SCIENTIFIC AMERICAN

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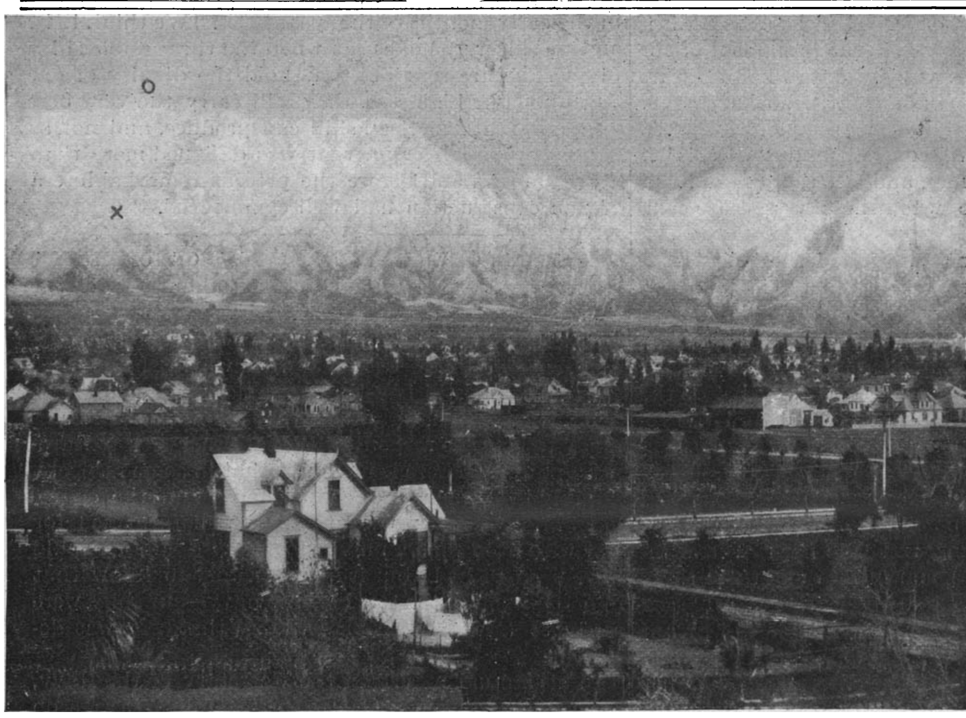
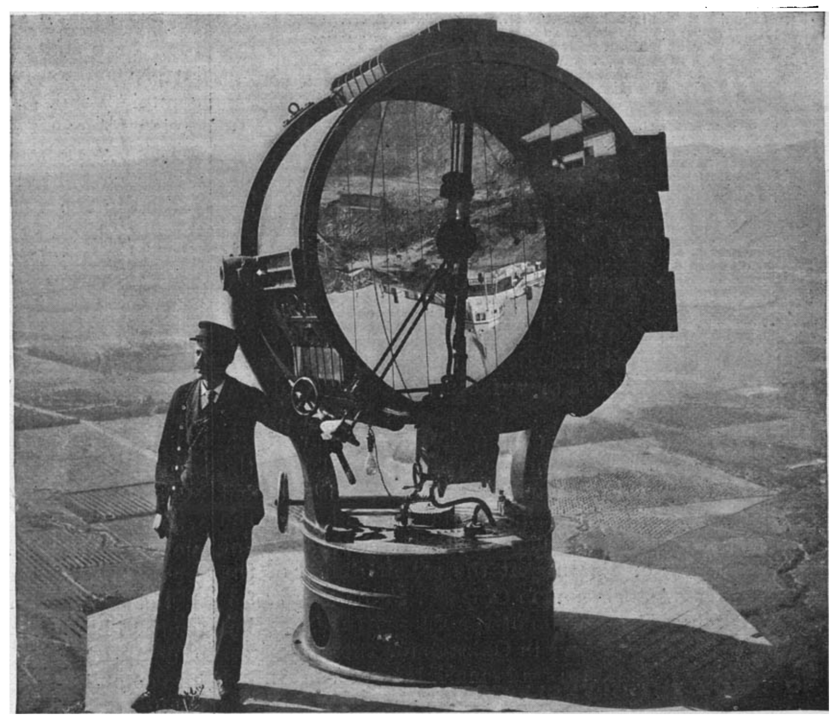
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS CHEMISTRY AND MANUFACTURES.

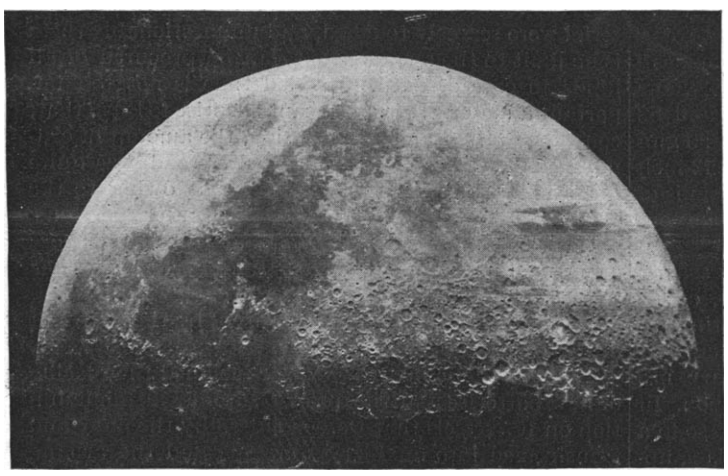
Vol. LXXIX.—No. 18. ESTABLISHED 1845. | NEW YORK, OCTOBER 29, 1898. | [$3.00 A YEAR. WEEKLY.



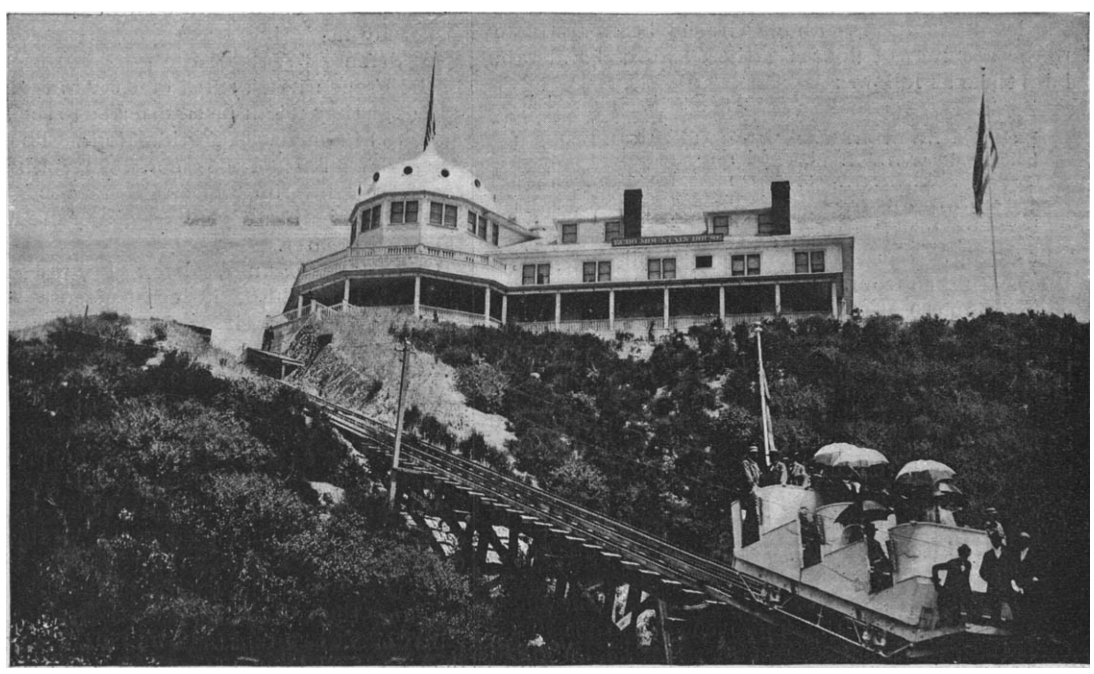
Echo Mountain and Mt. Lowe in Winter, from Pasadena.



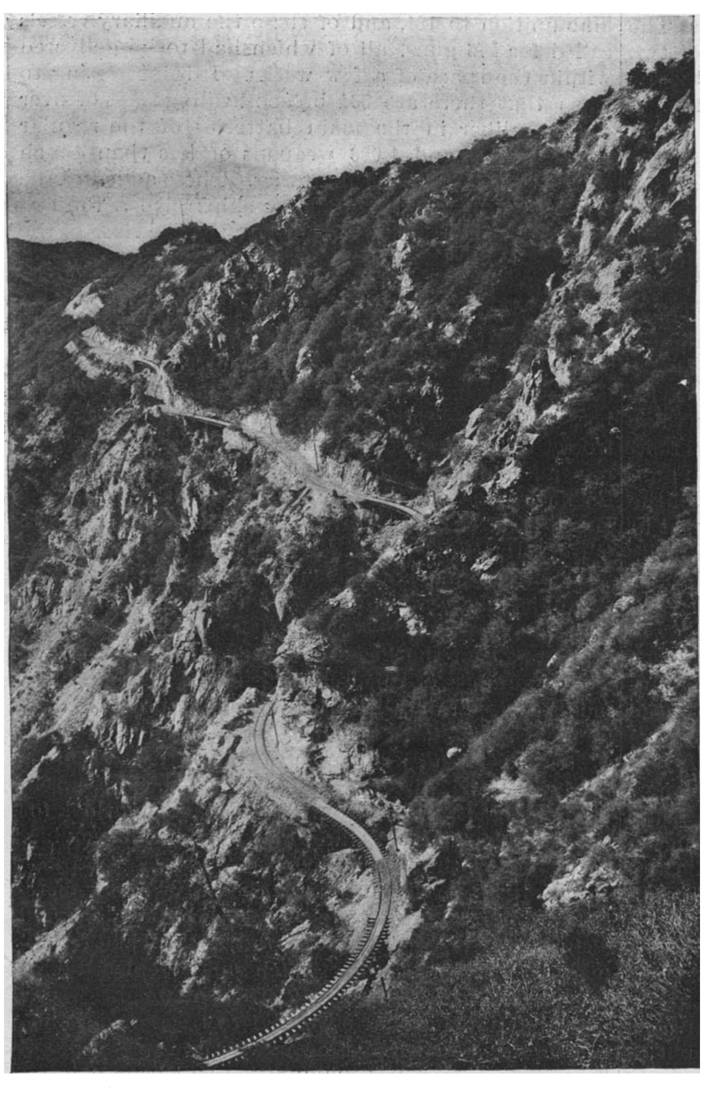
Largest Searchlight in the World, on Echo Mountain.



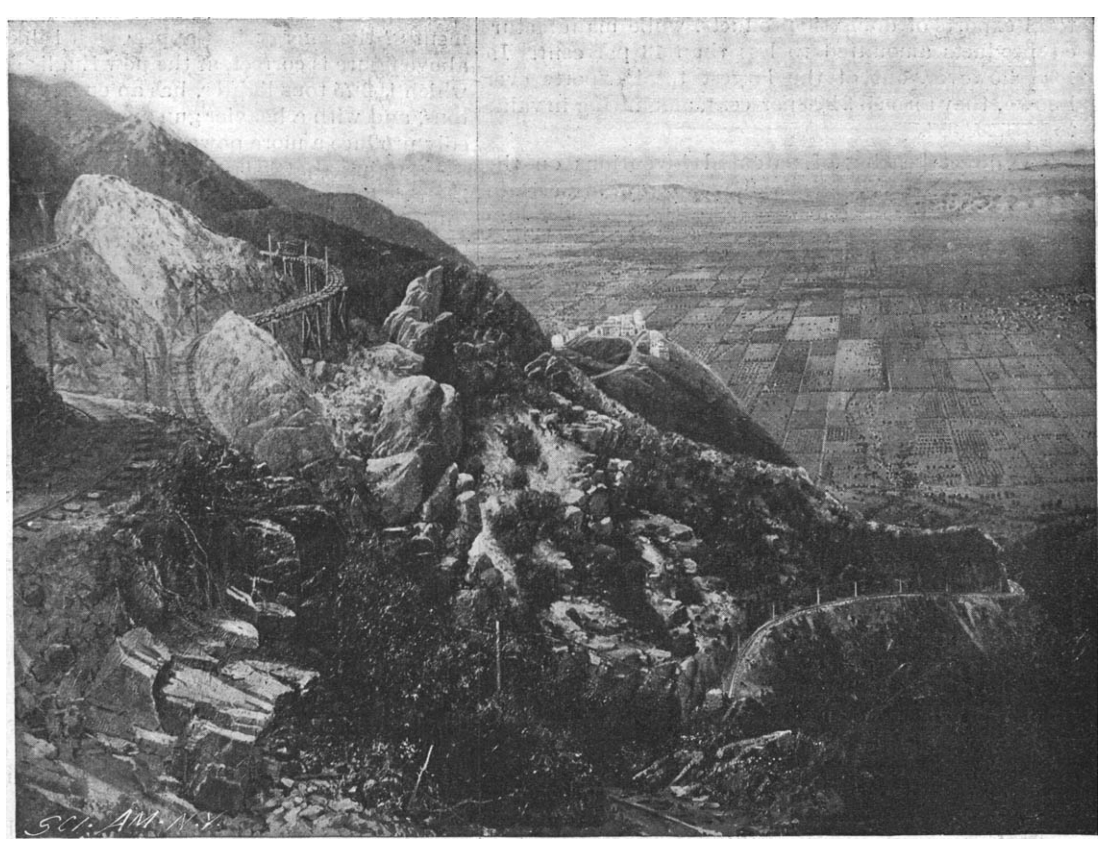
Moon Surface—Taken at Mt. Lowe Observatory by Dr. Lewis Swift.



Echo Mountain House, Mt. Lowe Railway.



Alpine Division, Half Way to Summit of Mt. Lowe.



Central Grades, Alpine Division, Echo Mountain—Hotel and Observatory, and Pasadena and Los Angeles Valley in the Distance.

MOUNT LOWE ELECTRIC MOUNTAIN RAILWAY.—[See page 279.]

Scientific American.

ESTABLISHED 1845.

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States, Canada, or Mexico......... $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845)........................$3.00 a year.
Scientific American Supplement (Established 1876)............. 5.00 "
Scientific American Building Edition (Established 1885)........ 2.50 "
Scientific American Export Edition (Established 1878)......... 3.00 "

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MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, OCTOBER 29, 1898.

OUR EXPORTS INFLUENCED BY OUR PATENT LAWS.

Twenty-five years ago the United States ranked fourth among the nations of the world in the value of her exports, but to-day she stands second only to Great Britain, and there is little doubt that in a few years she will lead the world as a manufacturing and agricultural nation.

The inventive genius of the American is largely responsible for our tremendous stride forward, and the claim for second place among the nations is founded upon undisputed facts which formed the basis of the address delivered by Judge A. P. Greeley, Assistant Commissioner of Patents, at the recent dinner of the Patent Law Association in Chicago. This dinner followed the opening session of the Patent Investigating Commission now sitting in Chicago for the purpose of revising the patent and trade mark laws of the United States.

Foreign statisticians have been quick to grasp the significance of figures bearing on the export trade of the leading nations. Judge Greeley bears testimony to the accuracy of figures gathered abroad and tabulates them as follows :

	Amount of Exports.		Rank.	
	1872.	1896.	1872.	1896.
England	$1,235,200,000	$1,422,000,000	1	1
United States	430,583,000	1,050,692,000	4	2
Germany	559,700,000	994,156,000	3	3
France	726,066,000	656,393,000	2	4
Russia	270,586,000	513,908,000	5	5

These figures do not, however, tell all the story, as they are taken from the statement for the fiscal year ending June 30, 1897, but in the next fiscal year, which ended June 30, 1898, the exports of the United States increased to $1,231,329,766—an increase over the preceding year greater than England's increase in twenty-five years. No more striking comparison of our wonderful advance in export trade is offered than this one, since Great Britain is the chief manufacturing nation in the world.

The increase in manufactures in the United States since 1860 forms the most remarkable feature of the growth in exports.

Judge Greeley states that the significant showing is undoubtedly due to the improvements in machinery made through patented inventions. Agricultural products have been outstripped in the race for foreign favor by the products of the inventor and mechanic. In 1860 agricultural products formed 81 per cent of the total exports of domestic products, while manufactured products amounted to less than 13 per cent. In 1898, however, out of the largest total exports ever known, they formed 24·06 per cent, amounting in value to $291,208,358.

The direct bearing of patented inventions on the exports of manufactures is shown by taking certain classes of products and comparing the export values for 1898 with earlier years. For example, in 1873 there were no exports of bicycles, while in 1898 there were shipped abroad $6,846,529 worth of bicycles and bicycle parts. Instruments and apparatus for scientific purposes, including telegraph, telephone, and other electrical machinery, were not included among the exports of the United States in 1873, but the records show that $2,770,803 worth of this class of manufactures has been exported this year. Typewriters, photographic materials, and celluloid are other examples. Another large item in the exports of 1898 is that of fresh beef, which was not exported prior to 1877 in sufficient quantity to be worthy of separate mention. It has been increased this year to the value of $22,966,556. Its export was only made possible by the invention of the refrigerating apparatus for cars and ships by which the meat can be transported without danger of spoiling. The most valuable comparisons that can be drawn from the exports of manufactured articles may be made by a glance at the annexed table :

	1873.	1898.
Agricultural implements	$2.585,914	$7.609.732
Iron and steel and manufactures of	13.649.027	70.367,527
Boots and shoes	421,518	1.816,538
Cottonseed oil	370,506	10,137,619
Paper and manufactures of	358,248	5,494,564
Total	$17,685,243	$95,425,980

There is no question that Judge Greeley is correct in assuming that we owe a large part of our success in the export trade to American inventions which have been fostered and protected by our patent laws.

IS THE THIRTEEN-INCH NAVAL GUN OBSOLETE ?

A correspondent writes us that in reading over the annual report of the Chief of Ordnance of the Navy, a review of which is given in the adjoining column, he notes that while a new and powerful 12-inch gun is to be mounted on the three new ships of the "Maine" class, the old 13-inch weapon is to be placed on the vessels of the "Alabama" class. He asks whether it is too late to make such changes in the armament of the latter vessels as will make it up to date when they are commissioned. Our correspondent further asks whether he is wrong in thinking that the armament proposed for the "Alabama," "Wisconsin," and "Illinois" is even now behind the times, and whether it will not probably be still more so when these vessels are commissioned.

