SCIENTIFIC AMERICAN

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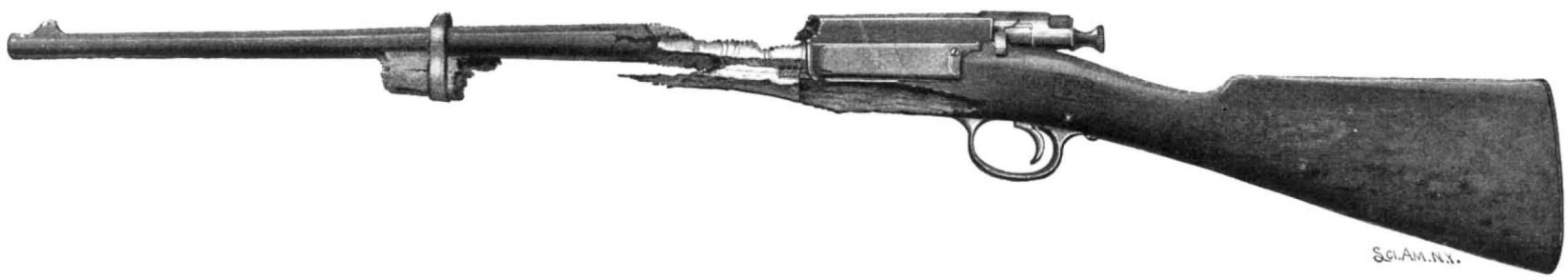
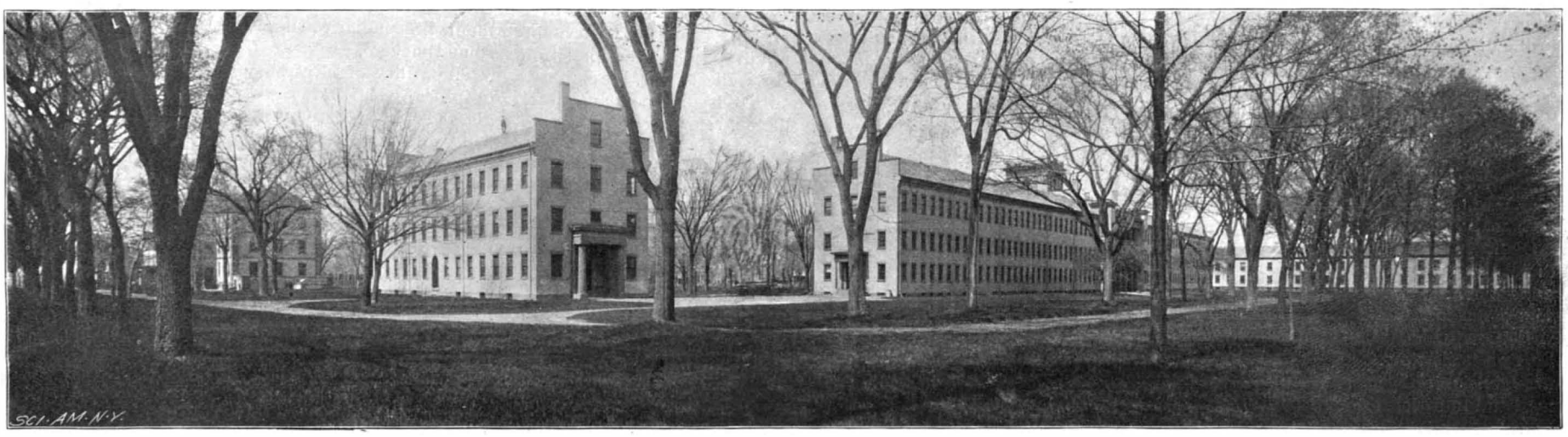
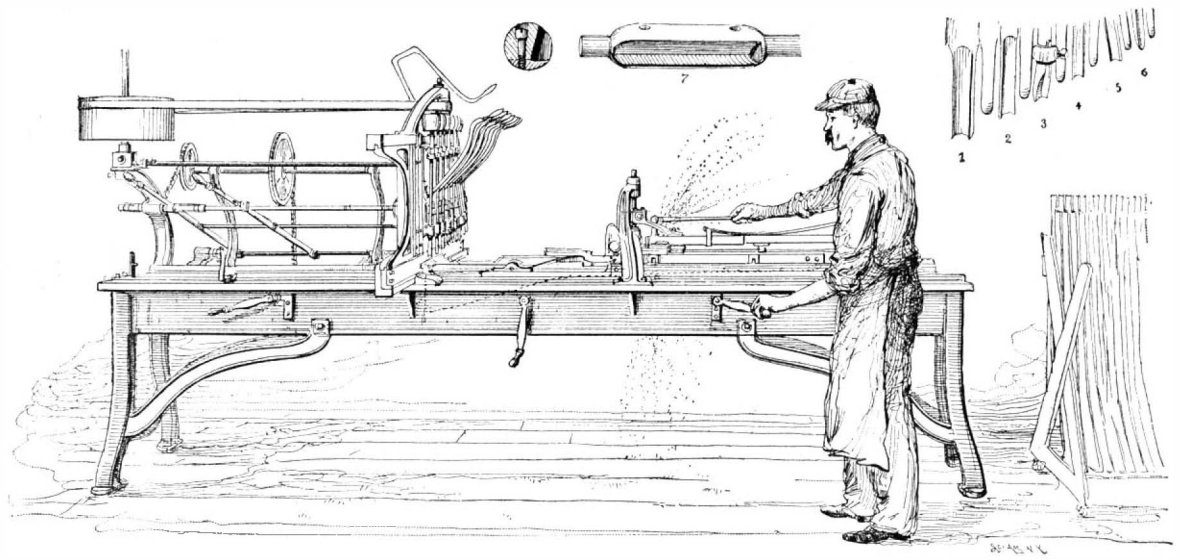


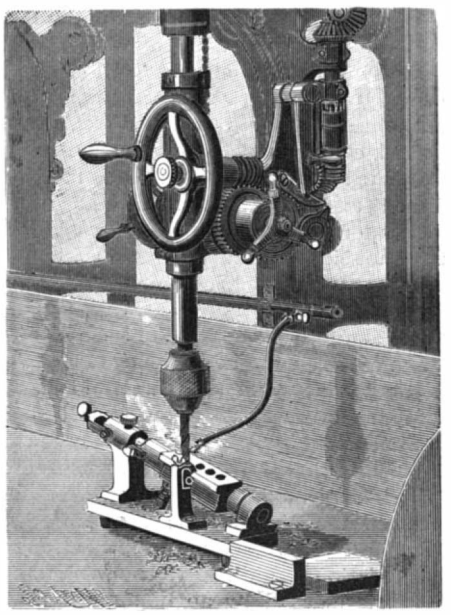
1.—Krag-Jorgensen Rifle Tested to Destruction—Chamber Pressure, 100,000 Pounds.



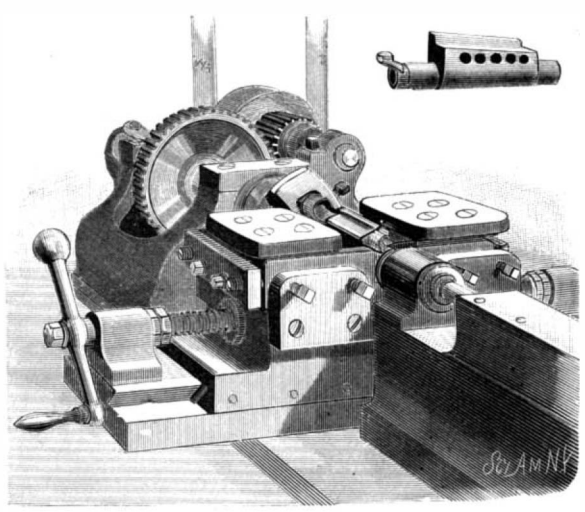
2.—Armory Square, Including Arsenals, Offices, and the Old Shops.



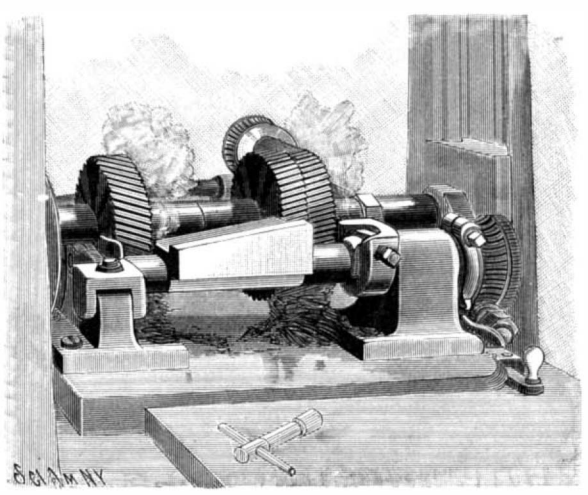
3.—Barrel-bedding Machine—Grooving the Stock to Receive Barrel.



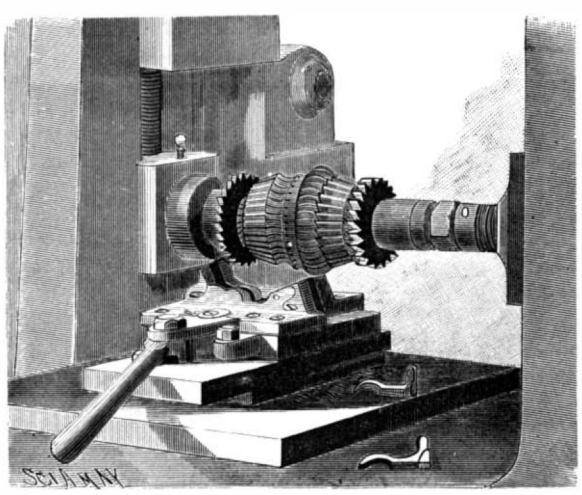
4.—Semi-automatic Drilling of Magazine Holes in Receiver.



5.—Clamp-milling Cylindrical Ends of Receiver.



6.—Milling Cylindrical Surfaces of Receiver and Facing Ends of Magazine.



7.—Milling Perimeter of Triggers.

MANUFACTURE OF KRAG-JORGENSEN RIFLES AT THE SPRINGFIELD ARSENAL.—II.—[See page 330.]

Scientific American.

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NEW YORK, SATURDAY, MAY 20, 1899.

"MAGAZINE SCIENCE."

The liquid air controversy—if controversy it can be called, the storm of criticism awakened by the offending article bearing entirely in one direction, though with varying strength—has produced some of the most lucid and every way admirable articles that have appeared for many months in the technical press.

The immediate and wholesale and wholesome way in which the new-born heresies were scented out, run to earth and slaughtered, is very significant, for it shows what a complete mastery science has obtained in the domain of reason, and with what jealous care she guards her own. This policing of the highways and byways of scientific thought is one of the prime obligations imposed upon scientific journalism, which not only pledges itself to keep its reading columns absolutely free from matter that savors of the "fake," or that cannot stand on its own merits, but it is forever bound to detect and expose such matter, if by any mischance it should force an entrance.

