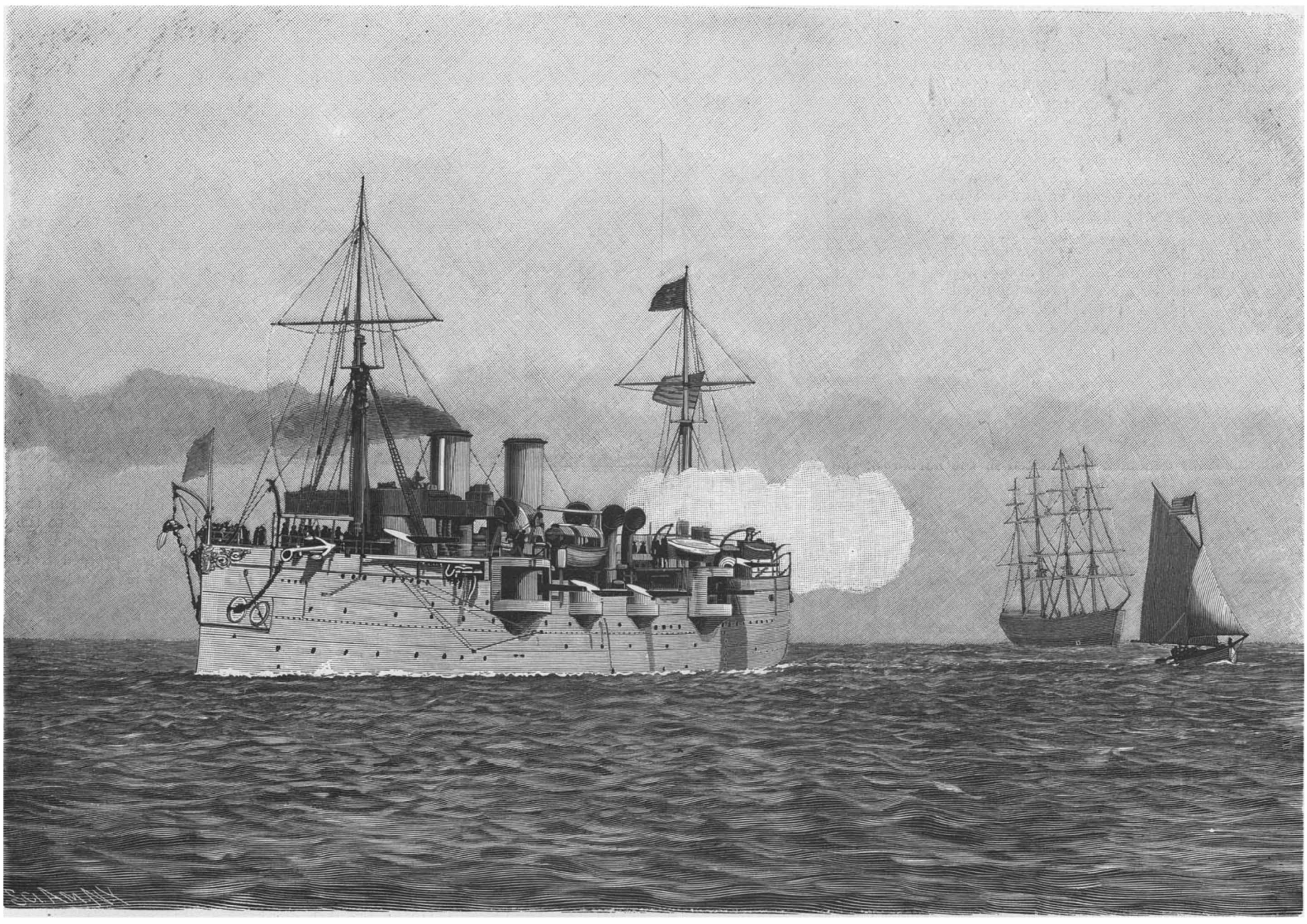
The "Philadelphia" is one of five vessels which were authorized by act of Congress on March 3, 1887. The others were the protected cruiser "San Francisco," the monitor "Monterey," and the gunboats "Concord" and "Bennington." The "Philadelphia" and "San Francisco" are practically sister ships, being alike in speed and armament, with a difference of a little over 200 tons displacement in favor of the "Philadelphia." The points of difference in the two ships may be gathered from the following table:

	Length.	Beam.	Draught.	Displacement.	Speed.	Bunker Capacity.
	Ft. In.	Ft. In.	Ft. In.			Tons.
"Philadelphia"	327 6	48 7½	19 2½	4,324	19·68	1,086
"San Francisco"	310	49 2	18 9	4,098	19·53	628

The "San Francisco" was built by the Union Iron Works, of San Francisco, and the "Philadelphia" by the William Cramp & Sons Shipbuilding Company, of Philadelphia. As the "Philadelphia" was contracted for under the old system, by which a heavy premium was offered for excess trial speed above contract requirements (the bonus in this case being $50,000 for every ¼ knot above 19 knots an hour), she won a premium of $100,000 for her builders.

It was the intention of the Navy Department to rearm the "Philadelphia" with the rapid-fire 6-inch gun when she was undergoing repairs and refitting at the Mare Island yard, San Francisco; but the urgent demand for the services of the vessel necessitated her being dispatched to Honolulu before the new type of gun could be mounted. She received, however, a very thorough overhaul, and as far as possible all woodwork was removed from the interior, notably in the between deck fittings, where the original wooden stateroom bulkheads were taken out and others of light corrugated iron put in. The heavy yards on mainmast and foremast were removed and replaced by the light signal yards shown in the engraving.

If asked to name the two most striking features of the ship, that is, those which would immediately impress a visitor on first approaching her, we would name her imposing freeboard and her unusually heavy battery. For a ship of 4,324 tons, a main battery of twelve 6-inch guns represents an extremely powerful broadside, and the disposition of the guns is such that the fore and aft fire is also heavy. Two of the guns are mounted behind shields on the forecastle deck, two behind shields on the poop, and of the eight guns in broadside on the gun deck, the extreme forward and after guns are sponsoned out to give a fore and aft fire. The total concentration of fire is four 6-inch guns ahead or astern, and six 6-inch guns on either broadside. Even when armed with her present slow-fire weapons, this renders her a powerful ship, and when the rearmament with the new rapid-fire 6-inch guns has taken place, the "Philadelphia," with her 19·68 knots speed, her bunker capacity of 1,086 tons, and her protective deck 4 inches thick on the slopes, will be as effective as many later cruisers that embody the experience of the last ten years of warship construction. The secondary battery consists of four 6-pounders, four 3-pounders, two 1-pounders, three 37-millimeter Hotchkiss guns, four Gatlings, and a field gun for landing purposes. The full complement is 384 souls, made up of 34 officers and 350 men. The contract price of the ship was $1,350,000, to which is to be added $100,000 for the excess of 0·68 knot above the contract speed of 19 knots.



UNITED STATES CRUISER "PHILADELPHIA" LEAVING SAN FRANCISCO FOR THE HAWAIIAN ISLANDS WITH THE ANNEXATION COMMISSION ON BOARD.

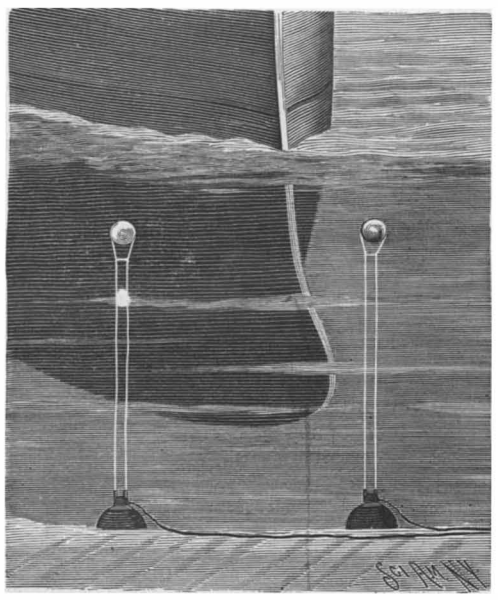
DISPLACEMENT, 4,324 tons. SPEED, 19·68 knots. MAXIMUM COAL SUPPLY, 1,086 tons. COMPLEMENT, 384. ARMOR, protective deck, 2½ inches on flat, 4 inches on slopes. GUNS: Main battery, twelve 6-inch slow-fire guns; secondary battery, four 6-pounders, four 3 pounders, two 1-pounders, three 37-millimeter Hotchkiss, four Gatlings, one field gun. AUTHORIZED 1887.