If the Navy Department were asked the question, it would probably answer that it is both too late and too early to substitute the new 12-inch gun for the old 13-inch weapon; too late, because the 13-inch guns for the "Alabama" class are already completed, and too early because the ships will be completed long before the new 12-inch gun could be built and tested, and the requisite number of weapons of the new type constructed.

The question, however, may reasonably be asked whether it would not be possible to find other employment for these 13-inch guns, and whether the great increase in the power of the main battery of these three first-class battleships, due to substituting the 12-inch for the 13-inch gun, would not be sufficient to warrant a delay of a few months in the date of their going into commission. If it should be determined that the change ought to be made, there would be no difficulty in disposing of the twelve 13-inch guns which would be displaced. They might be utilized for coast defense, either by mounting them on half a dozen sea-going coast defense vessels of the type of the "Jemmapes" in the French navy, ships of 6,600 tons and 16¾ knots speed, or they might be transferred to the army and be mounted in our coast fortifications. The 13-inch gun has about 2,000 foot-tons more energy than the 12-inch 40-caliber army gun, and as its breech mechanism is of the latest Fletcher type, its speed of fire would be considerably greater.

Is the 13-inch gun obsolete ? For use in the second class of battleships, in coast-defense vessels, or on shore fortifications, it is not ; but for mounting on first-class battleships, which will go into commission for the first time not before the twentieth century has opened, we think it is a decidedly obsolete weapon. In using the term obsolete in this discussion, we do so in a limited sense, as applied to the arming of first-class, up-to-date battleships. To determine its standing we cannot do better than compare the 13-inch with the new 12-inch weapon to be mounted on the "Maine" class. The correct way to determine the relative efficiency of two guns is to divide the energy of the projectile by the weight of the gun and compare the results. The 13-inch gun weighs 60·5 tons, and its muzzle energy is 33,627 foot-tons. The new 12-inch gun is to weigh, according to Captain O'Neill's report, 53 tons, and we believe its proposed energy is to be 48,000 foot-tons, with a velocity of 3,000 foot-seconds. Although no official statement of the energy has appeared, it is likely that the above figure is correct, as the new English 12-inch gun, which is 2·75 tons lighter, has an energy of 44,500 foot-tons, and with a heavier gun our experts will undoubtedly produce a more powerful weapon.

Assuming that 48,000 foot-tons is correct, and dividing this by the weight of the gun, and doing the same thing in the case of the 13-inch gun, we get 906 foot-tons of energy for each ton weight of the 12-inch gun, and only 556 foot-tons per ton of gun in the case of the 13-inch gun—an increase in efficiency of 63 per cent in the new over the old weapon. In view of these facts we must assure our correspondent that "the armament proposed for the 'Alabama,' 'Wisconsin,' and 'Illinois' is even now behind the times," and that it "will be still more so when those vessels are completed."

There are probably no structural difficulties of an insuperable character to prevent the substitution of the new 12-inch for the 13-inch gun. Turrets that have been designed for guns of a certain weight will certainly carry others of less size and weight. The new weapon, though of less caliber, will, probably, being designed for smokeless powder, be of greater length ; but the increase will be chiefly in the chase of the gun and outboard of the turret. There would be no difficulty in the arrangements of ammunition hoists, handling gear, and magazines, where the reduced size of the shell and charges would, indeed, favor the change.

Moreover, apart from the positively enormous increase in the power of the battery, there would be a great gain in the amount of ammunition that could be carried. Thirty tons would be saved in the weight of the four guns in each ship and about 600 pounds in the weight of each round, one round for the 13-inch gun weighing 1,650 pounds, whereas a round for the new 12-inch gun would weigh only about 1,050 pounds. Consequently, if the substitution were made, not only would the power of the main battery of the "Alabama" class be raised 63 per cent, but the reduction in the weights of guns, mounts, and ammunition would allow fully 50 per cent more ammunition to be carried. This increased ammunition supply alone might well prove the determining factor in a prolonged naval engagement.

In view of these facts, it may well be asked whether the 13-inch gun is not obsolete as the armament of a first-class battleship whose first commission will bear date in the early months of the year 1900 ? We think it is, and we sincerely hope that when the three noble ships in question are sent out to uphold the dignity of our flag upon the high seas, they will carry the very best weapons that American skill can produce, and not, as is now proposed, a gun that was designed more than a decade ago, and before the present remarkable era of gun construction had well commenced.

WORK OF THE NAVAL BUREAU OF ORDNANCE.

The reports of the various chiefs of bureaus of the navy possess a special interest, coming, as they do, at the close of a foreign war. We all remember the general sense of unpreparedness with which the country commenced hostilities—the conviction, based upon no one knew just what grounds, that we were quite unready to face the responsibilities of war with a European power. There is no doubt that in some respects, notably in the matter of coast defense and the equipment of our army, we were not as well furnished for war with even such a minor power as Spain as could have been wished ; but it is satisfactory to know that in one branch of the service—the navy—our ships were ready to take the sea on the day that war was declared.

In his annual report to the Secretary of the Navy, the Chief of the Naval Bureau of Ordnance says on this question, as far as it concerned his department, that the resources of the country to supply war material were scarcely touched, and unquestionably there is no limit to the amount that can be procured of all kinds, in case of need, provided time is not too important a factor. It is a pleasant surprise to learn that, contrary to the general impression, the amount of ordnance and ammunition purchased abroad was quite inconsiderable. We are informed that owing to the exigencies of the war, a number of minor caliber guns and some ammunition for them and a few torpedoes were purchased abroad, but that neither powder nor projectiles for heavy guns, nor in fact any war material, except as above quoted, was procured by the navy out of the United States.

The work done during the year included the placing of new batteries and the proper supplies of ammunition on 107 vessels that were acquired by the navy and transformed into auxiliary warships, and the arming of 12 torpedo boats and 2 gunboats. This brought up the total number of vessels furnished with guns and ammunition to 121, and of these the auxiliary vessels called for 576 guns, all of which had to be delivered within the space of a few weeks. It is interesting to learn that there are 564 breech-loading rifles of over 4-inch caliber in the main batteries of the regular naval vessels and 1,023 weapons of less than 4-inch caliber in the secondary batteries. These added to the guns mounted on the auxiliary ships give a total of 2,163 guns of all calibers in our navy at the close of the war.

It is gratifying to learn that the performance of guns, mounts, and their appurtenances under the active operations of the war "has been in general thoroughly satisfactory." The only defects occurred in the minor details of some of the mounts for guns of small caliber, and the general tenor of the reports received from the various vessels is that the guns, mounts, turrets, and ammunition worked well.

The lessons of the war from the view-point of the Bureau of Ordnance are of special interest. Capt. O'Neill, the Chief of Ordnance, is of the opinion that, while heavy guns in turrets must be regarded as one of the chief characteristics of modern battleships, the lessons of the day indicate that the greatest execution (except against the heaviest armor) may be expected from a number of quick-firing guns of small caliber, mounted separately in armored casemates or in a redoubt. While it is true that turrets afford the best protection for a gun, they provide no protection for the hull of the ship. They are cramped, close, hot in warm climates, provide only a contracted outlook for the gunner, and they are heavy and slow-moving. Nevertheless, they are a necessity.

But although we must retain the heavy armor-piercing gun, the Bureau is of the opinion that its caliber and weight may be reduced with advantage, and recommends that the 60·5-ton, 13-inch gun be replaced by a 12-inch gun, with a saving of 7½ tons of weight. While it is true that this does not seem to be a great reduction in itself, the reduction in size and weight of the turrets, barbettes, and ammunition will be very large. It is certainly encouraging to know that the Ordnance Bureau is at last moving in this important matter, and that our new battleships of the "Maine" type—the "Maine," "Ohio," and "Missouri"—will carry 12-inch guns as their main batteries which will equal the best of the foreign guns in velocity energy, and penetrating power. At the same time, as we have stated elsewhere, it is greatly to be regretted that the 13-inch gun is to be retained on our new ships of the "Alabama" class. The new 12-inch gun is also to be mounted on the four new monitors, contracts for which have recently been let.

Regarding armor plate, the report says that the Bureau is considering the advisability of reducing the thickness of the belt, diagonal, turret, and barbette armor, which on our battleships has heretofore been very heavy, more so than now in its opinion appears necessary or desirable, and it considers that 12 inches is the maximum thickness that will hereafter be required. Reference is made to the recent improvements in the manufacture of armor plate and the late tests of Krupp plates, an illustrated description of which appears in the SCIENTIFIC AMERICAN of August 27, 1898.

On the question of smokeless powder, the report says that after many difficulties the manufacture of a purely smokeless powder, made by the Bureau's formula from soluble nitro cellulose, which is uniform in character and possesses good keeping qualities, has become an accomplished fact. Henceforth it will be the standard powder of the navy, and a few vessels have already been furnished with a complete supply. All vessels hereafter fitted out will be supplied exclusively with smokeless powder, except that a few charges of brown powder will be carried by each ship for target practice. A parcel of land on the Indian Head reservation has been chosen for the erection of the government powder factory which was authorized by Congress at its last session.

TAXATION OF PATENT RIGHTS.

Once more the courts have had to intervene, and interdict the taxing of patent rights by local authorities. The opinion of Judge Parker, of the New York Court of Appeals, from which we quote below, is of special interest to inventors in that it shows an appreciative understanding of the purpose which the framers of the Constitution had in view in authorizing the granting of patents, i. e., to offer an inducement for inventors to freely communicate their secrets in processes, machines, and manufactures.

The case arose upon certiorari proceedings brought by the Edison Illuminating Company, of Brooklyn, to review the action of the Board of Assessors of the city of Brooklyn in assessing for the purpose of local and State taxation the various patents or patent rights owned by the company and upon which the company in making its return to the assessors had placed a valuation of $945,000. The proceedings were instituted in the New York Supreme Court, and the Special Term sustained the contention of the company that its patent rights were not taxable, and vacated the assessment. The Appellate Division, on appeal, affirmed the order of the Special Term (19 App. Div. 599) and an appeal was then taken to the Court of Appeals, which on October 4 handed down a decision affirming the order of the Appellate Division.

Chief Justice Parker, whose opinion is reported in 156 N. Y. 417 (advance sheets October 15), cites the cases, Webber v. Virginia, 103 U. S. 344; *Ex parte*, Robinson, 2 Biss. 213, and Patterson v. Kentucky, 97 U. S. 501, and thus states with approval the argument in support of the doctrine that patent rights are not taxable:

"The Constitution of the United States (Art. I, sec. 8, subdiv. 8) conferred upon Congress the power to promote the progress of science and useful arts, by securing for limited times, to authors and inventors, the exclusive right to their respective writings and discoveries.

"In pursuance of this power, Congress enacted that patents should be issued to inventors, which should secure to them for a limited term the 'exclusive right to make, use, and vend the invention or discovery through the United States and the Territories thereof.' (U. S. Rev. Stat. S. 4884.) Patent rights are, therefore, granted under the Federal Constitution and necessarily for the promotion of federal purposes. (Grant v. Raymond, 6 Peters 218, 241; Ames v. Howard, 1 Sumner 482; Blanchard v. Sprague, 3 Sumner 535). The federal purpose is primarily to stimulate genius, talent, and enterprise by holding out that encouragement which patents give, but ultimately to secure to the whole community the great advantages that flow from the free communication of secrets, processes, and machinery.

"The next step is, that patent rights being created under the federal Constitution and laws for a federal purpose, the States are without the right to interfere with them. The right to tax a federal agency constitutes a right to interfere with, to obstruct, and even to destroy the agency itself, for, conceding the right of the State to tax at all, then it may tax to the point of destruction. This doctrine is elaborately discussed by Chief Justice Marshall in the U. S. Bank case (McCulloch v. Maryland, 4 Wheaton 316), wherein the court decides that Congress has power to incorporate the bank as a federal agency, and that having done so, the State cannot tax the bank upon its circulation. The latter proposition is regarded as a necessary conclusion from the former. The federal government having the right to create the agency, it necessarily has the right to protect it, not only from destruction, but from interference from any other government, whether such interference be in the guise of taxation or otherwise, as the power to tax involves the power to destroy, and the power to destroy may render useless the power to create. In the course of his opinion, Chief Justice Marshall said:

"'If the States may tax one instrument employed by the government in the execution of its powers, they may tax any and every other instrument. They may tax the mail; they may tax the mint; they may tax patent rights; they may tax the papers of the custom house; they may tax judicial process; they may tax all the means employed by the government to an excess which would defeat all the ends of government.'"

Justice Parker's opinion was concurred in by all the judges of the court, and the State of New York has now formally and firmly concurred in the decisions of the United States courts that patent rights may not be taxed by the State or municipal authorities.

THE HEAVENS IN NOVEMBER.

BY GARRETT P. SERVISS.

The advance guard of the great November meteor swarm is due this month, and on the nights of the 13th, 14th and 15th astronomers in all parts of the earth will be awake and on the lookout. They will be both surprised and disappointed if a meteoric spectacle, which may be a brilliant one, is not beheld by some of the watchers. The main swarm of the meteors is not due until November, 1899, but their advancing columns, broken into parallels and separated by considerable gaps, occupy so much space on the celestial highways they traverse that millions of the mysterious little bodies must already have reached the neighborhood of the earth's orbit, and it can hardly happen that many of these will not become entangled by the terrestrial attraction, and dart their fiery spears through the upper air.

The reader may like to be reminded that this, the greatest known "meteor shower," has a period of 33¼ years; that the history of these meteors has been traced back to the year A. D. 126, when the planet Uranus is believed to have captured the wanderers and turned them into a permanent orbit around the sun; that a comet (Tempel's) is known to be traveling in the same orbit with them, and that the world was astonished at the magnificence of the displays which they made in 1833 and 1866. At their return in 1866 changes had taken place in the array of the meteors, indicating a considerable scattering, and in November, 1867, enormous bodies of them were still rushing across the earth's orbit, and another splendid display occurred.

The point in the heavens from which the meteors appear to radiate is situated within the curved blade of the imaginary "sickle" which marks the constellation Leo. This is not well risen until midnight, but late in the evening meteors radiating from it may be seen shooting upward from the northeastern horizon. Observers are advised to begin watching for them about 11 P. M. on November 11, keeping up the watch for five nights altogether and continuing it until the morning twilight begins. Fortunately, there will be no trouble from the moon, which is "new" on the 13th.

The November meteors are very swift in movement, since the earth meets them "head on," and they frequently exhibit bright colors and leave brilliant trains.

The Harvard College Observatory offers to send maps and forms of record to all who will take part in systematic observation of the meteors.

If the expected display on the 13th or 14th does not equal expectation, another chance will be presented on the night of the 27th, when the celebrated Andromeda meteors are due. These are believed to be part of the debris of the vanished comet of Biela, and they furnished dazzling spectacles in 1872 and 1885. Their period is thirteen years. During the shower of 1885 an iron meteor, supposed to belong to the Andromeda swarm, and subsequently famous under the name of "a piece of Biela's comet," fell at Mazapil in northern Mexico. Unlike the November 13th meteors, which are known as the Leonids, the Andromeda meteors are slow, because they overtake instead of meeting the earth. Their color is frequently reddish. The full moon will interfere with the observation of these meteors, whose radiant point is overhead between 9 and 10 o'clock in the evening.

THE PLANETS.

Mercury is an evening star, but does not attain its greatest eastern elongation until early in December. It moves from Libra into Sagittarius.

Venus ends its career as an evening star with the last day of the month. It is in the constellation Scorpio.

Mars, in the constellation Cancer, rises about 9 P. M. in the middle of the month.

Jupiter has become a morning star in Virgo, but is too near the sun for satisfactory observation.

Saturn remains on the borders of Scorpio and Ophiuchus, slowly moving eastward. It is still an evening star, but, like Jupiter, too near the sun to be well seen.

Uranus passes from the evening into the morning sky on the 25th, and is hidden in the solar rays.

Neptune, in Taurus, rises early in the evening, but being invisible to the naked eye, possesses little interest for the amateur star gazer.

Several planetary conjunctions occur in November. On the 11th, at 10 P. M., Mercury and Uranus meet; on the 18th, at 1 P. M., Mercury and Saturn; on the 20th, at 3 A. M., Mercury and Venus; on the 24th, at 3 A. M., Venus and Saturn.

THE MOON.

New moon occurs on the 13th about 7 P. M.; first quarter on the 20th at noon; full moon on the 27th at midnight; last quarter on the 6th at 9 A. M. The moon is nearest the earth on the 16th, and farthest from it on the 4th.

The lunar conjunctions with the planets occur as follows: Neptune on the 3d, Mars on the 5th, Jupiter on the 12th, Uranus on the 14th, Mercury on the 14th, Saturn on the 15th, Venus on the 15th, Neptune again on the 29th.

MISCELLANEOUS.

There will be minima of the variable star Algol on the 14th at 8:23 P. M., and the 11th at 11:35 P. M.

The wonderful variable Mira Ceti, having reached its maximum in October, should be seen fading during November.

The winter constellations are advancing into view, but will be better seen and described in November.

THE HISTORY OF THE MASSAGE TREATMENT.

It is often impossible to determine the origin of our methods of treatment, particularly as most of them date back to the dark ages, when accuracy in detail was not a characteristic feature in medical records. Sweden is usually credited with being the place of origin of the scientific system of massage and physical exercises. This, says The British Medical Journal, is no doubt correct as far as modern Europe is concerned, but the real originators of massage and physical exercises appear to have been the Chinese. An interesting article appeared recently in the Deutsche medicinische Wochenschrift, in which reference was made to a book lately published by P'an Wei, Governor of Hupeh. The author, a great authority on massage, was consulted by the late Empress of China. The Chinese legends contain many references to various systems of physical exercises, and these are associated in a curious manner with metaphysical thought. Life, according to the Chinese traditions, is entirely dependent on "air currents," which are designated as the primary aura of the organism. So long as the body is permeated by the "air current" it is proof against disease. The object of physical exercise is to circulate the "air current." The Chinese system is divided into three periods, each period occupying one hundred days. The first period should commence at the time of the new moon. The patient must rise at 4 A. M. and walk outside his house, and take seven deep inspirations; immediately after this two youths, who have been specially trained, commence a gentle friction all over the body, starting over the cardiac area. At the time of full moon a further set of inspiratory exercises must be taken. Later on in the second period the various parts of the body are rubbed with wooden planks until the muscles are hardened. It is not until the hardening of the muscles takes place that the real physical exercises commence. Between the fifth and sixth months is the period of greatest activity; the European dumb-bell is replaced by large sacks filled with stones. In the third period the back muscles are chiefly exercised. Great benefit is said to have resulted from this system.