One of the most trenchant articles, traceable indirectly to the liquid air discussion, that has come under our notice, appears in a recent issue of "The Locomotive," under the title "Magazine Science." The writer is of the opinion that all science may be divided into "science that *is* so and science that *isn't* so," the first division appearing in treatises written by eminent men and in articles that appear in high class scientific journals, while "beautiful examples of the kind of science that *isn't* so" can be found in newspapers and many "popular" books. The writers of these books think that "that mythical individual, 'the average man,' cannot understand the real facts of nature, and they appear to think it necessary to tone down those facts and smooth them off and fix them up and elucidate them by 'popularized illustrations' that are more or less inaccurate, until their books, when they are completed, contain much of the second kind of science, that is, much of the science that *isn't* so." To these two broad classes the writer in "The Locomotive" would add an intermediate division, or sub-class, "so as to include the science that is *almost* so, but *not quite*." For science of this kind the name "Magazine Science" is proposed, and it is stated that while magazine science may degenerate into the kind of science that is *not* so, it seldom rises so as to be in the class that *is* so.

We think that while the three-fold classification of scientific literature given above is well made, a broad distinction should be recognized between the purveyor of science that is *not so*, as represented by the "yellow" element of the daily press, and he who prints magazine science that is *almost* but *not quite* so. For the first sins by intention, and fairly revels in its exaggerations and distortions of the truth, whereas the latter is marked by an honest intention to state the facts and only fails through ignorance or incompetence, or an underestimate of the ability of the lay reader to follow a line of simple scientific description.

The average daily press reporter (there are a few gentlemen engaged on certain high class daily journals to be excepted) approaches a scientific subject caring very little whether his dishing up of science belongs to the *is so* or *not so* class, provided it is sufficiently lurid and sensational, and amenable to the artistic requirements of "scare head" type and the broad blotches of ink which answer for the illustration end of yellow journalism. To him science is nothing if it is not sensational; it is indeed a vast and fruitful hunting ground where game of the "three to ten" variety is the object of his diligent and only too successful quest. The idea of investigating a scientific subject for the purpose of separating the true from the false, and giving the public the facts for which they pay, is so subversive of the first principles of yellow journalism as to be to its average reporter absolutely unthinkable.

It is undoubtedly true, speaking of magazine science, that in the attempt to "write down" technical and scientific subjects to the level of the average lay reader, many magazine contributors are led into phraseology and symbolism that is needlessly puerile, and derogatory to the dignity of the subject. But we must remember that in all journalism there is nothing more difficult than this art of expressing scientific fact and reasoning in the simple terms and objects of everyday life. Tyndall could do it, witness his "Heat considered as a Mode of Motion," while Huxley was and is without a peer in this respect; and though it is hopeless, and may be disastrous, for the average scientific writer to attempt the kindergarten style which "The Locomotive" condemns, we believe it should be the aim of all writers of popular science to state abstract truth or explain intricate processes or constructions in the very simplest terms and sentences with which their knowledge of the Anglo Saxon language can supply them.

THE ELECTRICAL EXHIBITION.

The exhibition opened at Madison Square Garden, in this city, on Monday evening, May 8, 1899, under the auspices of the National Electric Light Association. The association also holds its annual convention this year at the same place, during the present month.

On the opening night several exhibits were not in place, but there was enough to interest the visitor. Governor Roosevelt opened the exhibition by sending a signal over a special Postal Telegraph wire from Albany, New York, telegraphing also a congratulatory message. President McKinley also sent a similar message. These were read by Senator Chauncey M. Depew, and were followed by his opening address, given in his usual entertaining way. He alluded to the progress made in wireless telegraphy during the past year, predicting that the time would probably come when ocean liners would have the news of the day telegraphed to them each day while on their voyage over the Atlantic, or they could report at once to their home office any accident that might occur. The possibilities in this line were endless. Electricity, he claimed, did everything for us, and dwelt particularly on its use in the practice of medicine, referring especially to the Roentgen discovery.

He contrasted the way the news was communicated during the Revolution with the rapidity of the way it was received during the Spanish-American war; how the news of Dewey's great victory was flashed to the United States 6,000 miles away before the smoke of the guns in Manila Harbor had disappeared. He described the advances made in the use of electricity for transportation purposes, how rapidly it was supplanting the horse, cable and even steam power, and remarked that in previous years he had walked to these exhibitions, but on this night he was brought there by an electric automobile.

Electric vehicles form the leading feature of the exhibition, and occupy about half the floor space. There are three Western exhibitors against two Eastern, and the styles vary somewhat, those of the Eastern exhibitors being rather more solid and symmetrical in appearance.

The single-seated runabout, for two persons, is the most popular style. Next is the "Stanhope," for physicians, provided with a collapsible top. Ladies' runabouts are also a new style, and two-seated traps and surreys for four persons, of neat and light construction, may be seen, while the electric coupe is a handsome and serviceable vehicle. Delivery wagons are also conspicuous for their solidity and compactness, and one exhibitor shows an electric emergency wagon, designed similar to fire patrol wagons, but for use in an emergency in case of an accident on a trolley road.

In the heavy vehicles, power from the electric motors is applied to concentric gear wheels attached to the spokes of the wheels, but in the lighter grades large gear wheels, keyed to the driving shaft, are used, protected by a light metal casing.

The claims of the different makers, as to how far the vehicles will travel on one charge of the storage battery, vary from twenty-five to sixty-five miles, according to the character of the roads. Little is said as to construction and care of the battery, each manufacturer claiming a specialty of his own in that respect. Each vehicle is equipped with the usual controller, brake, and electrical measuring instruments, one style being supplied with a recording meter, for registering the quantity of current used. All of the vehicles are as handsomely finished as any horse vehicle.

Next in importance is the exhibit of the Ball & Wood Company at the further end of the room, where there is erected in operation a compact 300 horse power duplex compound non-condensing engine for driving two direct-connected generators. A smaller type of engine with generator also adjoins it; both run remarkably quiet and uniformly. Near this exhibit at the east end of the hall is an interesting show of electrical heating and cooking appliances in great variety, and a separate exhibit of an electric incubator by the Bausch & Lomb Company. On a small electrically heated sand bath was an egg covered by a glass cover having an aperture about half an inch square cut through the shell. Within could be seen the shape of the young chicken which should come to life in about three days. The remarkably unvarying degree of heat obtained by an electric current of uniform potential provides a perfect means for successful egg hatching. The New York Telephone Company have an exhibit of standard telephone equipments, and near their stand, close to the main entrance, is an exhibit of the application of electric motors by direct connection to various kinds of machinery, such as lathes and grinding wheels, by the Bullock Electric Motor Company, of Cincinnati, O., and the Niles Tool Works of the same State. Near this entrance the College of Electrical Engineering has a booth where novel electrical experiments are carried on. There are several exhibits of electric incandescent and arc lamps, also of insulated wires and conduits.

In the north gallery is an interesting exhibit of a field telegraph and signaling apparatus, also heliograph instruments, installed by the United States Signal Corps of the War Department. The searchlight from the destroyed Spanish cruiser "Vizcaya" is also on exhibition, and a few other relics. Prof. Henry's original electrical apparatus, loaned by the Smithsonian Institution, is also to be seen. The United States Weather Bureau exhibits a full line of meteorological instruments. Not far from this is a historical group of electric arc lights, showing the numerous improvements from 1854 to the present time.

In the south gallery is an example of wireless telegraphy; a transmitter rests on one end of a sheet of glass about twelve feet long, and the receiver at the other end with a set of dry batteries for operating a tape-recording receiver placed in a local circuit. A large sheet of copper resting on the glass and located at one edge of each instrument and connected thereto by a single wire collects the electrical waves, which travel over the glass to the opposite end. The instruments are similar to those illustrated in these columns some time ago.

The utility of electricity as an aid to the diver is graphically shown in the south basement, where a large glass-faced tank is erected, filled with water in which fishes and turtles swim about. A woman diver dons the usual costume, heavily weighted with lead, and descends beneath the surface. She takes up and pets turtles swimming about; shows how the life line is manipulated, uses an electric hand searchlight for finding property, and communicates to friends on the surface by a telephone in the helmet. Messages were quickly sent, she writing them on a slate held in her hands under water, which she would turn outward for the audience to see. It is a very useful object lesson on the art and appliances of the diver. There is also on exhibition in this basement, an X ray apparatus. The middle basement has been decorated to appear like a grotto, and the north basement is devoted to a display of the application of electricity for the illumination of theater stages and light effects.

There is to be on exhibition a radiophone and a picture telegraph apparatus. While the exhibition is not as comprehensive and varied as it might be, there is still enough in a general way and in particular lines to make it of special interest to visitors.

LOSS OF SPEED IN WARSHIPS.

The almost universal practice of crediting warships with a rate of speed based upon their trial performances is extremely misleading, at least for the general public. The contractors who build the ships and the professional men into whose care they are handed over know perfectly well that the trial trip is a "grand stand" performance, carried out under specially favorable conditions, which, in the nature of things, can never be repeated during the lifetime of the ship. Some writers upon naval affairs have boldly acted upon this conviction, and always credit warships with a speed from two to three knots lower than they made on trial.

This loss of speed is not confined to any one navy. It is noticeable in greater or less degree in the navies of Europe; it has occurred in our own. We all remember the trip of the commerce-destroyer "Columbia" across the Atlantic in the summer of 1895, in which the Navy Department determined to ascertain what speed this vessel could maintain continuously and what likelihood there would be of her being able to overtake the fastest ocean liners of the day. It took the "Columbia" a fraction under seven days to make the trip at an average speed of 18·41 knots per hour under natural draught; yet the rated speed of this vessel under forced draught is 22·8 knots, or about 4½ knots higher than this average. She was to have completed the journey under forced draught, but was unable to bring the coal to the furnaces fast enough to maintain the necessary steam pressure.

In the running fight at Santiago the average speed for the 40 miles covered was from 12 to 13 knots per hour, and yet the trial speeds of the ships that followed up the "Christobal Colon" were for the "Brooklyn" 22 knots, for the "Oregon" 16·8 knots, and for the "Texas" 17·8 knots. The "Brooklyn," it is true, had only half her engines coupled up, but the "Oregon" and the "Texas" had everything going full blast, and neither ship had been out of dry dock more than three or four months. Here we have a falling off in the "Oregon" of 4 knots, and in the "Texas" of 5 knots in speed, and this in just the very kind of emergency for which forced draught in warships was designed.

The same loss of speed was shown in a forced draught trial which took place on April 24 among the ships of

the squadron that has lately returned from southern waters. It was known two days beforehand that the trial would occur and that it would be made under full power and would last for four hours. The fastest speed was made by the "New York," the slowest by the "Texas." The original trial speeds and the speeds made on this occasion are as follows: "New York," rated 21 knots, speed 19·2; "Brooklyn," rated 22 knots, speed 17 knots; "Massachusetts," rated 16·2, speed 14·8; "Indiana," rated 15·5, speed 14·0; "Texas," rated 17·8, speed 12·2. The falling off is therefore as follows: "Texas," 5·6 knots; "Brooklyn," 5 knots; "New York," 1·8 knots; "Indiana," 1·5 knots; and "Massachusetts," 1·4 knots. The best performance was that of the "New York" (always a most consistent vessel), for she had been eight months out of dry dock, longer, indeed, than any other ship, and her bottom was necessarily foul. The poor showing of the "Brooklyn" is attributed in part to an exceptionally foul bottom, due to six months' service, and to recent changes in the engine and boiler room force, though it is hard to understand how these causes alone could account for the woeful disparity between the speeds of 22 and 17 knots. Of the battleships, the "Indiana," which had not visited a dry dock for seven months, made a better showing than the "Massachusetts," which had left the dry dock only one month before the trial took place. It is stated, moreover, that the "Indiana" was able to use forced draught in only one of her boilers. It is claimed that the poor showing of the "Texas" was due in part to an accident to her machinery.