THE reports of the asylum at Cairo, Egypt, as to the native patients there exhibiting the nature of the mental disturbance associated with the excessive use of hashish are said to show some remarkable facts, it appearing that in 41 per cent of all the male patients hashish alone, or in combination with alcohol, caused the mental symptoms, while this was the case with only 7 per cent of the females. As to whether there is a special recognizable form of mental disturbance produced by hashish, authorities conclude that in a considerable number of cases in Egypt the hashish is the chief, if not the only, cause of such mental disease. The usual types of the disease are hashish intoxication—that is, an elated and reckless swaggering state, with optical delusions and hallucinations. Acute mania is another form of hashish insanity, involving frightful hallucinations, restlessness, sleeplessness, incoherence, and exhaustion; again, there is exhibited a weak-mindedness, the patients, though well behaved, being excitable about small things and unconcerned as to the future.

EXPLOSION OF SUBMARINE MINES IN BALTIMORE HARBOR.

The naval operations of the late war with Spain have afforded another demonstration of the value of submarine mines as an element—we had almost said the chief element—of coast defense against an attacking fleet. Their value was abundantly proved during the blockade of Santiago, the actual objective of which was the capture or destruction of Cervera's squadron. From the day of their departure from the Cape Verde Islands to the fatal Sunday morning on which they were driven upon the Cuban coast, these cruisers and torpedo boats were the storm-center of the war. No sooner had they cast anchor within Santiago Bay than our whole available naval force was concentrated at the entrance, in the expectation that the capture or destruction of these ships would probably mean the immediate close of the war—an expectation which proved to be remarkably correct.

Cervera's fleet being definitely located at Santiago,



SUBMARINE MINES IN PLACE, WITH ELECTRO-CONTACT BUOYS ATTACHED.

it was to the obvious advantage of this country that the crisis should be reached at once; yet, as a matter of fact, the ships remained unmolested in the harbor for several weeks, and were only finally destroyed as the result of their own voluntary departure from the harbor.

What was it that prevented our fleet from entering the harbor, and necessitated the dispatch of an army twenty thousand strong to assist in the capture of the vessels? It was not the guns of Morro Castle, for these have proved to be old muzzle-loading weapons of very limited range and power, nor were the more modern guns on the opposite shores of the entrance sufficient to successfully resist a modern armored fleet such as was drawn up at the mouth of the harbor. Our battleships and armored cruisers could easily have forced the entrance if the nondescript batteries that guarded it had been the sole means of defense. It was known, however, throughout Sampson's fleet that the tortuous channel was sown with the deadly submarine mine, and the existence of these defenses was sufficient to keep our powerful fleet outside during all the long weeks of the blockade.

It is not stretching the point too far to assert that if it had not been for a few sunken mines between Smith Cay and Morro, the army operations at Santiago would never have taken place. But for the existence of these mines, Admiral Sampson would have entered the bay, captured or sunk the Spanish ships, and confronted the city of Santiago with the alternative of capitulation or bombardment within a very few days after Cervera cast anchor in the harbor.

Apart from its enormous destructive power, the submarine mine exercises a powerful moral effect on the enemy, because of its invisibility and the practical impossibility of determining its exact location. It is the most quickly available of all systems of coast defense, and, unlike all other means of defense, its cost is out of all proportion to the damage it can inflict. It is pre-eminently the weapon of the weak.

Submarine mines are of three different kinds:

1. Observation mines, otherwise known as judgment mines, which are fired by an operator on shore, when the hostile ship is judged to be within range.

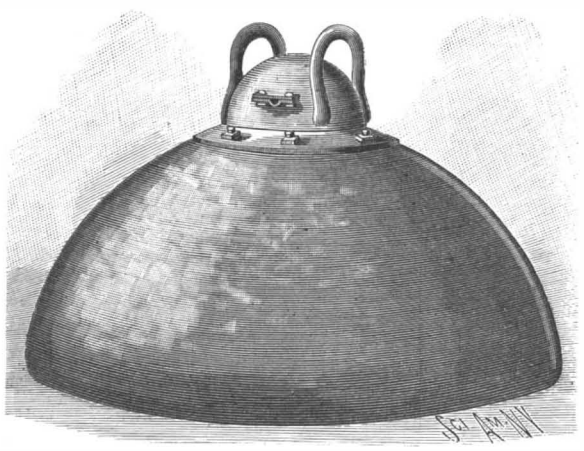
2. Automatic mines, which are self-firing on being struck by the hull of a ship.

3. Electro-contact mines, which are electrically connected with the shore, and, on being struck, cause a bell to ring at the firing station, where the operator switches on the firing current or not, according as the vessel is a hostile or friendly ship.

The accompanying illustrations show the form of ground mine most commonly employed in this country. It consists of the mine proper, containing the explosive, which is placed on the bottom of the channel, and the electro-contact buoys, which are anchored above the mine at a predetermined depth below the surface of the water. The body of the mine is made of cast iron. It is of a hemispherical shape, and is 4 feet in diameter and about 2 feet in height. The shell is 2 inches in thickness, and at the crown is a filling plug with electrical connections over which is bolted a wrought iron cap. The electric cable passes in through the clip shown on the side of the cap. The capacity of the mine herewith illustrated, which represents one of those which were used in the defense of Baltimore Harbor, is 250 pounds of explosive. When it is to be used as an automatic or as an electro-contact mine, the floating buoy is attached to the ears of the cap.

The floating buoy is a hollow, buoyant sphere, in which is placed a circuit closer, and it is provided with wires which lead from the buoy to a fuse in the ground mine and to the signal station. The mechanism usually consists of a ball or a pendulum, which, on the buoy being struck by a passing vessel, swings into contact with a metallic ring and closes the circuit. If the mine is fully automatic or self-firing, the closing of the circuit sends a current directly through the ground mine and explodes it; but if it is to be fired from a station on shore, the circuit closer merely serves to give warning to the operator, who, by the throw of a switch, sends a powerful current through the mine and explodes it.

Our readers will remember that immediately upon



SUBMARINE MINE OF TYPE USED FOR DEFENSE OF OUR HARBORS.

Charge, 225 to 250 pounds.

the declaration of war the harbors of this country were planted with mines, which were maintained in working order until news came of the destruction of the Spanish fleet at Santiago. This occurrence and the overtures for peace on the part of the Spanish government led to the removal of these obstructions to navigation. In some cases the mines were removed and in others they were exploded, in order to observe the probable effect they would have upon a passing vessel. Those placed for the defense of Baltimore were all removed from the ship channel except one group of three, which was exploded on July 18, with results as shown in Fig. 1.

This group consisted of three mines, placed 100 feet apart, in a triangle, and connected with the firing case-

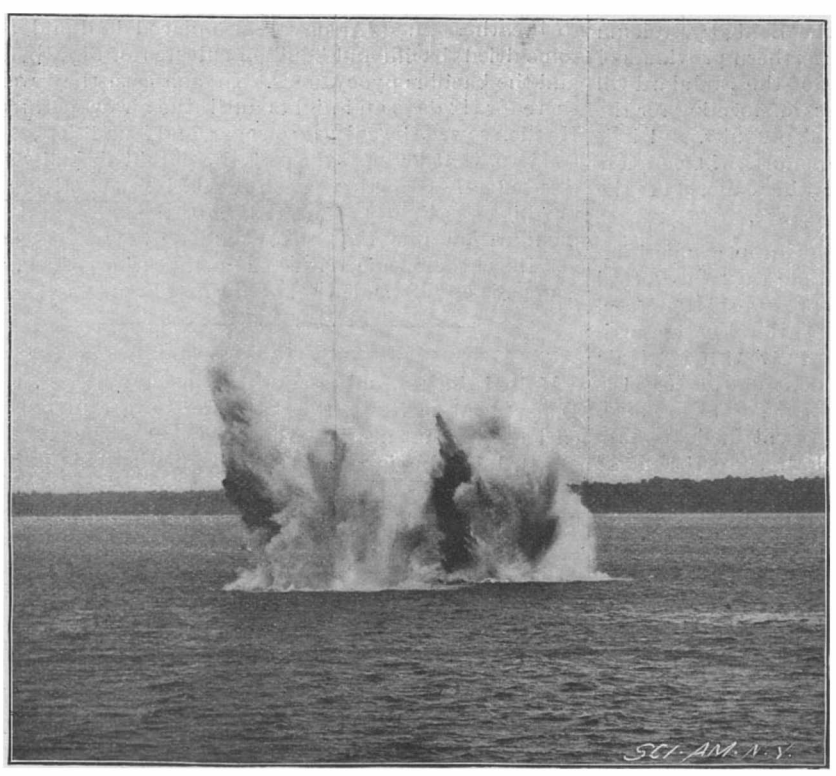


Fig. 1.—EXPLOSION OF A GROUP OF THREE GROUND MINES IN BALTIMORE HARBOR.

