SCIENTIFIC AMERICAN

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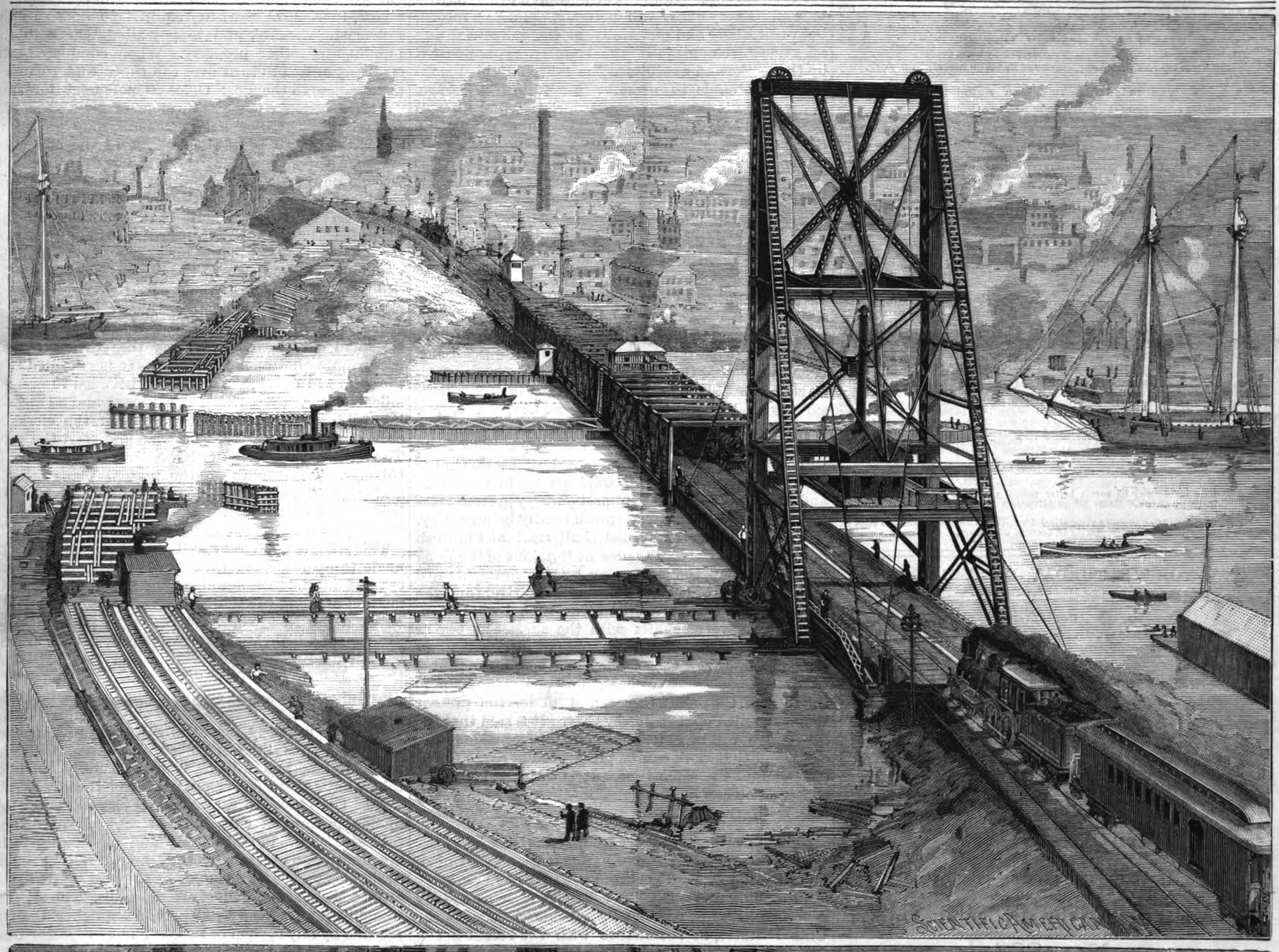

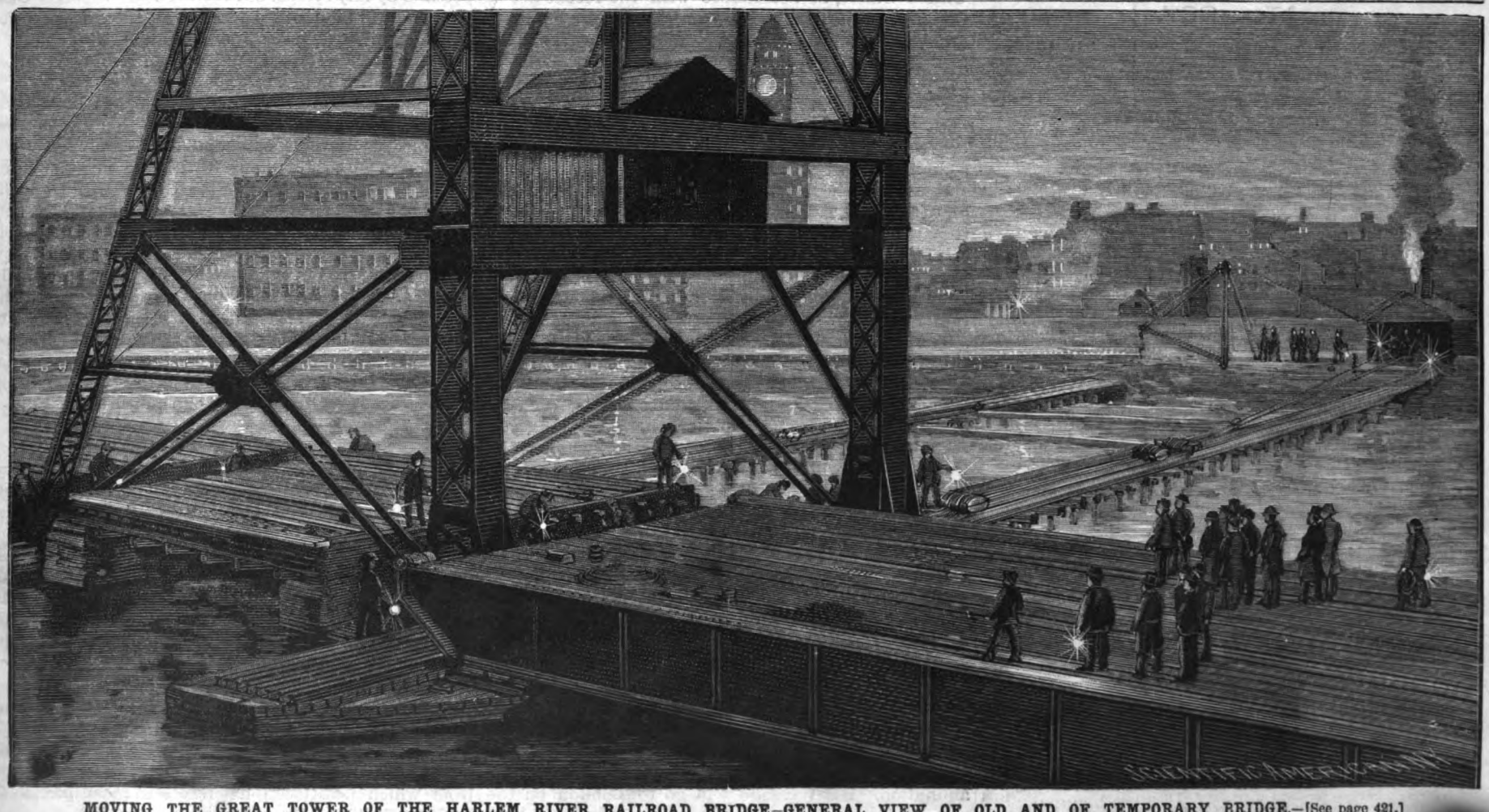

MOVING THE GREAT TOWER OF THE HARLEM RIVER RAILROAD BRIDGE—GENERAL VIEW OF OLD AND OF TEMPORARY BRIDGE.—[See page 421.]

Scientific American.

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NEW YORK, SATURDAY, DECEMBER 31, 1892.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 887.

For the Week Ending December 31, 1892.

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RENEW SUBSCRIPTIONS NOW.

The year of 1892 will be closed with this issue of the SCIENTIFIC AMERICAN and many subscriptions expire with this number. The publishers desire to call attention to this fact for the reason that, by remitting the subscription price without delay, the name of the subscriber will not be taken from the books and he will continue to receive the paper without interruption. It is the intention of the publisher to make the paper during the coming year of especial interest. An unparalleled opportunity to procure subjects of interest to the reader will be afforded by the World's Fair, and with a special correspondent and artists on the spot, this opportunity will be taken every advantage of. Every effort will be made to make a record, both editorially and pictorially, of the industrial and scientific development of the country, as manifested by the works and exhibits at the fair, and this record will be valuable to preserve for future reference. Many subjects that cannot appropriately find place in the SCIENTIFIC AMERICAN will be published in the SUPPLEMENT.

Those who send their subscriptions directly to this office will be assured of the regular receipt of the paper, by mail prepaid.

PROPOSED RAILWAY TUNNEL UNDER THE TWO RIVERS AT NEW YORK.

A large railway tunnel under the North and East Rivers, connecting Brooklyn, New York City, and Jersey City, has been projected by Mr. Austin Corbin, of the New Jersey Central Railroad and the Long Island Railroad. It is said the Pennsylvania Railroad has been considering the matter of joining in the construction. Some $50,000 has been expended in preliminary surveys and borings, under the supervision of Mr. Charles M. Jacobs, C.E., who reports that the construction under both rivers, and under the city of New York, will all be, with the exception of a short section in the North River, through very solid gneiss, in such firm and regular position as to almost entirely prevent leakage, and so that a lining even will hardly be necessary. It is planned that the tunnel shall start at Flatbush Avenue, in Brooklyn, the present terminus of the Long Island Railroad, thence passing by easy gradients to a greatest depth of 140 feet below the two rivers and the lower end of New York City. The tunnel will be connected by elevator shafts with the surface at two or three places in Brooklyn, and there will be similar stations in New York City as may be desired, the tunnel passing under the city from the foot of Maiden Lane to the foot of Cortlandt Street, and under the present Pennsylvania depot in Jersey City. It is said that the excavation will be 29 feet high and 21 feet wide in the clear, and that work can be prosecuted at seven different points at the same time. It is estimated that the construction can be completed in three or four years.

THE TWO ENGLISH-AMERICAN STEAMERS.

The two magnificent ocean steamers of the Inman line, the City of New York and the City of Paris, heretofore sailing under English colors, though owned by American citizens, will shortly assume the flag of the United States, in accordance with the recent act of Congress authorizing such assumption. At present these are the fastest passenger vessels afloat. They are of 560 feet length, 10,500 tons, 20,000 horse power, built to carry an armament in the event of war, and may be taken by our government should hostilities make it necessary. The change of flag will take place in February and March next. At the same time there will be a change of ports in England.

Heretofore the ships have sailed between New York and Liverpool, calling at Queenstown. In March next they will change to Southampton, where passengers can be landed at the dock, and reach London in less than two hours' time, thus avoiding the delays, inconveniences and long railway rides of the Liverpool route.

The speed supremacy heretofore enjoyed by these ships will probably be overcome in the course of a few months, when the two recently launched Cunard steamers Campania and Lucania, each of 30,000 horse power, 700 feet length, 20,000 tons, are ready for sea. It is a question, however, whether the Cunard boats will be able to beat our ships more than half a day in time; and it seems probable, therefore, that passengers by the latter will be able to reach London fully as quickly as they could via Liverpool and the new Cunarders.

Under the new order of things, commencing in March, the City of Paris will deliver the United States mails at the London post office at least eight hours earlier than she has previously been able to do, and from four to five hours sooner than any other steamship, except the City of New York. By the new route the passenger will embark at the Inman line's new pier at New York, and upon arriving at the new Empress docks, Southampton, will board a special train for London, after passing a brief custom house examination. His baggage will go to London on the same train, and a ride of an hour and a half will land him in the English metropolis, where he can enjoy a half day's sightseeing before the tourist who came by Liverpool arrives.

IMPROVEMENT OF LOCAL POSTAL FACILITIES.

Postmaster-General Wanamaker has entered into an agreement with the United States Automatic Dispatch Company, of New York, by which the company agrees to lay, at its own expense, a double line of tubes or other form of conduit, connecting the main Post Office building in New York with the main Post Office at Brooklyn for the transmission of the mails. It agrees to pay all expenses connected with the construction of the system, to maintain and operate it for a year, to remove it when required to do so by the Postmaster-General, and to pay all damages to the buildings or other property. When completed, the company agrees to turn over the tubes and their appurtenances to the Post Office Department for such practical tests as the postmasters of New York and Brooklyn or the Postmaster-General may see fit to make, the tests to be at the expense of the company.

It is further agreed that the company shall provide electric power for the operation of the system, and shall lease it to the United States year by year, or sell it to the United States at its actual cost. The transportation, it is said, will be done by a miniature trolley railway, inclosed in a 16 inch square conduit. The mail matter will be placed in carriers of steel wire, 4 feet long and 14 inches square, each carrier taking a pouch containing 3,000 letters, or an equal bulk of other classes of mail. In the end of each carrier or car is a small electric motor, taking the current from a wire running between the tracks. It is expected that the cars will develop a speed of between 70 and 100 miles an hour. The cutting off of power and all switching will be done automatically, so that the clerks at either end will merely have to load and start the cars. The author of this plan is Mr. Andrew Bryson, Jr., of this city. The conduits, if the present plans are carried out, will be suspended from the iron work of the bridge and of the elevated road on Adams Street, Brooklyn.

This scheme reads very well, and could, no doubt, be made to operate; but the cost of maintenance, interest, and attendance would render it a very expensive method of doing the simple work of carrying the mails between the New York and Brooklyn post offices—a distance of a little less than two miles. A tube system is limited to mere transportation between fixed stations. It does not embrace the far more important work of rapid letter collection and quick local delivery.

What is urgently needed for the improvement of postal facilities in New York, Brooklyn, Chicago, Philadelphia, and all our towns, is not a plan of tubes, but a systematic employment of the street railways. Our cities are ramified in every direction by numerous lines of cars, horse, steam, elevated, and cable, which are in motion day and night. There is, apparently, no reason why they might not be made available at once, as adjuncts of the post office, in the rapid collection and delivery of the mails. The expense would be far less and the operation quicker than is possible by any system of tubes. The Postmaster-General who will inaugurate a comprehensive system for street car mail delivery and collection will confer a lasting benefit upon the public and achieve a most honorable distinction.

In St. Louis a street car mail system has been commenced on a small scale, and works with much success. Now let us have it extended and employed in a thorough manner to all our towns and cities. When this is accomplished the United States will lead the world in respect to internal postal facilities and the people will enjoy therefrom rare advantages. To be able to hand mail matter to traveling postmen and to know that it will have immediate delivery is what everybody requires. The means for doing this stand ready. The Postmaster-General is clothed with the necessary authority. All that is needed to set the work in motion is an act of Congress granting a reasonable appropriation. The increased postal business would soon bring back returns greater than the expenditure.