ARMY TENT STOVES.

Bids were recently opened in St. Louis for two thousand conical tent stoves. They are very curious in appearance. The stove has the form of a frustum of a cone and is constructed of number fourteen United States standard gage common annealed plate iron and is in one piece, except the collar and door. The aperture for the door is 6 inches wide and the covering is sufficiently large to lap over. There is a vent in the bottom of the stove, directly under the door. The height of the stove to the top of the collar is 28 inches. Its outside circumference at the bottom is 58 inches, and at the top 13 inches; the distance from the bottom of the door aperture to the base of the stove is 14 inches. The total weight is 19 pounds. The cost to the government for those on hand is $1.23 each.

THE observatory established on Mont Blanc at an altitude of 4,400 m., by M. Vallot, is being moved to a position where the drifting snow will not interfere so seriously. The woodwork for the new building, which is larger and better arranged than its predecessor, is being carried up the mountain by some forty men, work having been begun on July 16.

SPIRIT SLATE WRITING AND KINDRED PHENOMENA.—IV.

BY W. E. ROBINSON.

A favorite trick of one medium was to have a pile of slates on top of the table. After the slates had been thoroughly examined, he would clean them and place them on the floor, showing each slate after cleaning. He would then pick them all up at once and replace them on the table and select two of them, putting them together and holding them in his hands above his head; he would then separate them and show one covered with writing. There was no trick about the slates themselves, as would be easily proved by the examination to which they were put before and after the spirit manifestations. The explanation of the trick is as follows: The floor was covered with a carpet in which there was a slit or cut just wide enough to pass a slate through. Before the séance, a slate written on one side is placed under the carpet with the writing downward. (See Fig. 9.) The slates, as they

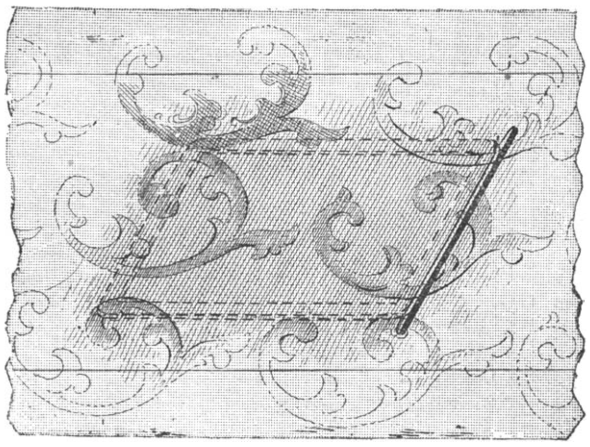


Fig. 9.—THE SLATE UNDER THE CARPET.

are cleaned, are laid on the carpet immediately over or near the concealed one, and on lifting the slates from the floor, this one is also carried with them and placed on the table. Of course, it is this slate and one of the prepared ones that are afterward used. There is little likelihood of anyone taking notice of there being one more slate in the pile.

We now come to what mediums term the "double slate." It is, to all appearances, two ordinary slates hinged together at one side and locked with a padlock, the shackle of which goes through a hole in the sides of the frame of each slate. This slate also contains the false flap or slate, but the slate or flap is held firmly in either frame in the following manner: The inside edges of both ends of each frame are beveled inward a trifle. One of these ends of each slate frame is also made to slide or pull out about a quarter of an inch. These are prevented from sliding, until the medium desires it, by a catch in the framework, which is connected with a screw in one of the hinges. This screw stands a little higher than the rest, so that it is easily found by the medium. The hinges are on the outside of the frame instead of the inside. When the screw is pressed it loosens the catch, which allows the ends to be moved a trifle. The false flap is just large enough to fill in the space under the bevels of the frame, and if the catch in the top frame is released and the end moved, the flap will drop into the bottom slate, where it is held tight and firm, by releasing the catch in that frame and moving the end until the flap settles into its place and then sends the end back into its original place again. The writing is placed beforehand on one slate and on one side of the flap, both the written sides being face to face, but after the flap has changed places, or, we might say, changed slates, two slates are presented with written sides.

There is another double slate made with hinges and padlocks. (See Fig. 10.) One of the ends of the wooden frame of one slate is fastened securely to pins on the slate, which is made to slide out completely from the frame. This, of course, allows the sides of both slates to be written upon. After that is done the slate is slid back into its frame. Care should be taken in sliding the pins back not to reverse it so as to bring the writing side out.

Another spirit trick is performed as follows: The stranger is allowed to bring two slates and to wash and seal them himself in the presence of the medium. The medium places a piece of chalk between the slates before they were sealed. The slates were then sealed in a most elaborate manner; court plaster and sealing

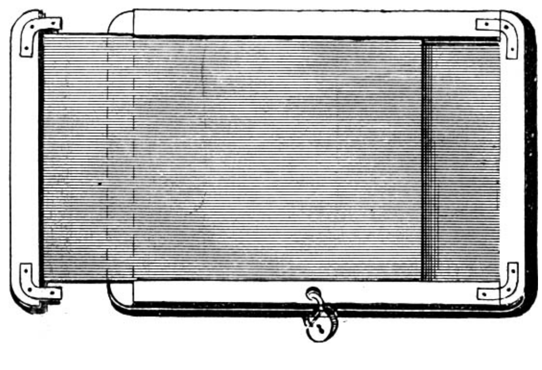


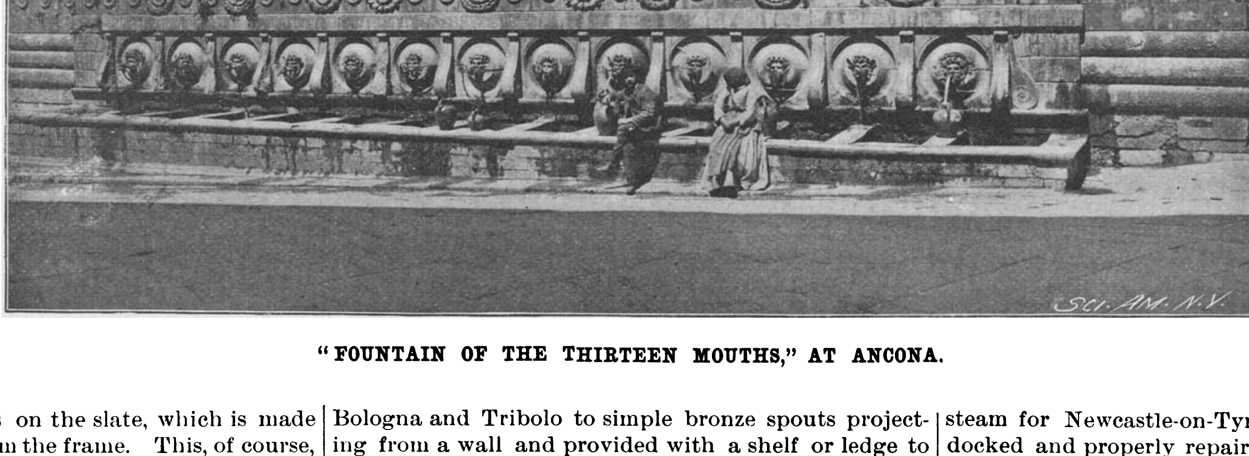
Fig. 10.—THE PADLOCKED SLATE.

wax being profusely used, making it an utter impossibility to insert the minutest piece of wire or like body between the slates; nevertheless, after the slates were held under the table, they were unsealed and writing was found upon the inner surface of one of them, although it could hardly be called writing, being little more than a scrawl. Our Fig. 11 shows how the trick was performed. The piece of chalk the medium placed between the slates was composed of pulverized chalk mixed with a little glue water and iron filings and allowed to become hard. The medium while under cover of the table traces with a magnet below the slate the words found upon the inside, but backward. The chalk, on account of a considerable percentage of iron filings it contains, rolls around over the slate, making a kind of mark.

AN INTERESTING ITALIAN FOUNTAIN.

Americans who have never been abroad can hardly appreciate the importance which the fountain assumes in Southern Europe. With us a fountain usually suggests an ornamental work of an architectural order with stone or bronze figures or groups and a basin as constituent parts; but in the countries bordering on the Mediterranean the fountain, while ornamental, or at least picturesque, has utility as well. In the large cities, such as Rome, Florence, Naples, etc., there is an abundant water supply piped directly to the houses, but as in sanitary matters Italians are somewhat backward, many of the inhabitants are forced to obtain water from prosaic iron hydrants. In the smaller places, however, the fountain is one of the institutions, and even though there is a system of water supply in use, the people depend largely upon the fountains, and the gayly dressed women may be seen at all hours resorting to the fountains with their polished brass or copper kettles or large earthenware pitchers, which they deftly carry away poised on their heads. Naturally, the fountain is the center of gossip and the scene around it is always animated.

The Italian fountain is of every conceivable style, from the splendid and artistic creations of Giovanni Bologna and Tribolo to simple bronze spouts projecting from a wall and provided with a shelf or ledge to hold the water vessel. Our engraving represents one of the most curious fountains in Italy, the so-called "Fountain of the Thirteen Mouths" at Ancona.



"FOUNTAIN OF THE THIRTEEN MOUTHS," AT ANCONA.

Ancona, on the Adriatic, is an old Greek city and its streets are narrow and steep, running up the sides of the hills and for the most part ending in a square, the Piazza del Teatro. Turning to the right, by the Strade Calamo, we come to "La Fontana del Calamo," as it is also called. It is believed that the name originated from the inequalities of the street, the fountain being built on an incline, as will be seen from our engraving. The original fountain was very old, and in 1503 it was demolished and the great stones which formed it were used in the construction of the portico of the Palazzo della Anziani. It was rebuilt in its present form by the architect Pellegrino Tibaldi, in the sixteenth century.

The fountain consists of a long rectangular trough divided into sections by cross stones which are built in to support water vessels. Against the wall of the building there are thirteen circular recesses, each filled

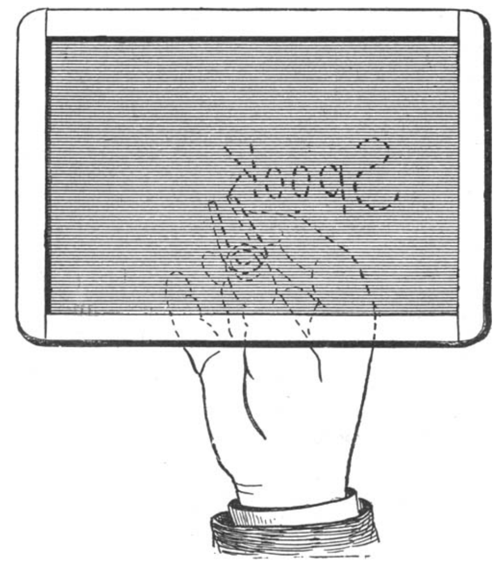


Fig. 11.—MAGNETIC WRITING.

with a lenticular disk, the top being cut off so as to leave a plane surface. Each is terminated by an ornamental mask, the mouth serving as an outlet pipe for the water. A cock in this pipe regulates the flow of water. The thirteen masks are separated by reversed consoles decorated with volutes. Pilaster consoles to match form the end finish. Above are ornaments carved in stone. The whole effect is naturally very picturesque.

A Tank Steamer Fire.

We are indebted to Mr. Ellepiaux, United States Vice-Consul at Rouen, for the following notice of a remarkable fire in a tank steamer:

One of the first, if not the first, tank steamers to have been saved after taking fire, without exploding, occurred in the port of Rouen last Monday, and in which a young American, A. V. Patterson, manager of Bedford & Co., displayed unusual nerve and courage. The steamship "Vindobla" was in port discharging a cargo of crude oil, which was about half unloaded, when an explosion occurred in No. 4 compartment on steamer, and which flooded engine, fire room, and cabins with burning oil, which naturally caused the ship to be abandoned by her crew. Mr. Patterson, with the assistance of some of his employes, connected a 2½-inch steam line from shore boilers, and by extending same through port holes, together with streams of water played on hatches and wooden decks, succeeded, after five hours of labor, in extinguishing the fire. The ship is constructed with double deck from the middle to the stern, and it is between these two decks, the upper one in wood, that the hatches open that lead to each tank, and these hatches were not bolted down; this makes the saving of the vessel most surprising. The damage done the vessel was not so great but that, with some temporary repairs, it cleared with its own steam for Newcastle-on-Tyne, where the boat will be docked and properly repaired.

Rouen, September 26, 1898.

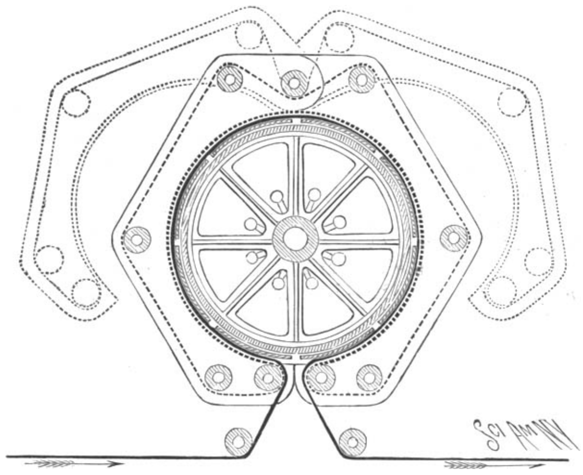
AN average star of the first magnitude is one hundred times as bright as one of the sixth magnitude.

RAPID PHOTOGRAPHIC PRINTING, DEVELOPING, AND DRYING APPARATUS.

Some time ago we described in these columns an automatic printing apparatus in which glass negatives were mostly employed, involving a mechanism for raising the negative at stated times from the sensitive paper.

Our engravings show a new form of apparatus, invented by Mr. Arthur Schwarz, a German inventor, arranged principally for rapidly printing from continuous ribbon negatives upon sensitized bromide paper, and the method by which it is done is somewhat ingenious.

Referring to the small upper diagram engraving, a cross section of the exposing cylinder, the course of the paper is shown by the heavy black line. The cylinder consists of a circular frame supporting on its circumference a perfectly transparent film; secured around this film is the flexible film ribbon negative. The sensitive bromide paper is next passed around the cylinder in a non-actinic light, then the hinged portions of the inclosing box, shown extended by the dotted lines, are brought together, which also brings the endless contacting band into contact with the surface of the paper, pressing it tightly against the flexible negative. Ranged radially around the axle of the exposing cylinder are electric incandescent lamps, lighted at stated periods by suitable switches. As the cylinder rotates, these lights give the proper exposure from the center outward through the negatives to the paper, the negative rotating in a continuous circle, while the paper enters on one side and passes out the other side duly exposed, as indicated by the arrows.

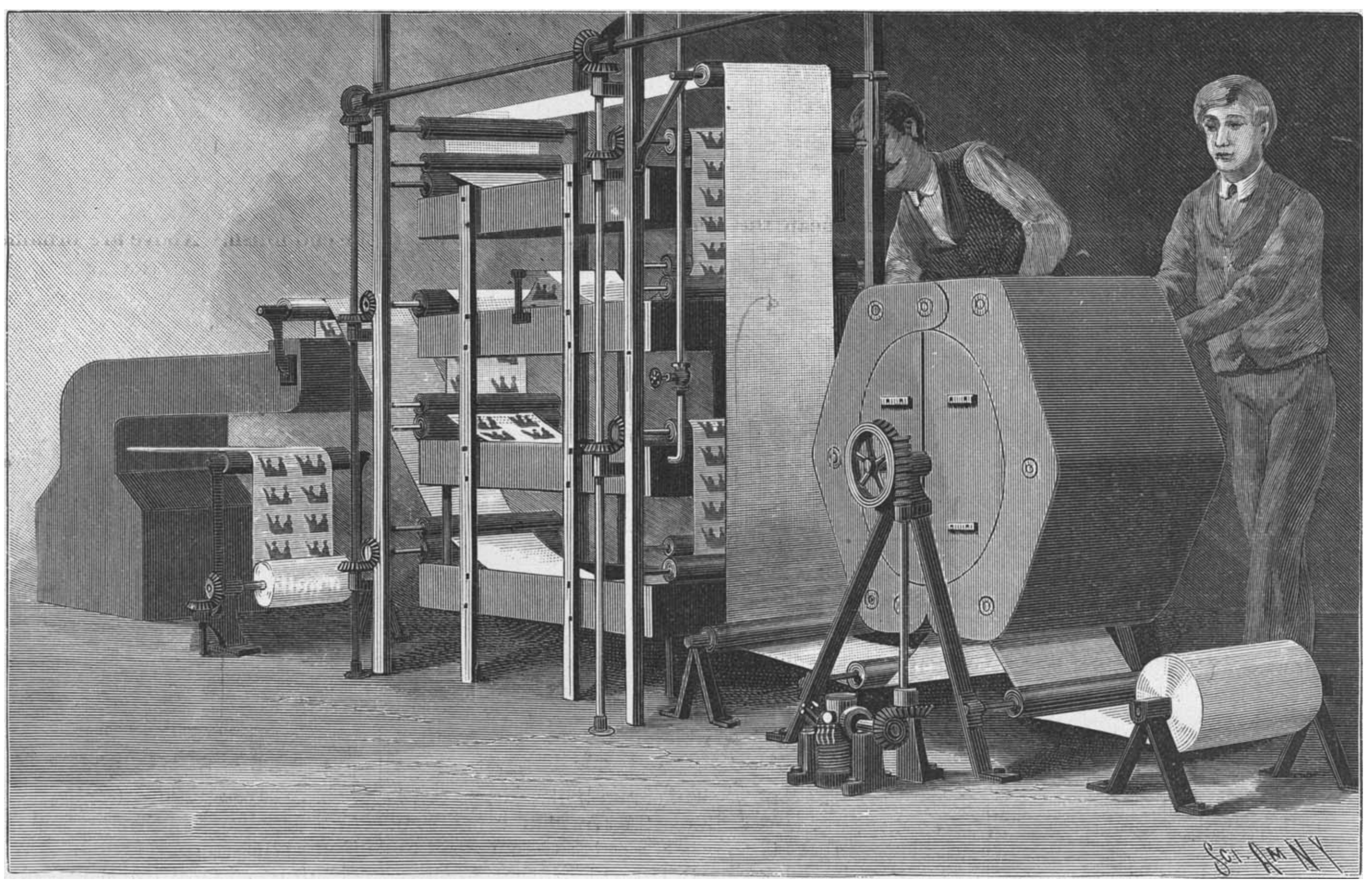


THE EXPOSING BOX.