Charge of 225 to 250 pounds dynamite. Water 31 5 feet deep. Column of water 200 feet wide and 225 feet high.

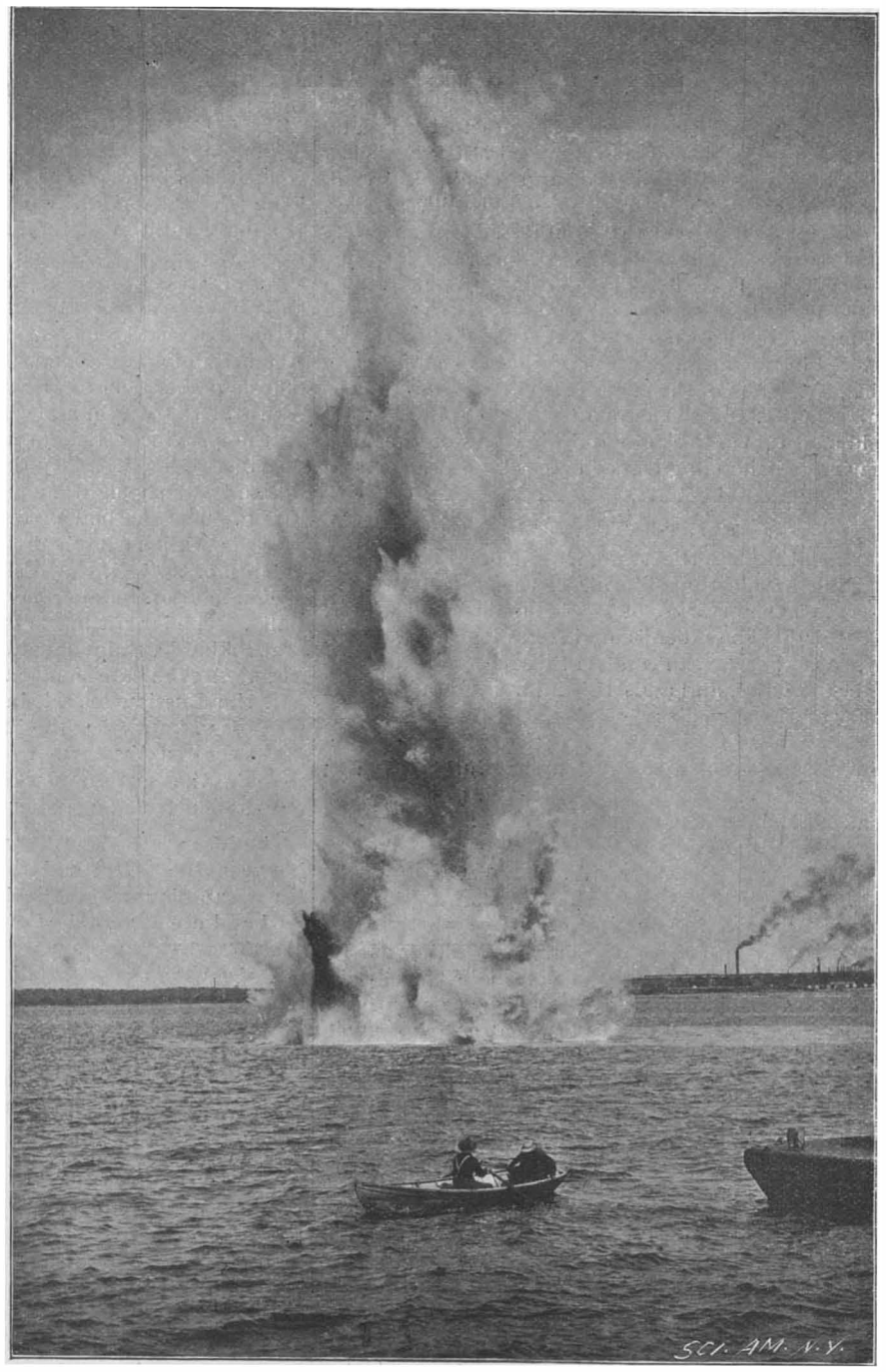


Fig. 2.—EXPLOSION OF A DOUBLE MINE IN BALTIMORE HARBOR.

Base of water column, 100 feet wide; height, 246 feet.

mate. They were each charged with 225 to 250 pounds of dynamite and were placed in 30½ feet of water; but, as the bottom consisted of soft mud, it is likely that in course of time the mines settled considerably. The photograph was taken at a distance of 1,200 feet and from a point 35 feet above the water. A careful measurement by triangulation showed the column of water to be 225 feet high and the base of the disturbance 200 feet wide.

The other mines, which had been removed away from the channel and placed in water 22 feet deep, were exploded on the 27th of August and the results photographed as before.

Fig. 2 was a double mine exploded at a distance of 500 feet. The base of the column was 100 feet wide and its height 246 feet.

In each explosion, except the first one, fragments of the cast iron shell were thrown to a great height and some of them were recovered. The negatives made as the column of water was ascending show the iron fragments in their flight.

A study of these photographs will give a more vivid impression of the terrific energy of these machines than can be gathered from any verbal or written description. They fully justify the caution which prevents a naval commander from entering a harbor protected by mine fields until by countermining operations he has cleared the way for his fleet.

A High Balloon Ascent.

A remarkable balloon ascent occurred at the Crystal Palace, near London, on September 15, by Prof. Berson, of Berlin, and Mr. Spencer. The large balloon reached an altitude of more than five miles, the exact height being 27,500 feet. This altitude has only been once exceeded, and that was by Glaisher and Coxwell in 1862, when they ascended 37,000 feet. A complete equipment of instruments was carried, and the observations and scientific results were most satisfactory. Mr. Spencer says the balloon went straight up at the rate of 1,000 feet a minute for 10,000 feet, when it struck air currents which turned it toward the southeast; at 18,000 feet it took a southwesterly direction; at 25,000 feet there was a decided feeling of dizziness and breathing became difficult. The aeronauts than began inhaling compressed oxygen, and the result was instantaneous. The men would have been unconscious had they delayed using the oxygen a moment longer, but with the aid of this gas they were able to attend to the manipulation of the balloon and the instruments. At 27,500 feet there were only four bags of ballast left, and it was decided it would not be safe to throw any more away. The thermometer showed 29 degrees below zero and the aeronauts shivered and trembled, though they were very warmly dressed. All metallic articles, such as the steel tube of the compressed oxygen, were coated with ice. The sun was so dazzling that they did not dare look at it. The descent was made at a terrific speed in the upper altitudes. When the ballast bags were thrown out to steady the balloon, sand scattered in the air and played around the car. When within 10,000 feet of the earth the balloon began to descend steadily, and the aeronauts alighted in safety in a field of stubble after accomplishing one of the most remarkable ballooning feats on record.

Purity of Cave Air.

Commenting on the statement made in a recent magazine article that the air of the Mammoth Cave preserves a temperature of 54° F., summer and winter, the editor of The Alienist and Neurologist, St. Louis, July, says that he can confirm this fact from his personal experience, and adds this information about the quality of the cave air:

"The cave may be said to breathe twice a year—inhaling during the winter and exhaling during the summer. This breathing of the cave, and the purity of the air and its freedom from germs, are among the most interesting problems to be studied. By what process the air in the cave becomes sterilized remains to be determined; but it is supposed the air gets into the cave after having been first drawn through water, the river in the cave being subject to rising and falling at certain times. Neurasthenics and persons extremely debilitated feel invigorated after they once get into the cave, so that they can endure physical exertion much beyond what they could outside.

"The influence of the cave appears to be rather antirheumatic than otherwise, owing probably to the remains of the saltpeter beds therein, which were the chief source or one of the chief sources of the supply to the gunpowder makers during the war of 1812. A colony of consumptives once took up their abode in the cave, but it did not cure them, and consumptives used to be sent to the cave for its pure air, but the absence of sunlight is a serious counteracting influence to these cases. But a life near this cave, with frequent visits into the cave enjoined, ought, because of its restful quietude and pure air, to prove a good prescription for part of the treatment of chronic city neuratrophics. Asthmatics have also been much benefited by the air of this cave."

Miscellaneous Notes and Receipts.