A Large Freight Steamer.

On the 22d of October last Messrs. William Doxford & Sons, of Pallion, Sunderland, launched from their ship building yard the steamer Samoa, which has been built to the order of Messrs. Crow, Rudolf & Co., of Liverpool. This vessel is not only the largest ever built on the Wear, but is said to be the largest deadweight cargo vessel in the world. She is 465 feet in length, has a gross register of 6,400 tons, deadweight capacity of 9,250 tons on 25 feet draught, and gross displacement of 13,600 tons.

A MEDICAL CENTENARIAN.—The death of Dr. Enoch Fithian, of Bridgeton, N. J., on November 15, removes the oldest living medical graduate, as he was reported to be, of the University of Pennsylvania, from which institution he received his diploma in medicine in 1815. He was born in May, 1792.

POSITION OF THE PLANETS IN JANUARY.

MERCURY

is morning star. The swift-footed planet is the first member of the solar family to contribute an incident to the January record. He reaches his greatest western elongation on the first at 3 h. A. M., when he is 22° 17′ west of the sun. He is then visible to the naked eye, rising about an hour and three-quarters before the sun and a half hour later than Venus, who serves as a guide to his position. The observer will find him in the southeast. He should commence his quest at 5 o'clock in the morning, commanding a clear view of the horizon. Venus will quickly appear, and, a half hour later, Mercury will follow, being about 7° southeast of his brilliant neighbor. The morning must be exceptionally clear, or the search will be in vain, on account of the planet's great southern declination. A morning view of Mercury and Venus in near vicinity is worth getting up early to behold. Mercury, after elongation, approaches Venus, both planets oscillating eastward toward the sun.

The moon, one day before her change, is in conjunction with Mercury, on the 16th, at 4 h. 54 m. A. M., being 4° 11′ south.

The right ascension of Mercury on the 1st is 17 h. 12 m. His declination is 21° 12′ south, his diameter is 6″.4, and he is in the constellation Ophiuchus.

Mercury rises on the 1st at 5 h. 40 m. A. M.

On the 31st he rises at 6 h. 45 m. A. M.

JUPITER

is evening star. The mighty planet is in quadrature on the 6th, at 3 h. 15 m. A. M. He is then 90° or 6 h. east of the sun, is on the meridian at sunset, and sets at midnight. He has reached the second epoch in his course, counting his opposition as the first. His orbit is so much larger than the earth's that he shows no sensible phases, excepting that, when in quadrature, the limb farthest from the sun is slightly darkened. This is the best time for observing his moons. When Jupiter is exactly in opposition or conjunction, his shadow lies directly behind him, out of our sight, and we cannot observe the eclipses of his satellites, but only their transits across his disk. When he is in quadrature, and before and after this epoch, his shadow is on one side, and the whole phenomena in the revolution of his satellites may be witnessed.

Jupiter is in conjunction with Mars on the 25th, at 10 h. 59 m. P. M., being 1° 56′ south. The conjunction is not a close one, but will be interesting to observe, for the planets are near setting when it occurs. Jupiter will be west of Mars on the evening of the 26th, showing that the planets have passed each other on the celestial road.

The moon, two days before the first quarter, makes a close conjunction with Jupiter on the 23d, at 7 h. 43 m. P. M., being 6′ south. Moon and planet will be so close together that there will be an appulse, and they will seem to touch each other. The conjunction is visible, the time is convenient, and the celestial picture when moon and evening star seemingly touch each other will delight lovers of the beautiful in nature. It is to be hoped that the clouds will not conceal the scene from mortal view.

There was a similar appulse of the moon and Jupiter on August 13th, 1892. Two astronomers of Marseilles, France, witnessed the conjunction with the naked eye, between 7 o'clock and 8 o'clock in the morning, the time when the appulse occurred in that locality. Jupiter was seen just touching the northern horn of the moon, the phenomenon being plainly visible in full sunlight. The planet was then near perihelion, near opposition, and was observed in the pure, serene atmosphere of Southern Europe.

The right ascension of Jupiter on the 1st is 1 h. 0 m., his declination is 5° 2′ north, his diameter is 39″.6, and he is in the constellation Pisces.

Jupiter sets on the 1st at 0 h. 31 m. A. M. On the 31st he sets at 10 h. 47 m. P. M.

MARS

is evening star. He is fast fading into insignificance, but plays his part in one of the most interesting events of the month, his conjunction with Jupiter on the 25th, which has already been described. The planets after conjunction are no longer conspicuous companions.

The moon is in conjunction with Mars, two days before the first quarter, on the 23d, at 5 h. 37 m. P. M., being 1° 43′ south. The conjunction is visible, as it takes place an hour after sunset, and about two hours before the much closer conjunction of the moon and Jupiter. Mars, Jupiter, and the moon will be near neighbors on the evening of the 23d.

The right ascension of Mars on the 1st is 0 h. 12 m., his declination is 1° 6′ north, his diameter is 8″.2, and he is in the constellation Pisces.

Mars sets on the 1st at 11 h. 25 m. P. M. On the 31st he sets at 11 h. 8 m. P. M.

SATURN

is morning star. He is in quadrature with the sun, on the 2d, at 9 h. 21 m. A. M., being 90° west of the sun. He then rises at midnight, continuing to rise earlier every night, until on the last of the month he appears above the horizon at 10 o'clock, and will be in convenient position for observation. He is nearly as far as possible from Jupiter, being on the 2d 90° west of the sun, while Jupiter is 90° east of the sun on the 6th. Saturn is stationary on the 22d, and commences to retrograde or move westward.

The moon on the day of the last quarter is in conjunction with Saturn on the 9th at 3 h. 23 m. A. M., being 35′ south—a distance a little greater than the diameter of the moon. The conjunction is visible for observers who are willing to get up in the small hours to see it. The moon will occult Saturn to observers who are between the limiting parallels of 10° north and 86° south, and who also see her in her geocentric position.

The right ascension of Saturn on the 1st is 12 h. 50 m., his declination is 2° 43′ south, his diameter is 16″.4, and he is in the constellation Virgo.

Saturn rises on the 1st at 0 h. 9 m. A. M. On the 31st he rises at 10 h. 8 m. P. M.

VENUS

is morning star. The invisible chain that binds her to the sun is shortening, and, at the close of the month, she rises only an hour before him and will soon be lost in his light.

The moon, two days before her change, is in conjunction with Venus on the 15th at 2 h. 3 m. P. M., being 4° 47′ south. The conjunction is invisible, moon and planet being below the horizon.

The right ascension of Venus on the 1st is 16 h. 43 m., her declination is 21° 1′ south, her diameter is 12″.2, and she is in the constellation Scorpio.

Venus rises on the 1st at 5 h. 10 m. A. M. On the 31st she rises at 5 h. 58 m. A. M.

URANUS

is morning star. He is in quadrature with the sun on the 30th, at 0 h. 57 m. A. M., being 90° west of the sun. He is the third of the giant planets that reach quadrature during the month, Saturn and Jupiter preceding him.

The moon, two days before the last quarter, is in conjunction with Uranus on the 11th at 11 h. 28 m. A. M., being 1° 1′ south. The moon will occult Uranus for observers between the limiting parallels of 25° and 90° south, who see her as she would be seen from the center of the earth.

The right ascension of Uranus on the 1st is 14 h. 30 m., his declination is 14° 21′ south, his diameter is 3″.6, and he is in the constellation Libra.

Uranus rises on the 1st at 2 h. 33 m. A. M. On the 31st he rises at 0 h. 38 m. A. M.

NEPTUNE

is evening star. His right ascension on the 1st is 4 h. 31 m., his declination is 20° 15′ north, his diameter is 2″.6 and he is in the constellation Taurus.

Neptune sets on the 1st at 4 h. 56 m. A. M. On the 31st he sets at 2 h. 56 m. A. M.

Mercury, Venus, Saturn and Uranus are morning stars at the close of the month. Mars, Jupiter and Neptune are evening stars.

TWO FULL MOONS IN JANUARY.

The first full moon occurs on the 2d, at 8 h. 41 m. A. M. The second full moon makes its advent on the 31st at 9 h. 11 m. P. M., a little less than three hours before the month closes.

A Unique Mathematical Memory.

Jacques Inaudi, called by some "the modern Colburn," is the son of Piedmontese peasants, and he did not learn to read and write until about five years ago, when he was twenty years old. He learned the numbers from his brother by repeating them after him, and after that devised for himself methods of calculation that are peculiar to himself—that is to say, they differ from those in ordinary use. In problems of addition and subtraction he begins with the left hand numbers. This is stated to be the method of the Hindoo arithmeticians as well. The boyhood of this young man was passed in tending sheep, and while he was thus engaged his mind developed a passion for numbers—figures they cannot properly be called in this instance, for the processes are auditional, not visual, with Inaudi. Colburn and all prodigies in numerical memory who have been enabled to give any explanation of their mental work have stated that visualization was the basis of memory. Inaudi is rather disturbed than helped by the use of visible representations of the factors of proposed calculations. If this is true, and there is no reason to doubt it, Inaudi stands as the unique mnemonic prodigy of modern times, by reason of the fact that his powers are based upon the auditory faculty. Athough his memory for numbers is prodigious, his memory for words is quite poor. Neither prose nor poetry is well remembered by him, and melody not so well as by most persons. Color, form, time, and place do not fit in with his capacity, and it is simply incomprehensible to him, he says, that chess can be played blindfold.

According to Binet, in his recent paper in the *Revue des Deux Mondes*, the complexity of Inaudi's mental calculation and his rapidity are alike remarkable. Nearly all the proposed problems have many figures to add, multiply, or divide and to compare, and yet the time taken to announce the answer is extremely short. In a few seconds he adds numbers requiring ten numerals for their notation, and subtracts those requiring twenty; he rapidly finds the square or cube root of large numbers; if fractional parts of multiples are in question, the interval between question and answer is longer; he finds in a few seconds the sixth and seventh roots of true powers. He appears to do the mental part of ordinary examples in multiplication and division in less time than is required to enunciate their answers. He has been known to carry in memory a number expressed by twenty-two numerals for a week, although he had not been warned that he would be requested to repeat it. He can repeat a number forward or backward or give any section of it, as, for example, in millions or billions. At the end of a *seance* he can recite all the figures that have been mentioned up to the number of four hundred.

The head of Inaudi is large and his features are regular and surmounted by a forehead full and high as it is broad. At the Salpetriere a close anthropometric examination was made, under Professor Charcot, that revealed some few unimportant signs of degeneration. Inaudi converses agreeably and is skillful at cards and billiards. His character is marked by modesty and amiability, and his intelligence is that of an untrained but receptive person. It is quite a mistake to set him down as a mere calculating machine. All inquiry as to hereditary influences has resulted in a negative response. He comes from a family of peasants and was among peasants all his earlier years.—*N. Y. Med. Jour.*

Oxygen in the Purification of Coal Gas.

The main reason for the use of oxygen, says Mr. Harrison Veevers, is that the oxide of iron is revivified in the purifiers, without being exposed to the oxygen of the atmosphere, with its consequent expense of labor in emptying and filling the boxes, and turning over the oxide to get a thorough reoxidation. But, irrespective of this, there was a more serious matter to be considered. Every time a box was opened, there would be a loss of at least 1,000 cubic feet of gas, and, when replaced, an equal quantity of air would either be included or have to be expelled by a similar quantity of gas. In winter, a purifier frequently required changing ten times a week, entailing loss of either 20,000 cubic feet of gas or the inclusion of a quantity of air, which, by diminishing the illuminating power, had to be rectified by the use of a greater quantity of expensive cannel. After mature consideration, I advised the adoption of the system of the Brin Oxygen Company, and the board consented. A brief description of this method of obtaining a separation and imprisonment of oxygen from the atmosphere may not be superfluous. Air is drawn through a small purifier containing freshly burned lime, which desiccates the air, and also removes any carbonic acid gas, and to make assurance still more sure, it then passes through a vessel in which there is caustic soda. Being thus in an almost dry state, the air is forced through steel or iron retorts, set vertically, which contain caustic baryta in a spongy condition and are heated to a faint red heat (about 1350° Fahr.) The baryta, when heated and under pressure, has the property of absorbing the oxygen and rejecting the nitrogen, which escapes by means of a valve. It gives off this oxygen when a vacuum is created. This work of alternately arresting and removing the oxygen is performed in a most admirable manner by an automatic machine, which may be worked by steam or else by a gas engine. This machine can be regulated at will to suit the action of the baryta. The pressure in the retorts is 10 pounds and the vacuum 13 pounds. After being abstracted from the retorts, the oxygen is forced into a small holder on the Gadd & Mason principle, and thence conveyed to a meter regulated by a valve to admit 1 per cent of the quantity of gas made. The holder contains an amount equal to one day's demand, but I should advise one of double that capacity, or even larger. The proportion of oxygen in the holder is about 90 per cent.

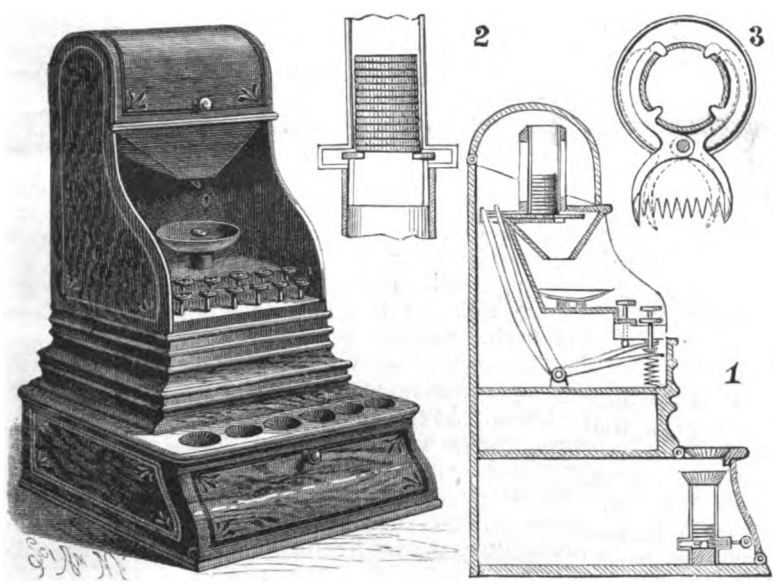
The process may claim to have the following advantages:

1. Revivifying the oxide saves labor.
2. It also excludes the admission of nitrogen, and in consequence of this, less cannel is required to produce the necessary illuminating power.
3. Increased value of the spent oxide. It is impossible to get the strength of the spent oxide to 65 per cent without more frequent revivifying in the air, at a greater expenditure in labor than the value of the extra 15 per cent of the sulphur.
4. As the oxide abstracts more sulphur, less oxide is required annually.
5. Greater uniformity in the illuminating power of the gas, particularly in small or medium sized works.