Now it is evident that the loss of speed in warships must be due to general causes which affect every vessel, irrespective of its style or nationality. The instances which we have quoted in our own navy can be duplicated in any other; and although in her latest ships England has very wisely adopted the natural draught speed as the rated speed, her older ships do not pretend to reach in service the speed attained on forced draught trials. The forced draught trial speed is fictitious, as we have said, for many reasons. In the first place, the conditions of the trial are unnatural and in the nature of things impossible of repetition. The contractors are allowed to select the very best steam coal and place a gang of picked and experienced stokers at the furnaces. The coal is always carefully screened and selected of such a size as will give the very best steaming results. Under service conditions, the coal is frequently inferior stuff, certainly not to be compared with the selected fuel of the trial trip; and the engine and boiler room force is continually subject to change, men familiar with the engines and boilers leaving and new men having to be broken in to their duties. Thus differences in coal and crew may easily account for a loss of from a knot to a knot and a half of speed.

Again, it is a well known fact that warships grow heavier as they grow older. Numerous improvements are made from time to time, which usually involve the addition of weight in smaller or larger amounts, the draught of the ship growing greater year by year. Auxiliary engines are added within and heavy bilge keels are attached without the ship. Old slow-fire guns are replaced by longer and heavier rapid-fire pieces, and this again involves a proportionate increase in the ammunition supply. The personal belongings of the officers and crew tend to increase rather than diminish in weight; so do the stores; and as for coal supply, it is an easy matter when preparing for a long cruise to cram into the bunkers, by "close stowage," a few hundred tons more coal than the ship carried on the trial trip.

Of course, the most active cause of reduction of speed is the marine growths which, especially when a ship is in tropical waters, soon cover the submerged hull. This alone may be answerable for the loss of two knots of a vessel's speed, and coupled with the causes already referred to will explain the great disparity between the speed of our ships as set down in the official tables and as actually accomplished under service conditions. The surest way to maintain some parity between the trial and the service speed is to run the trial trips under natural draught with the ordinary commercial coal as used under service conditions, and to sheathe and copper all the warships of 2,000 tons displacement and upward. We would then be no longer in the false position of having our vessels rated at speeds which are from two to four knots greater than they can accomplish in actual service.

POTASSIUM CHLOROPLATINITE.

A NEW AND SIMPLE METHOD OF PREPARATION.

Photographers who use large quantities of chloride of gold have long been in the habit of preparing it for themselves; and now that platinum printing and platinum toning involves the use of large quantities of a platinite salt, they would prepare it too, but that hitherto the process has been sufficiently complicated to be beyond their power.

In a recent issue of the Bulletin of the Chemical Society of France, M. Vèzes described a process so simple that it will be within the capacity of any one.

Platinic chloride, $PtCl_4$, is as easily made as the ordinary "chloride of gold," by simply dissolving spongy or scrap platinum in aqua regia, and evaporating to dryness by a gentle heat. To convert the platinic into the platinite salt, to remove the extra two atoms of chlorine, Mr. Vèzes adds to a quantity of water, considerably more than it can dissolve, even at the boiling point, of platinic chloride, and to the mixture, molecule for molecule, of neutral potassium oxalate, about 37 grains of the crystallized oxalate for each 100 grains of the platinic chloride. When heated to the boiling point, the oxalate reacts on the dissolved part of the platinic salts; carbonic acid is evolved, and the solution from a yellow changes to a bright red. The undissolved platinic salt then begins to dissolve, and if the temperature be kept up, will altogether disappear, leaving the solution a deep bright red.

The solution is now set aside, and if the evaporation has been sufficient, crystals of potassium chloroplatinite, to the amount of 80 per cent of the theoretical quantity, will be deposited; while the addition of alcohol to the mother liquor will precipitate the rest.

THE PROPOSED UNIVERSAL DAY.

BY LIEUT. R. SCALLAN, R.A.

If the government of the United States will but ratify the conclusions arrived at in Washington some thirteen years ago, it is possible that the 1st of January, 1901, will witness not only the dawn of a new century, but also the inauguration of what has come to be known as the "universal day."

This question of a common method of reckoning time is of very old standing. Sir John Herschel, the celebrated astronomer, advocated the proposition strongly in his time, and pointed out the advantages arising from such a course, as well as the defects of the astronomical or sidereal system, but no government was found bold enough to uphold the scheme in the face of the opposition of other nations, and until the present time, there has been no prospect of unanimity on the subject. The confusion and inconvenience resulting from the disparity in time all over the country was recognized by the President of the United States as far back as 1884, when he invited the civilized governments of the world to send representatives to an international conference at Washington, to devise means and ways for the rectification of the existing difficulty. After a lengthy discussion, the twenty-five representatives who attended in response to the invitation adopted seven resolutions in all, practically unanimously, most of which have since borne fruit. The first three related to the now established method of computing latitude and longitude, and the adoption of the Greenwich longitude as a prime meridian. The remainder were concerned in the unification of time, especially at sea, and the creation of a "universal day."

Naturally, the unification of time is more important to mariners than to landsmen, as the intricacies of astronomical time, as laid down by the "Nautical Almanacs" or Ephemerides of the world, are a constant source of trouble to the captains and others who take observations at sea. Still, landsmen who have dealings and telegraphic correspondence with many countries are often very much "at sea" in consequence of the disparity in the time of day over the universe.

The present agitation is designed to effect a remedy for this objectionable state of things, by establishing a common day everywhere, not necessarily to interfere with the local standard time, but to facilitate communication on land, and calculation on the ocean. On land, for instance, in drawing up time-tables, railway companies have had to make allowances for over seventy differences of time between New York and San Francisco. The Washington conferees thought that the best plan would be to take the mean solar day, or civil time of Greenwich Observatory, in England, and make it the time of the world. The hours also should be altered to the Italian fashion, and run from zero to twenty-four, so that the confusion arising from the use of the terms A.M. and P.M. might be abolished. The majority of astronomers and practically all master-mariners have indorsed the proposal, but with the stipulation that such a change should only be made at a notable epoch of time; hence it is suggested that the first day of the twentieth century would be most suitable for the inauguration of the scheme.

The Royal Society of Canada is now endeavoring to revive the proposal in the interests of the maritime world, and has solicited the opinions of the various nations who publish Ephemerides. The reason for the seeming haste is that these publications, notably the "Nautical Almanac," which is under the supervision of the British Lords of the Admiralty, are usually got up for the press some three or four years in advance, so that it is high time to come to some definite decision if the almanacs of 1901 are to be altered. There are nine countries in all that issue Ephemerides, and of these the United States and Great Britain are the most influential. Of these nine, six governments have expressed their approval of the universal day scheme in unqualified terms. They are: Austria, Brazil, France, Great Britain, Mexico and Spain. The Lords Commissioners of the Admiralty in England have formally consented to the change if unanimity can be obtained, promising also the support of the British government. Germany and Portugal have not yet given a definite reply, but it is believed that the sentiments of the authorities of these countries are favorable to the plan.

Our own government, however, has furnished a great surprise in this matter, as in 1896 a rather adverse response was sent to the Canadians. President McKinley may now regard the matter in a more kindly light, and bestow his approval on what was undoubtedly an American idea originally. With the change would be destroyed the romance surrounding the sidereal day. No longer will the facetious journalist puzzle the uninitiated by declaring that he can publish accounts of events occurring in Europe "actually hours before they happen, sir!" and that delightful tale of how Phileas Fogg won his wager to the very minute in "Round the World in Eighty Days" will be relegated to the musty shelves of oblivion as a relic of barbarous antiquity.

THE GATHMANN SHELL TESTED.

The first of the two experiments with the new Gathmann shell took place at Sandy Hook on May 9, in the presence of ordnance officers of the army and navy. The Gathmann shell employs for its bursting charge guncotton in the place of powder, which had not always been satisfactory. Sometimes there is not sufficient gas generated by powder to burst the projectile, and this is particularly true in armor-piercing shells. The great danger from the use of guncotton in shells is premature explosion. The inventor, Mr. Gathmann, believes that his projectile will not explode inside the gun and that it will not explode prematurely on loading it, and that the wet guncotton will only explode by detonation. The chief recommendation of the shell was that it could stand the use of smokeless powder as a propellant. In the experiment an old 15-inch Rodman gun was taken to the beach and a very heavy charge of smokeless powder was placed in it; then a 15-inch Gathmann shell containing 82 pounds of wet guncotton was put in place. The gun was then taken to a hole twenty feet deep which had been dug in the beach and was lowered to the bottom, lying horizontally. An electrical fuse was attached and the bore of the gun filled up with sand and stone to increase the strain of the explosion on the shell. The officers and interested parties got out of danger and the gun was fired. It was shattered with the force of the explosion, which blew out a cavity in the beach 30 feet deep and 25 feet in diameter.

The work of digging for the shell was very severe, owing to the peculiar nature of the sand. The remnants which were found are satisfactory to Mr. Gathmann and his associates. The guncotton had been driven into the sand with such force that it was almost pulverized and, as it was recovered, seemed to consist of about as much sand as guncotton. The breech end of the gun had been shattered and was found in small pieces for a space of 16 feet. The base part of the bronze shell was also found much broken in the breech end of the gun. It was bright on the inside, and this, when added to the evidence of the unexploded guncotton found in the sand, showed that although the shell itself had been broken by the explosion, and although the detonator undoubtedly exploded, the Gathmann arrangement for protecting the charge of the shell had worked perfectly. The muzzle end of the gun for 5 feet was broken into five pieces longitudinally. A portion of the forward end of the shell was found about 3½ feet from where the muzzle of the gun had been. The official report on the experiment will be looked for with interest.

DEATH OF PROF. BUECHNER.

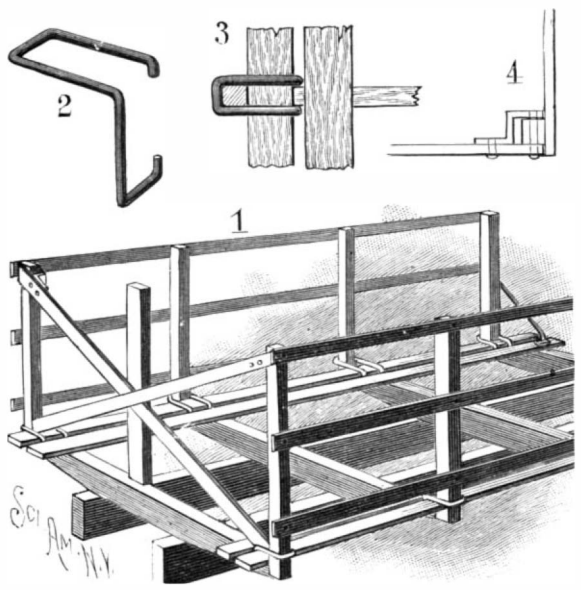
The death of Prof. Frederich Carl Christian Ludwig Buechner, the author of "Force and Matter," is announced. He died at Darmstadt, Germany. His great work is regarded by many European men of science as of equal importance with Darwin's "Origin of Species;" it was originally published in 1855, and has been translated since into every language in Europe. In it the theory of the ultimate indestructibility of force and matter, which is now generally accepted by scientists, was promulgated for the first time. The general principles of a complete philosophy in harmony with modern discoveries in natural science were first outlined by him. Prof. Buechner developed his philosophy in later works, and a few of their titles are the "Psychological Life of Animals," "Nature and Science," "Life and Light," "Power of Hereditary Transmissions," "Facts and Theories of the Naturalistic Life of To-day."