Wood with Metallic Luster.—A peculiar and certainly valuable process to impart the luster of metal to ordinary wood, without injuring its natural qualities, is described in the Paris Annales Forestières. The wood is laid, according to its weight, for three or four days in a caustic alkaline solution, such as, for instance, of calcined soda, at a temperature of 75° to 90° Celsius. Then it is at once placed in a bath of calcium. hydrosulphite, to which, after twenty-four to thirty-six hours, a saturated solution of sulphur in caustic potash is added. In this mixture the wood is left for forty-eight hours at 35° to 50° Celsius. It will be seen from this description that the process is somewhat laborious, and requires much time, but the effect is said to be astonishing. When the wood thus prepared, after having been dried at a moderate temperature, is polished by means of a smoothing iron, the surface assumes a very handsome metallic luster. The effect of this metallic gloss is still more pleasing if the wood is rubbed with a piece of lead, zinc, or tin. If it is subsequently polished with a burnisher of glass or porcelain, the wood actually gains the brilliancy of a metallic mirror, whereby, of course, handsome effects in wood ware can be obtained. Withal, the wood remains very firm and durable.

A New Substance Phosphorescent Under the Roentgen Rays.—A new mass, phosphorescent under the X rays, F. S. Kolle describes in the substance lately introduced by Van Molekebeke, which is said to be more sensitive for phosphorescent screens than all the substances heretofore known and employed. The production of the mass is as follows: Dissolve 1 gramme of uranium nitrate in 4 grammes of boiling water in a porcelain dish, adding 1½ grammes of ammonium fluoride and boiling the mixture a few minutes. The solution, which should not contain any precipitate, is cooled off and crystallized, which takes place in an hour. The octahedral crystals deposit on the bottom of the vessel, and the pale yellow solution turns perfectly colorless. The liquid is poured off from the sediment, and the latter, for the purpose of a complete removal of the ammonium nitrate, is repeatedly washed with cold water. The crystals are insoluble in cold water, but readily soluble in hot water. For the production of luminous screens, the dried preparation is mixed with collodion or gelatine. The quality of the preparation depends upon the perfect development of the crystals. The combination of the body is expressed by the formula $U_2\ O_2Fl_2\ 4NH_4Fl$—uranium ammonium fluoride.—Bayerisches Industrie und Gewerbeblatt, through Neueste Erfindungen und Erfahrungen.

The Japanese Petroleum Industry.—As is known, competition between the American and Russian petroleum is very keen in the petroleum markets of eastern Asia—a condition of affairs rendered still more acute by the steadily growing petroleum industry of Java and Sumatra. Japan has also entered the list of petroleum producers recently, and the demand for the home article is steadily increasing, although America and Russia still import about 6,000,000 yen annually. The petroleum districts of Japan reach from Hokkaido to Akito in the north, and throughout the entire length of the provinces Echigo and Shinano as far as the province Tolomi. Sixty drills have already been set up, and twenty-eight more will soon be ready for operation. The method of drilling has been largely improved; while formerly drillers did not venture beyond a depth of 200 feet, they risk at present 800 and more; the methods of refining have also been improved essentially. The largest markets for the Echigo petroleum are Hokkaido, Shinana, and the northern provinces of Yezo. A syndicate similar to that of the Standard Oil and the Russian trust is in process of forming for the purpose of improving the industrial pursuits, and it is also expected that, when formed, efforts will be made to gain the eastern market for the export of the Japanese petroleum.—Chemische Revue.

The French Lodeve Teasel.—The keen competition between the teasel and the metallic card has forced European planters and dealers to procure better teasel seed and use a great deal of care to grow a better article, so as to compete more successfully with its rival; for, of course, the entire displacement of the teasel is out of the question, at least for some time to come, because the metallic card, as at present made, is only suited for first roughening the cloth, the subsequent gigging operations requiring the vegetable card. All the efforts made to obtain a better teasel material must, therefore, always be thankfully acknowledged. Provence, and more especially the district around Avignon, is the principal country for cultivating the French card teasel, which is esteemed to be the best, by reason of its great resisting power. It was recognized long ago that that district was too limited in extent to supply the large demand for teasels in France and other countries, and experiments were tried to cultivate the thistle in other countries. These have been successful recently, and it was found that the region of Lodève and Carcassonne, south of Provence, in the department Aude, was well suited for the purpose. The region referred to possesses all the fundamental conditions for producing a good growth. This teasel is beyond doubt the best that can be used for the better grade of napped cloths, which require a fine and first-rate nap. The action of the finer hooks is distinctly visible in the goods in the process of teaseling, as well as when finished. A noteworthy advantage is that a core-rotten Lodève teasel is hardly ever found, but this disagreeable occurrence is only too common with all other kinds of teasels.—Der Confectionnair.

The Purification of Bad Butter.

It is with a certain feeling of regret that we understand that a new industry is about to be introduced in Ireland—namely, the making of good butter from bad. It has long been thought that, if we could once be sure that there was no margarine about, butter could be judged by its taste. What, then, are we to say to a process by which bad, rancid butter fat can be turned again into "fresh" butter? The data on which the process is founded are comparatively simple, and the process itself, although somewhat elaborate, is, after all, only a rewashing and then a remaking of the butter. What is unpleasant about it is that in future freshness and cleanness of taste is to be no security that the butter is the fresh product of fresh cream—no guarantee that from cow to butter pat all has been clean and free from rottenness. The rancidity of butter is due to the liberation of butyric acid, and other volatile acids and their derivatives, through the action of microbes—in other words, through the operation of decomposition. As is well known, this decomposition mostly takes place in butter which has been badly made; for really well-made butter, from which all the casein and buttermilk has been worked out, will keep for a very long time. In the process which has been lately introduced for the removal of these offensive products of decomposition the butter is melted down with a certain quantity of buttermilk, and stirred until a fine emulsion is obtained. Hot air is then drawn through the melted liquid, by which means a churning action is set up, and, while the volatile acids are carried off, the solid impurities sink to the bottom, and are removed. Then a current of cold air is made to take the place of the hot, and under its influence the butter begins to separate in granules, as in the ordinary method of churning. The result is admirable; good butter is made from bad, which is no doubt extremely ingenious.—Hospital.

Liquid Air as a Drink.

"At a meeting of the Society of Biology, held on June 9," says the Paris correspondent of The Lancet, London, July 23, "M. D'Arsonval referred to some researches which he had made with regard to the action of liquid air upon sundry tissues and upon mucous membranes. Actual contact did not take place, and the substance could be introduced into the stomach. M. D'Arsonval had offered a guest some liquid air mixed with champagne, and he, without waiting till the champagne thawed, swallowed the whole glassful containing about 15 cubic centimeters (about 1-10 gill) of liquid air. After a few moments his stomach was acutely distended, but a sudden violent expulsion of food and gas relieved this condition. If liquid air be poured upon the hand, it assumes the spheroidal state and breaks up into globules which scatter in various directions. It has been proposed to employ it in diving operations, for a diver carrying a liter (quart) of liquid air upon his back would have 1,000 liters of air to breathe. M. D'Arsonval also placed in liquid air some dried bacilli and bouillon cultures of diphtheria and the bacillus pyocyaneus. In one case they were there for six days and nights until the air evaporated. He then sowed the cultures on agar, and found that, contrary to what he had expected, the liquid air had very little effect. Growth went on regularly, the individual bacilli were slightly damaged, and the only marked modification was that the bacillus pyocyaneus had lost its chromogenic power—a modification which, of course, is not of the least importance."

Patents in Russia.

United States Ambassador Hitchcock writes to the Department of State from St. Petersburg that it is a curious fact that nearly seventy per cent of the patents granted in Russia are issued to aliens. This is important, in view of the new market for manufactured goods in the far East, a market which will probably, for a long time to come, be under the control of Russia. Patents are granted for inventions and improvements which represent an essential novelty in their totality, or in some part or parts, or in a combination of parts. One patent can cover several inventions or improvements, when, combined, they form a distinct process and cannot be used separately. No patents are granted where there is no essential novelty. It is a curious fact that the poor Russian subjects upon adequate proof to that effect can be freed from the fee which the government exacts upon filing the case. The expense of procuring Russian patents was considerably reduced when the new law went into operation.

THE FALL OF A BRIDGE AT CORNWALL, ONTARIO.

The great advance which has been made of late years in the theory and construction of long span bridges is proved by the small number of accidents that has occurred to structures of the kind that have been built by first class firms and under the supervision of qualified engineers. As regards the superstructure, that is, the bridge proper, it may be said that the possibility of serious failure or complete collapse due to inherent weakness has been practically eliminated; and it is only in the substructure, the foundations and piers, that any doubts as to stability may ever be said to exist. Even as regards the subaqueous foundations, it is only in rare cases that the engineer is unable to state with absolute certainty that they are permanently stable; for modern methods of diving and boring make it possible to learn with great certainty the composition of the river bottoms and determine how far it is necessary to carry down the foundations before they rest upon a durable stratum of ample bearing capacity to carry the superimposed structure.