IN our recent paragraph relating to Rife's hydraulic engine or ram the drive pipe was stated to be 18 inches; it should have been 8 inches.

AN IMPROVED CHANGE MAKER.

A device to facilitate the making of any desired amount of coin change is shown in the illustration, and has been patented by Messrs. George M. Hill and Fred P. Alter, of Centralia, Wis. In the upper portion of the casing, which has an inclosing cover,

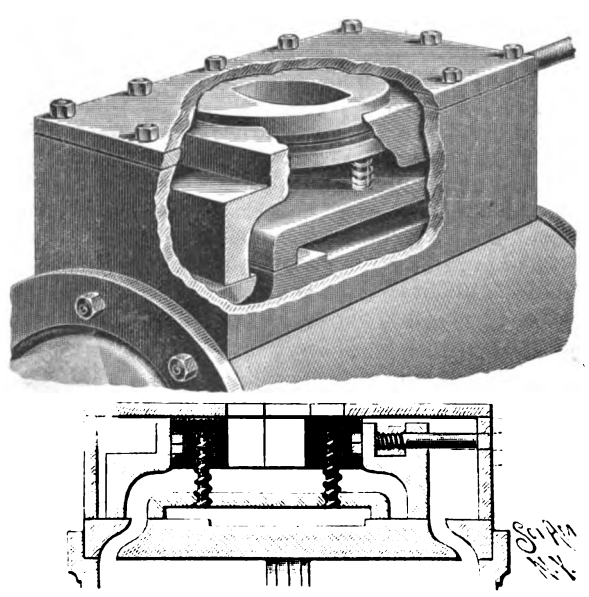


HILL AND ALTER'S CHANGE MAKER AND RECEIVER.

are six tubes adapted to receive the various coins—dollars, fifty-cent pieces, twenty-five-cent pieces, ten-cent pieces, nickels and cents. Each tube has a slot in front, that the coins may be seen, and all the tubes connect at their lower ends with a chute leading to a change table. By means of a push bar or slide, connected at its rear end with the long arm of a bell crank lever, as shown in the sectional view, Fig. 1, the lowermost coin in each tube may be released as desired, upon pressing a key which acts upon the free end of the bell crank lever, the coin then dropping into the saucer-like holder shown. The several keys are marked to indicate the coins in the respective tubes, and a spring holds each of the bell crank levers in such position that the push bar is normally retained out of engagement with the coin. Additional keys are provided, each having at its lower end a bar, by which several levers may be actuated at the same time by a single key, to make collectively a desired amount of change. In order to fill the coin tubes, a receiver is provided in the lower part of the casing, in which is a set of receiving tubes, shown in section and plan views in Figs. 2 and 3. In a circular hollow offset near the lower end of each tube is pivoted a pair of tongs, the handle ends of which are pressed apart by a spring, the inner ends extending into the tube to support a coin dropped upon them. The several tubes are of sizes corresponding with the coins to be received, and when one of the upper tubes is empty it is supplied by removing the filling tube and placing it in the upper tube, when, by pressing upon the handle ends of the tongs, the coins pass out of one tube into the other.

AN IMPROVED BALANCED SLIDE VALVE.

In the upper portion of the valve shown in the illustration is a central vertically movable disk, supported by springs, and provided with an exhaust steam passage. The improvement has been patented by Messrs. John Parker and Fred E. Clark. In the underside of the valve is a recess communicating at its ends



PARKER AND CLARK'S SLIDE VALVE.

with the interior of the steam chest, so that live steam can pass to the underside of the valve. The two exhaust ports terminate in a common port with an elliptical opening in the middle of a balance piston disk in the top of the valve, the disk being pressed upward by springs coiled on rods secured in the bottom of the valve, thus forming a steam-tight joint. The opening in the disk registers at all times with an opening in the cover of the steam chest connected with the usual exhaust pipe, and in the periphery of the disk are held expansion packing rings pressing against the inner surface of an annular flange of the valve. As the area of the valve portions seated on the top of the cylinder, and operating over the ports, about equals the area of the top surface of the balance disk, the valve is completely balanced. This valve requires about one-third less travel than the ordinary slide valve.

Further information relative to this improvement may be obtained of Mr. John Parker, Sturgeon Falls, Ontario, Canada.

Generation of Electric Power in the Coal Fields.

At a recent meeting of the Manchester Association of Engineers, a very interesting paper by Mr. B. H. Thwaite, C.E., of Liverpool and London, was read on the "Economic Possibilities of the Generation of Electro-motive Force in the Coal Fields, and its Application to Industrial Centers." Mr. Thwaite brought before the meeting three projects of electrical transmission of energy generated in the coal fields. The first for supplying the Lancashire centers of industry, and the area adjoining the ship canal; the second for supplying the Yorkshire centers of industry; and the third for supplying the centers of industry in the Midlands and the metropolis.

For generating power for driving electric generating machines they would require high efficiencies with small powers, and a motor of 500 horse power was the largest that should be used for this character of work. The efficiency of dynamos or electric generating machines was so nearly perfect that there was only questionable advantage in building excessively large types, but the motive power and elements should be such that if one or two parts went wrong it would not involve the stoppage of the entire motive power plant; besides, it should be possible to reduce or increase the power of dynamic energy production in proportion to the demand, and with large steam engines of 1,000 horse power and upward this would not be practicable. There was another and important advantage in relatively smaller gas engines. The pulsations of piston effort could be so arranged that their effect on the supply would be inappreciable. In the arrangements of the plant for the projected coal field generation stations, gas motors of 300 brake horse power were intended to be used, a pair of these engines being allotted to each alternating current machine, coupled direct, one driving the armature in one direction and the other the field magnets in a contrary direction.

Mr. Thwaite said that ten years ago he had forecasted that when once the Manchester ship canal was made, its banks would become the future area of new industrial developments, and with a line of power supply, a perfect railway connection, and a means of oversea transmission, it could be stated that no other area in the world would offer such facilities for cheap industrial production as this area would be with the supply of cheap electricity and unlimited energy proposed. To realize the marvelous industrial fecundity of Lancashire and Yorkshire, they had only to glance at the lines of the telephonic system already established and the proposed lines of electric power transmission. There they had the very acme of economy in transmitting thoughts; let them go a step further, and imitate nature by laying down a nervous industrial system to distribute power, and the picture, with the ship canal complete, was perfect, and would be worthy of the enterprise of the counties of the Red and the White Rose.

The chairman, after noting the rapid development made during recent years in the application of electricity, said they could scarcely brand as impossible even the most visionary scheme that might be brought before them in that direction. With regard to the central supply sources suggested by Mr. Thwaite, he thought, however, there were some disadvantages which must not be overlooked. Assuming that there were a thousand sources of engine power, if one source failed, then only one out of a thousand failed; but if there were a thousand motors drawing on one central source and that central source became stopped, then they had a thousand firms stopped simultaneously, and it struck him that the seven millions of horse power they now had in the country in steam engines and boilers would not be replaced by the new force as yet.

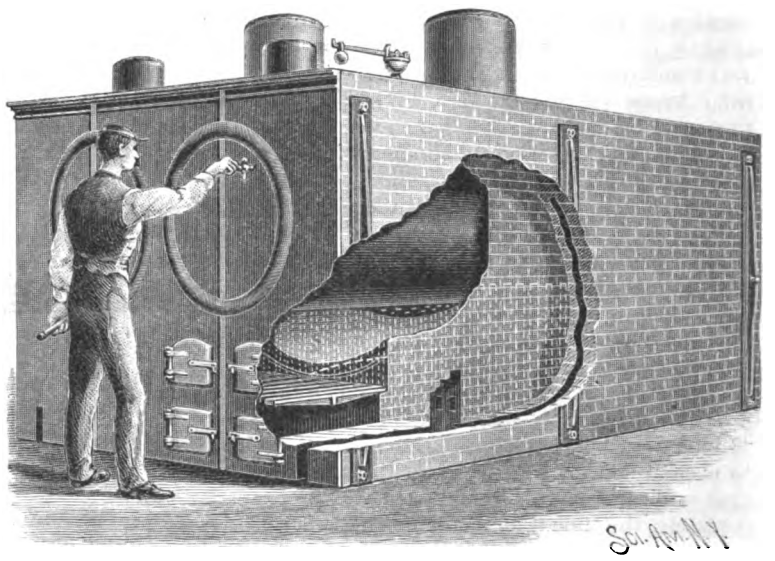
Mr. Brown said, in many establishments where they had replaced their engines by electric motors an immense saving had taken place, and he believed that it was not far from the actual fact to say that, taking an ordinary machine works, where several engines were required, at least 50 per cent of the power would be saved by a central generating station supplying electricity to motors in the various portions of the works, although, of course, the cost of such an installation would be pretty heavy. As to the hygrometric economy of the electric light, there was no question of its being far superior to any other form of light there was.

Mr. Saxon said that one of those questions which they, as practicing engineers, had to face with regard to Mr. Thwaite's suggestions was whether they would have as steady running in their textile factories by driving with electric motors—either of sufficient power to drive the whole of the machinery or perhaps separate motors for each room or story—as with the large engines now in use. His own opinion was that they would not. He thoroughly agreed with the author as to the advantage which would be gained in comparison with small engines. With regard to the cost of the installation, he thought that, what with the excavating, laying special pipes, copper castings, conductors, etc., the author of the paper had underestimated it very much indeed.

Mr. Beastow agreed with Mr. Thwaite that the steam engine in a few more years, especially for small powers, would become obsolete.

AN IMPROVED FURNACE.

A furnace patented by Mr. James S. Ecker, and designed to utilize the fuel to the fullest advantage, is shown in the accompanying illustration. The top of the bridge wall slants upwardly and rearwardly, and is



ECKER AND LAIDLAW'S COMBUSTION ARCH FOR FURNACES.

curved to correspond with the curved top surface of an inverted arch, concentric with the boiler, and forming a segmental space constituting a combustion and radiation chamber just beneath the boiler and extending back to the rear wall. In the rear of the bridge wall, at its base, is an air chamber extending to the rear brickwork and from one side wall to the other, the top of the chamber being arched, and this chamber is connected by numerous openings or ports with the combustion chamber above, formed by the inverted arch immediately under the boiler. Longitudinal ports from the front end of the air chamber lead to a transverse channel in the bridge wall, the latter channel connecting with channels in the side walls of the brickwork which open at their front ends to the air. Suitable doors in the rear of the brickwork give ready access to the air chamber and the combustion chamber to facilitate cleaning when desired. The large body of brickwork forming the arched top of the air chamber and the inverted arch radiating surface beneath the boiler has considerable storage capacity for heat, and in its construction allowance is made for contraction and expansion. The additional supply of air through the ports leading upward from the air chamber is designed to effect a perfect combustion of all smoke and gases.

Further information relative to this improved furnace may be obtained of Messrs. Ecker & Laidlaw, Portland, Oregon.

Ship Canal from the Lakes to the Hudson River.

A bill has been introduced in Congress for the enlargement of the Erie canal, with a view to its conversion into a waterway large enough to admit vessels of considerable size. It is to be 20 feet deep. The cost will be one hundred and fifty millions of dollars. This is a grand project, and would be of immense benefit to the great West. It would make ports of entry for foreign commerce at all the different harbors along the lakes, extending westward 1,100 miles beyond Buffalo.

THE BIDEL MENAGERIE.

Mr. Alexandre, a skillful operator of Brussels, has taken a series of photographs representing the animals that compose the celebrated menagerie of Bidel, the tamer, who has recently obtained the greatest success at the representations given by him at the capital of Belgium. Mr. Alexandre has sent us the photographs that he has taken, and the specimens given here will show our readers that they are worthy of being reproduced.

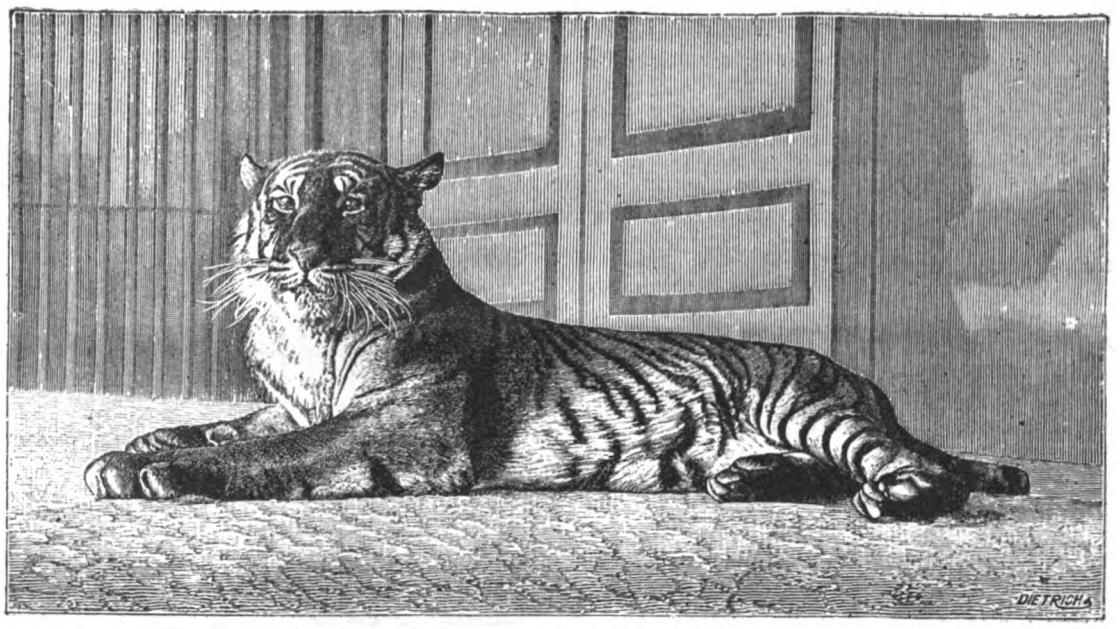


Fig. 1.—BENGALI, A ROYAL TIGER OF THE BIDEL MENAGERIE.

In Fig. 1 we have Bengali, a royal tiger, the finest in the menagerie. He was captured in 1880, in Cochin China, where the species is quite widely distributed, without, however, being as common as in Bengal. In Fig. 2 we have Sultan, a black maned lion of the Atlas mountains, Africa. He was born in 1872, and was captured in a trap in 1876. When he reached Lyons he was the cause of a terrible accident, an account of which we reproduce from the *Salut Public:*

A sad accident, caused by the inconceivable imprudence of the person who was the victim of it, occurred at the Vaise Station, at Lyons. On the first of September, 1876, Mr. Bidel, proprietor of the great menagerie installed upon the Perrache, received from Africa a magnificent lion, which had been very recently captured in the deserts of Central Africa. This animal, confined in a strong barred cage, had been placed in a special car, with the following inscription: "Ferocious animal; lion; one is forbidden to open."