Prof. Buechner was born in 1824 and became a doctor of medicine; he studied at Giessen, Strasburg, Wurtzburg, and Vienna. He occupied the position of professor at Tübingen, but lost his position in consequence of his philosophical doctrines. He then returned to Darmstadt and resumed practice as a physician.

A NEW HAY OR GRAIN RACK.

A patent has been granted to John W. Bruns, of Westgate, Iowa, for a simple and strong box-rack which may be readily attached to or removed from the ordinary bed-rack of a hay or grain wagon, without employing bolts or screws.

Fig. 1 is a perspective view of the rack; Fig. 2 is a perspective view of a removable socket-loop employed; Fig. 3 is a section taken near the bottom of one of the uprights; Fig. 4 is a detail, showing the means for attaching the upper ends of the front braces.



BRUNS' HAY OR GRAIN RACK.

The rack is provided with the usual sills, crossbeams, and longitudinal strips, placed upon the crossbeams at the ends. In order to hold the uprights of the vertical side-racks in place, socket-loops of the general form shown in Fig. 2 are employed, which loops embrace the uprights and bind the crossbeams, longitudinal strips and uprights firmly together. The socket-loops are easily removed or placed in position, and form a keeper for the uprights when in position.

The side-racks are braced at the front by crossed brace-bars secured to the upper ends of the front uprights by pins passing through the braces, through the uprights, and through metal straps attached to the braces (Fig. 4). The lower ends of the braces are secured to the crossbeams and longitudinal strips, also by pins. Short brace-rods support the rear ends of the side-racks, but do not interfere with the loading of the rack.

THE NEW LOCOMOTIVES FOR THE MIDLAND RAILWAY.

The accompanying photograph of the first of the twenty locomotives ordered by the Midland Railway, England, from the Baldwin Locomotive Works, is of special interest. It is the first standard gage locomotive to be built in this country for the regular service of an English railroad, and unless the present signs are deceptive it will prove to be the introduction to an extensive trade in this direction. American machine tools have already established themselves in the good opinion of the English engineers, and the same qualities for handiness and low cost will probably win for the American locomotive a similar recognition. At any rate, the forty locomotives now building for the Midland and Great Northern railways will have an opportunity to show what they can do in competition with the standard freight locomotives of English make, and the test will be made on a fair field and with no favor.

As will be seen from the cut, these engines differ very slightly in appearance from a standard American mogul, the only discernible difference being the absence of the bell and pilot. The former is not used on English roads and the latter is replaced by two vertical guards, one over each rail just in front of the leading wheels. As the English do not use the single central coupling, it was necessary to attach the twin "buffers" which will be noticed on the front and rear of the engine. Other minor differences are the brass top on the smokestack and the use of the Gresham steam sander in front of and behind the main drivers. The front sander connects with a sand-box on the top of the boiler and the other with a smaller sand-box located beneath the running-board.

The really radical difference from American practice is in the firebox, which together with the stay-bolts is made of copper. It is the practically universal English custom to use copper for these parts because of its durability, but its greater cost goes to offset this advantage, and is one of the causes of the increased cost of the English machine. The customary screw reversing gear is replaced by the lever, and to compensate for the absence of water scoops the tank will be of unusual capacity.

The leading dimensions are as follows: Cylinders, 18 inches diameter by 24 inches stroke; wheels, 60 inches diameter; weight on drivers, 83,100 pounds; on truck, 17,150 pounds; total for engine, 100,250 pounds; total for engine and tender, 179,550 pounds; heating surface, firebox, 120 square feet; tubes, 1,246 square feet; total, 1,366 square feet; grate area, 16·7 square feet; boiler pressure, 180 pounds per square inch.

The most striking features to English eyes will be the roomy and comfortable cab, and the method of carrying the tender on two trucks, the custom being to use six wheels on rigid axles. The cab will be certain to commend itself to "engine drivers," as they are called on the other side, especially during the severe and stormy weather to which the railroads which run to the North from London are liable to be exposed in the winter months.

The Bacteriology of Rum.

It might be thought impossible on the face of it that there could be any bacteriology of rum, seeing that it contains nearly 75 per cent of alcohol; but according to the results of a very interesting investigation recently made by Mr. V. H. Veley, M.A., F.R.S., of Oxford University, and his wife, there does exists an organism in rum which accounts for an apparent disease to which it is liable at times and which is known in the trade as "faultiness." The cause of this disease has long been unexplained, for it has never occurred to those concerned that it could be due to a microbe, especially as the strength of the spirit is only 25 per cent short of pure alcohol. The "faultiness" of rum is at once obvious when the spirit is diluted with an equal bulk of water, the diluted liquid either immediately or after some hours becoming cloudy and depositing on longer standing a more or less copious precipitate or showing the presence in greater or less abundance of floating flocculencies. The micrococcus which has been isolated and identified as the cause of "faultiness" is a very interesting organism. It does not, however, appear to be pathogenic or toxic according to the results of inoculating a guinea-pig. Its survival in spirit—that is, in a liquid which has hitherto been considered to be one of the best materials for preserving anatomical specimens — is remarkable. Strictly speaking, however, the organism does not flourish in alcohol, but "in its gelatinous envelope, thus living as it were in a state of siege in its own castle, through the walls of which it can obtain its necessary supplies of food in the form of sugar while keeping out its enemy alcohol." No definite information has been obtained as to the original habitation of this peculiar micro-organism. The discoverers of this new micro-organism propose to call it provisionally Coleothrix methystes, from κολεός (a sheath) and μεθυστης (a drunkard)—a name ingeniously suggested by a fellow of Corpus Christi College.—Lancet.

AN AUTOMATIC SAFETY APPLIANCE FOR RAILROADS.

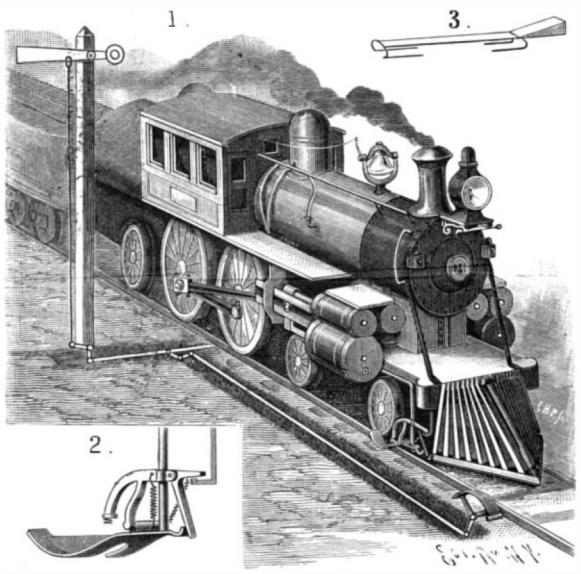
An invention has been patented by Gideon S. Jeffries, of Reading, Pa., by means of which the application of the air brakes of a train can be controlled independently of the engineer, the invention providing means whereby a device operated upon by an obstruction on the track opens a vent in the train-pipe and permits the air to escape to set the brakes.

Fig. 1 shows the invention applied to a locomotive and used in connection with a semaphore arm. Fig. 2 is a detail perspective view of the device carried by the locomotive. Fig. 3 is a perspective view of an obstruction for application to the rail.

The air-brakes can be applied either by an obstruction of the type shown in Fig. 3, or by means of an arched plate operated in conjunction with the semaphore signal.

The train-pipe is connected with the air-brake system and is braced to the truck of the pony-wheels. A bracket is secured to the train-pipe, which bracket has a supporting arm to which a lever is pivoted. This lever is provided with a valve controlling a vent in the train-pipe, and is tilted by the obstruction on the track to open the vent in order to apply the brakes. A latch is provided which holds the lever in the position to which it has been tilted. In rear of the supporting-arm carrying the lever, a downwardly-curved arm depends, provided with a spring to form a yielding abutment to cushion the lever when operated by the obstruction. The latch which holds the lever in tilted position is released by an arm operated from the locomotive cab and is actuated by a spring to force it down upon the lever, another spring connecting the lever with the bracket acting to readjust the lever.

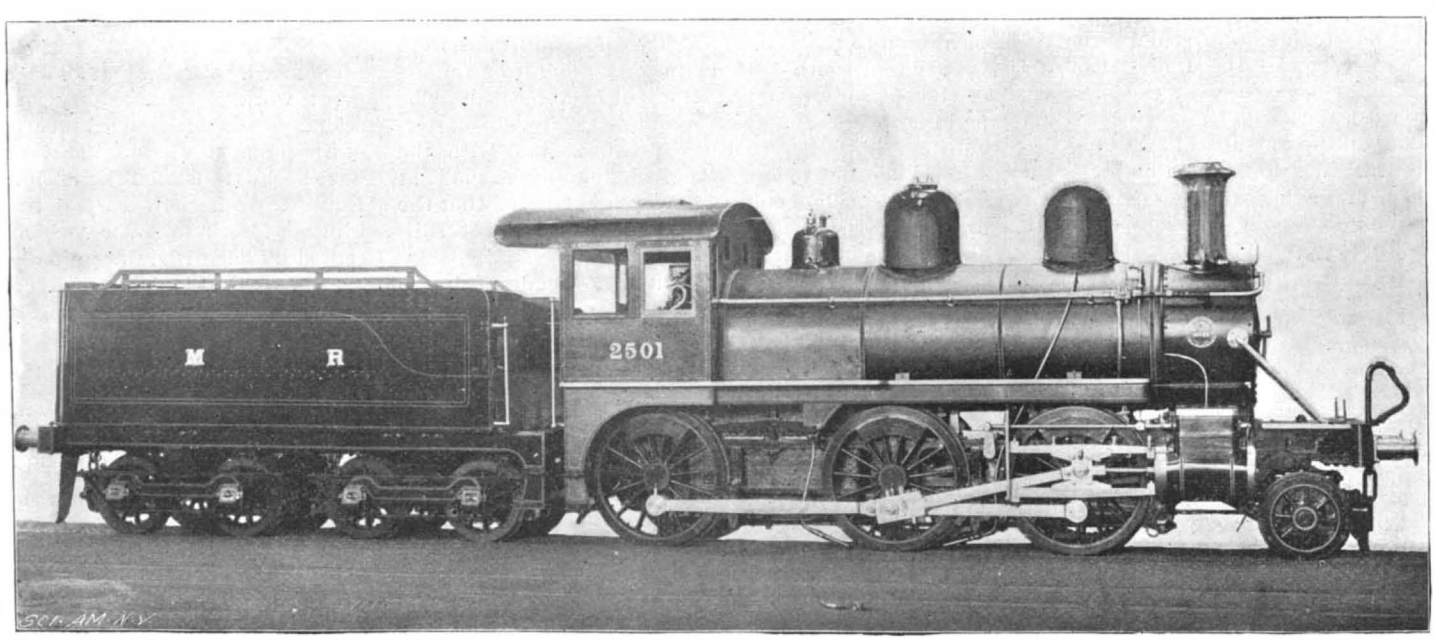
If the various parts be in the position shown in Figs. 1 and 2, the pressure in the train-pipe will be retained and the brakes will not be set. But if the obstruction shown in Fig. 3 be placed upon the track, or the arched



JEFFRIES' SAFETY APPLIANCE FOR RAILROADS.

plate connected with the semaphore be lifted alongside the rail, the lever will be tilted as it passes over the obstruction, and the latch will be forced by its spring into engagement with a seat on the forward end of the lever. In this position of the parts the vent in the train-pipe will be open and the brakes will be set. The parts may be readjusted by the engineer to the positions shown, by operating the connections which control the arm of the latch, the lever being forced by its spring to its normal position, so that the vent will be closed.