The terrible disaster at Cornwall, Ontario, in which a river pier and two adjacent spans fell into the river, is a case (now happily very rare) of the collapse of a presumably first class structure which was being erected by well known contractors under the supervision of engineers of standing and reputation. For the reason that the swiftness of the current has prevented any thorough examination of the river bottom, it is impossible to determine, except by conjecture, the cause of the disaster; but such facts as can be gleaned point to the probability of the swift current having undermined the first pier from the south shore, causing it to fall over, dragging the shore span and the intermediate span with it.

The bridge is located near the Long Sault Rapids of the St. Lawrence River. It consists of a draw span over the canal, a cantilever across the north channel, and three spans across the south channel of the river, each of latter being 370 feet in length. At the time of the disaster the piers had all been built, and the three 370-foot trusses had been practically completed, the two river spans being swung and the falsework still remaining beneath the shore span.

At the time of the accident a large force of men was at work on the shore span, and the crash appears to have come without the least preliminary warning. Fifteen men were killed outright, and sixteen were seriously injured. The drawings and specifications were made and drawn up under the direction of F. D. Anthony, chief engineer of the New York and Ottawa Railway Company, for whom the bridge is being built, and they were approved by the engineers of the Canadian government and by Mr. Stewart, the consulting engineer to the railway company. The contractors for the superstructure are the Phœnix Bridge Company, and the piers were built by Sooysmith & Company, of New York.

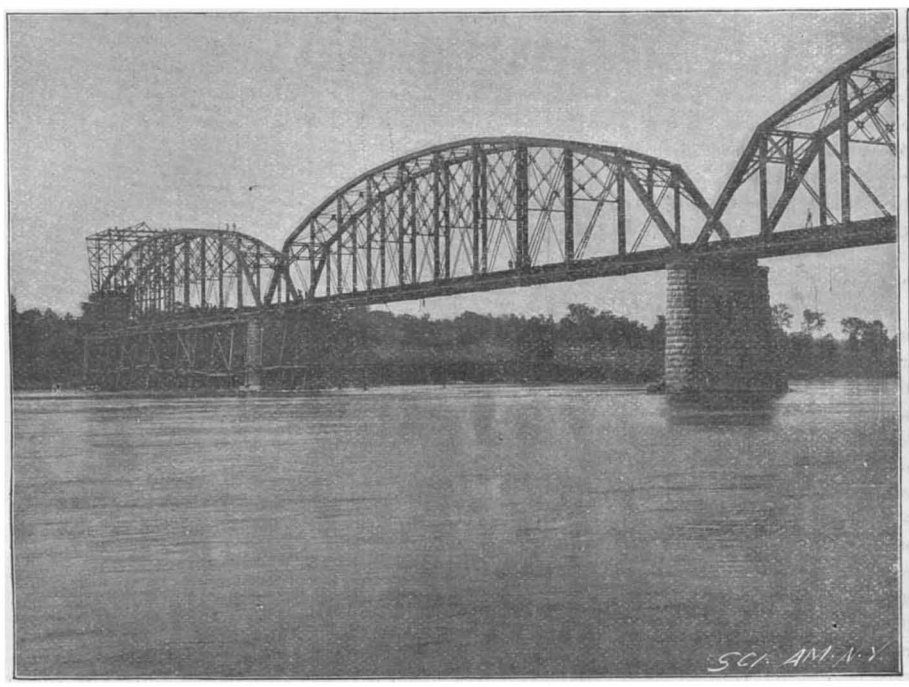
The testimony of eyewitnesses is pretty well agreed that it was the pier that collapsed first, and it is probable that the source of the mischief will be found, as we have said, at the base of the pier where it rested upon the bed of the river. The river at this point is deep and swift, the depth being from 35 to 40 feet, and the speed of the current between 5 and 8 miles per hour. It was decided to sink wooden cribs, fill them with concrete, and upon this foundation erect piers of solid masonry. As the current was too swift for examination of the bottom by divers, soundings were taken and the approximate contour obtained in this way. The timber crib was 18 feet wide by 62 feet long and 38 feet in height. When it was sunk to the bottom, divers went down and brought up samples of the bottom, which is reported to consist of clay hardpan overlaid with pebbles and bowlders. It was considered that the bottom was satisfactory, and the filling of the crib commenced forthwith. Bags of concrete were laid by the divers around the sides of the crib to the amount of 50 cubic yards, and then the concrete was deposited by means of self-discharging buckets, having a capacity of 1 cubic yard. It was deposited in 18-inch layers, and is stated to have set satisfactorily as the filling proceeded.

The cribs, which were built in the customary way of 12×12 timber walls, securely drift-bolted, and tied together by 12-inch cross timbers, were built up to a few feet above water. When the concrete had been carried up to within 4 feet of low water level, the crib was pumped dry, and the masonry of the pier was started. It should be mentioned that, during last winter, when work was shut down with only two courses of masonry in place, the crib was subjected to severe test by the pressure of the ice and by being struck by a swiftly moving and heavy raft of timber. Neither of these caused any movement of the structure. The masonry was completed in the spring to its full height of 35 feet above the water, the total height of the pier above the bed of the river being 70 feet.

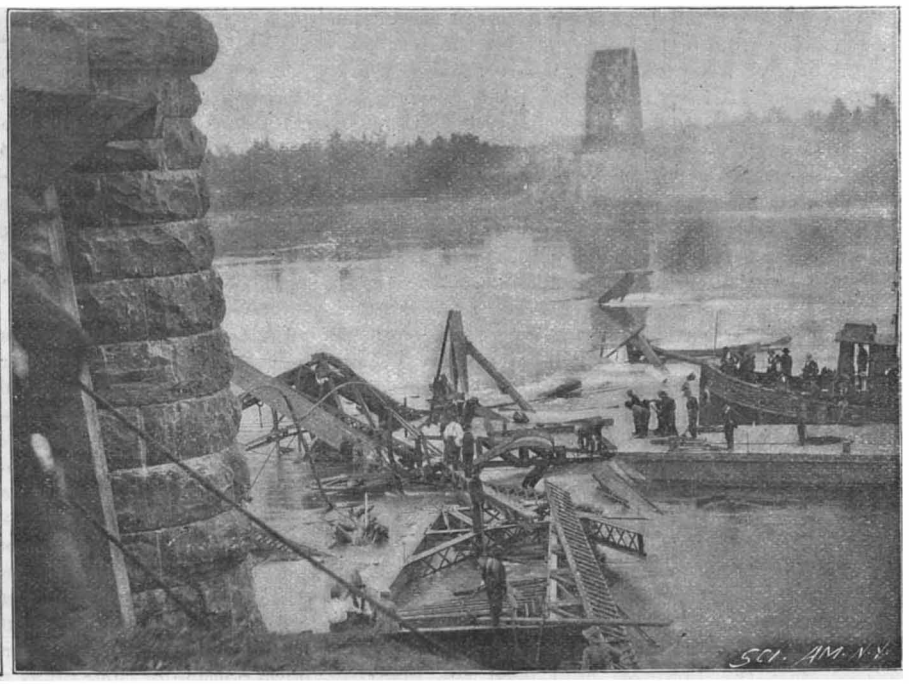
The cause of the accident is, as we have said, purely conjectural. It is not in the least likely, as one or two witnesses have stated, that the pier was pulled down by the breaking of one of the spans. The fallen river span lies, practically intact, at the bottom of the river, and the supporting falsework was still beneath the shore span at the time of the accident. Even if a span had broken apart, it would not have pulled down the pier with it in falling, but would rather have torn away the fastenings by which it was anchored to the pier.

Some eyewitness spoke of the pier as having crumbled away in falling. This is, of course, possible, the masonry consisting of rock-faced ashlar with a backing of Portland cement concrete; but it is highly improbable, for the reason that masonry that fails through overloading invariably gives some premonitory signs in the way of cracks and crumbling of the materials, neither of which was observable in this case.