A drover of beeves named Vicard, in the absence of the conductor, opened the car, switched off into one of the annexes of Vaise Station, and held out a piece of bread to the lion. Naturally, the animal, being carnivorous, did not care for it, and only exhibited the appearance of being disturbed. Emboldened by this apparent somnolence, our man passed his arm through the bars of the cage, in order to pat the lion's head. The animal uttered a roar and seized the arm of the imprudent fellow with his mouth and paws. In a minute Vicard's arm was crushed by the powerful jaws of the beast, from the wrist to the shoulder. The men of the gang, running forward armed with iron bars and wooden stakes, were unable to make the furious animal let go his hold, and he kept half of the arm of the unfortunate man between his jaws. Vicard died in consequence of his injuries.

On the day following the accident Mr. Bidel gave a representation for the benefit of the widow and her child, and worked the terrible beast, which continues to have an ever increasing success.

Fig. 3, from a beautiful instantaneous photograph, represents Bidel, the tamer, entering the cage of another lion, Pacha, a magnificent specimen of the leonine race of the Atlas, captured in 1887.

The Bidel Menagerie, which exhibited at Brussels, and a few days afterward at Lille, comprises also the following animals: Nero, a superb lion from the Cape of Good Hope, captured in 1871; three panthers from the Indies; a guepard, native of Asia, captured in 1889; a Persian leopard; three superb lions, recently captured at the Cape of Good Hope; three royal Bengal tigers; two white polar bears; a black Russian bear; and hyenas, wolves, monkeys, etc.

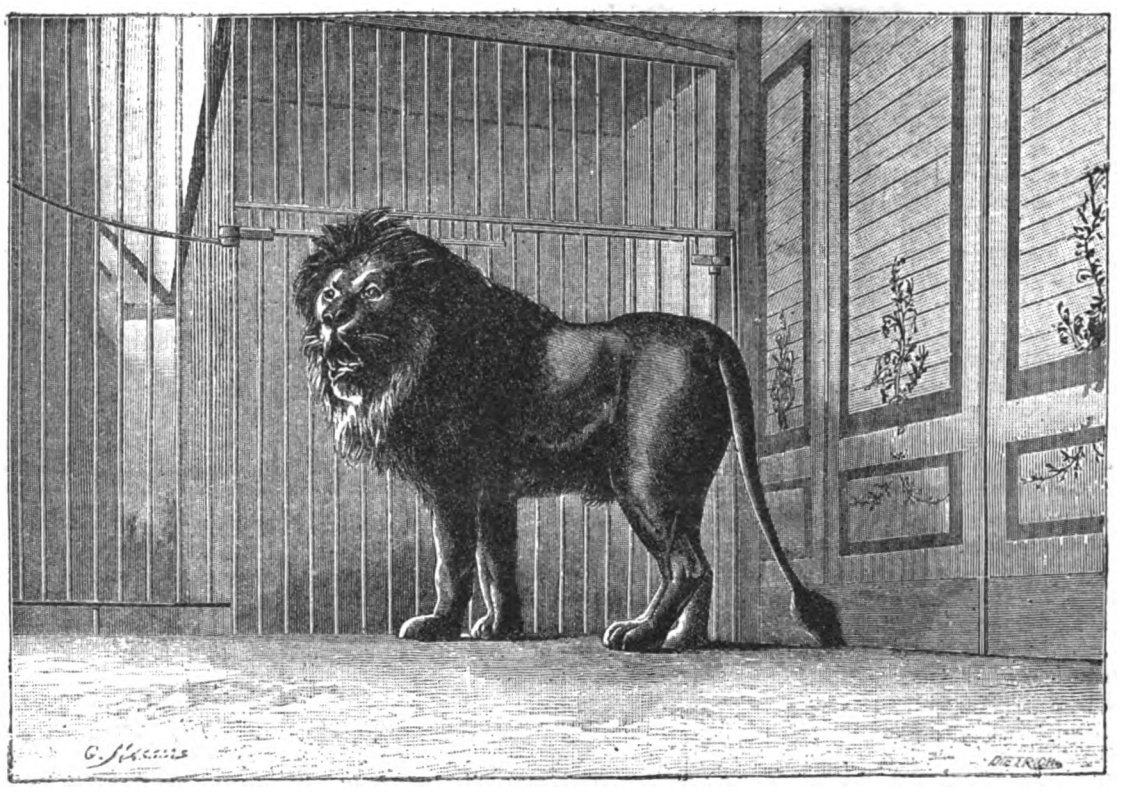


Fig. 2.—SULTAN, A BLACK MANED LION OF THE ATLAS.

This exhibition is very remarkable, and tends to develop a taste for the natural sciences, and zoology especially, among the numerous people who visit it.

Mr. Bidel's entire existence is devoted to the collection of rare animals and the exhibition of them at fairs in most of the cities of France, Italy, and Spain. The celebrated tamer avers that he has no special process for training ferocious animals. "It simply requires," says he, "great energy and much will and courage."

Bidel has, without any preliminary preparation, several times entered cages containing tigers, the most formidable of ferocious animals. He unhesitatingly presents himself to them, a whip in hand, looks at them fixedly, and does not fear to strike them if they make a threatening movement. Despite such courage and boldness, he has, nevertheless, been wounded by his animals, and sometimes quite severely.

Everybody remembers that in the month of July, 1886, at the Neuilly fair, a lion lacerated all of one side of his throat. The celebrated artist Edward Detaille was among the spectators of this dramatic scene, and made a sketch of it.

Some years ago, Pezon, a well known rival of Bidel, came near being devoured by one of his bears at a fair at Chalons-sur-Marne.

One has sometimes narrated the story of the tamer who, having discharged his valet, took a willing man, whom he put in charge of the cage cleaning. The next day, our tamer was much surprised to see his new servant in the lion's cage, quietly sweeping the floor with big licks of the broom between the animal's paws. The anecdote is more amusing than veracious.

The keepers of the wild animals in the menageries of our museums never enter the lions' cages, even when these animals have for a long time been accustomed to their prison life.—*La Nature.*

Fig. 3.—BIDEL IN THE CAGE OF ONE OF HIS LIONS.

Smokeless Powder.

The improvements effected in smokeless powder at the Newport torpedo station have produced some very gratifying results, and have shown that our new M N product, as it is called, is believed by our naval ordnance authorities to be better than the French B N or any other powder. A quantity of M N smokeless powder placed in an iron vessel, wrapped in felting, and exposed to 208° F. for six hours, was absolutely unaffected, while another quantity stood 212° F. for twenty hours before showing signs of change. Smokeless powder stored for six months at Indian Head during the past summer, which was unusually hot, showed in subsequent firings that its ballistic properties were unchanged. On the other hand, a sample of this powder, put in a freezing mixture at 5° below zero F., was unaffected. The safety of this powder has also been shown by experiments. Attempts to explode it by the service detonator of mercury fulminate have failed.

Gold and Silver from the Sea—A Proposed New Method for Coating Ships' Bottoms.

The method of J. Bridges-Lee, London, consists in first sheathing the vessel with copper by any ordinary accepted means, thereafter joining up the copper sheathing to the negative pole of a galvanic battery or direct current dynamo electric machine, and in amalgamating the whole external surface of the copper with mercury. The positive pole of the battery or dynamo must make earth away from the vessel. Some of the chief benefits resulting from the employment of this method will be:

1. That the exposed surfaces of the sheathing can be kept exceptionally smooth, bright and clean. The mercury will hold well to the surface of the copper and fill in any scratches or other minor irregularities, and the electric current will effectually prevent oxidation. The passage of the electric current will assist in maintaining uniform adhesion of the mercury to the copper.

2. The surface will be of such a character as not to afford good hold for barnacles and other marine organic bodies which commonly attach themselves to ships' bottoms and cause fouling.

3. Skin resistance will be much reduced, not only on account of the smoothness of the metallic surface, but also because of the development under the influence of the electric current of films of gas upon the exposed surface. If the electric energy is sufficient to cause the escape of streams of tiny bubbles all over the surface, the layers of water charged with those streams of tiny bubbles in close contact to the vessel's skin will oppose less resistance than ordinary water free from bubbles.

4. Under the influence of the electric currents, passing traces of the precious metals (gold and silver) will be precipitated from oceanic and other waters upon the sheathing, and will be there held by the mercury as amalgam. From the surface scrapings, after a vessel so sheathed and fitted has been some time afloat, the precious metals can be recovered by ordinary chemical means.

5. The gain from diminished skin resistance will much more than compensate for the cost of maintaining the electric circuit and for supplying the requisite quantities of mercury from time to time.

6. The quantities of gold and silver which may be recovered from the waters of seas, rivers, or lakes will often more than compensate for the loss of mercury, and will nearly always constitute an important item on the credit side.

In applying this method of sheathing, the ordinary rule should be followed of using the thickest copper sheeting toward the bows and thinner sheeting behind, and it will ordinarily be found best to make earth with the positive pole in advance of the ship. A result of this arrangement will be that there will be greatest electrical action over those parts of the sheath at the bow and over the areas just behind the bow and least action toward the stern, so that while gas bubbles are freely escaping from the foremost surfaces, the hinder surfaces may experience only sufficient electrical action to keep them bright and clean. There will be some economy about this arrangement, and if the positive pole makes earth in front of the bow of the ship through a metallic plate of difficultly oxidizable or non-oxidizable metal held in a vertical plane by rigid attachments projecting from the bows, the frictional resistance which it will cause need not be very serious, especially as that pole will also develop streams of gas bubbles. Of course the plane of the plate which constitutes the positive pole should be such that if extended backward it would bisect the ship and the supports should be sufficiently firm to hold it continually in that plane. The electrical connections with the galvanic battery or dynamo should be thick copper wires. The wires from the negative pole may ramify to various parts of the sheathing as may be found most convenient, and suitable switches may be provided to control the distribution. Also the positive pole may, if desired, make earth at other places besides in front of the bow, through wires or plates dipping into the water at some distance from the walls of the ship.

A Gratuitous Number.

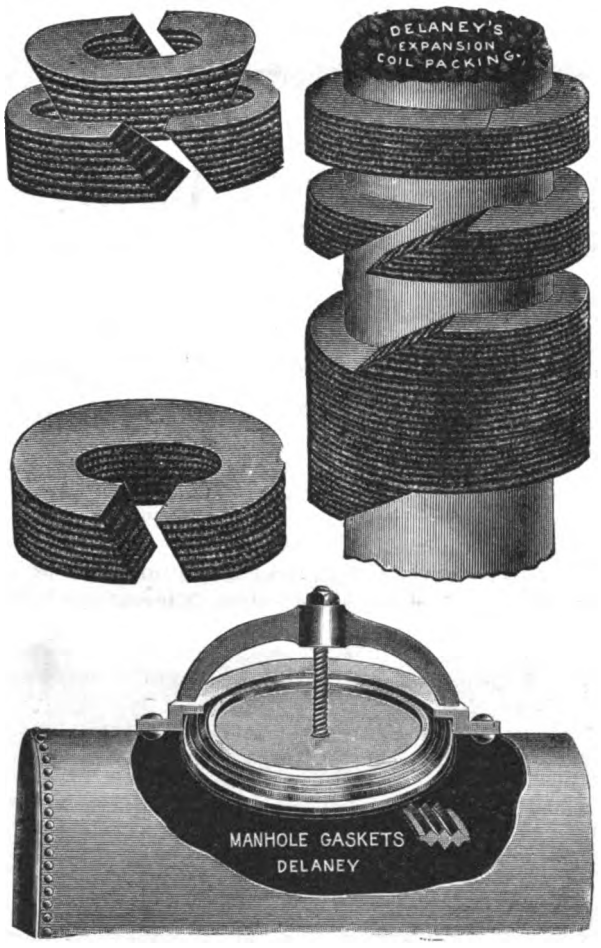
The day of publication falling one day earlier each calendar year has gradually antedated the issue of the SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT, so that in regular order the first number of the coming volume would naturally issue on Saturday, December 31.

To avoid the beginning of the new volume before the commencement of the new year, we have decided to give our mail subscribers the benefit of an extra number.

Instead, therefore, of stopping the SCIENTIFIC AMERICAN with issue No. 26, and the SUPPLEMENT with No. 886, which would give the subscriber fifty-two numbers for the year, we shall, at considerable cost, mail to him a fifty-third number. We hope our mail subscribers will recognize our liberality in presenting them with an extra paper, and favor us with a prompt renewal of their subscription.

IMPROVED PACKING AND GASKETS.

The sectional ring, expansion ring and coil packing shown in the accompanying illustration are severally made according to a patent process designed to afford a perfect lubricator, and so that the expansion will be horizontal, relieving the rod of all pressure. It is said to be extremely durable, not burning or getting hard in the box. The manhole gaskets of the same makers are said to form especially durable steam and water



DELANEY'S COIL AND RING PACKING AND GASKETS.

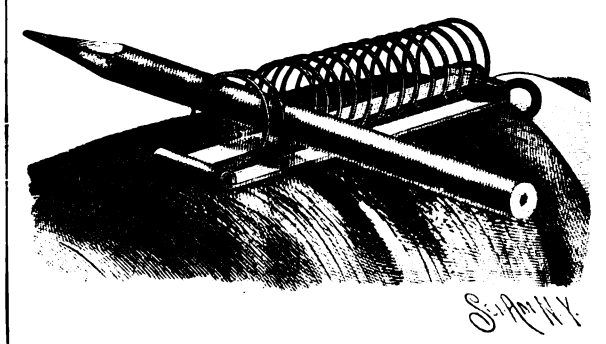
tight joints, being made to stand a pressure of 300 pounds. These goods are manufactured by Messrs. H. J. Delaney & Co., Milwaukee, Wis.

Spontaneous Combustion of Arsenic.

Recently powdered metallic arsenic which, in the process of powdering, had been moistened with water to prevent dusting, is recorded by E. Hirschsohn as capable of spontaneous combustion. A quantity of powdered arsenic in a double paper bag had been received late in the evening, and set aside overnight in a basket containing other articles packed in straw and sawdust. The next morning, upon opening the store, the peculiar garlic-like odor attracted attention to the basket containing the powdered arsenic. An examination disclosed that the arsenic had agglutinated to a solid, glowing mass; that the paper containers had been charred, and that a portion of the straw was scorched; a number of bottles in the basket had also burst, owing to the high heat, and upon the charred paper bag were sublimed some beautiful crystals of arsenious oxide. A fire, which probably would have been attributed to some other cause, was in this case averted.—*Pharm. Ztschr. f. Russl.*, 1892, 612; *Am. Jour. Pharm.*

A PEN RACK ON THE SLEEVE OR CUFF.

A convenient attachment for the sleeve or cuff of a coat or other garment, designed to hold a pen or pencil within easy reach, is shown in the accompanying illustration, and has been patented by Mr. Isaac W. Housser, of Winnipeg, Canada. It consists of a frame-piece composed of an upper and lower plate, carrying



HOUSSER'S PEN RACK.

between them the lower portions of a spring wire coil, the individual coils of which are sufficiently spread to receive and hold between them one or more pens or pencils. Attached to the holder is a spring clamp, one member of which presses against the inner side of the sleeve or cuff, gripping it with a spring pressure sufficient to maintain the holder in position on the outside of the garment. If desired, a strip of blotting paper may be held between the cuff and holder.