The large engraving illustrates the entire apparatus. Upon the right is observed the roll of sensitized paper, passing into the bottom of the exposing box, out again upward over the top of the developing trough, passing horizontally through that, thence downward into the fixing trough, and lastly through hardening and washing troughs upward into a drying chamber, finally being wound up on a spindle below, completely finished.

A cross rocking rod on the trough below the top one enables the operator to raise the paper out of the solution occasionally to readily examine the pictures. The apparatus is operated by an electric motor observed near the exposing box, motion being extended to the other parts by suitable shafting and gearing capable of easy regulation and adjustment.

One of the particular advantages of the machine is that the action of the chemicals is at all times observable while passing through the horizontal troughs, a point unattainable in the vertical dipping troughs; there is also economy in the quantity of solutions used. It will be seen that the duplication of prints can be made in enormous quantities with almost printing-press certainty and rapidity at a minimum of expense and labor.



IMPROVED PHOTOGRAPHIC BROMIDE PRINTING, DEVELOPING, AND DRYING APPARATUS.

Quick Method of Preparing Lantern Slides.

Recently we have had occasion to make between one and two hundred lantern slides, and some account of the modus operandi may be of service to those who are about to make slides for use during the coming winter. Although it was desired to obtain the highest possible quality, the work had to be done against time, and a rapid, simple, and yet certain method of development was a necessity.

The essentials of a good developer for lantern slides are, it seems to us, as follows: (1) Regular action, well under control, yet at the same time fairly rapid, to avoid waste of time, and admitting of local modification with the aid of a brush or otherwise. (2) The production of an image of good color, admitting of variations within moderate limits. (3) A comparatively transparent deposit in the shadows, free from what is commonly called "clogging up." (4) The absence of any tendency to produce fog, stains, or frilling. (5) Freedom from any necessity for the subsequent use of a clearing bath. (6) General applicability to the various brands of lantern plates now on the market.

Some of the newer developers only imperfectly satisfy condition (1), at any rate as regards ease of control. As regards the color of the image, the chief difficulty, as every slide maker knows, is to obtain blacks that have a warm brownish tinge, rather than the bluish, or, what is worse, the olive tinge so commonly met with. It is still more difficult, except by very slow development, to obtain yet warmer colors without losing transparency and vigor.

The clogging up, or loss of transparency, in the shadows, is due to several causes, but we believe that sufficient attention has not been given, in this connection, to the effect of the organic oxidation product which, under certain conditions, and with certain developers, is precipitated on the reduced silver. The popularity of ferrous oxalate as a developer for lantern slides and other diapositives may be attributed, in part at least, to its freedom from any tendency of this kind. Conversely, the objections often felt against the use of any modification of the pyro developer for diapositive work. Hydroquinone, used alone, is not free from objection on the same grounds.

On the other hand, in spite of its undoubted merits, ferrous oxalate fails to satisfy some of the conditions that we have laid down; the great difficulty of getting a warm colored image, the necessity for the use of something other than plain water for the first washings after development, and the special difficulties that attend its use with "hard" waters, to say nothing of the ease with which bad stains are produced by very minute traces of hypo, are points that tell heavily against it when a large quantity of work has to be got through rapidly.

No developer of which we have any experience so nearly satisfies all the specified requirements as ortol, used with sodium carbonate as the alkali. Moreover, it has the additional advantage that the same quantity of solution can be used over and over again—a fact which adds greatly to both convenience and speed, as well as economy.

All the slides to which we referred at the outset, numbering very nearly two hundred, were developed with ortol, and, although one particular brand of lantern plate was used for the majority, no fewer than six of the brands on the market have been used at one time or another with the ortol developer, and in all cases with satisfactory results. It follows that its range of applicability is wide.

As a basis in mixing the developer, we use the modification of Dr. Hauff's formula that we have described before, but will now repeat for the sake of completeness:

ORTOL SOLUTION.

Ortol	15	parts or	120 grains.
Potassium metabisulphite	7½	" "	60 "
Water to make up to	1,000	" "	20 ounces.

SODA SOLUTION.

Soda crystals	10	parts or	2 ounces.
Sodium sulphite	10	" "	2 "
Potassium bromide	0·23	" "	20 grains.
Water to make up to	100	" "	20 ounces.

Generally, we mix ortol solution one part, soda solution one part, water two parts, and this gives images that are decidedly warm in color. By using only one part of water, the action is more rapid, and the color of the image distinctly colder, while at the same time the exposure of the plate must be somewhat less in order to get the best results. A mixture of equal parts of ortol and soda solutions, without any added water, may also be used, but the action is then liable to be too rapid, especially in warm weather. Temperature, in fact, has an important influence on the action of the ortol, and if the developing solution is very cold, the rate of development will be much slower.

In warm weather the proportions, ortol solution one part, soda solution one part, water two parts, may be adopted as the normal proportions, while in winter the added water should be reduced to one part.

When making a large number of slides, it is very convenient to use the papier maché dishes, with divisions that hold four plates. A good plan is to have three dishes of this sort in use, so that while four plates are being developed in one dish, another four can be fixing in a second dish, while a third four are having their first washing after fixing in a third dish. The risk of injury to the plates is lessened by developing, fixing, and washing in the same dish, and no evil effects result from this practice if the washing after fixing is allowed to go on for several minutes before the plates are transferred to the rack of the washing tank for their final washing.

The possibility that some of the plates may be over or under exposed makes it advisable to have ready (a) a dish containing some bromide solution, say two per cent, into which a plate can at once be put if the image appears too rapidly; (b) a measure containing some ortol and soda solution without any added water; and (c) a vessel (such as a measure, or a short, wide mouthed bottle) containing some soda solution only.

Over-exposed plates are removed from the dish as soon as over-exposure is recognized, and placed for a short time in the bromide solution, after which they may be returned to the developing solution, or to some separate developer to which an extra quantity of bromide has been added. Sometimes it may be found necessary to place the plate alternately in the bromide solution and the developing solution.

On the other hand, if the plate shows signs of under-exposure, it may be lifted out of the dish, and flooded with some of the strong developer, which, after a time, is allowed to run into the dish containing the developer, the plate being also returned to the dish until the image acquires sufficient opacity. If this should not suffice, the plate may be flooded in a similar way with some soda solution previously diluted with more or less water, and then returned to the developer.

Local development with the aid of a brush is sometimes necessary, and either the strong developer or the soda solution alone may be used for this purpose.

How many times the developer can be used over and over again we are not prepared to say, but, if strengthened from time to time by addition of small quantities of strong developer, it may be used for three or four dozen plates without producing stains. No clearing solution is necessary.—C. H. B., in Photography.

Correspondence.

The Armament of the "Alabama," "Wisconsin," and "Illinois."

To the Editor of the SCIENTIFIC AMERICAN:

This morning's paper contains a summary of the report of Capt. O'Neill, Chief of the Bureau of Ordnance (Navy), from which it would appear that the bureau proposed to abandon the 13-inch gun for the primary battery of our battleships, and substitute a powerful 12-inch, as our cousins across the water have long since done. I note with regret the statement that the new guns will be first supplied to the three ships of the "Ohio" class, and that those of the "Alabama" will be armed with the present type of 13-inch.

While it may be too late to change the armament of the "Kentucky" and "Kearsarge," against which so much may be urged, is it too late to make such changes in that of the "Alabama" class as will make it up to date when those ships are commissioned?

Am I wrong in thinking that the armament now proposed for the "Alabama," "Wisconsin," and "Illinois" is even now behind the times and will be still more so when those vessels are commissioned? If so, I shall be glad if you will kindly set me right, and if I am not, should not an effort be made to secure for those ships a more modern battery?

EDMUND M. PARKER.

Boston, October 19, 1898.

Concerning Steam Boilers.

BY EGBERT P. WATSON.

An industry that comparatively little is known about, in the popular view of the subject, is the making of steam boilers, yet it is one of the largest in the country, if not in the world, employing immense capital and vast numbers of men. The stock of raw material carried by some boiler-making firms is enormous, and a faint idea of it can be had from the fact that one of them recently reboilered three of the monitors in thirty days, without buying a pound of stock outside of that in hand when the work was begun. Another firm, by no means the largest, told the writer that $100,000 would not cover the stock carried by them at all times; and this minor detail, so to call it, shows in some degree the large amount of capital employed all over the country in carrying on the business in question. Add to this the fact that the work is bulky and requires plenty of room to handle it in, that large shops in cities are costly in real estate, and as a corollary increase the interest account, and it is readily seen the business of making steam boilers is one of magnitude.

The writer has no means at hand of ascertaining the amount of money invested in boiler making, in comparison with other industries, but enough has been said to show that the sums are large, and the output is in keeping with it. A case in point is one order for California parties which required fifty freight cars to transport it, and the boilers were all for one plant too; it is by no means a solitary instance. There are countless boiler-making firms in this country, and, as a rule, they are always busy. Hundreds of tons of boilers and hundreds of thousands of horse power are turned out yearly, but so little is known of the vast extent of the trade, that the public generally hear little about it.

Another thing which shows the extent of the boiler-making industry is the demand for steel plates, for all boilers are now made of this material. At this writing it is not possible to get an order for steel plate filled in any sort of reasonable time. There are very few steel mills in the country that are not oversold for weeks ahead—months is the better word; for the principal of a boiler works told the writer a week ago that he had been waiting since July for an order from Pittsburg and had not yet received it. This seems incredible, in view of the number of steel mills in the country, but it is quite within the fact, for upon writing to one of the largest in the country to learn the reason for delays, the above statement was made. Parties have been waiting for months for steam boilers, all summer, in fact, and have not yet got them. This is a serious state of affairs, and is not likely to be improved very soon, in view of the new vessels ordered by the government, which will require large quantities of stock.

Steam boilers are of all classes, but may be broadly grouped into three—marine, stationary, and locomotive. These again may be subdivided into two classes—water-tube and fire-tube. Stationary boilers are by far the most numerous, and these are also fire-tube and water-tube boilers. The latter, although supposed to be modern, are in reality one of the oldest types; a boiler of this class was found in the ruins of Pompeii some years ago, where it had been used for heating water in a bath, and there are boilers in use to-day based broadly upon the same line of construction as this old-timer.

It is only very recently, however, that serious attention has been paid to this type for marine use, and it is gaining ground rapidly. The reasons for this are its lightness, rapidity of action, its ability to carry extremely high pressures safely, and its simplicity of construction, whereby units of great weight and bulk are avoided. The water-tube boiler has no shell, such as the fire-tube boiler has, and its steam drum, or dome, as the case might be, is so small as to be of no moment as regards weight. Few of them are over half an inch thick and from 15 to 18 inches in diameter, while the shells of high pressure marine boilers are from 1¼ to 1½ inches, nearly, in thickness; these shells are also very large in diameter; 16 to 18 feet is not uncommon, so that the total weight of the shell alone is very great. The rivets run from 1 inch diameter to 1½ inches in some parts, while the stay bolts from head to head are 3 to 5 inches in diameter. It will be seen from even this brief citation of sizes that a high pressure marine boiler of the Scotch type is a formidable affair as regards weight alone, and that water-tube boilers are highly desirable, since they weigh two-thirds less for the same rating. The torpedo boat and the high speed yacht would be impossible were it not for water-tube boilers.

MODERN METHODS OF MANUFACTURE.

Not very many years ago boilers were made wholly by hand. That is to say, the sheets were flanged over formers by sledges and mauls and the holes punched by gang punches with more or less accuracy. The sheets were rolled to shape as nearly as possible and sledged home the rest of the way when they failed to meet as closely as was necessary. If the rivet holes did not come fair, a tool called a drift pin was driven in them and the sheets pulled somewhere near to fairness in the rivet holes, then the rivets were closed up as best they could be under the circumstances. This was very bad work certainly, but it was the best that could be done with the crude appliances of the day.

Such work is not now permitted, and no tool or appliance is too costly, if it will expedite the business. Some of the machines in use will take a shell rolled to shape and drill every hole in the circumferential and longitudinal seams, and after the sheets are drilled the sheets are taken down again, and all the burrs left by the drill in going through the plates are dressed off, for, in marine boilers particularly, no punching of holes is permitted. For one thing, it is not possible with the very thick plates; and, for another, the government says that, as far as its work is concerned, we must not punch. In the matter of caulking the seams, men used to do this work by hand, and it was a tedious job. Now a man takes a pneumatic tool and goes over a seam very much as a woman would run up a skirt upon a sewing machine, and almost as quickly. By the old way, gangs of men closed all the rivets by laborious work with hand hammers; but in the new dispensation a grim, determined, hump-backed machine sets all the rivets with one fell stroke, and eats up a seam as fast as men want to handle it. The riveting gang is a thing of the past, except in the few instances on special jobs where the steam riveter cannot get at the spot.

So rapid are the processes of constructing modern boilers, that it is entirely possible to make a so-called 40 horse power return tubular boiler, and ship it on the cars near the shops, inside of eight hours. That is to say, the flat sheets are taken from the floor, bent to radius required, punched (this time because it is quicker), heads put in, riveted as to all seams, set as to all tubes, caulked and tested, and sent off to its destination. The writer's informant, as to this expedition, was a man who worked in the shop where it is done. If it is not quick work, it comes pretty near it.

POWER OF BOILERS.

Regarding the "power" of steam boilers, the word is misapplied, but it is still used by reason of custom, and because there is no other popular term to express a boiler of a given size. It is obvious that a steam boiler is merely a magazine of stored force which may be, and is, of varying power in accordance with the way in which it is used. A reservoir of water could not be said to be of 5,000 or any thousand horse power if its contents were directed on to a turbine wheel, unless it was also stated how long and with what volume and fall the water was used. Similarly, a steam boiler is of varying power for a given rating in grate and heating surface, according as its stored force is used. The rating of steam boilers is now expressed in terms of their ability to evaporate certain quantities of water into dry steam in a given time, and this is the only fair test that can be given. The purchaser then knows exactly what he is getting and can use the steam in one hour or in ten hours. No questions enter into argument as to the amount of heating and grate surface; these things rest with the designer of the boiler and it stands or falls by its performance. These last values, heating and grate surface, have greater or less significance, according to the disposition of them and their relation to each other. A square foot of heating surface on a boiler is of much greater efficiency in one place than in another. To merely state, then, that a boiler has ten square feet of heating surface to a horse power means nothing at all as regards its evaporative effect, and its performance cannot be accurately relied upon.

This will be clearer to non-technical readers when it is stated that a single engine, having a single cylinder, should produce a horse power upon 30 pounds of water evaporated into steam of 70 pounds gage pressure; a compound engine, having two cylinders and working at from 6 to 10 expansions, will produce a horse power for an expenditure of 20 pounds of water; and a triple cylinder engine, working at 16 to 30 expansions, should give one horse power for every 15 pounds of water evaporated into steam per hour, in all of the above citations. Now, the same boiler will supply all of these engines (in rotation) if the proper pressures for the work are carried, but the power developed is vastly greater with the high expansion engines than with the simple engine. Very much higher values could be given for high expansion engines, but the writer has taken the average. It seems plain, therefore, that the power of a boiler begins and ends with its ability to evaporate certain quantities of water in a given time.

Furthermore, the evaporative power of boilers depends largely upon the amount of coal burned upon the grate in a given time, so the power of a boiler of certain dimensions can be augmented over its normal power by using artificial draught of one kind or another, air driven in directly by a fan or air drawn in by induction, as with a jet or with the exhaust turned into the chimney.

Take the case of a locomotive; under the stimulus of the exhaust, a locomotive of say 1,200 square feet of heating surface and 18 square feet of grate surface will develop 600 horse power, but the normal capacity rating of a locomotive boiler under stationary boiler rules would be only 120 horse power. Each pound of coal boils off so much water into steam; with forced draught rather less per pound of coal than with natural draught, but since 75 pounds of coal are burned in the same time (per square foot of grate) that 15 pounds of coal are burned by natural draught, nearly four times the amount of water is boiled into steam in a given time.

The fact that high powers can be obtained from boilers of a given heating surface is well shown by fast yachts and by torpedo boats. A high speed steam yacht built last year has a boiler of only 1,200 square feet of heating surface, but this boiler has been worked up to over 600 horse power with quadruple engines and forced draught of great intensity. As regards this last, the punishment that a boiler will stand without giving up the ghost incontinently is astonishing, and water-tube boilers seem specially adapted to this method of driving them. The writer hesitates to mention all the reports he has heard in this direction, but it is asserted that the forced draught used on the tests of battleships and cruisers is so powerful that it will take the contents of a shovel off it when held to the mouth of a furnace. Forced draught, so called, is commonly used, but it is only a feeble zephyr compared with forced draught when crucial tests are made. Of those who attend boilers at such times, it may truly be said, "the smoke of their torment ascendeth forever," and the flying coal dust, the roar of the fans, and the gases battling together in the furnaces, the stifling heat from the radiation and the temperature of the steam, the mere physical labor of handling so much coal rapidly, all these combined make an inferno rivaling that which Dante described. It is astonishing that men can endure the nervous strain entailed by the work itself and the knowledge that if a tube blows out or bursts under the cruel punishment it is getting, there is but a short shrift for all in the vicinity. The seven labors of Hercules did not include firing a Scotch boiler under an air pressure of six to seven pounds (and no one knows how much more); if they had, he would probably not have come off so well as he did, for many a modern Hercules has been dragged away from the front of the furnace where he had fallen prone under stress of his work. Outside of the boiler it is pretty bad, but what is it inside? Shadrach, Meshach, and Abednego cast into such a fiery furnace would have shriveled into tinder before they reached the bridge wall; it is a white hot hell of glittering intensity, of inconceivable temperature, and no eye but that of an eagle, which can stare the sun out of countenance, can gaze long upon its ferocity. And yet modern steel plates stand this furious work for hours together, and are, apparently, none the worse.

A New Comet.

Dr. William R. Brooks, director of the Smith Observatory, Geneva, N. Y., discovered a new comet on the evening of October 20. Its position was R. A. 14 h. 35 m. 10 s.; declination north 60° 26'. The comet being circumpolar, and hence remaining above the northern horizon all night, Dr. Brooks was able to secure a second observation the same night, just before daylight, through breaks in the clouds. Its position at that time was R. A. 14 h. 46 m. 30 s.; declination north 59° 32'. This shows the motion to be quite rapid in a southeast direction. The comet at the time of discovery was in the constellation Draco.