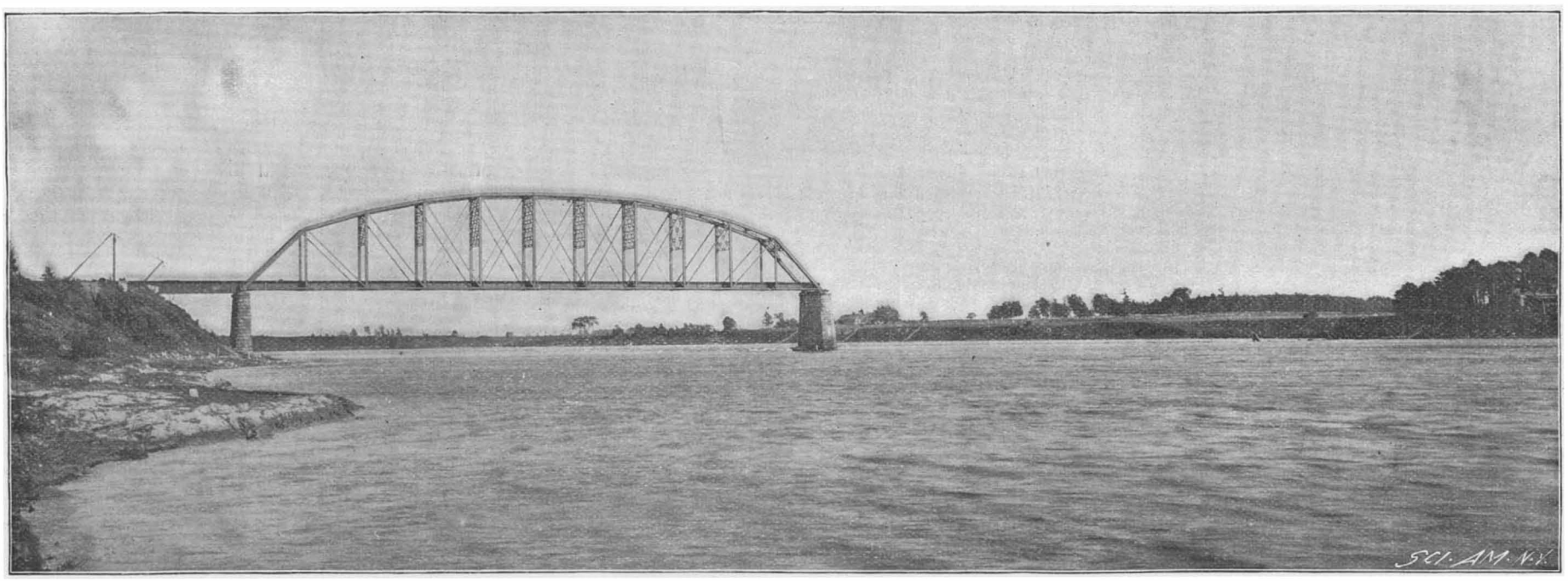
It is probable that the failure of the pier was due to the nature of the bottom on which it was built. In the first place, the method of building up a heavy pier upon the natural bed of the river is not to be commended, especially when, as in this case, the bottom consists of loose bowlders overlying a handpan; for when a bulky object like a crib is opposed to the flow of such a swift river as the St. Lawrence, there is an appreciable increase in the swiftness of the current, and a powerful eddying and scouring action is set up around the base of the pier, which is liable to cut away the bed of the river. Where the foundations are carried down well below the river



THE CORNWALL BRIDGE BEFORE THE DISASTER.



WRECKAGE OF THE SHORE SPAN AND FALSEWORK.



CORNWALL BRIDGE, SHOWING GAP MADE BY THE FALL OF TWO SPANS.

bed, scouring does not necessarily imperil the stability of the pier; but when, as in this case, stability depends upon the river bottom remaining undisturbed, any scouring and undermining at once threaten to overturn the structure.

There is no question that if undermining is proved to be the cause of the disaster, it will shake the confidence of engineers in this system of foundation. Although, on account of the swift current, it would have been a more difficult and costly undertaking to use the pneumatic process, a more satisfactory foundation could have been secured, as the crib might have been carried down through the overlying material to a bearing on a firmer substance below, where its base would have been protected from the scour of the river.

Saki, the Japanese Natural Drink.

Prof. Dr. Loew, of the Munich Brewing Academy, who had abundant opportunity to become thoroughly acquainted with saki (the rice wine of the Japanese) during his four years' residence in Tokyo as professor at the university of that city, recently made the liquor the subject of an interesting talk before the Munich Faculty, says The National Druggist. Saki, says the professor, has been used in Japan for upward of two thousand years. It is made from rice, the grain being first steamed, and then impregnated with a species of ferment. As soon as the impregnation has occurred, the rice is mixed in water, and submitted to fermentation. The yeast used in the fermentation is prepared from rice straw on which the steamed and impregnated rice is spread out before it is prepared for fermentation. Under the influence of the ferment and the yeast, all of the starch of the rice is taken up, so that the product has the character of a wine, and is hence called "rice wine." It is a somewhat remarkable fact that for ages past the Japanese have used the identical process known with us as "pasteurizing," or exposing the saki, in closed vessels, to a certain degree of heat, to give it a keeping quality, which it otherwise does not possess. Saki, when ready for use, contains from 14 per cent to 16 per cent of alcohol, or is about five times as strong as our beer. The latter, however, is forging its way into the land, and in all the breweries that have been established there beer is made after the German method. This seems to be in spite of the fact that Japan has, in the main, adopted the English and American culture rather than the German.

The Fortifications Board.

The war practically suspended the operations of the Fortifications Board, but, now that peace is returning, the Board will resume its labors. The Board of Fortifications and Ordnance is peculiarly constituted. In addition to the military officers composing it, there is one lay member, Hon. Joseph Outhwaite, member of Congress from Ohio. The appointment of this gentleman was due to the fact that there was a popular idea that the people should have a civil representative on the Board. The Board is a most important one, and consists of the Major-General commanding the army, Gen. R. T. Frank, Gen. Peter C. Hains, and Col. Frank H. Phipps. The Recorder of the Board is Lieut. J. N. Lewis. The function of this Board, as originally constituted, was to prepare an elaborate scheme of coast defense and to determine the merits of rival ordnance, and to adopt the types which should be used in the army. Of course, during the war the general scheme of fortification had to be suspended and all their efforts concentrated on the defense of the exposed parts of the coast. It is believed that the war will result in great attention being paid by Congress to the recommendations of the Board, and it is to be hoped a large portion of their plans will be carried out in their entirety.

The Current Supplement.

The current SUPPLEMENT, No. 1187, contains many articles of more than usual interest, and the front page engraving, an excellent portrait of "Wilhelmina, Queen of the Netherlands," is accompanied by a biographical notice of the Queen and the ceremonies attending her coronation. "High Explosives and Smokeless Powders and their Applications in Warfare," by Hudson Maxim, is a continuation of a most important paper by a great expert on explosives. "Object Lesson Roads" describes the good work which is being done by the Office of Road Inquiry, of the Department of Agriculture. Small sections of model roads are built as examples. "Some New Hand Cameras" describes some very clever new French cameras. "Typhoid Fever in Porto Rico" is an article by Dr. Nicholas Senn. "Development of Photography and Astronomy" is an important paper by the vice-president of the American Association for the Advancement of Science, Prof. E. E. Barnard. "Liquid Air" is a very interesting paper by Prof. George F. Barker, of the University of Pennsylvania, and is concluded in this number.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

DEVICE FOR PREVENTING RAILWAY ACCIDENTS.—CORNELIS PETERS, Nymwegen, Netherlands. Although the systems of signaling on railways have attained a high degree of perfection, accidents arising from the failure to observe signals cannot be entirely prevented. It is the purpose of this invention to overcome this difficulty. The desired end is attained by connecting a movable arm to the apparatus for setting a semaphore signal or a switch, in such a manner that when the line is closed against the train the arm projects outwardly, for example, in a vertical position, and is encountered by a lever arranged on the train and operating a cock or valve when turned by the arm, so as to put the air or steam-brake on and stop the train immediately.

COMBINED SWITCH AND SIGNAL MECHANISM.—CHARLES E. HARRIS, Ellwood City, Pa. This invention is an improvement upon those mechanisms in which a signal-lever is used to throw the switch and signal-operating mechanism, the two being connected so that the signaling mechanism is thrown to "danger" before the switch is moved. The switch-operating and signal-operating mechanisms each comprise toggle-levers for moving and locking the parts. The operating-lever has taut connection with the signal-operating mechanism and slack connection with the switch-operating mechanism, whereby the movement of the signal precedes that of the switch.

CAR-TRUCK—BENJAMIN F. ALLEN, Mobile, Ala. In this invention a car-truck is provided having two short axles at the forward end independently journaled in boxes on swiveling pedestals. The axles and their wheels are provided with means for holding these wheels alined with the rear wheels of the truck while the truck is traveling on a straight track and for permitting the front wheels to move laterally a proper degree when running on curves. The frictional resistance of the wheel flanges on the track is thus obviated. Novel means are also provided for supporting an electric motor on the truck-frame, so as to cushion the motor from shocks of percussion and adapt it to have a geared connection with the rear axle of the car-truck.