Rain Making by Means of Smoke Balloons.

The experiments on rain making now being conducted under the direction of General Dyrenforth in Texas recall the unsatisfactory tests of a year ago. Since presenting an article on the subject which appeared in *Science*, November 27, 1891, some few experiments have been made by the writer in preparation of an outdoor test. The lack of funds necessary for these (though the amount required is not large) has prevented the undertaking of experiments to the present time.

While the government has furnished General Dyrenforth with facilities, in general, equally applicable to methods now proposed, and as practical failure seems attendant upon his results, it would seem not unwise to test the theory advanced in the article above referred to. The gist of the theory is that dust particles in the upper strata of the air, under suitable meteorological conditions, may form nuclei where condensation may occur, and a rainfall be induced. So far as laboratory experiments go, as mentioned in that article, the presence of dust particles seems necessary for the condensation of moisture. Among other experiments mentioned, the following may be taken as interesting and suggestive. A jet of saturated steam was admitted into a large glass receiver, and the condensation of the steam showed a cloud filling the receiver. The air was then pumped out and filtered through cotton wool before being readmitted. In this dust-free air of the receiver the jet of steam was again admitted, but no trace of condensation could be seen. With repetitions of the experiments the results were the same. The conclusion seemed established, in the laboratory at least, that dust particles were necessary for condensation.

Similar conclusions are arrived at by Professor John Aitken, of Scotland, although I am not aware that he proposed any use of dust particles for the artificial production of rain. After performing these experiments in my laboratory, I was naturally anxious to try them on a larger scale in Nature's laboratory.

The objections that have been raised since the article appeared, that dust and smoke are frequently abundant in our atmosphere, especially over large cities, without the production of rain, does not necessarily prove that, should dust or smoke be let into the upper air layers, precipitation might not be caused. Further, the optical effects from dust and smoke seem to indicate that it is continually settling, and does not reach to any great height in the atmosphere above the earth. The experiments made since the above article was written were directed toward finding the substances most suitable for producing a dense and long-continuing smoke. Substances which give the densest smoke burn too rapidly. I tried various ways of increasing the duration of their burning without impairing their smoke-giving qualities. By mixing turpentine with saw-dust or with straw paper pulp, and then subjecting the mass to hydraulic pressure, the time of burning of a quarter of an ounce was increased from about one minute to twenty minutes, while the smoke given out was very dense. Balls made in this way, and two inches in diameter, would easily continue smoking over three-quarters of an hour.

From these preliminary tests, the plan proposed was as follows: To raise, at intervals of about one-half mile across country, a number of captive balloons, each capable of lifting about thirty pounds, and each containing approximately 1,000 cubic feet of gas. Suspended from each of these balloons by a light iron wire should be one of these slow-burning smoke balls weighing about 30 pounds, which could be lighted on the ground and raised by the captive balloon to about one-half mile into the upper air strata. The time for experiment must be determined by meteorological conditions. As the balls were consumed the balloons could be drawn down, new balls attached, and the balloons allowed to rise, and in this way over a considerable extent of country considerable smoke could be gradually turned into the upper layers of the air.

The chief expense in such an experiment would be for the balloons, which would cost in the neighborhood of $100 each. No expensive explosives are necessary, and as the Texas experimentalists seem provided with balloons, the experiments could be conducted there without appreciable expense to the government.

It was proposed by the writer to make a series of tests in the State of Kansas, but the comparatively small sum of money necessary is not available, nor will other work at present allow.

The reiteration of this dust theory for the artificial production of rain is given in the hope that it may suggest to others its desirability and a method of experimentation. A theory which has at least a laboratory verification is certainly worthy of test on a larger scale, and the expense of such testing is certainly not prohibitive. It need not be mentioned that such experiments should be accompanied by meteorological observations, and from these a place and time wisely determined.

LUCIEN I. BLAKE.
Physical Laboratory, University of Kansas.

IMPROVEMENTS AT THE HARLEM RIVER BRIDGE.

There are three railroad bridges across the Harlem River, the estuary connecting the water of Long Island Sound with the Hudson River. The principal one of these bridges, situated in the line of Fourth Avenue, is used by the New York Central, the Harlem, and the New Haven Railroads for their passenger traffic principally. An immense number of trains pass over it daily, so much so that it has become insufficient for its uses. It included always a center swinging draw. This draw was struck so often by passing boats that apprehensions were entertained as to its working perfectly. Accordingly, to preserve the integrity of the river navigation, and also of the railroad transit, an auxiliary draw was erected adjoining the swinging draw. This second one, from the designs of Mr. G. H. Thompson, of the New York Central road, was of the lifting type. In the upper cut, this draw is seen in position nearest the front of the picture, while immediately back of it is the old swinging draw. The floor of the new drawbridge was carried on the top of plate girders, which were free to swing up or down on horizontal pivot or hinge joints immediately adjoining the front of the tower. To open the draw, it was simply pulled upward, rising into a vertical position. To effect this operation, cable hoisting machinery was provided, and to give scope to its operation, the tower, shown in the cut, was erected.

The tower is an iron lattice work structure, 126 feet high, with a base 34 feet 6 inches wide and 48 feet 6 inches long. Its front pillars are vertical, and within them counter weights were provided to relieve the hoisting machinery of most of the strain of lifting the draw. It will be seen that in raising the bridge from a horizontal position, less and less power is required. Accordingly, the system was so arranged that as the bridge rose, counterweights were successively detached, thus compensating for the decreased moment of the structure. The bridge has now to be removed and replaced by another structure. Independent of the requirements of present traffic on the Harlem River, it is obvious that when the improvements now under way shall have been completed by the Federal government, it will become a waterway of considerable importance to the city. The bridge also is of increasing importance with regard to the railroad traffic, and the opening of its draw, even now, has had to be restricted, owing to the number of trains which have to pass it. A new bridge is to be built, elevated nearly 30 feet above the water, so that the majority of boats can go under it without the draw being opened. In accordance with the requirements of the Federal government, the new draw in the new bridge will have to give a minimum opening of 100 feet at right angles to the axis of the stream. As the bridge runs at an angle with this axis, the full opening of the draw will exceed 165 feet on each side of the center pier. The drawbridge truss which will swing in its center therefore will be about 400 feet long, and will carry four lines of tracks. The bridge will be the continuation of the elevation of the tracks in Fourth Avenue—a colossal work soon to be begun.

To enable the new bridge to be constructed, a temporary bridge is to be built at one side of it, which is shown in the upper cut. When this bridge is finished, trains will use it, and the old structure will be demolished and replaced by the elevated bridge just mentioned. The temporary bridge, however, must have a draw, and the Federal engineers exacted a minimum width, requiring trusses 106 feet long. The old trusses of the lifting draw spanned but a little more than 90 feet. To provide the new draw for the temporary bridge, it was determined first to move the tower bodily into position in line with the temporary bridge, and to use it to raise and lower the lattice girder draw, 106 feet in span. The line of travel of the tower having been decided on, rows of piles were driven; caps were placed on them, and on these 12 by 12 longitudinal timbers were placed. Rails were then spiked down on the timbers so as to form a horizontal sliding way. The tower was jacked up bodily 3 feet after being stripped of counter weights and other material so as to make it as light as possible. It is calculated that 100 tons weight were thus removed, of which 85 tons were represented by the counter weights alone. Even when this was done, the residual weight was in the neighborhood of 180 tons. When the tower was thus elevated, slideways in continuation of those laid on the outside were placed under it. The rails were lubricated with Dixon's plumbago lubricator and the tower was lowered upon them. A six-spool hoisting engine with falls of very large size, with great sheave blocks, being 18 inches in diameter, was arranged to draw the tower away from the bridge along the line of the slide. Some apprehension was felt as to the success of the operation, but it was found that the tower might be moved a distance of 8 feet without interfering with traffic, so it was decided that here, at least, was room for experiment. Accordingly, before the final operation, the tower was moved back and forth to distances of a few feet to test the practicability of the operation. When everything was ready, the final operation of moving, illustrated in the lower cut, was executed. It was done at night, in order to avoid interruption to traffic. At 12:30 A. M., the tracks were cut by the railroad company, and the way was cleared for the tower to be drawn out from its position. The foreman in charge of the work, as a signal code, arranged at one motion of his hand to indicate one revolution of the engine. When all was clear, the engine was started, first slowly, and then more rapidly, and in 21 minutes the great mass was moved 54 feet. The railroad company replaced the tracks, and by 3:30 A. M. all was ready for traffic once more. There was absolutely no interruption to traffic. The tower is to be moved along on its present course until the line of the new temporary bridge is reached, when it is to be moved forward in position. When installed here, the lattice girders will be put in position. As this will then be the only drawbridge, hoisting machinery of double the power of the original will be put in, so as to insure rapid operation.

The work of moving the tower was done by the firm of Coffrode & Saylor, of this city, who were its original constructors. All the operations were in charge of their foreman, Mr. Maylan, and the entire work was successful in every sense of the word.

On Smoke Prevention.

Professor William Ripper, of Sheffield, recently delivered, in connection with the Sheffield Technical School, a lecture on the important subject of "Smoke Prevention Appliances." At the outset, the professor said that although it might be impossible in some branches of manufacture without considerable difficulty to prevent smoke, it was now generally admitted that so far as steam boiler chimneys were concerned smoke may be almost entirely abolished. Notwithstanding between two and three thousand patents have been taken out for smoke prevention appliances, smoke is still with us, not because of lack of inventors or good inventions, but because it is cheaper and less troublesome to make smoke than to prevent it. If it had been shown to be cheaper to burn smoke, there would have been no need for acts of Parliament to prevent it. Smoke is the result of incomplete combustion. The conditions necessary for complete combustion are sufficient air, its intimate mixture with the gases to be burnt, and high temperature. A common oil lamp smokes, but when a chimney is fitted to it, it burns brighter and the smoke disappears. This is precisely the effect of a funnel or chimney on a boiler furnace; and the power of the furnace to effectively consume fuel depends upon the draught. Insufficient draught to burn the quantity of combustible gases proceeding from the fuel must result in smoke. High temperature —at least 1,000° F.—is necessary for ignition of the gases; the presence of a relatively cold water jacket round the furnace is not conducive to complete combustion.

The smoke trouble is largely due to want of appreciation of the importance of the boiler. No care or expense is considered too great to save 5 per cent with the engine, but while engineers were racking their brains to make a small saving with the engine they often lost sight of the fact that two or three times the economy might be obtained by turning their attention to the boiler. Every engineer who knows his business recognizes that the boiler is as important a machine as the engine, and requires just as much skill and intelligence to properly manage it. The phenomenal 1·3 pound of coal per indicated horse power per hour says a good deal for the boiler engineering on steamships, and where such results are obtained the shovel has probably more to do with it than the valve gear. A fireman's life—especially a marine fireman's—is certainly not a happy one, but it is none the less certain that the skill and intelligence with which he does his share of the work have a good deal to do with the efficiency and economy of the engineering department.

Professor Ripper mentioned the fact that the medical officer of health for Sheffield had told him that the cases of smoke nuisance are more often due to want of care than to want of appliances, and this, the professor said, he could confirm from personal observation. It has been said a good stoker is the best smoke burner, and (said the lecturer) there is much truth in this, though he did not like to press it, as it might be considered a reflection on the stokers of our smoky towns. Hand firing is still the common method of firing boilers, and where a boiler is not overpressed, a good stoker can fire so as to make very little smoke.

The most approved method of firing is to fire lightly and often, and on each side of the furnace alternately, so that the gases from the green coal on one side may be burnt by the bright fire on the other side. In addition the grid on the fire door might be open, and air admitted at the back of the bridge. Admitting air at the back of the bridge is a common method in some places, and it certainly consumes the smoke. But such an arrangement should be fitted with a door for regulating the supply of air, otherwise, although the smoke might be burnt, a large amount of heat might be wasted by the passing of cold air through the flues during the time there was no smoke to burn; and if the chimney temperature was say 500° F., then each pound of air not required for combustion was carrying with it about 105 units of heat to waste. In some devices for at least half the day cold air was going through to no purpose, and seriously affecting the efficiency of the boiler. Some boilers are fitted with automatic arrangements for opening the air supply to back of bridge or in fire door when it is opened, and with a regulator for allowing of the gradual closing of the air supply. These automatic fittings are an improvement, but they are not perfect, as they have to be set to suit the average needs of the furnace, in which case, after firing or raking, they are sometimes open too long and sometimes not long enough to burn all the smoke.

Now, the object of the air is to burn the fuel, and the best place to burn it is in the furnace, where it should pass either through or over the fuel. Air admitted at the bridge spoils the draught through the fire bars. The cold air takes the line of least resistance to the chimney, and will not go through the fuel if it can find a short cut through the bridge. Air through the fire door and steam jet air injectors cure smoke. A great advance upon our present methods would be the admission of hot air in the front of the furnace to pass over the fire, the air being first heated by the waste gases. This is now being done with much success by Messrs. John Brown & Co., Limited, with marine boilers and induced draught; and for stationary work there is certainly a future for hot air supply to the furnace.

As a natural result of the endeavor to increase the economy of the boiler as well as of the engine, many devices have been proposed to feed the furnace by mechanical means, and so obviate the necessity for the frequenting opening of the fire door and the consequent admission of large volumes of cold air. There have been many mechanical difficulties in the way of their introduction, but these difficulties are now largely overcome. The machine stoker has not yet been found practicable with marine engines, but for stationary work it is undoubtedly finding considerable favor. The advantages claimed for the mechanical stoker are: More water can be evaporated per pound of coal, the cheapest kinds of fuel can be used, more steam can be produced per hour, and there is little or no smoke when the stoker is not driven too hard. In some instances these stokers, where adopted, have been taken out again, and a return made to hand firing; but this fact should not condemn the mechanical stoker without further knowledge of the circumstances. Strong evidence can be brought to show that in many districts throughout the country these stokers are giving great satisfaction, and it may be taken for granted that where they receive as much ordinary care and attention as is needed by any other machine, and where they are not hard pressed, they will do good work—burn the smoke and soon pay for themselves.

If a manufacturer requires more steam, and it is a choice between having another boiler or a mechanical stoker to the existing boilers, he should choose the additional boiler. In some instances the manufacturers have chosen the stoker, overworked it, been disappointed at the results, and discarded it.

To sum up, Professor Ripper maintains that smoke can be prevented by care in firing, assisted by automatic devices for admitting air at the door and bridge. But such a method is not perfectly satisfactory in point of economy. A mechanical stoker, especially a stoker receiving ordinary attention, and not overpressed, will burn the smoke, consume cheaper fuel, and pay for itself.

Gum Arabic.