It is of good size, round, with central condensation, and visible in moderate sized telescopes.

This is the twenty-first comet discovered by Dr. Brooks.

MOUNT LOWE ELECTRIC MOUNTAIN RAILWAY.

To unite in one hour's ride the orange orchards, the vineyards, and rose gardens of Italy with the mountain scenery and pine forests of Norway would seem to be an impossible feat anywhere except in California. The "Golden State," it must be borne in mind, is almost an epitome of the globe in its scenic features, its topography, and its climatic subdivisions. It is doubtful if the object lessons of glacial action can be studied anywhere to greater advantage than in the high Sierras of California, unless it should be in Alaska. Captain Dutton, the volcanologist, will say the same as regards the opportunities for studying out the past volcanic history of this coast; and meteorologists can study every climatic zone, including that of the heart of the Sahara, if through the seasons they will only station themselves at the varying altitudes and observe local conditions prevailing in California from the sea-level up to the summits, and beyond the same in the Pacific slope desert areas on the eastern base of the Sierras. The botanist and the zoologist will be equally rewarded.

It is the total ensemble, however, of ocean, valley, coast, hills, and towering mountains that at once impresses the beholder. It is not the gold, it is not the gigantic pumpkins, but it is the endless panorama of beauty and grandeur that unconsciously and permanently takes possession of the true Californian and to which the many cultivated visitors of the Eastern States become equally attached. California, particularly in its southern half, is a condensed edition of the beauty and the sublimity of the North American continent. The Grecian archipelago never rejoiced in a softer or pure atmosphere than that which enfolds the islands of this southern coast; there are no more beautiful and productive orange orchards between Palermo and Turin than those found in the sheltered valleys at the base of the great coast ranges of Southern California; while the Alps of Switzerland and Tyrol do not possess a more grandly picturesque beauty than those snow-covered summits, the splendid whiteness of which will soon bathe the roots of the orange and lemon groves in the form of rippling brooks.

Standing on the high summits of the Sierra Madres, taking in at a glance the singularly harmonious and gracefully undulated landscape from crest to sea, it is difficult to realize that the oranges and roses are at least 5,000 feet below the pine trees against which we lean. The ideal suburban town of Pasadena is ten miles distant by the nearest mountain trail. Los Angeles, down yonder hill slopes, is some thirty miles away, while those frolicsome white caps, seemingly as full of merriment as the bathers themselves, are still further to the west, some fifty-five miles in all.

The initiation and the successful construction of an electric railway connecting the sea shore with the summits, the pine with the rose, the orange with the snowball, were due to Prof. T. S. C. Lowe, of Pasadena. With the exception of the electric road now in process of construction up to the Jungfrau glacier of Switzerland, there is probably no enterprise identical in scope and attractiveness, nor one where greater obstacles have been surmounted.

All the other systems of such mountain roads built for the purpose of making the natural attractions of a region available for the sightseer are constructed on the plan of a revolving cog wheel catching in a center rack-rail and operated by a steam locomotive. One of these roads lands one on top of a sulphurous caldron on the crest of Vesuvius; the Rigi, pioneer of its class in Europe, gives one a delightful glimpse of the mountain meadows of the land of William Tell and its hundreds of glacial lakes; the Pike's Peak rack-rail road lifts one up to an unparalleled view of a vast ocean of gray plains. But here on the summits reached by the Mount Lowe Railway, every one of the attractive landscape features of the others has been included. Below us, seemingly within speaking distance, lies all the beauty of contour, the fragrance, as well as the productiveness, with which we are accustomed to associate the classic lands of the eastern half of the Mediterranean. Round about us are the massive uplifts, the great chasms, the waterfalls, and the evergreen forests associated with our ideas of Alpine fastnesses. In some respects, most impressive of all is that comparatively limited but effective reminder of North Africa, the Mojave Basin desert. There it lies, three hundred miles in circumference, at the base of these mountains, on the northeast flank of the range on which we are standing, while on this side of the range, embowered in luxuriant orange groves, is Pasadena. The Sierra Madres—mother range—is so placed as to apparently divide these natural antipodes equally in this part of the State. There is room enough and to spare, for this country is cast in a gigantic mould, and these seemingly so antagonistic spheres sustain a remarkable and even beautiful relation to each other, which, however, cannot be touched upon here, except in passing and with a view of further enlisting the interest of students of nature in the endless object university here presented. The great desert over to the east, with its contiguous areas in Nevada and Arizona, is undoubtedly the very latest and most remarkable theater of volcanic action on this continent. To the east of the range Vulcan seems not yet through with his seemingly appalling reign, while every phase of natural evolution which should precede human occupancy appears completed on the west side of this same range. It may be, however, that all this dreary incompleteness which so repels us is only another way of stating our lack of insight into Nature's laboratory.

The "Wise Men" who came to the Divine cradle hailed from the East; they were learned, greatly so, in the lore of the stars, and they knew more about these stars than anyone else, because the great warm deserts that fringed their Arabian home had absorbed all needless moisture from the atmosphere, and so left them an endless succession of clear, starry nights from which to obtain their "wisdom." For the same reason, these summits are ideal abodes for modern astronomers, one of whom, Dr. Lewis Swift, is already permanently established here in the Mount Lowe Observatory.

The comparatively close proximity of the great ocean, the wide expanse of fertile valley areas, and the mountains and deserts referred to, or perhaps, more correctly speaking, all these climatic and topographical features, together cause another phenomena which, for beauty and uniqueness, can scarcely be surpassed. Reference is here had to the frequent spectacle of a vast billowy sea of snowy white mist, co-extensive with the entire distance between the mountains and the sea, and entirely covering the vast valley as if a ceiling were extended over it. It has well been termed a "Phantom Sea." It is the Southern Pacific coast variety of fog, which, in this respect, as in all others, is sui generis.

Some twenty-odd years ago the passenger trains used to halt in the morning at a point high up in the foot hills of the Sierra Nevadas, just before descending into the Sacramento Valley. Here it was possible to observe this remarkable atmospheric effect, the result of mingling the ocean humidity with the warmer atmospheric conditions prevailing in the valley, and with the still greater variations of density and temperature as it begins its ascent along the mountain walls. The impression left on the beholder of such a spectacle, he himself standing in clear air, is one never to be forgotten. In Southern California these fogs are not so dense as in the northern half of the State, because the average temperature, both of ocean and valley, is higher. This implies greater buoyancy and more elastic movement of the "Phantom Sea."

These fogs never rise above 2,500 feet, thus leaving the mountains above in transparent sunshine, giving the beholder a clear and distinct view of all below.

It is sincerely to be hoped, in the interest of meteorological science, that Prof. Lowe's great desire to found a scientific school for the study of the meteorological conditions prevailing in a region so fruitful in atmospheric effects may be realized.

The cable incline, which constitutes the first division of this mountain road proper, is one of the most successful railroad devices of its kind in practical use in the world.

The electric power is transmitted by large copper conductors to the Echo Mountain power house, in which is a 100 horse power electric motor, which makes 800 revolutions per minute. By a series of gears the revolutions are reduced from 800 to 17 per minute, which is the speed at which the massive grip-sheave turns. The grip-sheave consists of a heavy wheel which carries some 70 automatic steel jaws. As the wheel revolves, these jaws close and grip an endless cable, to which the cars are permanently attached. By this method there is practically no wear whatever to the cable. It is not strained and chafed by the constant operation of gripping, as on the street railway cars, where the inertia of trains of cars of many tons weight has to be overcome by the gripping of the ever-moving cable.

So much for the incline division. From the end of this, i. e., starting from the Echo Mountain House, begins the overhead trolley road, which reaches the "Alpine Tavern" after a rapid and remarkable ascent by which the very heart of the range is penetrated, and over five miles of steep mountain grades are surmounted in the space of thirty-five minutes. The terminus of this Alpine division connects with some 30 miles of most excellent bridle paths and carriage roads, leading in all directions over the crest and through the range.

All European travelers will recall with pleasure the charming effects obtained at the mountain resorts in Switzerland by turning flashlights of colored rays on nearby mountain cascades. At the summit of Mount Lowe this idea is applied on a scale and under atmospheric conditions never before available. The gigantic searchlight which was placed on the top of the Liberal Arts building was one of the well remembered sights of the World's Fair. As its rays were projected up to the northward on the passing steamer or on the merry crowds of the "Midway," it constituted an unfailing source of comment and awakened endless curiosity, but it is doubtful if the inventor of that appliance himself had any idea of the latent possibilities of his instrument under conditions such as obtain at the summit of Mount Lowe.

Until this great searchlight was established in its present location its powers could not be brought out, on account of its location so near the general level of the surrounding country. Here, however, it is so located that its rays can be seen for 150 miles out on the ocean, and the most distant mountain peaks can be made visible. The beam of light is so powerful that its full sweep illuminates the peaks of mountains which are hundreds of miles apart.

It is of 3,000,000 candle power, and stands on a wooden base, built in octagon form, which has a diameter of about 8 feet. The searchlight itself stands about 11 feet high and its total weight is 6,000 pounds, yet it is so perfectly mounted and balanced that a child can move it in any direction.

The reflecting lens is 3¼ inches thick at the edges and only $\frac{1}{16}$ of an inch thick at the center, and weighs about 800 pounds. The metal ring in which the lens is mounted weighs about 750 pounds, the total weight of lens, ring, and cover being about 1,600 pounds. This great mirror is mounted at one end of a big drum, the outer end of which is furnished with a door, consisting of a narrow metal rim, in which are fixed a number of plate glass strips $\frac{5}{16}$ of an inch thick and 6 inches wide.

Prof. T. S. C. Lowe is one of the greatest living scientific aeronauts. While engaged as such he presented to President Lincoln the idea of aiding Gen. McClelian's operations on the Potomac by a regular system of observations of the movement of the enemy by means of captive balloons to be made a part of the equipment of the army. Prof. Lowe carried this plan into successful operation and earned international fame for his achievement. Many of the foremost institutions of learning in the United States and abroad have recognized his discoveries and scientific achievements. He is especially desirous that the practical scientific opportunities made available at Mount Lowe shall be utilized to the fullest extent, and he hopes to see established fully equipped stations for meteorological and astronomical research in the Sierra Madres. He would see in such establishments the crowning achievement of his long, useful, and most honorable career. Could the many wealthy patrons of science and art in the far East see and realize these opportunities as they only can be seen and realized by personal observation, it is believed there are scores of men who would hasten to identify their names with this unique and worthy enterprise. OLAF ELLISON.

Mausers vs. Krag-Jorgensens.

While no decision has yet been made as to what shall be done with the Spanish Mauser rifles which arrived at the United States Arsenal recently, it is expected that, after having been cleaned and repaired, these weapons will be sold to the public as curiosities.

Officials at the arsenal state that these Spanish guns, besides being in every way inferior to the Krag-Jorgensen rifles used by our regular army, show rough and ignorant usage at the hands of the Spanish soldiers.

The main difference between the Krag and the Mauser is that, while both are bolt guns, the former has a magazine which, filled with five cartridges, can be cut off so as to make the rifle practically a single shooter; the latter's magazine cannot be so cut off. It is, therefore, really a repeating rifle. Furthermore, in the Krag the bolt is opened and closed by the action of cams, while with the Mauser the soldier has to compress the main spring by direct force.

It is probable that these Mausers will be sold for not less than $15 apiece, so that for every one sold the government will be a little more than reimbursed for the manufacture of one Krag-Jorgensen, which, as made at the arsenal, costs $14.50.

Several Krags have arrived at the arsenal for repairs, after having been used by rough riders. They show that they can stand very hard usage without impairing their efficiency, proving thereby the excellence of their pattern, manufacture, and material. There are two which, after having been carried through the surf, filled with sand, and wet with water, and after having gone through all the fighting, were quite ready for use just as they were when they arrived, without any cleaning or oiling. The butt of one of these—carbine pattern—was split and perforated by a Mauser bullet, which most likely bored a hole also through the arm of whatever rough rider held the gun at the time.

One of the reasons for the inferiority of the Mausers is that they are made by contract by a firm in Berlin, Germany, while our guns are made at the Springfield Arsenal, says The Springfield Union, under the direct supervision of ordnance officers. Our guns are therefore exactly alike, one to the other, while the material and workmanship of the Spanish rifles show many degrees of quality.

IN Austria the manufacture of bicycles is making rapid progress. The lowest estimate of the 1897 output is 70,000 wheels, which is nearly double the amount produced in 1896. Exports increased from 5,735 bicycles in 1896 to 8,690 in 1897, or 69 per cent, while the production increased 66⅔ per cent (28,000 bicycles more than in 1896), and imports 37⅔ per cent (815 bicycles).—Uhland's Wochenschrift.

THE HAVANA FLOATING DRY DOCK.

There is one feature in the accompanying illustration of the Havana floating dry dock which proves that the photograph from which it was made must have been taken prior to the recent Spanish war. We refer to the armored cruiser "Vizcaya," which was evidently lying to the right of and a little astern of the dock at the time the photograph was taken. It will be remembered that the "Vizcaya" was on her way to New York at the time of the destruction of the "Maine," and that after spending a few days in port she left for Havana. Here she was joined by one of her sister ships, the two in company starting for the Cape Verde Islands a few days before war was declared. The present illustration shows the vessel during this her last visit to Havana, and it possesses special interest as being the last view taken of this vessel before she was destroyed in the Santiago engagement.

The vessel shown in the dock is the Spanish cruiser "Alfonso XII.," which was built at Ferrol and launched in 1887. She is built of steel and displaces 3,090 tons. Her length is 270 feet 10 inches; beam, 42 feet 7 inches; and maximum draught, 16 feet 5 inches. She is a single screw ship, her engines of 4,800 horse power driving her at the rate of 17½ knots an hour. The armament consists of six 6·2-inch Hontoria guns, two 2·7-inch, six 6-pounder, four 3-pounder rapid-fire guns, and five machine guns. This vessel is to be distinguished from "Alfonso XIII.," a more modern protected cruiser of 5,000 tons and 20 knots speed, and the auxiliary cruiser of the same name.

The big floating dock, of which so much has been heard in the last few months, was built to the order of the Spanish Colonial Office for use in the harbor of Havana. It was rendered necessary by the late Cuban insurrection, which necessitated the maintenance of a large fleet in the waters of the Gulf of Mexico. The bottoms of vessels grow foul very rapidly in the warm waters of the tropics, and it is necessary to dock, clean, and paint them at frequent intervals. With a view to the dock being able to accommodate the largest battleships and the big liners of the Spanish merchant marine, the dock was given unusually large dimensions as follows: Length over all of the dock, 450 feet; clear width between the broad altars, 82 feet; depth over the sill, 27 feet 6 inches; draught of water under these conditions, 42 feet 6 inches, and freeboard, 4 feet 2 inches.

The dock is of a comparatively new type and only a few on this system have as yet been constructed. One of these, illustrated in the SCIENTIFIC AMERICAN of September 24, 1898, was built for the great German shipbuilding yard at Stettin. In its construction and operation it may be described as a compromise between a graving and a floating dock. A graving dock is an excavation made in a foreshore, lined with masonry or timber, and closed at its entrance by a movable gate.

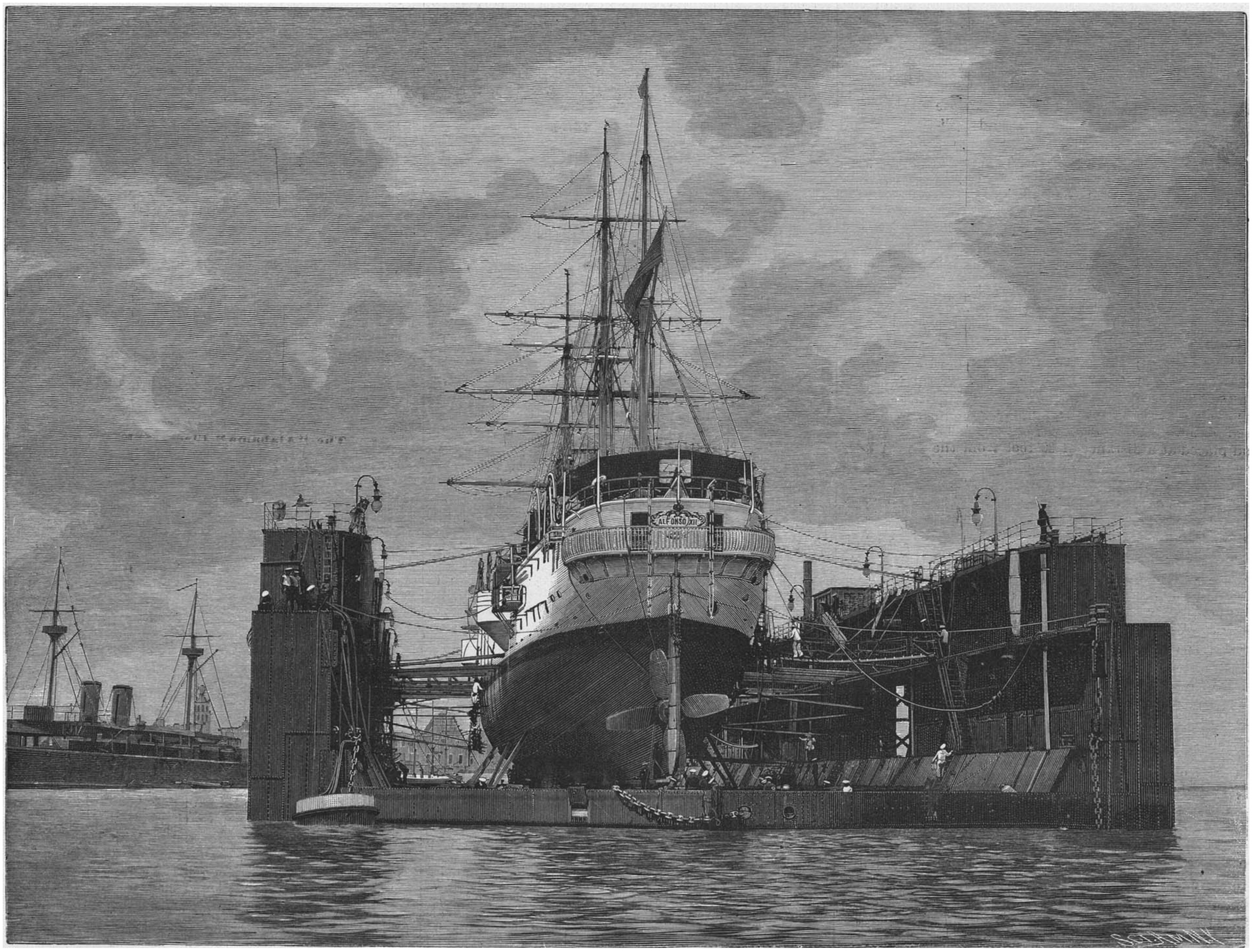
If such a dock were built of steel and its bottom were of sufficient strength to carry a vessel on its middle length, it would be independent of the support of the ground and might be used as a floating dock. That belonging to the British government at Bermuda is a floating dock of this description. A floating dock is merely a watertight box or pontoon into which water can be admitted or pumped out as required, the ship being lifted or supported simply by the displacement of the pontoon, which, consequently, must be sufficient to carry the weight of the ship, that of the pontoon itself, and the weight of the walls of the floating dock. This requires a depth of water which is sometimes unattainable. The Havana dock combines in one single structure the advantages of both types. It is an ordinary two-sided floating dock of an over-all length, as stated, of 450 feet, with a lifting power of 22 tons per foot linear. It has the advantage that, having no end gates, such as are carried by the dock at Bermuda, a ship of a greater length than the dock may be received, the ends of the vessel overhanging the dock to a considerable extent, if necessary. The dock consists essentially of the pontoons, which afford the required buoyancy, the high sides or walls which regulate the descent of the pontoons below the water and also afford the necessary stability, and the movable caisson or gates, which latter are only used when it is required to increase the lifting power of the dock.