The device, besides being simple in construction, positive in action, and operating to hold the train-pipe open as long as desired, possesses the merit of being readily applied to any locomotive.



THE NEW LOCOMOTIVES FOR THE MIDLAND RAILWAY.

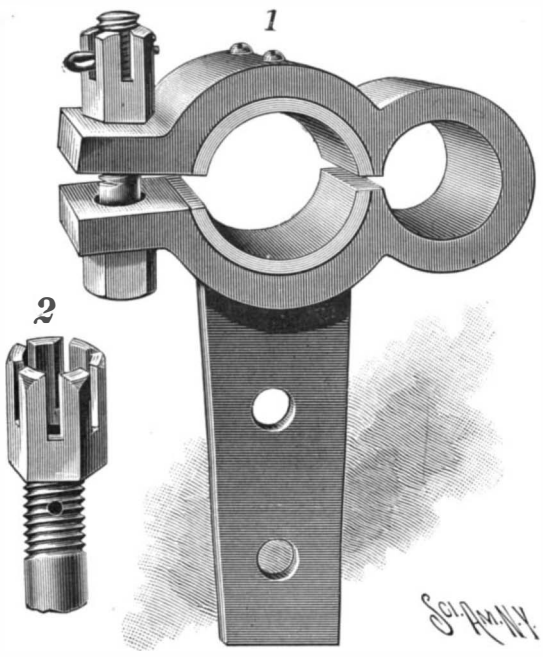
M. Secretan, of Paris, the owner of the famous Secretan collection which was dispersed some years ago, is dead. After having made a large fortune in copper, he lost his fortune and his collection was sold. He was the owner of Millet's "Angelus," which sold for $110,000.

A PITMAN-HEAD FOR HIGH-SPEED MACHINES.

The pitman-head illustrated in the accompanying engraving is especially designed for use on high-speed machines and is so constructed that wear can readily be taken up.

Fig. 1 is a perspective view of the pitman-head. Fig. 2 is a detail showing a peculiar form of bolt used in connection with the head.

The pitman-head is composed of a body and a cap integrally connected with each other at one side by a split-ring, so that the cap is spring-supported on one



JOHNSON'S PITMAN-HEAD FOR HIGH-SPEED MACHINES.

side of the body. At the side opposite the split-ring, the body and cap are provided with flanges connected with each other by a bolt, so as to enable the cap to be swung toward the body in order to take up any wear that may occur in the bearing of the pitman-head. In order to lock the nut in place after such an adjustment has been made, notches are made in the nut as shown in Fig. 2, which are engaged by a linch-pin removably held in an aperture in the bolt and passed through opposite notches in the nut.

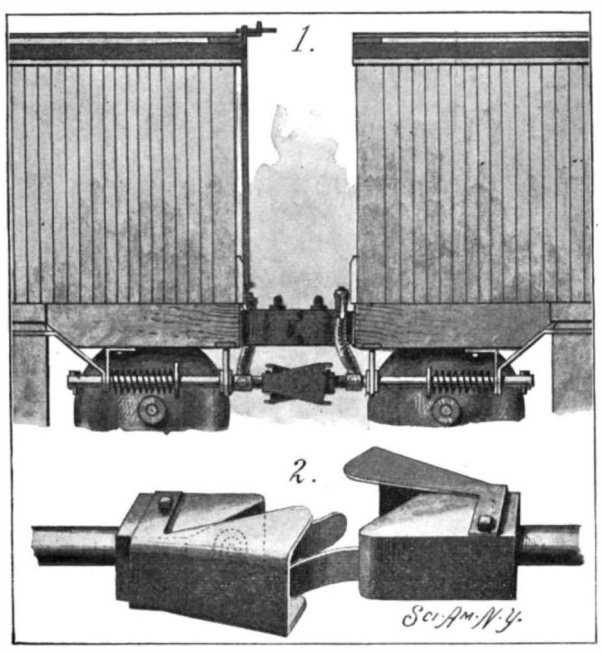
The bearing of the pitman is made in box-sections, secured to the head by set screws. Oil-holes in the cap and upper box-section permit the lubrication of the bearing and the wrist pin engaged by the head.

The pitman head is attached to the pitman bar or rod by means of an arm secured or formed on the body.

The inventor of this pitman-head is Walter Johnson, North Loup, Neb.

A COUPLING FOR THE AIR-PIPES OF RAILWAY-CARS.

In the accompanying illustration we illustrate a coupling for train-pipes, which is so constructed that



SINCLAIR'S TRAIN-PIPE COUPLING.

its sections can be automatically connected, and which is so mounted that it can move vertically and horizontally without danger of the parts' separating.

Fig. 1 illustrates the application of the coupling to two cars. Fig. 2 is an enlarged perspective view of the coupling-heads.

Each coupling-head is provided with an inclined face having an inlet valve communicating with a tubular shank. Opposite the inclined face of each head, a tapering hood is located, which is attached to the head and which has an inclination from its connection with the hood laterally in an outward direction. Each hood is also longitudinally tapered rearwardly, its front and rear ends being open. A spring-tongue is projected from the forward, contracted portion of each head, which tongue is laterally inclined in a direction opposite to the lateral inclination of the hood. By this arrangement the hood of one coupling is made to receive and guide the spring-tongue of the opposing coupling, the bearing of the tongues against the hoods being sufficient to cause the inclined faces of the opposing coupling-heads to be held in close engagement, so that the inlet-valves will be in alinement.

The tubular shank of each coupling has a branch to which the air-hose is attached, the communication between the hose and the air-pipes on the bottom of the car being controlled by angle-cocks which may be operated either from a point near the ground or from the top of the car.

At the rear end of the tubular shank communicating with the inlet-valve of each coupling-head, a collar is secured, which is attached to a bar. The bar and tubular shank are so held in hangers that the shank portions of each head may have vertical as well as lateral movement, in order to prevent uncoupling when the cars sway laterally or move vertically. The collars of the shanks are pressed toward each other by coiled springs, as shown in Fig. 1; and these coiled springs acting in conjunction with the spring-tongues of the hoods, maintain the relative positions of the various parts.

The inventor of this coupling is Millard F. Sinclair, of Humboldt, Tenn.

Students in Forestry.

The Forester of the Department of Agriculture announces that a few well qualified men may find positions as student assistants in the Division of Forestry. They will be assigned to practical field work, and their expenses will be borne by the government, which will also pay them $300 per annum. The students must have an excellent knowledge of botany and must also have some knowledge of geology, mathematics, physics, chemistry, entomology, zoology, surveying, etc. The plan will probably enable the government to get intelligent and fairly well equipped young men to do the field work of the Forestry Division, and it is probable that some time the services of the students will be turned to valuable account by the Department of the Interior in its forest conservation programme.

A WRENCH FOR TIRE-BOLTS.

The annexed engraving represents a device intended for use in connection with the tightening and removing of tire-bolts, one end of the bolt being engaged by one jaw of a pair of tongs to prevent the nut from rotating, and the nut at the opposite end being engaged by a wrench which may be rotated so as to loosen or tighten the nut.

Fig 1 is a perspective view of the wrench.

Fig. 2 is a detail view, showing the jaws of the wrench in partial section.

The device is mounted upon two levers pivoted together, so as to form a pair of tongs. One of these levers carries a single jaw, and the other a double jaw. The single jaw is provided with a threaded bolt, which is designed to engage the end of a tire-bolt, in order to prevent its turning. In the jaw-end of the other lever two gears are journaled. One gear has a hollow shaft forming a nut-engaging socket, and provided with a key-and-feather connection with the gear, the shaft being therefore slidable lengthwise, and yet being free to turn. A spring engages the outer end of this socket-shaft, to hold it upon the nut. The other gear has a shaft extending through the opposite jaw, which shaft carries a crank, by means of which the gears are turned.

In using this wrench the jaws are made to embrace the felly; and the threaded bolt carried by the one jaw is screwed down upon the head of the tire-bolt, the end of the socket-shaft of the one gear in the other jaw having previously been passed over the nut. On tightening the jaw-bolt, by bringing the ends of the tongs together, the pressure is resisted, not by the socket-shaft of the gear, but by the jaw. By reason of this construction the socket-shaft is not forced into the wood more than is necessary to hold the nut securely.

If it be so desired, a receptacle can be hung from the double jaw in order to receive a nut after having been removed from a bolt. The wrench has been patented by Walfrid Larson, of Kingsburg, Cal.

American Locomotive for Sweden.

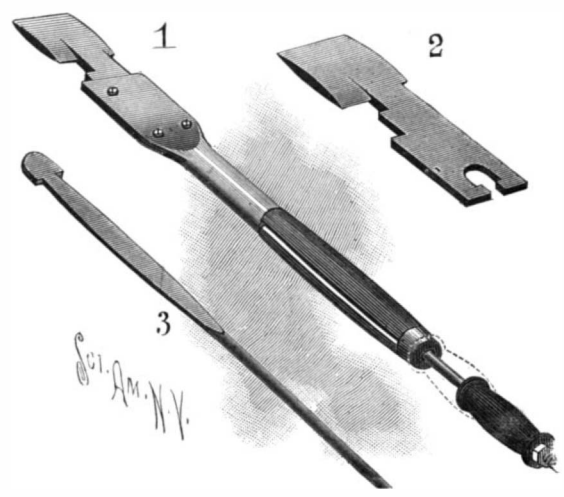
The first locomotive manufactured by the Richmond Locomotive Works for a railroad in Sweden has made her trial trip from Richmond to Newport News. The contract calls for a dozen engines, and work on them will be pushed at once. The locomotive has no bell, pilot or cowcatcher, all the railroads in Sweden being fenced in.

AN IMPROVED PRUNING IMPLEMENT.

A new form of pruning implement has recently been invented, which is well adapted to the trimming and pruning of tree-branches, and which is provided with a chisel to pare or smooth broken or jagged wood.

Fig. 1 is a perspective view of the complete implement. Fig. 2 is a perspective view of the cutter. Fig. 3 shows a portion of the reach-rod.