About a year ago it was noticed that the extensive falsification to which gum arabic was being subjected, owing to the disturbances in inner Africa, had made good gum rare and expensive. In consequence of this scarcity other substances are introduced from Australia, South America, etc., as substitutes for gum arabic, but none of them is equal to the genuine Soudan gum.

A. Jacksch, in a paper on this subject, states that inferior materials mixed with gum Gheziri are coming into Germany in large quantities, and being sold as "gum in granulo," and that many of the best firms have been deceived.

It is impossible to recognize this imposition by simply dissolving the substance, for the gelatinous particles, being very fine, are suspended in solution and remain invisible; but the adulteration can easily be detected as follows:

Some of the suspected sample is mixed with ten times its weight of hot water, and then allowed to stand for three or four hours, stirring the mixture occasionally. The insoluble matter will settle down, and then about half of the liquid should be poured off, and the same quantity of cold water added to make up the original bulk, which is then stirred and again set to stand, and this repeated twice.

A RED fir tree in Chehalis County, Wash., is 400 feet high, and nearly 54 feet in circumference six feet from the ground.

THE NEW ARMY MAGAZINE RIFLE.

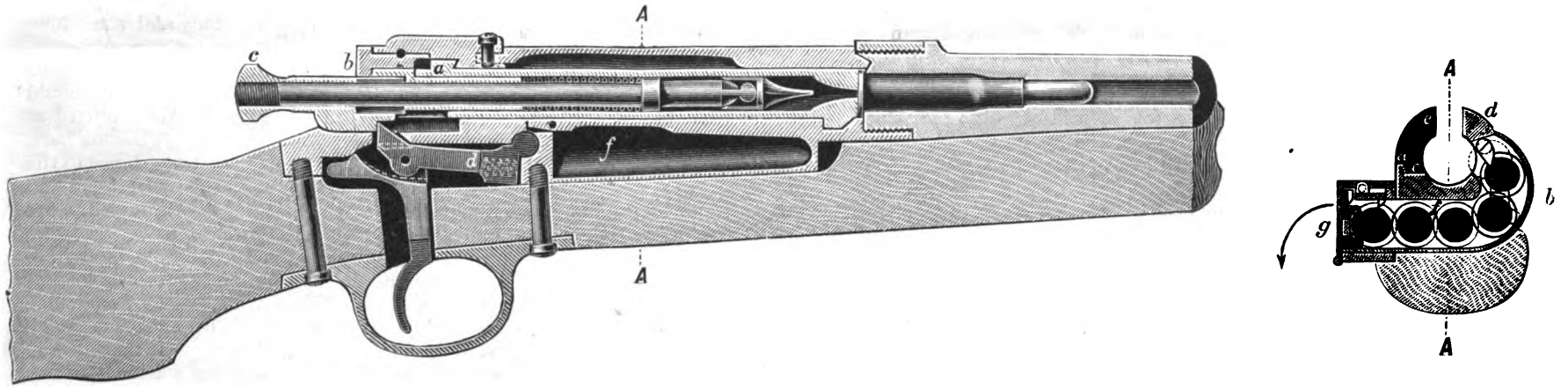
The Springfield rifle, which has been the standard arm of our soldiers for many years, and is undoubtedly one of the best old style single fire pieces ever used in any army, is at last to be superseded by a modern magazine rifle, the details of which have been definitely decided upon. Ever since the conclusion of our war, in 1865, all the European governments have been expending large sums of money in experimenting upon and constantly changing the infantry arm which has been placed in the hands of their soldiers. The needle gun of Prussia aided largely in deciding the conflict of that country with Austria, in 1866, in favor of the former, and its superiority over the French chassepot in 1870 was conceded, but since that time Germany has twice changed her infantry arm. France has also made important changes, finally adopting a perfected Lebel, and a Berthier gun for cavalry service. Austria, after trying different forms of guns, has taken as its standard a Mannlicher rifle and carbine, Belgium has a form of the Mauser, and Great Britain, after most elaborate trials, has adopted in a tentative way what is known as the Lee-Speed gun, very similar to the Lee or Remington magazine gun, which was highly commended by a board of United States navy officers in 1870, and has since been in regular use in the navy.

It has been principally from a just conception of the practical state of the case, and a desire to avoid the expensive errors of the military authorities abroad, that our own army officers have been apparently slow in deciding upon the new rifle with which our soldiers are to be hereafter armed. But the work has now been done, after examinations and trials which seem, as far as the guns submitted for examination are concerned, to be thoroughly exhaustive, and in which nothing has been neglected that the experience of foreign governments could suggest.

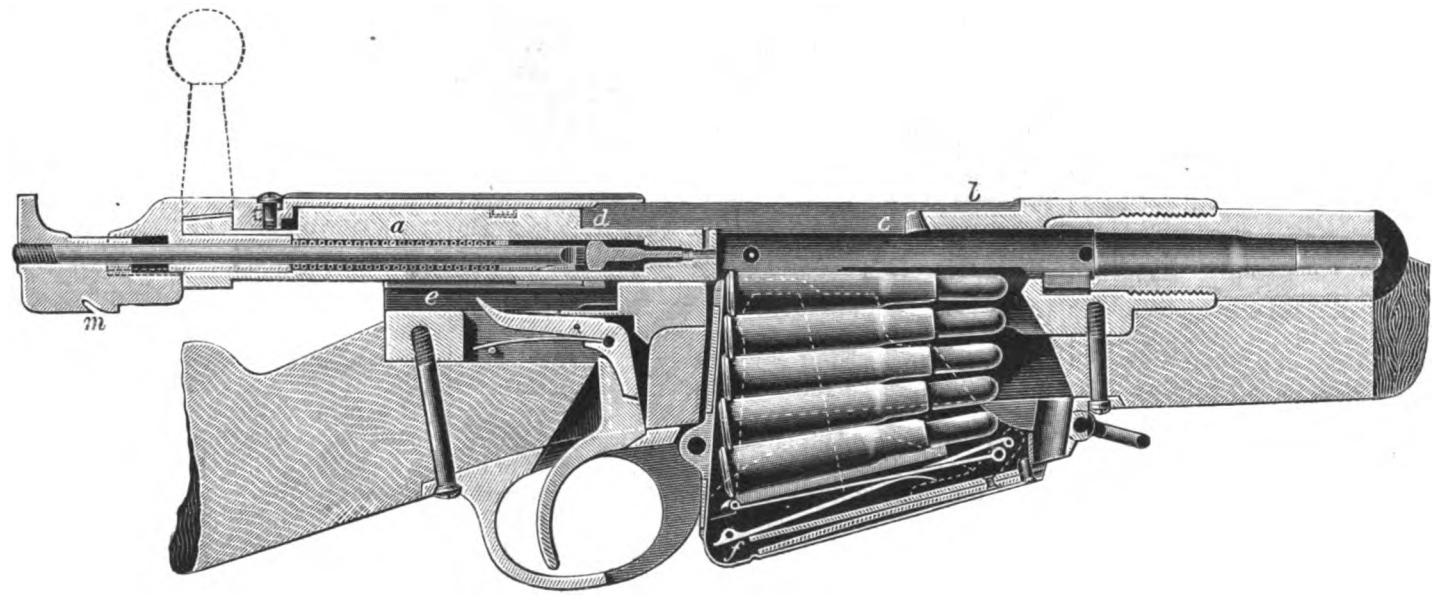
The Board on Magazine Arms, by whom this service has been performed, was constituted by an army order of December 24, 1890, and its report was submitted August 19, 1892, being signed by Lieut.-Col. Robert H. Hall, Sixth Infantry; Lieut.-Col. J. P. Farley, Ord. Dept.; Maj. H. B. Freeman, Sixteenth Infantry; Capt. S. E. Blunt, Ord. Dept.; Capt. Geo. S. Anderson, Sixth Cavalry. Fifty-three guns in all were subjected to trial, including those submitted by American and foreign inventors, and the officially adopted arms of Austria, Belgium, Denmark, England, France (for cavalry), Germany, Japan, Portugal, Roumania, Russia and Switzerland. It was unanimously decided that the gun selected should be an efficient single loader and a rapid magazine arm, holding at will the magazine in reserve, with a cut-off plainly indicating to the officers the class of fire being delivered. The bolt system of breech closure, as developed in the last few years, was also strongly recommended instead of the block system.

The gun finally selected is a modification of what has been heretofore known as the Krag-Jorgensen gun, adopted by Denmark for its army, but the piece has been considerably changed to meet the severe tests required by the board. A longitudinal section of the breech mechanism, with the bolt in the firing position, and showing also the magazine space, is given in our illustration, the small figure being a section of the magazine and receiver. The bolt differs from the Danish gun in the absence of a half-cock notch on the cocking piece and the introduction of a safety lock similar to that on the German and several small arms. The lock is operated by a thumb-piece, *b*, which causes the spindle to turn down into a notch, *a*, in the body of the bolt, locking the firing pin when in the firing position and preventing the opening of the bolt. The form of the thumb of the firing pin and cocking piece is slightly altered. A spiral spring, *d*, is substituted for an original flat sear spring. An ejector, *e*, *f*, is placed in a cut in the bottom of the receiver, a channel in the lower side of the bolt extending nearly to the bolthead, and permitting it to pass freely over the ejector until, in withdrawing the bolt, the head strikes the knob, causing the longer arm of the lever, *f*, to rise, and, with a blow on the cartridge shell, throw it clear of the receiver. The magazine space itself does not, as in the Danish gun, project beyond the left face of the stock, and the gate is hinged horizontally and opens downward, instead of swinging out to the right, as in the Danish gun.

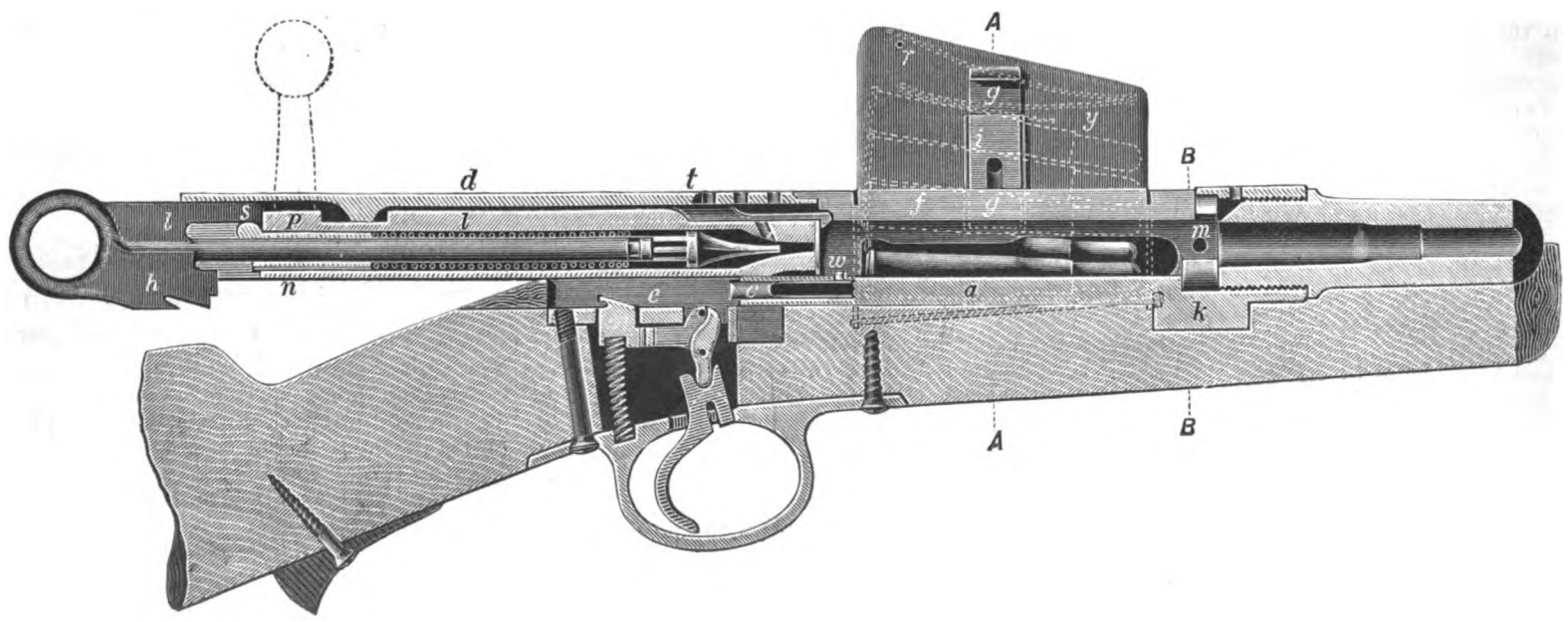
It is difficult to imagine a more trying series of tests than those to which the different arms before the board were subjected, and in all of which the finally selected piece proved its eminent superiority. The gun was first fired twenty shots from the shoulder, magazine loaded, and held in reserve till the last; then as rapidly as possible for two minutes, both as single-loader and as a magazine gun. An endurance test of 500 continuous rounds, without cleaning, followed, both with using the magazine and holding it in reserve. Afterward the piece was exposed in a mechanical dust box to a most severe dusting, and then tested after



THE NEW UNITED STATES SERVICE MAGAZINE RIFLE, ADOPTED AT THE RECENT TRIALS.



THE "BRUCE" MAGAZINE RIFLE.



THE "HAMPDEN" MAGAZINE RIFLE.

simply wiping with the bare hand. Still further tests consisted in thoroughly rusting the breech mechanism, and then firing the arm in this condition, while yet other tests were made by using defective cartridges in the gun, to determine its liability to being permanently disabled from such cause, as occasionally happens in actual service.*

From the first, the board made every possible effort to induce American inventors to enter these competitive trials, desiring especially to secure for the service an arm of distinctively American origin. And it was the general expectation at the outset that American inventors would lead all others in this field, but the guns of home design presented, although containing many highly ingenious features and some special merits of high character, were generally found wanting in the combination of qualities which had been decided upon as the standard. The delay of inventors in presenting their arms caused an undue prolongation of the work of the board, some of the arms tested being withdrawn several times for correction and improvement. There is reason to believe that a knowledge of the rules laid down by the board, and a general understanding of the manner in which these exhaustive tests were conducted, will have the effect of stimulating American inventors to making renewed efforts in this line.

Among the other guns tested by the board which made a remarkably good showing, notwithstanding the severity of the trials, was one presented by the inventor, Mr. L. F. Bruce, of Springfield, Mass., of which we give a sectional view of the breech mechanism, with the action open and magazine full. The left wall serves as a guide and support for the long rib, *a*, of the bolt, and in front the casing, *b*, considerably overhangs the receiver with a helicoidal surface, *c*, which, when the nose, *d*, of the guide rib comes into bearing, cams the bolt around to the right. A channel, *e*, in the tang permits the passage of the cocking piece, *m*. The magazine is a hinged box revolving down and to the rear, and it can be cut off and held in reserve while the gun is used as a single loader.