CAR-COUPLING. — RICHARD C. BECKETT, West Point, Miss. This invention is an improvement in automatic pivoted-jaw car-couplings, the novelty residing chiefly in the construction and arrangement of the springs and disengaging devices. The coupling is composed of hollow draw-heads, having their ends halved and forming abutting shoulders. Beveled catches are pivoted in the draw-heads and are provided with spring attachments. These attachments consist of hooked stop-rods, secured to the free front portions of the catches and extend through adjacent holes in the draw-heads. Helical springs encircle these rods and are seated in sockets in the draw-heads. Lever-triggers, composed of straight bars, are pivoted in a slot in the catches and pull-rods extend through holes in the draw-heads.

CAR-FENDER. — WILLIAM T. WATSON, Victoria, British Columbia, Canada. The car-fender provided by this inventor has a frame comprising a main-section with tubular side-bars. The spring-pressed side-bars of a sliding section enter the side-bars of the main section of the frame. Brackets are secured to the rear portion of the main frame-section at its sides and carry a cross-bar. Standards are pivotally attached to the brackets. A yielding bed is attached to the standards and the forward portion of the main section of the frame. A second yielding bed is attached to the forward portion of the sliding section of the frame and to the bed carried by the main frame-section, the attachment of the latter bed being near its center. This car-fender can be transferred from one end of a car to the other and can be conveniently folded up in front of the dashboard.

ROLLER BEARING.—GEORGE W. DICKINSON, Tacoma, Washington. This invention is designed more especially for car-axles, to prevent overheating. It consists of a series of steel rollers in place of ball bearings, ranged around the end of the car-axle in the axle-box, the interior construction of the latter being such as to prevent undue friction and hold the rollers in position, so they cannot become clogged or caught, while the end thrust is also provided for.

Bicycle Improvements.

BICYCLE STAND.—PERCY W. KIRKPATRICK, Bellair, Fla. This bicycle stand is so constructed that it can be readily carried on a bicycle without appreciably increasing the weight and at the same time be always ready for use. It consists of two tubes, one sliding over the other telescopically, the lower tube working inside of the upper tube and having at its bottom a horizontal foot. The top of the upper tube is suspended from the bicycle frame, between the seat and handle bars. A spring extends from the top of the lower inside tube to the under side of the upper end of the outer tube, and tends to force down the foot tube onto the ground. The movement of this tube is regulated by a catch of special construction which travels in a longitudinal groove in the stationary tube, the groove having at each end bayonet-like grooves for locking the movable tube when the foot is up or down. As the foot tube carrying at the bottom end the horizontal foot is raised, the latter is at the same time rotated to be in the same plane as the bicycle frame and out of the way of the rider's feet. When, however, the catch is turned in the groove releasing the tube, the interior spring forces the foot downward upon the ground, rotating it meanwhile so that it shall strike the ground transversely to the plane of the bicycle, and thus hold the latter securely in a vertical position.

Miscellaneous Inventions.

COMBING MACHINE. — ALFRED WENNING and CHARLES HUBERT GEGAUFF, Mulhouse, Germany. The object of this invention is to counteract the tendency of drawing rollers to flex apart and to lose their nipping power at their central portions. This is accomplished by forcing the ends of the rollers apart, and locating, between the devices which have this separating function, additional pressnre-exerting devices tending to force one roller toward the other. With this arrangement, the rollers may be made much longer than usual, without any loss of nipping power, and thus the output of the machine can be increased.

WATER-TRAP.—JOSEPH PATTON, Sharpsville, Pa. This device is designed to receive and discharge automatically the water of condensation from steam-engine cylinders, and comprises a reservoir with an elevated dome, a reticulated baffle-plate located transversely in the reservoir and provided with a vertical slot-guide, a waste-pipe attached on the under side, and an inlet pipe extending from the dome to connect with the engine cylinders. Pivoted in the reservoir and movable in the guide mentioned, is a lever to which a valve and stem are connected for controlling the waste. Connected with the lever and extending above its free end is a float movable in the dome, thus leaving the reservoir chamber mainly unobstructed.

WATER-HEATER AND STEAM-GENERATOR.—JAMES MCCARTNEY, Oakland, Cal. The purpose of the present invention is to provide an improved water-heater and steam-generator arranged to insure a proper circulation of the water. The invention consists primarily of a conical water-chamber, the base of which is arranged directly over the burning fuel in the fire-box, and a spreader placed within the chamber above the base and having a central inlet for the water to enter the chamber. The sides of the spreader form with the sides of the chamber, an upwardly extending outlet for the heated water.

HYDRAULIC PUMP.—CHARLES F. CARTY, Washington, N. C. The pump of this inventor comprises a pair of casings each having a suction-pipe and a discharge. In the casings, reels are mounted to turn, and on the casings stuffing-boxes are held. A band or wire passes through the stuffing-boxes and is connected at its ends with the reels, so that, upon rotating the reels, one winds up the band while the other unwinds it. A pulley is adjustably mounted outside of the casing, and over this pulley the band passes on its way from one casing to the other. The diameter of the pulley corresponds to the distance between the centers of the stuffing-boxes.

SLEIGH ATTACHMENT FOR VEHICLES.—ANDREW C. NYGAARD, Rawlins, Wyo. This sleigh is so constructed that the sleigh-runners may be folded up beneath the running gear, permitting the wheels to travel on the ground, or that the runners may be made to engage with the surface over which the vehicle is to be passed, at which time the wheels of the vehicle will be raised from the surface. By this arrangement the vehicle is enabled to travel over snow-covered surfaces through the medium of the runners and to travel over clear surfaces through the medium of the wheels.

CANDELABRUM.—HERMAN F. NEHR, New York city. The candelabrum forming the subject of this invention consists of a standard made in adjustable sections, reversible and interchangeable arms carried by one section of the standard and means for securing the arms to this section of the standard. Each arm is provided with sockets located at its upper and lower longitudinal surfaces, the sockets receiving the candlesticks. By this arrangement the design of the candelabrum may be varied at will and the necessary changes be quickly made.

CIGAR-BOX ATTACHMENT.—JOSEPH R. GRINSFELDER, Spokane, Wash. This invention provides a simple device capable of being expeditiously attached to a cover of a cigar-box and serving to hold the cover open at an angle to the body of the box. The device supports a price-card or any other card in such a manner as not to interfere with the reading of the cigar-box label. The device is so constructed that when it is applied to a cigar-box cover, the box may be handled by the lid without interfering with the device.

NUT-LOCK.—CULLEN E. LARAWAY, Plaquemine, La. This nut-lock belongs to that class in which the nut is held by a dog engaging the bolt to prevent the turning of the nut. The invention embodies a nut-casing carrying the dog and an eccentrically bored collar, which collar, upon being turned independently of the casing, throws the dog into engagement with the bolt.

LOCK-BOTTLE.—GEORGE W. BETJEMANN and WILLIAM CANDLAND, London, England. The purpose of this invention is to provide a lock-bottle to contain perfume, liquors, and the like, which bottle is arranged to permit the owner to lock the stopper in place. The bottle has a lock with its casing secured on the neck of the bottle. A lock-plate is movable on the casing and is adapted to be engaged by the lock-bolt of the lock to hold the plate against movement. The plate is also adapted to lock the stopper to the neck of the bottle when the plate is locked by the bolt.

TILE.—WILLIAM THOMSON, Manchester, England. This improved tile is made either from opal or other glass. On the back or on the side of the tile small pieces of granite, marble, or like material, are fixed, by means of which the tiles thus produced can be readily and firmly fastened in place. In order to make the tile readily attachable, the inventor applies to the surface a solution of soluble glass mixed with an insoluble silicate and with zinc oxid. The tile is then heated to a temperature slightly above that of boiling water, causing the mixture to form an enamel-like coating.

GRATE.—WILLIAM EDGAR, Mobile, Ala. The purpose of this invention is to provide a grate especially adapted for burning sawdust. The top plates of this grate are so connected with the supporting ribs that an efficient draft is obtained. The invention consists principally in forming the top plate with a series of circular openings in close proximity to one another. Each opening has its walls extended above the main top surface of the plate. By this means there is formed an annular conical ring or projection around each opening so as to prevent the sawdust from running through.

DEVICE FOR HEATING SAD-IRONS.—FRANCIS W. NEWTON, Gainesville, Texas. According to this invention, a body mounted on a base is provided with faces against which irons are adapted to be placed and with openings below the faces. Inclosing covers there are for these openings, one side of the covers being open. A slide is adjustably mounted on each cover and is arranged to close the open side thereof. By manipulating the slides, the desired degree of heat can be sustained with the consumption of a minimum amount of fuel, and the sad-irons resting against the faces thus receive a uniform degree of heat.