The combined pruning hook and chisel comprises a cutter-iron having a chisel-edge on its front portion, and a pruning-knife edge which is formed in the side and which coacts with a shoulder to cut the branch. This cutter-iron slides in the flattened sleeve of a socket



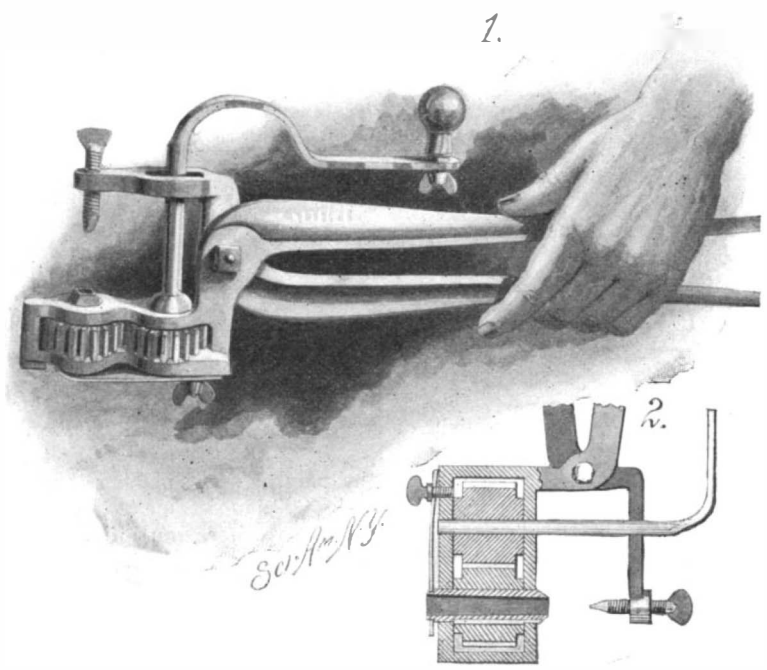
SMITH'S PRUNING IMPLEMENT.

on the handle of the implement. The inner end of the cutter-iron is formed with an aperture the shape of which conforms to the shape of the outer end of the reach-rod; so that the reach-rod and cutter-iron can be detachably connected. The reach-rod is flattened at one end to slide in the flattened part of the socket of the handle, and is provided with a nut at the handle-end. To deliver blows upon the stock or handle, or upon the nut on the reach-rod, a hammer-weight of convenient form for a handhold is used.

In operation the pruning-knife edge is hooked over the branch to be cut off, with the branch resting against the shoulder opposite the knife-edge. By means of the hammer-weight repeated blows are struck upon the nut on the end of the reach-rod; and these blows are communicated through the rod to the cutter. For the purpose of smoothing or cutting away wood the chisel-edge on the front portion of the cutter-iron is used, the blows in this instance being delivered upon the handle.

The implement is the invention of Isaac Smith, South Bend, Washington.

A TEXAS inventor has devised a simple shower bath which can be used where a bathroom is not piped so as to provide a fixed shower bath. It consists of an ordinary bucket with a double bottom; the lower bottom is perforated for the purpose of distributing water into fine sprays, while the second one has only one opening, which is controlled by a valve, the handle of which extends through the wall of the bucket to the outside. The bucket is filled with water and suspended on a bracket over the tub. The shower is then secured by simply turning the handle of the valve, which releases the water.



A TIRE-BOLT WRENCH.

Correspondence.

More Light on the Smokeless Powder Question.

To the Editor of the Scientific American:

The Scientific American of May 6 contains a letter from E. J. Ryves, of London, England, relative to the recent wrecking of a 10-inch gun at Sandy Hook. The tenor of this communication is to the effect that this deplorable accident is directly chargeable to inherent faults of multi-perforated powder. This attack upon a brilliant solution of the smokeless powder problem involves insinuations and charges that I cannot allow to pass by in silence. Those who are acquainted with the relations of the Maxim brothers have already read between the lines of Hiram Maxim's—I should say Mr. Ryves'—letter. But the vast majority of your readers are ignorant of this fraternal warfare, and I crave your permission to place before them in the columns of your paper some facts that may convince them that our ordnance officers, though unprogressive, are not yet fit subjects for the attention of alienists, and that all knowledge did not desert this country when the plans of a certain machine gun crossed the Atlantic.

My claims for consideration in this matter rest with the fact that I acted as assistant in the experiments of Dr. Schüpphaus and Hudson Maxim and as superintendent of the company formed for the commercial utilization of the results of those experiments, which covered very fully the field of smokeless powder. As the inference from the letter in question and an article in the Scientific American Supplement for May 6 inspired by Hiram Maxim is that the Schüpphaus-Maxim powder was founded upon the early work of that gentleman, it will be necessary to add some more secret history. Hudson Maxim had undertaken to develop a smokeless powder torpedo gun system. Mr. Maxim associated with himself Dr. Robert C. Schüpphaus. To produce a progressive powder, Mr. Maxim had in view a tubular powder, with a thin non-combustible or slowly burning cover. Practical difficulties made us discard the idea. Recalling Capt. Rodman's work with multi-perforated cakes of black powder, multi-perforated grains without covering were adopted, since mathematics showed that such grains could be made to approximate the theoretical advantages of a covered tubular powder with regard to an increasing burning surface.

But no smokeless powder formula of the day was suitable for the production of a satisfactory multi-perforated powder. New lines entirely had to be pursued. While Mr. Maxim gave his attention to dies and torpedo guns, Dr. Schüpphaus busied himself with this problem with the most happy results, discovering a suitable formula, capable of wide variations to meet all intelligent views, and a process for manufacturing commercially that formula into a perfect multi-perforated grain. Later I brought out the "segmental grain," relating to the most advantageous shape of the perforations, for which patents have been granted me in the United States and Germany. This history will dispose of the implication that the Schüpphaus-Maxim powder may be traced to Hiram Maxim through Hudson Maxim's early connections with his brother. If Hiram Maxim would but publish the retraction he made to Mr. Vickers of his firm concerning this point, his understudies might be more guarded in their statements. A word in regard to Dr. Schüpphaus will not be out of place, for he is a pioneer in the American smokeless powder field. When smokeless powders began to make a stir in America, his investigations were turned in that direction, with the result that in 1890 he submitted several powders to the United States government. For the 0·30 caliber gun, then in its experimental stage, two forms of guncotton powders were offered, representing ideas that have not been improved upon to this day. But the ignition of these with the primers in use proving very unsatisfactory, and the cry being for the high ballistics inherent in the nitroglycerin powders, he produced such a powder that gave superior results in the 0·30 caliber rifle. He then took the ordnance office by surprise in presenting samples of this powder for the 8-inch rifle. Satisfactory results were obtained, but to no avail.

Rip Van Winkle of the Ordnance Department turned in for another sleep, with the result that utter consternation ruled throughout the department when the adoption of the Krag-Jorgensen rifle brought the realization that they had no American powder even in sight for it, since the early inventors had retired permanently in disgust from the field of small-arms powder.

It was certainly premature upon the part of Dr. Schüpphaus to poke Rip Van Winkle, of the Ordnance Department, in the ribs five years ahead of any other American inventor and say, "Wake up, old man, and try to catch up with Europe; here is some smokeless powder for a large rifle."

When Dr. Schüpphaus took up the powder question some years later with Hudson Maxim, the erosive qualities of high grade nitroglycerin powders had been recognized, and the demand was for guncotton powders, with higher ballistic properties than they then possessed.

Mr. Ryves' discovery that multi-perforating is not advantageous, but dangerous, is novel. The Ordnance Department of the United States Army has never been accused of jumping to conclusions. After three years' experience it announced very firmly that multi-perforated powder was to be credited with all the advantages that had been claimed for it. Powder was supplied for all the guns of the United States Army, and duplicated in part of them many times. What excited particular comment, outside of the powder's high ballistic and low erosive value, was its remarkable reliability and regularity. However, Mr. Ryves has made tests. The trouble with those experiments is that they were comparative ones. The experienced engineer will always go shy of such tests. The comparative test deals with relatives, and generally omits some essential condition. It had been attempted to manufacture multi-perforated cordite, with no success at all. There was a quasi-peace between the Maxim brothers then, and they were working together for the introduction of multi-perforated powder into England. Hiram proposed, however, that some credit should go to him, and so walked the cordite formula onto the scene. But flat failure followed. Whatever is added, vaseline or castor oil, is put in for the simple purpose of keeping the larger rods from warping and checking badly. It does not succeed any too well with plain rods and is utterly out of the question with the intricate forms of multi-perforated grains. Then transversely perforated rods were tried. Cordite being too brittle for being punched into, some rods of Chilworth powder were secured and perforated transversely, it having a rubbery consistency. Theoretically, I cannot figure out any particular advantage in transversely perforating the usual long solid rods to which the process must be applied. The rod of circular section employed in England was a very poor form additionally for the purpose. It is probable that the Chilworth powder was just right for the gun. This was perforated with sapient wisdom in a manner that rendered it a quicker powder for that gun, and that meant a lowering of ballistics obtainable with it. That the perforated powder gave equal ballistics with the unperforated is explainable by the fact that the perforations were such as but to quicken the powder to a degree that the slight advantages of transverse perforations could counterbalance. Furthermore there could exist doubts as to the action of such transversely perforated rods in a gun where experience and theory both dictated that the short longitudinally perforated grain offered especial advantages for regularity of action. Mr. Ryves' witnessed some loosely conducted experiments of a system never tried before, and would damn something else by it. He may have fired more rounds of ammunition than most men alive, but inhalation of powder gases has never been classified by the medicinal profession as a brain tonic.

No powder was sent to England at that time on account of troubles in the company. But it had been distinctly understood that we would not guarantee our powder to pass the English heat test. While the United States was conning its smokeless powder primer, prudence did not dictate the building of a costly guncotton plant, and that article was purchased in the American market. It was the best to be had, but not up to the English standard, and it is manifest that a powder cannot be more stable than its ingredients. The implication that the process hurt the stability of the ingredients is best answered by the fact that the Schüpphaus-Maxim powder led American powders in that regard and contributed largely to the raising of the American heat test that then existed.

Then again the powder is damned because it contains di-nitrocellulose. There must be many fools in the business, then, since the Russian, German, French, and American powders for large rifles contain that article by intention. Even cordite has some that is always produced in the manufacture of military guncotton. The only powder that made use of military guncotton from which the soluble cotton had been specially extracted has a nice headstone in the powder graveyard. The truth of the matter is that di-nitrocellulose is a generic term comprising a large number of varieties of nitrocellulose, many of which are eminently suitable for use in smokeless powders.

Basing an opinion upon experience derived by my connection with the development and manufacture of multi-perforated smokeless powder, and upon such information concerning the trend of commercial production of powder in this country during the last year or so that has reached me, I do not hold with any explanations that have been publicly advanced. That placing it upon the multi-perforated feature seems to me to border upon the nonsensical, for it is reason that an inherent defect should have put itself in evidence during three years of trials. The same thing was alleged of brown prismatic powder with its central hole to account for abnormal pressures occasionally encountered. But Vieille showed that such pressures arose from wave action in the powder gases induced by certain conditions of loading. When these conditions were avoided in practice, abnormal pressures disappeared. My opinion would involve responsibilities that I do not care to assume in absence of direct proof of any cause. In addition, I know that a most eminent authority in Europe, with a wide experience in powder matters covering many years, has stated firmly that any smokeless powder may detonate in a gun under certain conditions. What those circumstances are I do not know, since the man in question vouchsafed only the general statement. The report of the board investigating the accident will be a basis for the advancement of ideas by those who may not agree with the conclusions.

Fred. H. McGahie, M.E.

580 Henry Street, Brooklyn, N. Y.

Japanese Clock.

To the Editor of the Scientific American:

In your issue of May 6 is an illustrated article about a Japanese clock in which mention might be made of some interesting facts pertaining to Japanese horology.