In the tests of this gun 15 shots were fired as a single loader in 55 seconds, the magazine being then turned on and its five shots fired in 15 seconds. Thirty-six shots were then fired, using the gun as a single loader, in two minutes, 38 shots being fired in two minutes at another trial. As a single loader the fire was more rapid than as a magazine loader. In the endurance trial the bolt worked stiffly as the gun became heated toward the close of each set of 50 shots, and some minor but apparently easily remediable defects were disclosed. The dust test also disclosed some defects, there being difficulty in extracting shells, and the mechanism working stiffly. No injury was done to the piece by the use of defective cartridges, or by excessive charges, but the mechanism always required the exertion of considerable force to operate it.

The "Hampden" arm, shown in section with the action opened in one of the illustrations, is so named in honor of Hampden County, Mass. It was submitted by the inventor, Mr. Thomas B. Wilson, of Springfield, Mass., and showed wonderfully good qualities when subjected to the prescribed tests. The magazine mechanism, including the cut-off, is entirely contained in the cartridge packet, which is placed in a receptacle to the left of and above the receiver. The latter is cut away at the right side, having a straight shoulder, *a*, upon which the long guide and locking rib of the bolt rests when ready for firing.

In the tang is a channel, *e*, for the passage of the nose of the cocking piece, *h*, and the extractor, *d*, has hooks engaging over the body of the bolt and the sleeve assembling the parts of the bolt. In the top of the cartridge packet is a folded leaf spring, *y*, one end secured under a cross bar, *r*, while the other end acts as a follower, the weight of the cartridges assisting the action of the spring. The cut-off, *g*, is a flat piece of spring steel sliding in the socket, *i*. From the position and form of the cartridge packet, by simply using larger packets a greater number than five cartridges can be introduced into the magazine, the number being limited only by the convenience of handling the packets and the amount of projection above the gun.

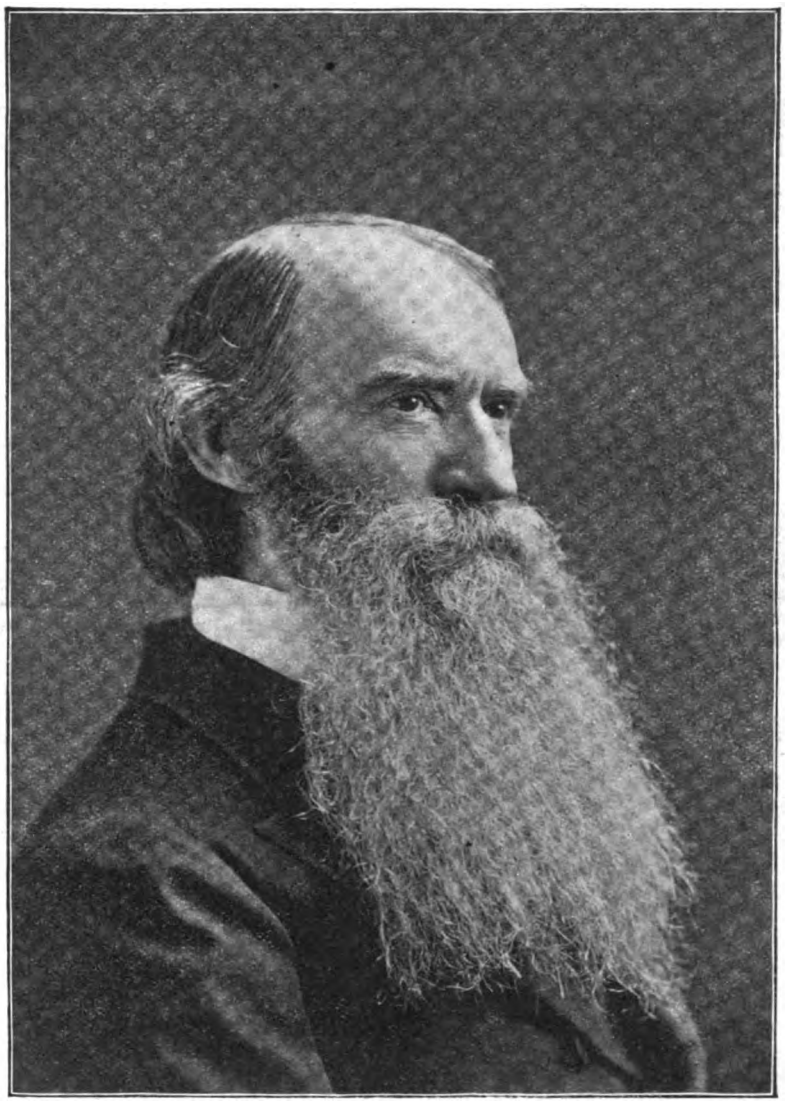
In the first test 15 shots were fired as a single loader in 54 seconds, followed by the 5 shots from the magazine in 15 seconds. Forty-five shots were then fired in two minutes, using the piece as a single loader. In testing the piece for two minutes as a magazine arm, six trials were made, on account of various mishaps, the last trial resulting in 50 shots being made; and in firing from the hip at short range, 30 shots were made and 5 cartridges introduced into the magazine in one minute. Throughout the 500-round endurance test the mechanism worked well, and also as a single loader for 100 rounds. The gun also worked well after both dust tests, with the magazine loaded and empty when exposed, and defective cartridges and excessive charges in no way affected the mechanism, which worked freely and well and to the satisfaction of the board. After rusting the bolt had to be opened with a mallet, and the firing pin was rusted fast, so the gun could not be fired.

The other American guns submitted to the board included one by John H. Blake, of New York City, in which the magazine, lying below the receiver, contains a revolving cylindrical packet holding seven cartridges; a gun by the Chaffee-Reece Arms Co., of Washington, D. C., with a tubular magazine carrying five cartridges in the butt stock; one by M. H. Durst, of Wheatlands, Cal., having a cylindrical ten-cartridge magazine lying directly below the receiver, the cartridges being loaded singly or stripped from a clip as with the Mauser gun; one by Ivert Larsen, of Chicago, with five-cartridge magazine and cut-off; one by J. W. Mullins, of Fariston, Ky., in which the magazine is designed to hold but three cartridges; one by Major W. R. Livermore and Captain A. H. Russell, of the United States army, very similar to the Lee-Speed gun of England; and one by Arthur Savage, of Brooklyn, N. Y., with a magazine adapted to carry nine cartridges.

Before the question of selecting the best breech mechanism was submitted to the board, the War Department had fixed upon 0·30 of an inch as the caliber of the new rifle, instead of 0·45 of an inch, the old standard. It had also settled upon the length of the barrel, the twist of the rifling, the number and form of grooves, and the dimensions of the chamber corresponding to the new cartridge, which will have a bottle-necked shell, and will, when loaded, be 3·09 inches long. The bullet will be 0·309 inch in diameter and weigh 230 grains; it is made of hardened lead incased in a jacket of copper. A charge of 36 grains of smokeless powder is to be used, giving an extreme range of 4,000 yards, or a range of some 1,500 yards with a very flat trajectory. The smokeless powder used on the trials came from Wetteren, Belgium, but we already have a smokeless powder, perfected by officers in the service, which has many superior points, and is thought to be fully equal to any of the smokeless powders heretofore made in Europe.

The report of the board, forwarded to the War Department in September last, approved by the chief of ordnance and the Major-General commanding, has also received the approval of the department, and in November orders were issued for the commencement of work upon this new United States magazine rifle at the gun shop of the Springfield Armory. A great amount of preparation is necessary before it will be possible to turn out the guns rapidly in quantities sufficient to supply the army, much of the present machinery having to be materially changed and considerable new machinery having to be supplied, but this work of preparation is now well under way. It is being energetically pushed under the immediate direction of Captain S. E. Blunt, of the ordnance department of the army, who was the recorder of the board, and who has a national reputation as being one of the most competent officers in the service in all matters pertaining to the manufacture, handling, and use of small arms. It is expected that deliveries of the new arm to the army will commence about June or July, 1893.

* An illustrated description of the manner in which these tests were carried out was published in the SCIENTIFIC AMERICAN of August 22, 1891.



PROF. NEWBERRY.

JOHN STRONG NEWBERRY.

The present year will be long remembered in the history of the National Academy of Sciences by the large number of deaths among its distinguished members. Scarcely had 1892 been ushered into existence when the loss of the venerable Quartermaster-General Montgomery C. Meigs was made known. In quick succession came the announcements that the physicist Lovering and the chemist Sterry Hunt were no more. The botanist Watson and the astronomer Rutherfurd died before the year had reached its fullness. In the early autumn the engineer Trowbridge died, and now, as the year is fast drawing to a close, death claims as its victim one whose genius placed him easily among the very first of our geologists.

John Strong Newberry was born in Windsor, Conn., on December 22, 1822. His ancestry was thoroughly American and his grandfather served with distinction in the revolutionary war, attaining a high rank in the army. At an early age the boy accompanied his parents to Ohio, and, as he grew up, determined to study medicine. Accordingly he entered the Western Reserve College, where he was graduated in 1846, and two years later received his medical diploma at the Cleveland Medical College. This education he supplemented by two years in Europe, where, besides pursuing special studies, he visited the great capitals.

Few men at that period were able to begin a professional career so well equipped in every respect as young Dr. Newberry. The city of Cleveland was, even in those early days, a large place and was beginning to feel the prosperity that came to it in consequence of the building of Western railroads. Perhaps more than any other city in Ohio it was a social center, and in 1851 Dr. Newberry settled there in the practice of medicine. For four years he was active in his profession, but his scientific researches were steadily leading into those branches which subsequently became his life work.

Soon after the discovery of gold in California, the desirability of a transcontinental railway was agitated, and the selection of a suitable route was one of great importance. The national government took an active interest in the matter, and during the years 1853–6 no less than five separate lines of geological reconnoissance were in active operation in different sections of the country west of the Mississippi River. To a young and enthusiastic student of natural history, here was a new and great field to be studied. James D. Dana and Philip T. Tyson had made brief reports on the geology of California, but otherwise it was a *terra incognita*.

Accordingly, in 1855, Dr. Newberry joined the United States army as an assistant surgeon, and in that capacity, but with charge of the geology, he was assigned to the exploring party sent out under command of Lieut. Robert S. Williamson, to examine the country between San Francisco and the Columbia River. He gathered information on the botany, geology, and zoology of the territory visited, and his reports appear in the sixth volume of the "Reports of Explorations and Surveys to ascertain the most Practical and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean, made in 1853–6," which was published in Washington in 1857.

The work proved congenial, and, promptly on finishing his report, he joined the expedition under Lieut. Joseph C. Ives, assigned to the exploration and navigation of the Colorado River. With this party he entered the river at its mouth and ascended the turbulent stream by steamer some five hundred miles, until the entrance of the Grand Cañon was reached, where he spent nearly a year in making researches in the geology and natural history of that territory. His observations formed the most interesting material that was gathered by the expedition, and more than one-half of the "Report upon the Colorado River of the West, explored in 1857–8," issued by the government in 1861, was written by him. It was doubtless the interest aroused by this account that ten years later led Major John W. Powell, now director of the United

States Geological Survey, to make his famous exploration of the great cañons of the Colorado.

When the war broke out he was elected a member of the U. S. Sanitary Commission, and was instrumental in extending the work of the commission throughout the Western States. After the war was over, he was called to fill a chair of geology and paleontology in the then recently established School of Mines of Columbia College, on the duties of which he entered in the autumn of 1866. In this capacity he continued until December, 1890, when a sudden stroke of paralysis compelled him to relinquish work. A year's leave of absence was promptly granted him, but at the expiration of this term he was unable to return, and he was made professor emeritus.

He was appointed paleontologist to the United States geological survey in 1884, and assigned to the charge of certain portions of fossil botany and fishes, concerning which he reported on the "Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and Connecticut Valley" (Washington, 1888), and on "The Paleozoic Fishes of North America" (Washington, 1889). Material on the fossil plants of the cretaceous and tertiary rocks of the far West was for some time in his possession, but had not been sufficiently completed for publication up to the time of his death.

Of honors he had many. In 1867 the degree of LL.D. was bestowed on him by the Western Reserve College, and in 1888 the Geological Society of London conferred upon him its Murchison medal, which was the first time this honor had been bestowed upon an American geologist. It was then well said of him that "He is a geologist after Murchison's own heart—keen of eye, stout of limb, with a due sense of the value of detail, but with a breadth of vision that keeps detail in due subordination."

In his death science loses one of its masters, for he was rich in those accumulated experiences which we call wisdom. Humanity loses a friend, for seldom has a life been spent in more active philanthropy; but his influence cannot die, and will live to

"Reach thro' nature, moulding men."

—M. B.

Draining of Lake Angeline.

Lake Angeline, in the Marquette Range, was a little lake near Ishpeming, Mich. The Cleveland Iron Mining Company and the Lake Superior Iron Company owned together about four-fifths of the area of the lake. The rest was owned by the Pittsburg and Lake Angeline Company. The lake was a beautiful sheet of water nearly a mile long, one-third of a mile wide, and about forty-five feet deep in a number of places. Its average depth was 20 feet. The operations of the mining companies have for some time extended beneath its bed, and it was determined by the mining companies to drain it. Operations were begun last spring, the contract being awarded to C. B. Howell, of this city. The work began with sinking a crib and putting in operation a centrifugal pump, with 20 inch suction and 22 inch discharge, and a capacity of 15,000 to 20,000 gallons per minute. The water was discharged into the Carp River. A few days ago the work was brought to a successful culmination. The lake, of 800,000,000 gallons estimated capacity, was emptied, and a handsome profit is expected as the result of the operation.

A LION AT LARGE.

The accompanying illustration represents an incident which lately occurred in the streets of Bordeaux. A traveling menagerie had taken up its quarters on the Boulevard de Cauderon, on the outskirts of the city near the Parc et Jardin d'Acclimatation, and, during feeding time, one of the lions managed to evade the keepers and escape from his cage. The wild beast tore down the spacious boulevard to the consternation of the passers by, and suddenly turned into a by street. Here he observed, outside a tavern, a sleepy cart horse harnessed to a hay cart, and evidently awaiting the return of its driver from the *estaminet*. Although pursued by his keepers and a crowd of police, the lion at once flew at the horse and fixed his jaws into its neck. The poor beast plunged and kicked, but it was of no avail, and while he neighed piteously the police began firing with their revolvers at the struggling pair. The firing does not seem to have injured the lion, for as soon as he had had his fill of horse flesh he turned to continue his promenade. At this moment a young man proposed to attempt to lasso the beast, and covered by the revolvers of the *gens d'armes*, he made the attempt. After many futile efforts, the noose eventually fell about the neck of the lion, and, being pulled tight by the excited crowd of pursuers, the animal was dragged, half-strangled, back to his den. It was fortunate that the cart horse was the only victim of this unusual excursion.—*Daily Graphic.*

AN ESCAPED LION ATTACKS A DRAY HORSE.

Antiquity of the Saw.