In the Havana dock each pontoon is divided into four watertight compartments, and each wall is divided below the engine deck into five watertight compartments. Each of these can be emptied of water by means of an electrical pumping installation, which consists of two generating plants, one for each wall, which are furnished with connecting cables, so that each can serve the whole dock. The pumping machinery is capable of lifting a warship in two and one-half hours.

An important feature of the dock is the arrangement by which any portion of it can be examined, cleaned, and painted. Each pontoon can in turn be detached, lifted, and hung on the side walls, where any necessary work can be done upon it. The underneath portion of the walls may be exposed for cleaning and painting by careening the structure. It is this quality that gives the dock the name of self-docking.

After its completion the dock was manned by a captain, officers, engineers, and crew and towed successfully across the Atlantic from the English yard where it was built to Havana Harbor.

The manila hawser used for the towing was 22 inches in circumference and weighed about five tons. The total cost of the structure was $900,000.



THE HAVANA FLOATING DRY DOCK.

A Higher Peak than Mount St. Elias.

The report from the geological survey party under Mr. G. H. Eldredge, which has just returned from the Cook's Inlet country, asserts that it has discovered the highest mountain in North America. The peak, which is higher than Mount St. Elias, is situated in Alaska at the right of the Sushitna River. The government topographical engineer took triangulations, and, according to his calculation, the height of the peak is more than 20,000 feet. The mountain was named "Bullshae," which was the exclamation of the Indian guide when the peak was discovered. The mountain is extremely precipitous, and the members of the survey are of the opinion that the ascent will be almost impossible.

A BRAZILIAN correspondent writes as follows: Machines for treating coffee, used in Brazil, are made in the United States, but require improvement in view of local conditions. Thus the coffee driers are very unsatisfactory, and the inventor of a thoroughly effective drier would reap a fortune in Brazil. Driers as now made use too high a temperature and the product is not uniform. It seems the solution of the problem would lie in the use of comparatively low temperatures and of an exhausting pump.

THE DIRIGIBLE BALLOON OF DE SANTOS-DUMONT.

On the afternoon of September 20 M. De Santos-Dumont, a well known Parisian sportsman, made a highly interesting experiment with a balloon of his own invention in the Jardin d'Acclimatation.

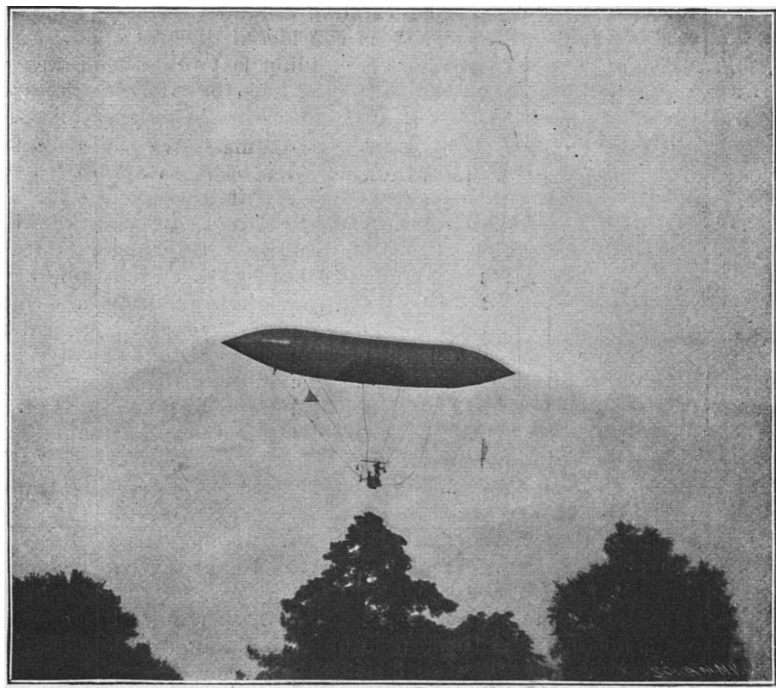
The aerostat, a cylinder tapered at both ends, was made by M. Lachambre, a constructor of military balloons. According to L'Illustration, the gas-bag is 82 feet long, 11 feet 10 inches in diameter, has a capacity of 6,569 cubic feet, and is made of extra light Japan silk, rendered waterproof by means of a special varnish. This gas-bag is provided with a small compensating balloon having a capacity of 883 cubic feet, and with two automatic aluminium safety-valves, one controlling the gas, the other controlling the air supply.

On each side of the balloon and at a convenient height there is sewn to the material a horizontal gusset 53½ feet long, in which small wooden rods one foot long are secured. To the middle portion of each of these wooden rods thin cords are fastened, to which the rigging is secured. The rigging, by means of which the car is suspended, consists of cotton ropes running through boxwood thimbles, and dispenses with the usual network of cords and with a covering for the balloon, thus decreasing the weight and facilitating inflation. For further security, ropes sewn in the material and covering the upper part of the gas bag form a network which unites the two gussets by means of which the car is suspended.

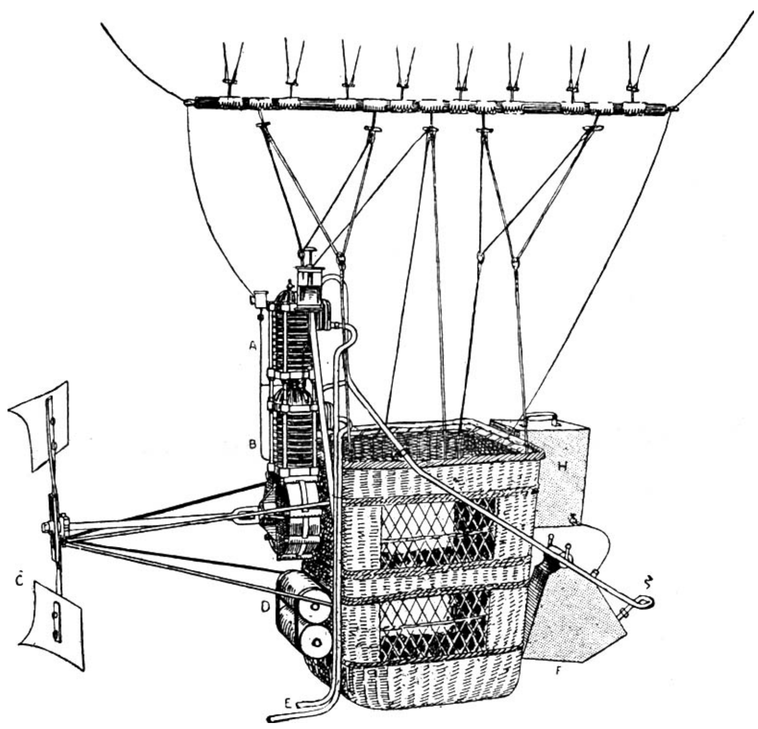
The car itself is made of rattan and willow with a skeleton of chestnut wood, and is attached to the rigging by means of an intermediary steel trapeze bar. The weight of the entire balloon, including the engines and rudder, is 114 pounds.

The motor used by De Santos-Dumont is of the kind usually found on automobile tricycles, but is, however, provided with two superposed cylinders. This is said to be the first time that motors of this type have been used on aerostats. Firmly secured to the car and placed at a distance of 33 feet from the gas-bag, the motor drives an aluminium screw 32 inches in diameter at the rate of 1,000 to 1,200 revolutions per minute. The motor develops an energy of 3 to 3½ horse power, and with its accessories and with the screw weighs 154 pounds. In the perspective view of the car, *A* and *B* represent the superposed cylinders; *C*, the screw propeller; *D*, bobbins; *E*, escape pipes; *F*, the carbureter; *G*, the admission pipe; *H*, the fuel reservoir. After having been cast loose, the aerostat, driven by its screw, ascended rapidly. As it rose, the aerostat several times encircled a captive balloon in the grounds, and finally took a course in the direction of the Bois de Boulogne at an altitude of 650 feet. M. De Santos-Dumont was, however, soon compelled to cease his experiments on account of a defective air pump that supplied the small compensating balloon; the aerostat, losing its rigid form, collapsed.

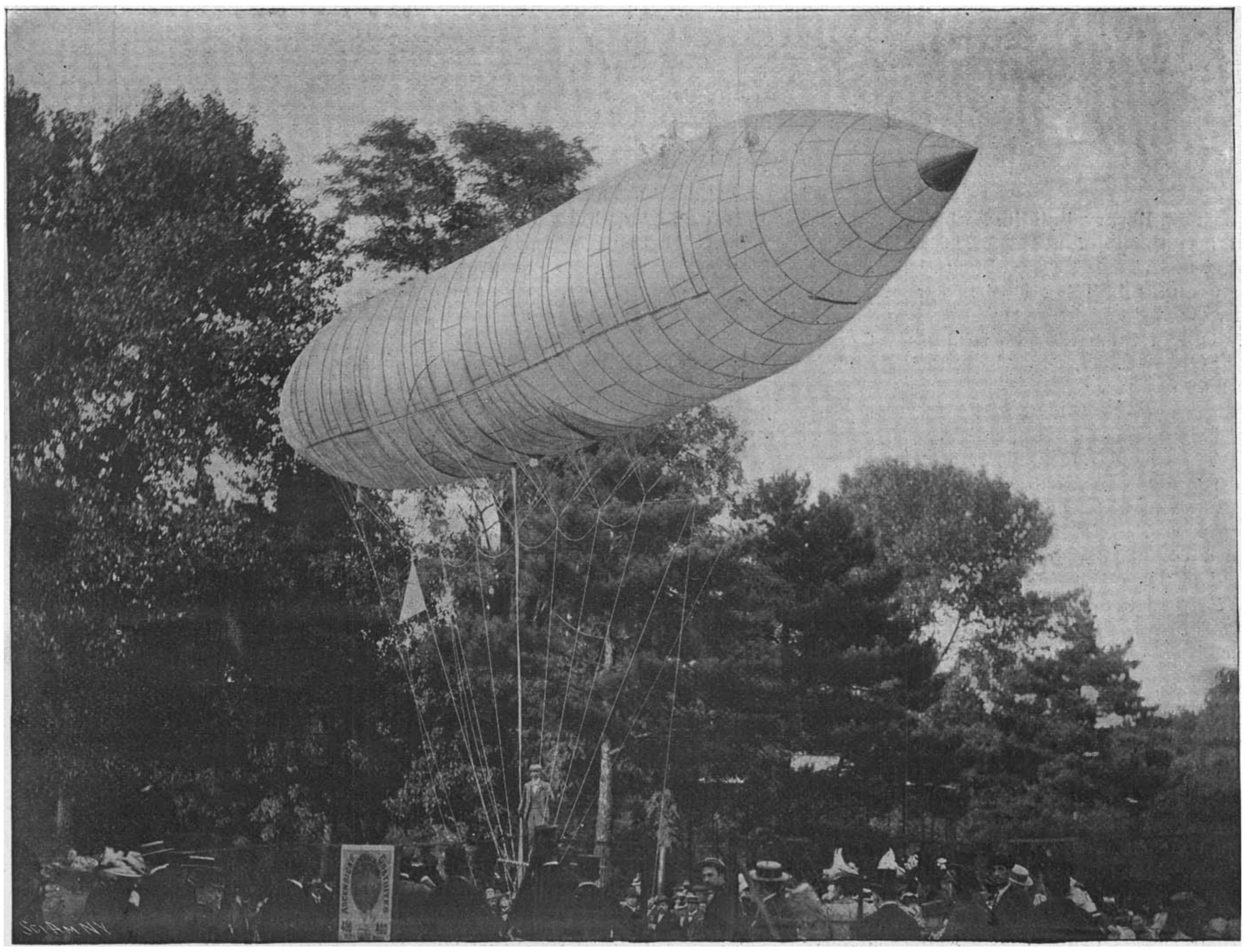
While at a height of 1,300 feet above the ground, the aeronaut opened the valve in order to hasten his descent and to avoid falling into the Seine River, toward which the lower currents of air were driving him. The descent was made without difficulty.



THE BALLOON IN MID-AIR.



THE CAR AND THE MOTOR.



THE START FROM THE JARDIN D'ACCLIMATATION, PARIS.

Berlin's Drug Stores.

The German drug store is always a mystery to the American when he first becomes one of its customers, says The New York Sun. It is not nearly so comprehensive as the American institution of the same kind. The apothecary's department, which is only one feature of the American drug store, is an independent establishment in Germany and is devoted to the filling of prescriptions and the duties of the apothecary. The "droguerie," quite a separate place, provides half the articles customarily found here in the drug store. It is to the droguerie that one must go for soap, tooth-brushes, drugs in the pure, and all of the articles not dealt in by the apothecary. The division may be a convenient one after the mysteries have been mastered, but it is confusing at first.

Another peculiarity of the apothecaries is that most of them have names displayed. That custom dates from the earliest days of their history. One of the most famous in Berlin closed its doors the other day, and the incident recalled some interesting facts. The old names of the shops have survived to some extent, although the purely fantastic names have given place to others better suited to the commercial exigencies of modern times. The city to-day possesses 164 shops of apothecaries, and many have adopted names taken from the street, square, or region in which they are situated. There are fifty-six of these, and nineteen are known only by the names of their proprietors. Nineteen are named after birds, the eagle having ten named in its honor. There are all sorts of eagles among these ten, black, red, and white. Other names include wild animals, mythological names such as Minerva and Flora, and royal titles like Friedrich and Augusta Victoria. Most curious are those called after famous historical personages, such as Arminius, Roland and Siegfried. One difference between the early days in Berlin and the present is the practical disappearance of the French apothecaries. In 1780, when the first count was taken, three out of twenty-one were French. Twelve of these original places are known to-day by the names they bore then.

The "Alabama" Class of Battleships.

In our article in the last issue of the SCIENTIFIC AMERICAN on the launching of the "Illinois" we instituted a comparison between the "Alabama" and the "Canopus" of the British navy. The "Illinois" is one of three identical ships, the "Alabama," "Wisconsin," and "Illinois," and, as is customary in naval matters, the class is named after the first vessel of the class to be constructed—in this case the "Alabama." Our readers will therefore understand that the comparison is made with the "Alabama," as representing the class, and that everything that is said of this vessel applies equally to the "Illinois."

WOODEN vessels such as pails, barrels, etc., often become so dry that the joints do not meet, thus causing leakage. In order to obviate this evil, stir together 60 grammes hog's lard, 40 grammes salt, and 33 grammes wax, and allow the mixture to dissolve slowly over a fire. Then add 40 grammes charcoal to the liquid mass. The leaks in the vessels are dried off well and filled up with the putty while still warm. When the latter has become dry, the barrels, etc., will be perfectly tight. If any putty is left, keep in a dry place and heat if to be used again.—Der Seifenfabrikant.

THE NEW BUILDINGS OF PRINCETON UNIVERSITY.

The history of the library of the College of New Jersey probably began with the college itself, but the first mention of it is in the resolution of the Board of Trustees in 1755 authorizing the president to purchase a bookcase for the college. From the modest beginning, when one bookcase could contain all of the literary treasures which the college possessed, the library has grown until it now has over 150,000 volumes, and is one of the best arranged and most usable libraries which belongs to any university.