The Japanese divide the twenty-four hours into twelve periods of time, of which six belong to the night, and six to the day, their day beginning at sunrise and ending at sunset. Whether the day or night be long or short, there are always six periods in each. To attain this the characters or numerals on the scale are adjustable, two of them are set, one to agree with sunrise, the other with sunset, and the four characters between them divide the space into equal portions. Thus, when the period of daylight is longer than the night, the day hours will be proportionately longer than those of night. Another peculiarity in their scale is, that they only use six characters, those from four to nine, and these read backward. The scale on your clock is numbered consecutively or

$$6, 5, 4, 9, 8, \underset{7}{7}, 6, 5, 4, 9, 8, \underset{7}{7},$$

Why these are so arranged from top to bottom I should like to know.

The United States National Museum has a clock like the one you illustrate. It also has a Chinese watch with adjustable figures on the dial that are placed in the same order as those on the clock scale.

E. H. Hawley.

Smithsonian Institution, United States National Museum.

The Speed of Warships.

To the Editor of the Scientific American:

I have read with much interest the several articles on the various foreign navies, and note the widespread popularity which they, as well as the Naval and Coast Defense Supplements, have gained. A discussion of the various navies, also of the different types of vessels contained therein, proves to be an unusually interesting subject at the present time, and I am pleased to note that the Scientific American is aiming to keep its readers thoroughly informed on naval matters. One fact impresses itself very forcibly on the reader's mind, namely, the superiority both in number and excellence of the British vessels over those of the Continental navies. A very important advantage, and one which is somewhat overlooked in the comments on the British navy, is that the rated speed of their vessels is based on natural draught instead of forced as in all other navies, and as a result a 21-knot vessel of the "Cressy" class would be able, under forced draught, to easily overtake a 22-knot vessel of other navies should it come to a chase on the open sea, as she could make over 22 knots under forced draught, a very important advantage not to be lost sight of in speed comparisons. While the British vessels as a rule do not carry as heavy armaments as some others of the same or even less displacement, the additional weight will always be found to be well accounted for in the more powerful boilers and engines required to give them their excellent high speed under natural draught, and in the additional ammunition and stores carried. British ships were they rated at forced draught would be found to be the fastest vessels afloat for their class by a large margin, a very important advantage. A British vessel to-day, in case of hostilities, would be able to accept or refuse battle from hostile ships of equal or superior power for this reason, to say nothing of being able to maintain her most advantageous fighting range should she choose to risk an engagement with a more powerful foe. A comparison of the run from Southampton to New York of our "Columbia" (22·8 knots trial speed) when she averaged 18·41 knots per hour with the British cruiser "Diadem" (20·5 knots rated speed), from Gibraltar to the Nore, when she averaged 19·27 knots per hour, both runs being made under natural draught, proves the above beyond any question. It is with no little humiliation that all admirers of our navy note the following facts in a speed comparison of our ships with England's. Our "Kearsarge" and "Alabama" classes, which are not yet in commission (nor will the last named class be for another year), have the low speed of 16 knots (equal to 14½ or 15 in service), and are several knots slower than ships of the same date in foreign navies. Of course the "Maine" class are a great improvement over the last named of our navy, and the fact that the Senate effectually blocked the

construction of our 13,500-ton battleships and 12,000-ton armored cruisers until next year, while greatly to be deplored, would be fortunate should the Bureau of Construction see fit to take advantage of the fact and increase the speed of the battleships and armored cruisers to 19 and 23 knots respectively; in which case they would be more up-to-date vessels at the time of their completion. It is likely that Congress would have to be asked for an additional appropriation to cover the increased cost, also the displacement would probably have to be increased; but according to the exact wording of the naval bill this would be feasible. There is no plausible reason why the United States should not have ships the equal of any afloat or under construction. England has set the speed of her new battleships and armored cruisers of the "Duncan" and "Drake" classes at 19 and 23 knots respectively and they will be completed and in commission sometime before our new vessels. It is difficult to understand why, in view of the all-important lessons taught by the late war, the naval authorities do not replace the 1 and 6-pounder guns on the plans of the "Maine" class, also the proposed new vessels, with 12 and 3-pounders. It was clearly demonstrated that the 1-pounder gun has no place on armorclads where the fighting range is from 1,500 to 3,000 yards. The 12 and 3-pounders are conceded by nearly all naval authorities to be the ideal light rapid-fire guns for both battleships and cruisers.

The construction of six unprotected cruisers of about 2,500 tons trial displacement, of the low speed of 16 knots per hour, which seems to have been decided upon according to the clipping I inclose, if true, seems to be only one step removed from the absurd act of Congress, over a year ago, when it inserted a clause in the naval bill providing for the four obsolete monitors now under construction. It has lately been discovered that the six small cruisers can be raised to about 3,200 tons displacement, and still be constructed within the amount appropriated, $1,140,000 each. Why not build six protected cruisers of a little less displacement, and about the speed of the "New Orleans," or six improved "Raleighs," and arm them with two 6-inch and ten 5-inch rapid-firers, or ten rapid-fire 6-inch.

It is reasonably certain that vessels of the above type could be built for the amount appropriated, and would not be a comparatively useless waste of the people's money, as will be the case if the present plans are persisted in. It would be fortunate if Secretary Long would withhold his approval of the plans for such extremely slow vessels. An expression of opinion from the editor as to the value of the proposed slow vessels in time of war would be interesting. If they were attached to a squadron they would be of no value, and would keep down its speed to about 14½ knots. If they ventured out to sea, and encountered a hostile ship or fleet, they would probably have to surrender, or fight a more powerful antagonist, as they would have no choice of battle on account of very low speed. Of course they could be used for police duty in times of peace, but warships are supposed to be built to fight also, and these vessels seem to be wofully deficient in two of the most important requirements, speed and protection.

The proposed large coal supply of the small cruisers is unusually heavy, and is important, but good speed, protection and armament will win a vastly greater number of battles than a hundred or so tons of coal. It is sincerely to be hoped that the plans as outlined in the inclosed clipping will not be the ones finally adopted, and it does not seem possible that the Bureau of Construction would commit itself to vessels of the unheard-of speed of 16 knots in this advanced period of warship construction. A SUBSCRIBER.

Billings, Montana, April 26, 1899.

[The question of speed in warships is treated at some length in our editorial columns. In comparing the speed of our new battleships and cruisers with that of the new 19-knot battleships and 23-knot cruisers of the British navy, our correspondent overlooks the fact that our ships will be more heavily armed. We are willing to sacrifice a knot of speed for a preponderance in armament. The six new vessels referred to by our correspondent have been designed to meet the new conditions imposed by our possessions in the Pacific and the West Indies. They are intended for service on distant stations, to reach which, it is necessary to make long unbroken trips, or on stations more or less remote where docking facilities are wanting.

With a view to this they are to be sheathed and coppered (the weight of which covering reduces the speed by from a quarter to half a knot) and they are to have an unusually large coal supply, sufficient to carry them 8,000 miles without recoaling.

The comparatively low speed is in agreement with a growing belief among naval men all over the world, that while higher speed is desirable in the battleships and large cruisers, it is not so essential in the smaller cruisers which do police duty on distant stations.—ED.]

PLANS are being made for the projected canal between Berlin and Stettin by which vessels of heavy tonnage will be able to reach Berlin.

Mr. Eddy's Later Experiments.

Mr. W. A. Eddy, of Bayonne, N. J., has been continuing his experiments of sending up a hot air balloon carrying a thermometer, to which we have already referred. The balloon was held captive at a height of 400 feet. The earth temperature when the balloon first ascended was 69° above zero. Five minutes later when it was hauled down the thermometer registered 66°. At the second ascension, when the height of 600 feet was reached, there was a difference of 3°. The balloon is 12 feet in diameter and exerts a lift of 4 pounds. The thermometer weighs 3 ounces and is arranged to give the readings of the extreme heat and extreme cold. It was impossible to use kites because the wind was so light that they would not remain aloft. The expenses of the experiment are borne by the Hodgkins Fund of the Smithsonian Institution.

A BEDSTEAD FOR INVALIDS.

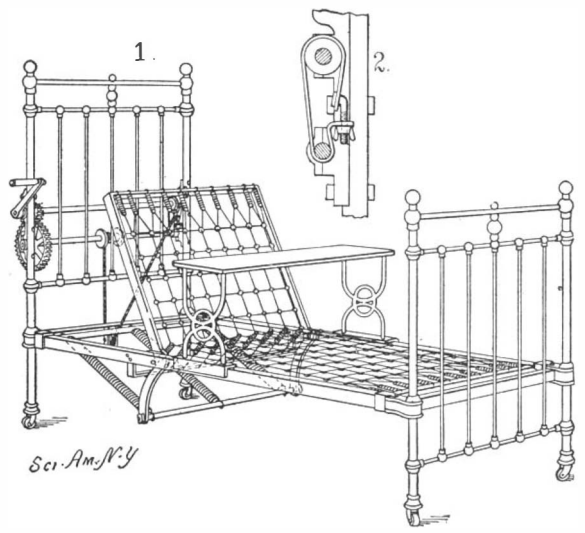
We illustrate herewith a bedstead for invalids, which has a head portion arranged to be raised and held yieldingly in an inclined position by springs.

Fig. 1 is a perspective view of the bedstead. Fig. 2 shows a brake employed for the purpose of preventing too quick a movement of the head-portion under the action of the springs.

The movable head portion of the bed bottom is pivoted to the side rails of the bedstead. Arms extend downwardly from the sides of the head-portion and are connected at their lower ends by a cross rod. To these cross rods and to another cross rod secured to the side rail springs are secured which serve to swing the head portion into an inclined position.

In the head-posts of the beadstead, a power-shaft and a drum-shaft are journaled, connected by gear-wheels, and operated by a crank. Around the drum-shaft a rope is wound which is connected with the movable head-portion.

By releasing a dog which controls one of the gear-



COUGHLIN'S BEDSTEAD.

wheels, the spring secured to the cross rod connecting the downwardly-extending arms of the head-portion will swing the head-portion upward, the springs being of sufficient strength to raise the patient lying upon the bed. In order to prevent too violent a movement of the head-portion, a brake-strap engaging the power-shaft and the drum-shafts as shown in Fig. 2 is employed.

As indicated in Fig. 1, a table may be placed upon the side-rails, the table being so mounted that it can be pushed lengthwise but not sidewise.

The beadstead is the invention of William Coughlin, 252 East Fifty-second Street, Manhattan, New York city.

American Bridges for Burma.

The Burma Railways Company invited six English and two American firms to make a tender for the Goktick viaduct in Burma. Four of the English firms responded, and the most favorable English tender required three years for completion of the work, and the cost was to be $590,000. The American tender proposed to complete the work in one year at a cost of $300,000. It is needless to say that the Burma Railways Company accepted the tender of the American company.

Our Losses in Two Wars Compared.

The War Department has prepared a memorandum which compares the losses in the Spanish War with those in the first year of the Civil War. The aggregate strength of the troops employed in the war with Spain was approximately 267,000, covering a period from May, 1898, to April, 1899, inclusive. During this time deaths from all causes amounted to 6,190, or 2¼ per cent. The mean strength for the first year of the Civil War was 276,371, and the aggregate loss by deaths from all causes was 19,159, a percentage of 6·8.

Science Notes.

The Belgian consul at Manila states that money for the construction of the projected railway connecting the north and south portions of the island of Luzon with Manila has already been subscribed in Belgium.

Prof. Campanile and E. Stromei explain that phosphorescence in Geissler tubes is due to gradual charging and extremely rapid discharging of the walls of the tube at the part covered externally by the anodic tin foil, the phosphorescence being set up on the opposite wall during the extremely rapid discharge.