The saw is an instrument of high antiquity, its invention being attributed either to Dædalus or to his nephew Perdix, also called Talos, who, having found the jaw of a serpent and divided a piece of wood with it, was led to imitate the teeth in iron. In a bass-relief published by Winckelmann, Dædalus is represented holding a saw approaching very closely in form to the Egyptian saw. St. Jerome seems clearly to allude to the circular saw, which was probably used, as at present, in cutting veneers. There are also imitations of the use of the center bit, and even in the time of Cicero it was employed by thieves. Pliny mentions the use of the saw in ancient Belgium for cutting white building stone; some of the oolitic and cretaceous rocks are still treated in the same manner, both in that part of the Continent and in the south of England. In this case Pliny must be understood to speak of a proper or toothed saw. The saw without teeth was then used just as it is now by the workers in marble, and the place of teeth was supplied, according to the hardness of the stone, either by emery or by various kinds of sand of inferior hardness. In this manner the ancient artificers were able to cut slabs of the hardest rocks, which consequently were adapted to receive the highest polish, such as granite, porphyry, lapis-lazuli, and amethyst.

Carrying Capacity of Wires.

The safe carrying capacity of a wire is that current which it will convey without becoming painfully warm when grasped in the closed hand. In reference to this it must be remembered, says the *Electrical Age*, that this test cannot safely be made with the wires carrying currents for arc lights, and it is intended to be applied only with reference to the conductors of incandescent lights. These may be handled without risk; but with the conductors of the arc lights, where, as is usually the case, there are a number in series, a severe shock may be experienced on touching the wire, and if a ground connection existed by chance elsewhere, and some other conditions were present by which the full force of the current passed through the body, this shock might be fatal.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

METALLIC TIE.—Andreas Mattijetz, Giddings, Texas. This tie is made of U-shaped channel iron, with inverted U-shaped cross plates secured by their sides to the sides of the channel iron, flanged lugs secured to the cross plates being adapted to engage the bases of the rails to lock them in position on the cross plate, while flanged vertically extending plates are passed through slots in the ends of the channel iron. The tie is designed to be cheaply manufactured and very durable, preventing the spreading of the rails and displacement of the ties, especially on curves.

RAILROAD FROG.—John S. McAdams, Ashland, Pa. A pivoted point is by this invention formed of two rails with an intervening throat piece bolted together and pivoted at the juncture of the switch rails and the rails of the main track, and connected with a pivoted letter, the arrangement being such that a train passing over the frog has a continuous bearing, and jar and noise are avoided. As the wheels have a full bearing, with trains moving in either direction, on the main truck or turn-out, the wear and tear are reduced to a minimum.

ROD STRAIGHTENER.—Patrick McCann, St. Ignace, Mich. This is an improved clamp for straightening metal rods, bars or braces, and more particularly for straightening sliding switch rail rods or braces on railroads. The improvement consists of a screw clamp with attached turning or pressure foot, which can be readily employed by one man, and without removing the rods or braces from the rails, or necessitating any stoppage of trains.

Electrical.

ELECTRIC GAS LIGHTER.—Lucien M. Kilburn, Council Bluffs, Ia., and Scott Van Etten, Omaha, Neb. This invention relates to automatic lighting and extinguishing burners in which an oscillating gas valve in the gas tube is opened and closed by armatures and levers operated by magnets, a sparking device igniting the gas when it is turned on. The improved burner is designed to have greater efficiency, capacity, and certainty than has heretofore been afforded by such burners, while obviating all danger of leakage of gas through the valve and burner.

LIGHTNING ARRESTER.—William R. Garton, Keokuk, Ia. An armature is arranged to slide in a solenoid having at one end a guide rod which receives a flexible conductor, and at the opposite end a carbon rod, while a pair of serrated plates are arranged with their faces near each other, one of the plates being connected with the ground and the other normally in contact with the carbon carried by the armature. A closed chamber, nearly airtight, incloses the upper surface of the lightning arrester plate and the carbon carried by the armature. This improvement is designed to protect all electrical apparatus connected with the lines, and the dynamos and lamps upon the lines.

Mechanical.

WRENCH.—Daniel C. Wiest, Mohrsville, Pa. This is a simple, strong, and durable ratchet wrench, readily adjustable to nuts of various sizes, and which can be conveniently operated. It is provided with improved means for changing the ratchet, so that the wrench may be used either as a right or left hand wrench. It has a revoluble jaw-holding nipple, held to turn in an interior aperture of the wrench head, assisting the action of the jaws.

BOX MACHINE.—Charles W. Roberts, Lawrence, Kan. Box blanks may, by the machine provided by this invention, be rapidly and accurately shaped and held in place until they are fastened by nails or otherwise. Upon a suitable support is a stationary form, below which are vertically movable and pivoted jaws and a pivoted bottom plate, in combination with means for simultaneously operating the bottom plate and jaws. The machine is especially adapted to make berry and other light boxes, such as are usually formed of wood veneers, paper board, etc.

BELT HOLDER.—William F. Cleveland, Rounthwaite, Canada. This is a simple and readily applied device, more especially designed for use on thrashing machines, etc., where driving belts are exposed to the wind, the device holding the belt in proper place and preventing displacement by the wind. The device rises and falls with the ordinary vibration of the belt, thus lessening the friction, and it also serves as a belt tightener.

DIFFERENTIAL HOISTING MACHINE.—Charles F. Cliff, Durham, Canada. In this construction a fixed and a revoluble internal gear wheel are employed, a wheel receiving motion from the fixed wheel and imparting motion to the other wheel, there being two sets of intermediate gearing, with which also the driving shaft is connected. The differential gearing is very simple and compact in construction, and prevents any accidental backward motion of the drum shaft when the drum is heavily loaded.

Agricultural.

CULTIVATOR.—James Birch, North Ontario, Cal. This is a light and durable cultivator for orchard use, provided with a suitable riding frame for the driver. The cultivator frame can be readily raised or lowered while the machine is moving in a straight line or rounding curves, and the various shovels and scrapers employed can be quickly and easily attached to and detached from the cultivator frame. The riding frame may be detached, if desired, and the machine used as an ordinary cultivator.

STUMP PULLER.—Adams C. French, Rapid City, South Dakota. The frame of this device carries an upright shaft, formed with conical large and small cylindrical portions, to which the bore of the main drum is conformed, having at its upper end a tenon-like portion on which is journaled a second drum, above which, on the upright shaft, is journaled a sweep, pins on the sweep being movable into and out of engagement with the main drum or the second drum. In addition to its use in stump pullers, this drum may be used with advantage in derricks and other hoisting machines.

Miscellaneous.

LUMBER DRIER.—John W. Piver, Americus, Ga. A lumber support is arranged in a drying room of a house warmed by a heater, and is composed of an inclined side support and a base support formed of a series of step-like blocks having their upper surfaces approximately at a right angle to the side support, whereby lumber may be piled in an edgewise inclined position, without the use of racks having

separate seats for each row of boards, and without requiring the boards to be set endwise into the pile.

APPARATUS FOR CONDENSING FUMES.—Albert F. Schneider, St. Louis, Mo. This apparatus comprises a cooling chamber having a flue inlet at one end and a discharge at the other end, a perforated horizontal partition near the bottom on which pipes are mounted endwise, spraying nozzles delivering into the chamber, and means for collecting the condensed material beneath the perforated partition. It is designed to condense and collect the fumes, gases and dust of shaft, roasting and reverberatory furnaces, and is especially adapted to furnaces used in silver, lead, gold and copper ore smelting and milling works, and in refineries treating the metal products and by-products.

ACCOUNT KEEPING DEVICE.—William W. Maxwell, Champaign, Ill. This device consists of a number of movable files mounted in a suitable frame, each fly having an index arm, while account sheets made in the form of endless belts are held to turn on the middle portions of the files. The device is designed for use by banks and large mercantile firms, to take the place in a great measure of journal, ledger and balance books, enabling the bookkeeper to make his entries easily and quickly and readily prove the accuracy of his work.

REIN HOLDER.—George W. Thompson, Sag Harbor, N. Y. This device is designed to hold the reins in such a manner that the horse cannot easily throw his tail over them. The device has a base with a recess to receive the hip strap, a wedge-shaped slide being dovetailed into the recess, the outer portion of the slide having a curved horn or guide. By this improvement the reins when slack are prevented from dropping down over the horse's sides. The device is readily fastened to the hip straps of the harness.

HORSE COLLAR.—William Murr, Fountain City, Wis. This collar is designed to preserve its shape at all times, and is adapted to be readily opened and closed at the throat, having a flexible top which serves as a hinge to conveniently swing the sides apart. The stuffed sides of the collar have each a plug fastened in their lower ends, the inner ends of the plugs being beveled and curved rods secured flatwise upon them and extending upward in the middle of the stuffing.

SHAFT TUG.—John A. Lesh, Markelsville, Pa. An inner loop is fitted and movable in the main loop of this tug, there being side guides in the main loop alongside the inner loop and a connecting piece at the bottom extending through the inner loop. This construction prevents any twisting of the inner loop and relieves both loops of wear, while the back strap may be connected with the main loop without forming any protuberance at the back of the latter.

SNAP HOOK.—Samuel Brown, Quincy, Ohio. The hook proper, according to this invention, has a bifurcated nose portion, within which is pivoted and works a hook-shaped latch, also provided with a closing nose piece and backwardly extended saddle-like projection having a snapping or catching lip for engagement with the shank of the hook proper. The improvement dispenses with a spring for closing the latch, and there is no liability of the snap hook being opened either by its own play or movement or that of the usual ring or fastening held by it.

ROAD CART.—Alexander D. Curry, Istachatta, Fla. This invention provides a connection between the axle and thills, which permits the thills to rock without communicating any of the motion to the axle or the rigid portion of the connection, providing also a novel form of supports which can be quickly and easily adjusted. The construction affords a cheap and simple easy running cart, designed to entirely avoid horse motion.

FENCE POST AND HOLDER.—George W. Schofield, Jacksonville, Ill. The holder is tubular, preferably of earthenware, and with a base flange forming a support for a metal post, having a two-part lower end, both extremities of which project outward in opposite directions under the lower edge of the holder. The improvement is designed to afford a post of great strength and stability, especially adapted for corner or end posts, on which the pull or strain comes when tightening up the wires of wire fences.

COLLAR BUTTON.—David O. Parks, Denver, Col. Two spaced disks are connected together by a shank, a collar-receiving stud projecting from the outer disk, to which disk is hinged a plate adapted to be swung up in front of the stud to hold a collar on. It is a simple form of button, easily attached to the neck band, and not readily pushed or pulled out, by means of which the collar may be readily secured in place without pushing a button through the button holes of the collar.

LAMP HANGER.—George Albee, Susquehanna, Pa. This is a simple device for suspending electric lamps or lanterns, to be manipulated by a suspension rope. It comprises a pulley block, with a suspension loop pivoted upon and depending from the axis of the pulley, a lamp-supporting hook engaging the lower end of the loop, in connection with a releasing lever pivoted on the shank of the hook and an operating cord or cable.

DENTAL PLUGGER.—Henry R. Kline, Ashtabula, Ohio. The hammer tube of this device has the usual hammer and pneumatic connections, and there are projecting stay rings secured to the hammer tube, a tubular socket sliding in the stay rings and having shoulders to engage them, in connection with a fastening device to fix the plugger in the socket. The device is adapted to hold any of the usual hand pluggers, and is so constructed that the air tube cannot accidentally close to interfere with the working of the hammer. It has a pair of air bulbs, so that sufficient force may be given to the hammer by a slight pressure of the foot.

DENTAL SEPARATOR.—Benjamin Simons, Charleston, S. C. This is a device for forcibly separating two adjacent teeth to give access to cavities difficult to reach. It consists of two pairs of gripping claws to clutch the adjacent teeth to be separated, and two right and left screw shafts geared together by cog wheels, the shafts being tapped through the shanks of the claws, and when rotated forcibly separating the teeth.

GAME BOARD.—John S. Williams, Trenton, N. J. This board has three circular walls connected by straight walls, the circular walls each having an inward opening on the common inclosure. The game is played with white and black marbles, put together in one circle, and to be separated and rolled into the other two circles, the white marbles into one and the black ones into the other, by simply tipping the board, without touching the marbles.

DISINFECTING DEVICE.—John W. Bowerbank, Jersey City, N. J. A receptacle is provided with a depending metallic drip tube and inner rubber lining tube, the metallic tube being compressed transversely, thereby compressing the rubber tube and forming its bore into a narrow slit through which the liquid is adapted to drip. The device is inexpensive and designed to exactly control the dropping escape of the fluid to places where contagious exhalations may escape.

DESIGN FOR BICYCLER'S BAG.—Stephen B. Gilhuly, Long Branch, N. J. This bag has the form of a truncated scalene triangle, the wide and narrow ends being parallel, and the angle of the lower edge being considerably greater than that of the upper edge, while all the lines are straight.

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(4626) M. asks: 1. Does the Mississippi River run up hill, as it is said that its mouth is three miles higher than its source? A. Water never runs up hill. The Mississippi a thousand miles from its mouth is about 300 feet above the sea level for the difference of the two latitudes. The spheroidal form of the sea level is fixed by gravity, and all water above that level gravitates toward the sea or down hill, although it may be running farther from the earth's center. 2. If the earth in going around the sun in its orbit makes one day in a year without turning, how many times does it turn on its axis to make 365 days? A. The days, as ordinarily reckoned, are solar days of 365¼ in 1 year, but 366¼ revolutions on its axis. 3. If you increase the speed of the crosshead of an engine so that it is no longer on the point where it changes its direction than it would have been if it had not changed, does it stop any more in one case than in the other? A. Reciprocating motion stops at the end of the stroke, under any possible speed. 4. As it is farther over a half circle than across the base, why does it not take more board to make a tight fence over than across? A. If the boards are vertical, the chord or straight line is at right angles to their edges, and their width is their measure. While on the vertical curve the measure is at an angle equal to the angle of the curve, which is greater than the chord measure. This is readily demonstrated by a diagram. 5. When the earth cooled down wasn't the climate tropical at the poles a long time before it became frigid? A. The polar regions are supposed to have been tropical in the early geological ages, when the sea was warm and rain prevailed at the poles, or possibly the polar axis may have gradually changed its position.

(4627) F. K. W. writes: Suppose that to a car having four wheels we apply four brake shoes, but not with pressure enough to slide any wheel. Also to another car of same kind under same conditions we apply two shoes, with force enough to slide two wheels dead. Which will stop quicker? Will not the car with wheels sliding be stopped just as quick as the distance covered by the inertia of the car's motion? In other words, two wheels running loose against two locked, the loose wheels will have no propelling power, will they? A. The car with the four brakes will stop the car quicker. There is less friction in a sliding wheel than with a rolling wheel held by a brake, up to near its sliding resistance. The relation of the momentum of the car and the sliding friction of its wheels is an uncertain amount, depending upon the condition of the surface of the track and wheels.

(4628) S. A. D.—Luminous paint can be applied to cardboard without any previous preparation. SUPPLEMENT No. 497 contains an article on luminous paint.

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