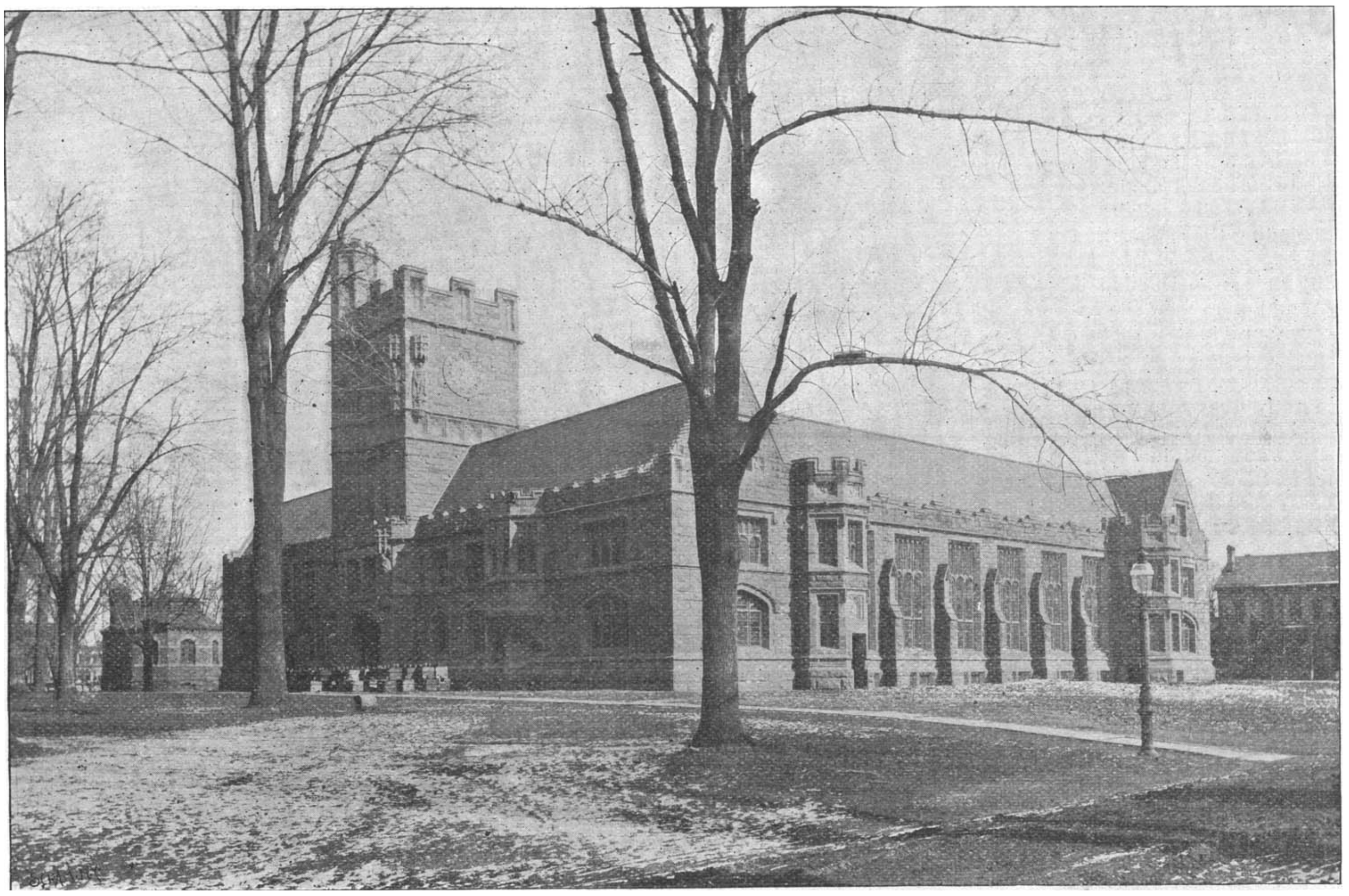
The Chancellor Green Library, an octagonal building with pavilions, was built in 1872, and was arranged to accommodate 100,000 volumes. It was in many respects a model library building for a college library, but the phenomenal growth of the collection during the years following the erection of the building was such that as early as 1888 the librarian recorded the fact that the building was already overcrowded. During the next seven or eight years volumes were stored in the cellar and attic, and still the building was inconveniently overcrowded. In connection with the Sesqui-centennial celebration a donor, whose name is still withheld, came forward and offered to provide a thoroughly adequate extension of facilities by the munificent gift of a building which was to cost $600,000. Shortly after Dr. C. E. Green made provisions for extensive improvements to the Chancellor Green Library, so that the library building to-day consists of the Chancellor Green Library and the new library building, which together represent an investment of about $800,000, and which affords storage room for 1,250,000 volumes.

The Chancellor Green Library building consists of a central octagon with two wings, which are themselves an elongated octagon. One of them may be seen at the very left of our engraving. The extreme length of the whole building from wing to wing is 160 feet. The central octagon is 64 feet in diameter and 50 feet high. It contains an elevated floor about 12 feet from the floor and 16 feet wide. The wings were used for trustee and administration rooms. The architect was W. A. Potter, of New York. The Chancellor Green Library has now been fitted with a complete system of forced ventilation and a complete system of electric lighting. It is now used as the general reading room and will accommodate 200 readers or more. Reference books are shelved in this library. This room contains the desk of the reference librarian, whose office it is to assist investigators in their studies, and it is connected with all parts of the building by telephone, so that any book in the stack rooms can be sent for at any time and it will be delivered at the desk of the reader by a page.

The new library building is connected with the Chancellor Green Library by the gallery shown in our smaller engraving, which measures 50×20 feet. This is used as a delivery room. The room is handsomely finished with a brown-stained paneled oak ceiling and mosaic floors. It contains the delivery desk and here readers must present their tickets before they are admitted to the stack rooms. The new library building, which forms the subject of our large engraving, is a quadrangular building 160×155 feet square, two and a half stories high, and is built in the so-called English collegiate style. The center is occupied by a court 75×75 feet. The building running around the quadrangle is 40 feet wide, which is considered the proper width for a stack room. The building is two stories and a half high in the seminar rooms, five stories in the stack rooms, and the towers are higher still. After the gift was presented through Mr. M. Taylor Pyne, plans were submitted, and those of W. A. Potter, of New York, the architect of the old library, were accepted and work was begun August 2, 1896. Great care was used in the selection of an architectural style which was thoroughly practical for the library of a great university. As a matter of fact, the hollow quadrangle is the most practical form for a library, as it allows of indefinite expansion in the same form and permits of obtaining light from both sides. The building and the connecting passageway contains the delivery room, the stack rooms, and about 40 smaller rooms for various purposes, including 10 administration rooms, 16 for seminar work, 13 for machinery, toilet, etc. It has the latest systems for heat, light, and ventilation and is provided with electric light, interior telephone system, two electric elevators, etc. The stack rooms have a capacity for 1,250,000 books and occupy a room running all around the quadrangle. Roughly speaking, all of the north and south portions of the building, except at the ends, are taken up in this way. The stack is what is known as the library bureau system and consists of five stories, each being 7½ feet high. The construction is of iron, steel, and glass, except the shelves, which are made of wood. The shelves are supported on brackets attached to a center upright. The light and graceful structure of the shelving system with the glass floor makes the stack room particularly attractive from a technical standpoint. Even on the ground floor practically the same amount of light is obtained by the use of glass prisms. It is expected that the electric light will not be needed in the daytime, only on the very darkest days and toward the end of the afternoon. The whole building, however, has been fitted with electric light, so that it can be open in the evening, if desired.

Immediately adjoining the delivery room in the northwest corner of the stack is an exhibition room 40 by 50 feet, with an alcove 12 by 25 feet which has been made by leaving out two stories of the stack for this space and fitting this up with oak cabinets and show cases. The alcove contains the unique collection of portrait masks presented by Mr. Laurence Hutton. The northeast corner of the building is occupied by the administration room proper. Cataloguing is done in the corresponding rooms on the second floor. On the third floor there is a room for the cataloguing of periodicals and pamphlets. The ordering room is connected with the cataloguing room by a small electric elevator. Books are brought into the former room by a door opening under an arch of the east tower. After they have been checked up with the order slips they are taken on the elevator to the floor above, where they are catalogued. The room in the east tower is furnished with two stories of stacks, which are used for the "purchase system" of the collection, the booksellers' catalogues, clippings, recommendations, etc., which form the apparatus from which the list of books most needed for the library is being prepared. The list at present includes 200,000 volumes, which is being increased to 500,000.

A special feature of the new library building is the provision for what is known as seminar rooms or rooms for instruction in the methods of research. This instruction is chiefly intended for post-graduates, and necessitates having the actual sources immediately about the instructor and the handling of them by the pupil. This is peculiarly a method of book research and corresponds for the historical, philological, philosophical science to the laboratory for instruction in the physical sciences. There are nineteen seminar rooms, measuring 27 by 22 feet each. The basement contains the printing, binding rooms, and for storage and machinery. Four portrait statues on the west tower are by J. Massey Rhind, and represent James Madison, Oliver Ellsworth, President Witherspoon, a signer of the Declaration of Independence, and President McCosh. In many respects the library of Princeton University is the most remarkable in the world. It is planned primarily for university use, and no essential convenience has been sacrificed for mere architectural effect, and ample provision is offered for necessary growth. The rooms are planned for economical administration and supervision with the fewest number of attendants possible. Natural light is provided in every room and the accommodations for special readers near the books is unexcelled, and no shelf is higher than a person can reach.

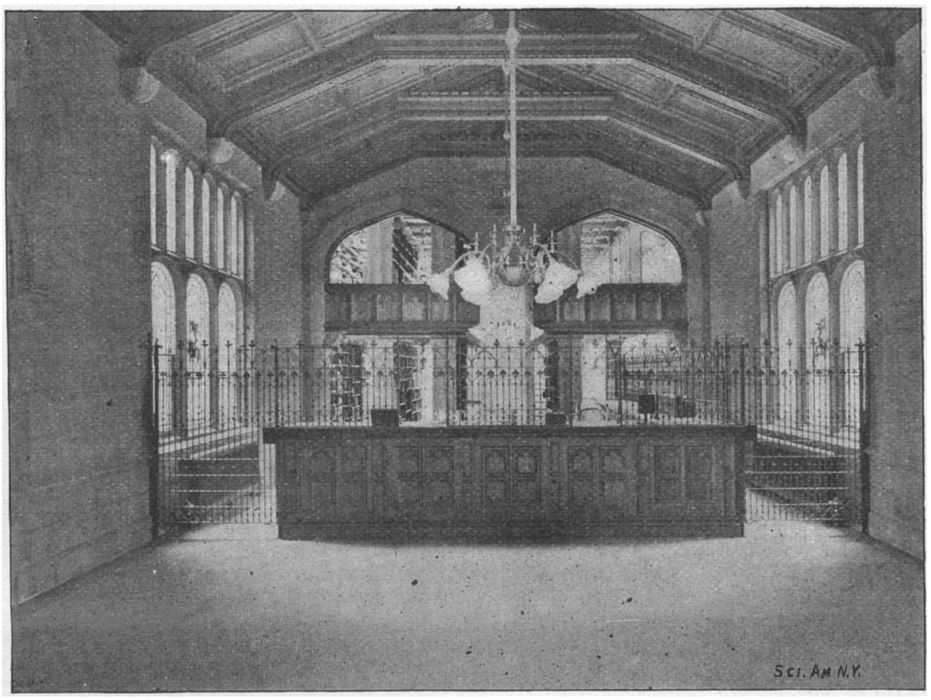


THE NEW LIBRARY OF PRINCETON UNIVERSITY.

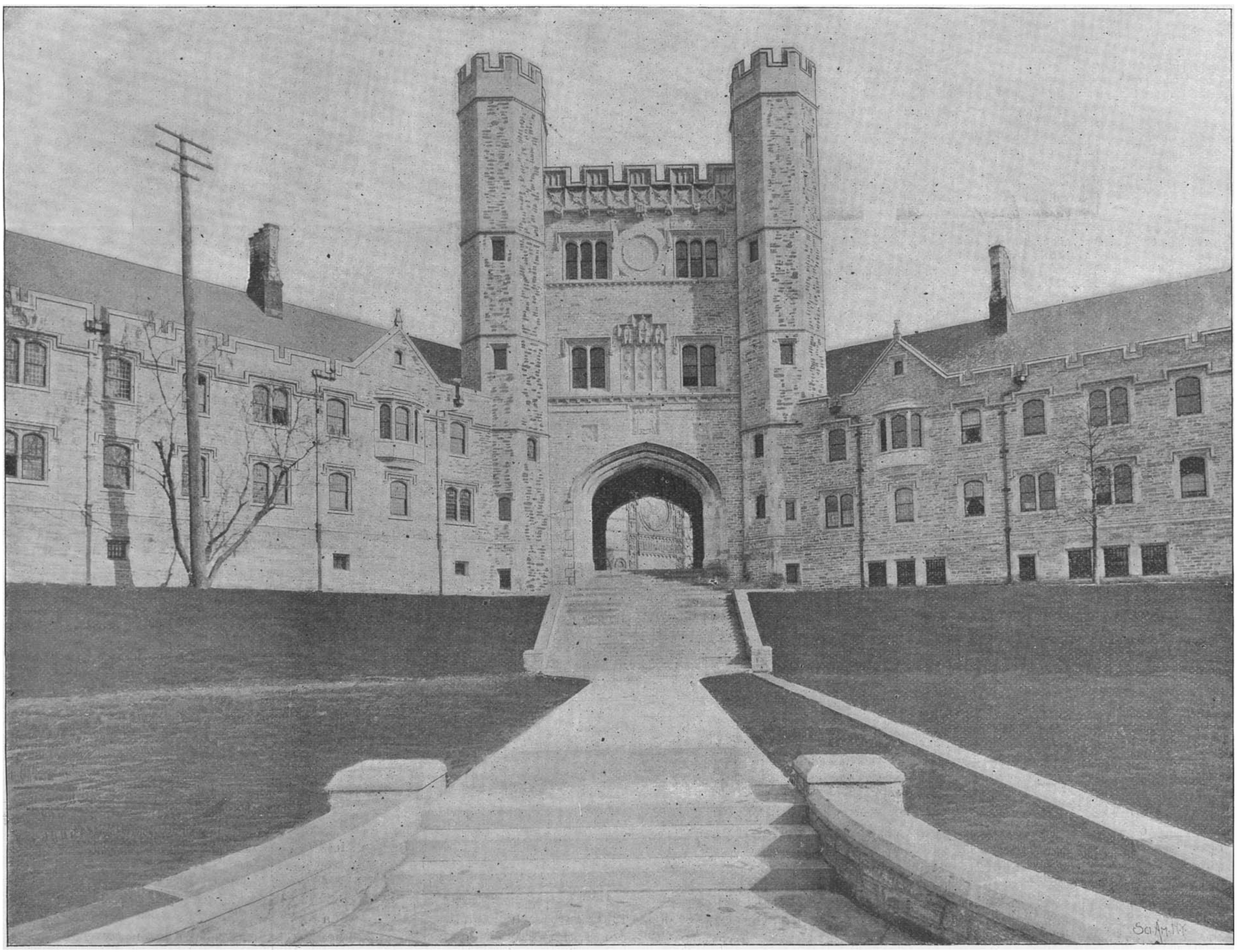
Princeton University is also fortunate in possessing another new building which has added greatly to the architectural appearance of the lower end of the campus. "Blair Hall" is a dormitory building, costing $150,000, and was the gift of Mr. John I. Blair. Our engraving shows the approach to Blair Hall from the railway station. The building stands at the end of the elevation upon which the college buildings are erected, overlooking the valley, and through the archway may be seen Alexander Hall, one of the most imposing buildings on the campus.

The new dormitory building is approached from the station by a flight of bluestone steps, twenty-five feet wide. These steps give access to the tower, which is four stories in height, and is terminated by a machicolated parapet and four battlemented tourelles. The tower passageway, with its fine groined roofing, is a very effective approach to the buildings scattered about the campus. The building proper is long and narrow, being shaped somewhat like the letter Z. The section at the left of the tower is 143 feet long, the section on the right is 93 feet 8 inches long, and the third section, which projects from this, is 50 feet long. The width inside the walls is about 32 feet.

The building is of the ordinary stone which is common near Philadelphia, and the face of it is roughly tooled off. The color is a warm yellowish gray. The stone at the windows, doors, and quoins and all stone for carving is Indiana limestone. The roofing is of Vermont green slate. In plan the dormitory consists of a series of isolated blocks entirely separate from each other. Access is given to these apartments by eleven different entrances, in each of which is a staircase leading to the second story. Eight students live in each section, but in two or three instances the number is increased. The total capacity of the building is 110 students. Each student has a bedroom, and two students have the use of a common study or sitting room. This arrangement gives much more privacy and comfort than in a large dormitory, which may have from fifty to a hundred apartments. The architects are Messrs. Cope & Stewardson, of Philadelphia, Pa.



DELIVERY ROOM, LIBRARY, PRINCETON UNIVERSITY.


PRINCETON UNIVERSITY'S NEW DORMITORY—"BLAIR HALL."

A New Spectroscope.

What is the most remarkable advance in optical research in many years, in the judgment of experts, is the invention of a new form of spectroscope by Prof. A. A. Michelson, of the Ryerson Laboratory, University of Chicago. He has been using it this year for investigations of great delicacy, and descriptions of it are now creeping into the technical publications.

The old style of spectroscope was made with a prism. This broke up a ray of light into the constituent colors and spread them out in a rainbow-tinted band, the red at one end and the violet at the other. If the ray proceeded from the sun, the prismatic ribbon was found to be crossed by a number of black lines. If it emanated from incandescent vapor, the lines were bright instead of dark. The position of these lines along the spectrum, which can be measured with great precision, tells the scientist a good deal about the nature of the substance that emits the light, and reveals something in regard to its motion if, as is often the case, the object under examination be a star.

Naturally, so soon as spectroscopic work was undertaken by the astronomers, it became desirable to stretch a spectrum out as far as possible, in order to separate adjacent lines. Hence a train, or series, of prisms was used, instead of a single prism. Thus a higher "dispersion" was secured, and the lessons of the lines in solar, planetary, and stellar spectra could be more rapidly grasped. With faintly luminous objects, like nebulæ and very small stars, only a limited degree of dispersion is practicable; for when a spectrum is greatly expanded it becomes less and less visible, and beyond a certain point it will not reveal anything to the spectroscopist. On the other hand, when the light is intense, like that of the sun, and when it is important to distinguish positively between lines that occupy nearly the same position, the utmost separative power is wanted, and it can be used with safety.

After a little it was found that an excellent spectrum could be obtained by a piece of apparatus quite unlike the prism. A small mirror, slightly concave, was ruled with fine parallel lines. This device, called a "diffraction grating," has been improved wonderfully by Prof. H. A. Rowland, of Johns Hopkins University. His principal achievement in this field was in devising the machinery for ruling the lines. Many of the best gratings are only a few inches in diameter, but have from 10,000 to 20,000 lines to the inch! It is said, though, that the famous ruling engine in Baltimore is capable of cutting over 100,000 lines to the inch. The narrowness of such scratches is almost inconceivable.

The grating is superior to the prism in two respects. It is more compact and manageable and it has a higher dispersive power. In the latter respect, if not in the former, the new instrument of Prof. Michelson surpasses the grating. The best gratings now in service have a resolving power of 100,000. That of the spectroscope which Prof. Michelson has recently been using is 300,000, and he expects soon to have one that will rate at 500,000. With such an inquisitor the physicist is sure to get at a host of secrets hitherto beyond his ken.

The general arrangement of this instrument is easily understood even by one who does not master the principle on which it works. A series of glass blocks, shaped something like rather thick dominoes, compose it. An idea of their appearance and position can be obtained by imagining these blocks to be placed on edge, on a table or other horizontal surface, close together, with the face of one against the back of the next. The spectroscope at the Ryerson Laboratory has eighteen of these pieces and they are all about seven-eighths of an inch thick (18 millimeters, to be exact). It may be assumed that they are all of the same width, say three-quarters of an inch, and as they stand on their edges, the "width" here means height above the surface of the table.