GATE-HINGE.—HERMAN F. NEHR, New York city. This hinge is provided with a cap mounted to rotate on the upper end of a post. Between the cap and post, a block of hard metal is interposed. A casing surrounds the post, is secured to the cap, and is supported solely by the cap. The construction is such as to adapt this hinge to the heavy doors and gates used in churches.

FLASH LIGHT APPARATUS.—ISRAEL COHN, New York city. The idea of this invention is to facilitate the measurement and use of specified charges of magnesium powder obtained from a larger magazine, yet so constructed that there will be no danger of the powder in the larger magazine being ignited. The larger magazine consists of a long tube, having attached to the top a short revolvable tube, sufficient in length to hold a charge of powder enough for making a flash-light photograph. Attached near the lower end of the short tube is a small, flexible pipe leading to a mouthpiece. On one side of the tube, parallel with its length, is a small wick tube holding a wick which projects slightly at the top, and filled with alcohol. To fill the small tube it is revolved till the hole in the bottom coincides with the hole in the top of the magazine supply tube; then the thumb is put over the mouth of the small tube, and the whole is inverted, the magnesium in the large tube falling, by gravity, into the small tube. The latter is now revolved, which cuts off the magnesium and the whole is reversed in position. The wick is lighted, the mouthpiece placed in the mouth, and the charge of magnesium in the small tube is blown upward into the flame, producing the flash. At the time the small tube is revolved for filling, it also cuts off connection with the air tube and prevents the powder from going into that.

FILTER.—WILLIAM A. MADDIN, Moscogee, Indian Territory. This invention consists essentially of a filter made in three separate sections, each provided with varying thicknesses of filtering substances and the whole, when put together, inclosed in an outer casing, leaving an air space between them for the air to circulate freely around the filtering portion. The upper section of the filter is filled with coarse sand held between wire gauze of suitable mesh. The center and largest section has broken charcoal supported by a perforated bottom, while the lowest section is filled with coarse sand and gravel between gauze wire ends. It is designed to filter rain water from spouts, is readily taken apart for cleaning, and the sections are reversible, while the ventilation feature is one of its chief merits.

Designs.

FABRIC.—ALICE A. AZEEZ, New York city. The leading feature of this design consists of a fabric having a raised elongated figure rounded at its lower end and converging toward its upper end and having a ribbed surface.

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References to former articles or answers should give date of paper and page or number of question.

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Minerals sent for examination should be distinctly marked or labeled.

(7502) C. V. F. asks: 1. Will you please tell me if the moon gives any heat? A. Certainly; the moon gives off heat. You will find a statement on this point in "The New Astronomy," by Prof. Todd, price by mail, $1.50. This, however, is probably heat which the moon has absorbed from the sun and afterward radiates. The part of the moon which is near the close of its long night of two weeks is probably at a temperature of about 300° below zero. 2. Where are some of the best art galleries in New York? A. The Art Gallery of the Metropolitan Museum is probably the best in New York.

(7503) F. D. B. writes: In a recent Notes and Queries column you gave the ingredients of a polarity tester that discolors at the positive pole. Will you please let me know what is used in the testers that give a purple discoloration at the negative poles? A. To produce a purplish discoloration at the negative pole prepare two solutions as follows:

1. Alcohol ..... 10 parts.
   Phenolphthalein ..... 1 "
   Dissolve and add
   Water distilled ..... 110 "
2. Water distilled ..... 10 parts.
   Sodium sulphate ..... 1 "

Soak blotting paper in No. 1. Drain and soak in No. 2. After this let it dry. To test pole of open circuit, moisten a strip of the paper and place the ends of the wires about an inch apart upon it.

(7504) J. L. C. writes: I should like to know if there is anything about new hay to attract the lightning, as a number of barns have been burned by lightning this year after the hay was in. A. We have no explanation to offer for the belief prevalent among farmers that barns are more frequently struck by lightning when full of hay. We have seen no statistics on this point. We have seen other buildings struck by lightning while barns near by were unharmed. Until it is shown by figures that more barns are struck than other buildings, we would not attempt to account for this belief. It should be remembered that thunder storms are frequent only at the season when barns are full of hay.

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THE TELEPHONE. Outlines of the Development of Transmitters and Receivers. By William J. Hopkins. New York, London, and Bombay: Longmans, Green & Company. 1898. Pp. 83. Price $1.

This book gives a clear and connected explanation of the principle underlying the design of the telephone transmitters and receivers. It is not a descriptive catalogue of instruments, but deals with the facts and principles in such a way that they will be easily and thoroughly understood. For this reason only those instruments have been described which have demonstrated their importance by long service or which seem to mark steps in the development of the modern transmitters and receivers. A thorough grasp of these principles will make it easy to apply them to the instruments.

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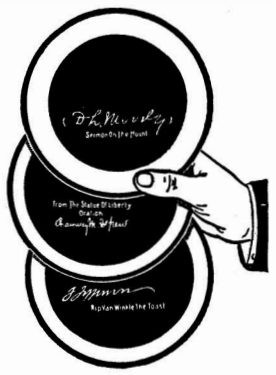

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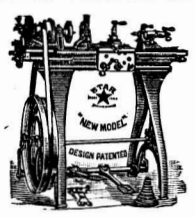

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Pulverizer, W. A. & J. R. Raudabaugh	610,919
Pump, rotary sand, J. Manff	610,992
Pumps, adjustable cutoff for steam, V. H. Rood	610,975
Pumping and winding machinery, combined, J. Symington	611,085
Pyroxylin compound, J. H. Stevens	610,953
Rail bond, J. E. Lloyd	610,909
Rail brake, D. W. Davis (reissue)	11,693
Rails, strut tie for preventing creeping of, A. Bonzano	611,101
Railway construction, electric, Chapman & Davies	611,056
Railway signal apparatus, W. F. Renton	611,149
Railway tie, F. T. Wright	610,935
Railway tie, metallic, T. G. Jacklin	611,037
Rake head, S. H. Jones	611,127
Reclining chair, E. E. Allen	611,049
Reclining chair, M. J. Sprigel	610,925
Reel and support, I. E. Palmer	611,020
Refrigerator, E. J. Kneeland	611,013
Registering apparatus, L. D. Orr	611,139
Regulator. See Feed regulator.	
Respirator, A. R. Moody	610,914
Rheostat, Richardson & McMakin	611,185
Ring. See Ornamental ring.	
Rock breaker and crusher, J. R. Moffitt	611,205
Rock drill, Brooks & Altman	610,892
Rope driving machinery, T. S. Miller	610,912
Salt pan, W. Shedlock	611,152
Sash fastener, H. B. Ives	611,171
Saw filing machine, Wallace & Reed	610,980
Saw, hand, J. W. Helton	610,900
Scaffold hanger, C. H. Bowie	610,888
Scaffold, portable, L. E. Webber	610,934
Screen. See Window screen.	
Seal, E. Tyden	610,955
Shutter operating device, W. Zehnder	611,165
Shuttle mispick and smash preventer, G. Fair	611,213
Sifter and receiver, combined ash, J. M. Ryan	611,150
Skirt, cycling, E. M. Hoey	610,988
Sole, shoe, J. E. Kennedy (reissue)	11,694
Spout, sap, W. J. Sager	610,922
Spring. See Door spring.	
Spring bottoms, manufacture of, J. P. Leggett	611,131
Spring clasp, G. Hill	610,967
Spring seat, C. A. Chapman	610,960
Starching machine, S. Moe et al	611,015
Station, portable automatic way, T. H. Pollock	611,145
Steam boiler, Shanks & Kelly	611,083
Steam drier, H. P. Dyer	610,962
Step and platform gate, combination, R. H. Catlett	611,196
Stock yard gate, B. F. Strange	611,153
Stone composition, artificial, J. & H. Hobson	611,200
Stopper. See Valve stopper.	
Stove, knockdown, J. F. Pjerrou	611,143
Stove or range, J. Erben	610,941
Supporter. See Drawers supporter.	
Surgical case, F. A. Reichardt	611,023
Surgical injector clamp, B. H. Lohman	611,038
Swimming appliance, S. Stone	611,005
Switch. See Circuit breaking switch.	
Switch operating device, L. J. Bennett	611,193
Table. See Ironing table,	
Table, W. M. Grace	611,117
Theatrical appliance, L. J. Carter	611,054
Thermostat, J. F. McElroy	610,998
Thill coupling, L. E. Macomber	611,135
Thill coupling, W. Pearce	611,140

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