But the lengths vary. If a ruler or other straight edge be brought against the series, so as to bring their left-hand ends in a line, it will be discovered that the other ends do not match, but constitute a regular flight of steps. The first domino is an inch or more long. The second is shorter by 1 millimeter. The third is 2 millimeters shorter. The eighteenth is 18 millimeters shorter, and therefore is not more than a third of an inch long.

When this instrument is in use, the ray of light to be analyzed is sent through the whole series from the wide to the narrow end; and the magnifying apparatus or eyepiece is placed next the latter. It will be perceived, therefore, that if the beam be wide enough, this succession of events will ensue: After going through the first plate in the series, most of the light will pass on through the next one, but a small portion of it will come out into the open air, in consequence of the diminution in size of the second block. That portion which comes out will travel parallel with that which goes into the second plate, but it will move a trifle faster, because the glass offers some resistance to its progress—only a little, yet enough to produce a certain peculiar optical effect.

At each step in the series this phenomenon is repeated. Another small portion of the original beam comes out into the air, but continues to go on in an unchanged direction. At the further end of the instrument, then, there are eighteen slices of the beam, each traveling at a slightly different rate.

The retardation in the progress of the light amounts to 20,000 waves for each plate it goes through. Therefore, the small portion of the original bundle of rays that has traversed the whole eighteen plates is about 360,000 waves behind the portion that did not go through any of them. So soon as one recalls the fact that color is due merely to differences in the rate of vibration, he can see that this gradual retardation must break up the beam, not into all the colors of the rainbow, but into infinitesimally delicate shades of some one hue. The instrument is not intended to give a full spectrum, but to examine microscopically a minute portion of it.

Owing to its peculiar shape, Prof. Michelson calls his device an "echelon spectroscope." Although the design is exceedingly simple, the construction is unspeakably difficult. The plan here employed for treating a light ray makes necessary a degree of uniformity in the thickness and levelness of the plates that can scarcely be imagined by the uninitiated. Workmanship of the most wonderful precision is required in the process of manufacture. In practice, the optician would make one little plate of glass of the proper thickness and smoothness, having, as the mathematicians say, "perfectly plane and parallel surfaces," and then cut this up into the proper number of pieces.—New York Tribune.

ACCORDING to British patent No. 11,695, of May 11, 1897, an alloy of 63 parts of iron and 37 parts of nickel has a coefficient of expansion almost equal to naught, and is therefore particularly adapted for scientific instruments, for water tubes for boilers, etc.—Stahl und Eisen.

The Current Supplement.

The current SUPPLEMENT, No. 1191, contains many articles of great interest. The "Ghost Dance," by Cosmos Mindeleff, is continued and is illustrated by engravings from the reports of the Bureau of Ethnology. This series of two articles is particularly interesting in view of the uprising in the Northwest. The "Trunk Trick" describes an interesting trick which has proved very popular in Paris and London, and is fully illustrated. "The Improved Photogravure Process for Printing from Stone, Aluminum, Zinc, and Copper," by Benno Koerner, gives practical directions for working the same. "The Opening Address before the British Association," by Prof. W. F. R. Weldon, President of Section D, discusses the principal objections which are urged against the theory of natural selection and describes the way in which these objections may be met. "Recent Advances in Science," by Prof. Virchow, is also a most important paper. An article on "Phosphorescence" completes this issue.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

THRESHING MACHINE.—JAMES E. WOOD, Hetland, South Dakota. With the automatic bundle-feeder and rotary threshing cylinder of this machine are connected an intermediate band-cutter composed of a rotary shaft having a series of curved cutters or blades, and a vibrating table provided with slots for the blades, the table being hinged in the rear of the shaft and extending forward of the latter to a point contiguous with the cylinder. Cams on the shaft successively vibrate the table. All shafts are driven from the threshing cylinder by means of belts. All moving parts operate simultaneously.

REEL FOR HARVESTERS.—JOHN C. LEE, Climax, Minn. The purpose of this invention is so to construct a harvester-reel that the blades may be given any desired lateral or horizontal inclination relative to the reel-shaft, and may be quickly restored to the usual straight position. To this end the reel shaft is made in two telescopic sections, the exterior section having V-shaped slots, one at the front and one at the rear. A sleeve on the exterior section has opposite angular slots, the arms of one slot being inclined upwardly from the center and the arms of the other slot being inclined downwardly from the center. A pin extends from the interior section of the shaft into all of the slots. Means are provided for operating the sleeve.

SPRINKLER.—JOHN EVANS, Salt Lake City, Utah. This sprinkler is designed to deposit upon plants a liquid poison, by which vermin on the plants may be killed. The device comprises one or more tanks or reservoirs, and a drag-bar for each tank, the bars controlling valved outlets from the tanks and being actuated by engagement with the plants.

CULTIVATOR.—WILLIAM H. SAYER, Adams, Ore. By means of the present invention, the shovels of a cultivator may be caused to travel at any desired depth or to be carried entirely out of the ground. In the main frame a crank-axle is mounted which is provided with wheels. Cultivator-shanks, having blades, are carried by the frame. Pivotally connected with the main frame by its forward end is an auxiliary wheel-supported frame. By means of an adjusting lever on the main frame and a connection between the lever and the crank-axle the cultivator-blades may be raised or lowered slightly. By means of a second lever, the blades can be carried deeply into the soil or raised entirely from engagement with the ground.

Bicycle Appliances.

BICYCLE-FRAME.—MOSES L. HALL, Knobel, Ark. The purpose of this invention is so to construct the seat-mast that a perfect spring seat will be obtained, and that the distance between the seat and the pedals will remain constant. To this end the saddle-post is spring-controlled, and the spring-controlled crank-hanger attached to the saddle-post is made movable therewith. In order that the chain may be kept tight under all conditions, the inventor journals the rear wheel of the bicycle in head-blocks moving in the rear forks. Springs guided by pins projected from the head-blocks normally pull the head-blocks rearwardly and with them the shaft and its sprocket-wheel.

TIRE.—OSKAR E. NATHANSON, Copenhagen, Denmark. This invention provides tires for the wheels of cycles and other vehicles, which are possessed of the same resiliency as pneumatic tires, and which need not be inflated, the tires not being affected by puncture. The tire consists of an inner rigid ring, two additional rings outward from the inner ring and at each side thereof, an elastic tube inclosing these additional rings and engaging the adjacent side of the inner ring, a wooden ring lying outside and between the last named rings, being in engagement with the elastic tube on the side exactly opposite that engaging the inner ring, and an envelop inclosing all the rings.

Engineering Improvements.

ROTARY ENGINE.—ALMER N. BLAZER, Mescalero, New Mexico. The engine forming the subject of the present invention has cylinders opening longitudinally into one another. Pistons are secured on shafts journaled in bearings on the cylinder-heads and extend beyond the heads to connect with the machinery to be driven. The pistons are mounted to turn in unison within the cylinders, and are formed on their peripheries with spiral piston-heads running in opposite directions. One piston-head fits into the spiral groove formed by the piston-head of the other piston. The spiral grooves have a long pitch, whereby the use of extra gearing for the connection of the piston-heads is avoided. At the ends of the cylinders are steam-chests into which open the ends of the spiral grooves of the pistons. The steam-chests have ports and a rotary reversing valve located between a steam-inlet port and an exhaust-port and controlling the inlet and the exhaust.

GAS OR OIL ENGINE.—FRANK S. MEAD, Montreal, Canada. In this improved engine, adapted to be run either by gaseous or liquid fuel, the gas is fed and mixed with fresh air upon entering the working-chamber of the power-cylinder. The amount of fuel used is completely controlled by a governor, according to the amount of work to be performed, maintaining at the same time a uniform speed under varying conditions of load. In most gas-engines, the vaporizing chambers are placed in the path of the air passing from the air compression chamber to the power cylinder, and hence do not maintain sufficient heat for economy. The inventor of this engine places the vaporizing chamber so as to be independent of this air passage, the only matter passing through the chamber coming from the spraying device.

MECHANISM FOR OVERCOMING DEAD CENTERS.—WILLIE H. JOHNSON, Navasota, Tex. The present invention is an improvement upon devices patented by the same inventor to overcome dead-centers. With the crank-shaft and the reciprocating rod in an engine the dead-center mechanism provided by this inventor is so connected that it will operate alternately about two centers as two levers, and then about one center as one lever. Locking devices alternately lock the mechanism about its single and double centers. A valve-gear is operated by these locking devices to admit steam to the cylinder at the dead-center points, thus doing effective work when the crank is on the dead-center.

Electrical Improvements.

UNDERGROUND ELECTRIC RAILWAY.—CHARLES W. JENKINS, Richmond, Va. In the conduit provided by the inventor for his railway, a yoke is provided having a central post. Hand-hole casings extend from the yoke in the direction of the length of the track. An insulating side beam spans this casing and a transverse insulating beam is supported at its ends by the side beams and the slot-plates carried by the yoke. By this arrangement of transverse insulators and side beams of wood, the insulators can be spaced a considerable distance from any point of contact with the earth, and thus reduce to a minimum the loss of power incident to a more direct connection.

Mechanical Devices.

TRANSPORTATION-APPARATUS.—NORMAN B. LANE, Lane's Mills, Pa. This improved transportation apparatus is designed to furnish a kit especially serviceable in the Klondike regions. In this apparatus are combined a boat, a sled, a storehouse, a place of abode, and a vehicle adapted for use on narrow bridle-paths. The apparatus consists essentially of a boat provided with brackets, in which wheels are supported, with runners extending along the bottom, and with carrier-bars, so that the apparatus can be carried by two men.

BRICK-CUTTING TABLE.—JAMES C. STEELE, Statesville, N. C. This apparatus belongs to that class of machines in which the clay is fed in continuous bars to the cutting devices. These cutting devices are operated from a main shaft having a crank projection. The feed of the clay to the cutting devices operates a pulley. A pivoted detent is arranged at one end to engage the crank-projection of the main shaft. A projection is connected with the pulley to operate the detent whereby the operation of the cutting devices will be controlled by the on-feed of the clay bar. The bed-plates which support the clay to secure a square, clean cut, are so controlled as not to interfere with the movement of the clay over the table or carriage.

FREIGHT AND PASSENGER ELEVATOR.—JOHN H. MOON, Portland, Ore. The cage of this elevator slides in the usual elevator guide beams. Embracing the top cage-bar is a clevis. Between the clevis and the bar a spring is arranged. A hoisting rope and its pulley are attached to this hanger. Links are pivoted on the pulley axle, which axle passes through the hanger. Spring-levers are connected with the links, and pendent rods and slidable blocks have projections to engage the guide frame.

LIFT FOR BINDING-MACHINES.—OLE JOHAN ANDREASON, Copenhagen, Denmark. The new and characteristic features of this machine consist in the arrangement of a second carrying belt lying above the common carrying belt, and provided with pikes to carry along the crop, by which arrangement the crop gathered cannot accumulate on the picking-up teeth. The teeth are so arranged, each on its revolving arm, that the single teeth, independently of one another, can follow the varying surface of the ground and, consequently, always grasp below the crop. Firm, but adjustable guide-wires are placed at the side of and on a level with or a little in front of the upper ends of the teeth for picking up, between these and the lower carrying belt. These guide-wires assist in preventing the crop from sliding away between the teeth. The belt prevents the upper ends of the teeth from being squeezed when the crop is passing.

WOOD-EMBOSSING MACHINE.—ALOIS KOHLER, New York city. This invention provides an improvement in those wood-embossing machines employing a circular die to impress a pattern in the wood. The rotary die is adjustable in angular position. An endless belt forms the work-supporting table, and is composed of connected slats having upwardly-projecting knees at one end adapted to take the side-thrust, and teeth formed on their inner sides. A toothed pinion is mounted to rotate in engagement with the teeth of the slats, and is located immediately below the die. Bearing bars are placed at each end of the slats and overlap the ends and bottom sides thereof.

COMBING MACHINE.—ANTHONY GUNERMAN, Hoboken, and GEORGE SCHACHT, Jersey City, N. J. The machine forming the subject of this invention is an improvement upon a similar apparatus patented by the same inventors. In the present machine a reciprocating upper comb is provided, having reversible tooth-carrying bars, the teeth of these bars being inclined. A lower comb is also provided having tooth-carrying bars mounted to rock. The toothed carrying-bars of the lower comb may be rocked by the action of the upper comb. Locking devices are provided for the toothed bars of the lower comb, whereby these toothed bars may be held stationary when desired.

DRILL.—THOMAS W. GRAY, Peoli, O. In this drill a frame is provided that comprises two sections sliding one upon the other, one section being provided with ratchet teeth. Dogs are mounted in the sections of the frame without teeth and are held in engagement with the ratchet-teeth by means of a spring. These dogs are provided with gear-teeth meshing with one another, and the shaft of one of the dogs is extended to receive a crank.

REVERSING MECHANISM.—FRANK S. MEAD, Montreal, Canada. The purpose of this invention is to provide a reversing mechanism for propeller-shafts by means of which the driven shaft may be quickly reversed or released without changing the direction of the power-shaft. An annular pulley running continuously in one direction drives from its inside surface an idle-pulley rotatably mounted on a stud and held in one position circumferentially relative to the annular pulley. A driven-pulley is made movable to engage either the driving-pulley or the idle-pulley.

BRICK-MACHINE.—JOHN ROWE, Sidney, Ia. This brick-machine is provided with a former having sets of openings, of which the openings in a succeeding set are larger than those in the preceding set. A presser operates in conjunction with the former to press the material successively in layers through the sets of openings into the registering compartments of the sanded molds. Means are provided to bring the sanded molds into position at the openings of the former.

Railway Appliances.

CAR-COUPLING.—JOHN G. SHERRILL, Gordon, Tex. The car-coupling of this inventor is of the hook-and-catch type, the two parts being adapted for automatic engagement with each other. The coupling has a draw-head in which a pusher-bar slides longitudinally and is actuated outwardly. A rockable coupling-hook having a notch in the circular edge on its flat rear end is pivoted on the pusher-bar. A detent-dog is spring-pressed toward the notch of the coupling-hook. A lever is pivoted on the draw-head and is shackled to the detent-dog so as to actuate the dog when rocked. An arch-piece on the car-body is adapted to hold the lever when rocked, to lock or release the coupling-hook.

RAILWAY-SIGNAL.—JEHU D. BUNDY and ARTHUR L. JACKSON, De Kalb, Tex. This signaling apparatus is designed to be attached to locomotive engines and to be thrown into action by a detent on the track. The detent is controlled by the switch, so that when the switch is opened the signal of the locomotive engine is actuated and the engine-driver is informed in time to check the train. The apparatus is automatic in its action and will therefore be actuated independently of signalmen, thus considerably lessening the danger of accidents incident to negligence.

Miscellaneous Inventions.

CASING OR TUBE ELEVATOR.—SCOTT E. LEECH and GEORGE ASLETT, Mannington, W. Va. The present invention is an improvement in elevating devices for use in lifting casing or tubings such as are used in wells. The links by which the casing is suspended are readily detachable, so that in case one or both such links should break, they can be readily removed and another inserted in a few moments, thus saving the expense and loss of time required to return the device to a repair shop.

FOLDING-UMBRELLA.—FRANK G. GROVE and FRANK E. STOVER, Luray, Va. These inventors have provided improvements in those collapsible umbrellas having ribs made in sections adapted to slide on one another. One of these sections in the present umbrella is free at its inner end and curved or deflected at this free end, thereby springing into engagement with the other section, whereby the two sections are interlocked. By depressing or straightening the curved portion, the sections may be unlocked. The handle of the umbrella is made in sections which are screw-jointed. A special locking device is provided, by means of which the handle-sections are prevented from rotating one on the other.

ATTACHMENT FOR BUOY-CABLES.—CHARLES A. HUTCHINS, Halifax, Canada. In the use of floating buoys, it frequently happens that changes in the tides and winds cause the cable to be fouled either with itself or with the bottom, so that the cable is shortened and the efficiency of the buoy is impaired; or, in a heavy sea, the buoy is liable to part the cable and go adrift. The inventor avoids these difficulties by holding the loose folds of the cable off the bottom of the body of water in which the buoy is placed so that the cable is slacked off and taken in according to the strain from the buoy. The strain in the mooring is also relieved by employing a drag against the strain from the floating buoy, so that as a heavy sea strikes the buoy, the strain on the cable is transmitted first to the drag and thence in a diminished degree to the mooring itself.

Designs.

SPOON OR SIMILAR ARTICLE.—AUSTIN F. JACKSON, Taunton, Mass. The leading feature of this design is the arabesque ornamentation of the inner end of the handle and the adjacent portion of the bowl or body. Another feature is the ornamentation of the outer end of the handle. The shank or intermediate portion of the article is ribbed and slightly tapered.

STAMP.—JOSEPH ROTHSCHILD, New York city. This design consists of a base or body from which depends the character-strip. A handle extends upwardly from the middle of the base or body and has a flattened portion in a plane approximately parallel to the inner face of the base-block.

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Minerals sent for examination should be distinctly marked or labeled.

(7512) J. H., Jr., asks how to produce hydrogen and oxygen from water by an electric current, also which is the cheapest way to produce hydrogen and oxygen. A. The decomposition of water by the electric current is fully explained in Sloane's "Electrical Toy Making," price $1 by mail. There is a cut of the apparatus; so you can easily repeat the experiment. The cheapest mode of producing hydrogen is by the action of hydrochloric or sulphuric acid on zinc. The cheapest way to make oxygen is by heating manganese dioxide and potassium chlorate in a retort. These processes are fully described in Remsen's "Chemistry."

(7513) W. J. L. asks: 1. What fluid expands and contracts most by heat and cold? Have been of the opinion that mercury does, as it is used mostly for thermometers. A. There are few, if any, substances, liquid at ordinary temperatures, which expand and contract so little by heat as does mercury. We do not know what liquid expands most; but ether stands very near the head of the list in that respect, expanding more than eight times as much as mercury. Mercury is used in thermometers because of its high boiling point (610° Fah.) and low freezing point (39° Fah. below zero). 2. Also kindly inform me if it will expand and contract equally as well if inclosed in brass, iron, or other metals instead of glass. A. Mercury expands just the same in one dish as in another. Its expansion could not be seen except in a transparent dish. Mercury cannot be kept in brass, copper, lead, zinc, tin and others, since it combines with and dissolves them. It can be kept in an iron vessel.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

OCTOBER 18, 1898,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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