A railway company of Brooklyn has a special car fitted with a hydraulic jack by which the car can be lifted off the rails of the crossings and put on another track having no connection by switches. They also have a special tower car with an adjustable platform on the roof enabling repairs to be effected on the "up" trolley wire while the tower car is on the "down" line. This car is very useful in stringing trolley wires.

Dr. Koeppe notes that distilled water is decidedly deleterious to protoplasm, absorbing from the same saline constituents and swelling its tissue even to the extent of destroying the vitality of the cells. Distilled water has a similar action on the cells of the stomach, producing in some cases vomiting and catarrhal troubles. He concludes that the toxic property of certain glacier and spring water is due to its absolute purity, which also explains why the sucking of ice and drinking of glacier water sometimes causes stomach derangement.

A German inventor has devised a curious display apparatus which consists of a mirror having its rear face silvered to such a degree as to render it capable of reflecting objects. A picture is secured in the rear of the mirror and under ordinary conditions it is indistinguisbable through it. An electric light is mounted in the recess at the rear of the mirror, which can be lighted and extinguished at will. When the current is turned on, the picture on the back is brought into view, and, as the light may be flashed intermittently, a curious effect is produced.

Sir W. B. Richmond is pursuing his campaign against the smoke of London. The Coal Smoke Abatement Society, over which he presides, is attracting leaders of artistic and scientific circles of the metropolis and now seeks to enlist as well the skill of those in the mechanical world. At a recent meeting of the committee it was decided to give gold, silver, and bronze medals to the three best exhibits in the coal smoke abatement section of the forthcoming Building Trades Exhibition at Agricultural Hall, London. Sir W. B. Richmond has promised to design the medals.

The "Ernest Bazin" will shortly be sold at auction at Liverpool. According to the announcement of the auctioneers, "this fine model of engineering skill," which cost nearly $100,000 to build, will be offered for sale. Great attention is directed to the suitability of this boat as an attractive novelty show steamer and advertising medium for the great coast pleasure resorts, and it will doubtless prove of more interest and importance to those in this class of business than it ever will be to navigators. It has also been suggested that the rollers may be used for gas buoys or caissons.

An Italian medical journal calls attention to the fact that a Brussels bank disinfects all its soiled notes and commends the practice which is followed by the Bank of England of destroying all its notes that come back to the bank. Our own government would be very wise in following such a course. Where the notes are very old they are destroyed, it is true, but every note ought to be as soon as it gets in the hands of the government. Infection by paper currency is probably not very frequent, but, at the same time, there are cases on record which can be directly attributed to this cause.

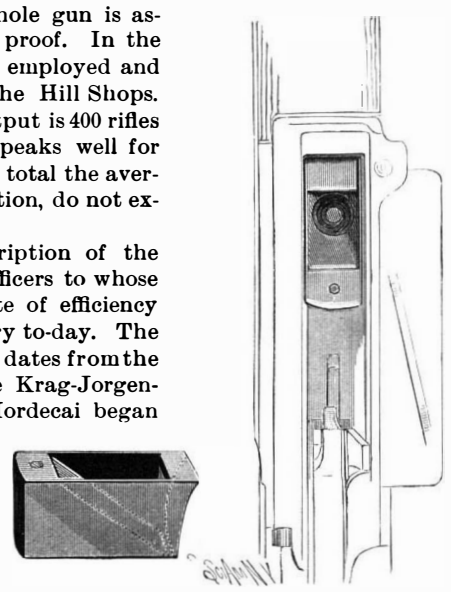
According to a decision of the Court of Errors and Appeals of the State of New Jersey, property owners need not permit telegraph poles, telephone poles, and electric light poles to be placed on the highways in front of their property without due compensation. Corporations cannot set their poles in the night time or at any other time when they can take property owners unawares and thus secure a right of way. They must obtain the consent and agree with the property owners as to the rate of compensation, or, if they cannot agree, they must go to court and have the issue adjudicated there.

In Sweden the food given to reindeer is "reindeer moss," a lichen highly prized by the Lapps, and which grows abundantly in the Arctic regions, almost as luxuriantly on bare rocks as in the soil. It covers extensive tracts in Lapland, making the summer landscape look like a field of snow. The domesticated reindeer are never as large as the wild ones. The domesticated Siberian reindeer are larger than those of Lapland. No care at all is taken of the deer. They thrive best by being permitted to roam in droves and obtain their own sustenance. The moss can be used as human food, the taste being slightly acrid. Attempts have been made to feed hay, roots, grain, etc., to the reindeer, but they have not succeeded.

MANUFACTURE OF KRAG-JORGENSEN RIFLES AT THE SPRINGFIELD ARMORY.—II.

Our first article on the manufacture of the Krag-Jorgensen rifle (see SCIENTIFIC AMERICAN of April 29) described the Water Shops of the Springfield Armory, in which the whole of the forgings are made and where the gun barrels are rolled, bored, turned, rifled, and tested, ready for assembling in the finished weapon. The present article will be confined to the Hill Shops, where the complicated parts which go to make up the breech mechanism, such as the receiver, magazine, gate, bolt, etc., are machined and finished and where the wooden stocks are made and the whole gun is assembled, completed, and given its final proof. In the whole armory there are about 2,000 men employed and three-fourths of them are employed in the Hill Shops. As we have already stated, the total output is 400 rifles a day, or over 10,000 a month, and it speaks well for the quality of the work that out of this total the average rejections, after a very strict inspection, do not exceed 11 rifles per month.

Before taking up the detailed description of the shops, credit should be given to those officers to whose energy and zeal is due the excellent state of efficiency that characterizes the Springfield Armory to-day. The period of reconstruction and renovation dates from the year 1892, when the manufacture of the Krag-Jorgensen rifle was commenced. Col. Alfred Mordecai began the good work of removing the antiquated machinery which had long outlived its usefulness and of introducing labor-saving tools and more modern methods of shop management. The same policy has been followed to such good purpose that these government shops can to-day compare in administration, economy, and excellence of the finished products with the best of the private shops in the country.

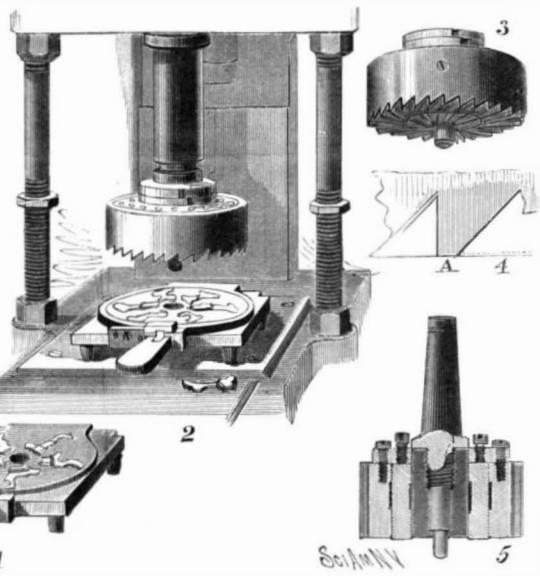


8.—Bore Mirror for Examining Bore of Finished Gun.

9.—Rough and Finished Stocks.

THE RECEIVER.—The most complicated and costly piece that is made in the Hill Shops is the receiver. It comes from the Water Shops in the rough as a solid steel drop forging weighing 6½ pounds, and goes through no less than 120 separate operations of drilling and milling before it has been brought down to the finished weight of 1·4 pounds. In the "receiver room" there is collected about as fine a set of automatic and semi-automatic machinery as one could ask to see; not quite so elaborate as that used in watch manufacture (see SCIENTIFIC AMERICAN, March 4, 1899), but showing a thousand and one "wrinkles," such as are dear to the heart of the machinist.

10.—Slotting the Stock—Roughing Cut Preparatory to Bedding.



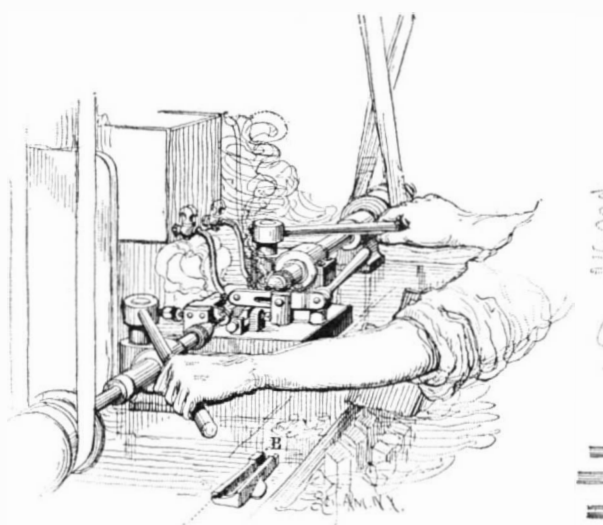
11.—Face-Milling Sears and Triggers.
1. Face-milling jig for triggers. 2. Face-milling sears. 3, 4. Details of cutters. 5. Cutters telescoped together.

The receiver answers to the breech-box of the big gun. Into it is screwed the barrel of the gun; it receives through the bolt the full force of the recoil; it serves as the magazine; and it has to withstand all the jar and shock of hasty loading and unloading in the heat of an engagement. Its parts must work together snugly, yet with great freedom, and they must stand long and hard usage without getting slack in the adjustments or allowing dangerous clearances to develop between breech and bolt. To secure this accuracy, only the best material is used, and the various operations are gaged from three points—the axis, the left side, and the front end. The first operation is to drill an axial hole by means of an automatic machine designed in the shops, which drills simultaneously from each end. These machines alone are saving $125 per day to the government. A closely fitting mandrel is then inserted, and all subsequent work is done from this mandrel as a center. The receivers are next milled on each face in milling machines that carry "double fixtures" and enable two pieces to be machined at one time. They are then shaped on the outside, and the cylindrical ends and the end faces of the magazine are milled in the machine shown in Fig. 6. The rotary milling may have left slight imperfections, to remove which the piece is given a finishing touch in the clamp miller, Fig. 4. This last cut has to be taken with the greatest care, as no tolerance is permitted in the finished work. Mention should be made of the fact that, wherever it is possible, the work in the milling shops is done with double fixtures, two identical pieces being clamped in the machine at a time. In some of the later machines, indeed, Lieut. Dickson is using quadruple fixtures, all the parts of the new rifle sight which he has designed being machined on this system, the economy of which is obvious. Previous to 1881, all similar work in the shops was done with single fixtures. The work of cutting out the stock and forming the irregular interior surfaces of the magazine is very tedious and involves an incredible number of operations. The stock is taken out by first drilling a series of holes in a semi-automatic drill, Fig. 4, and then using special rotary mills suited to cutting out the recesses and corners of the magazine. A noticeable feature in the machines employed in this work is the substitution of hand lever feed in place of the ordinary screw feed—one of those simplifications which account for much of the economy with which work is now turned out at the armory.

THE GATE.—To look at the "gate" one would never suppose that its construction involved 34 distinct operations, but as most of them are done on double fixtures, the work is turned out with great rapidity. They include, among others, the milling of the thumb-piece, the milling out of the joint (done by a mill with six different surfaces), and the drilling of the hinge-hole four inches in length. This last is done in the machine, Fig. 12, in which right and left hand drills, fed by hand, drill simultaneously from each end of the hinge.

TRIGGERS, SEARS, AND SMALL COMPONENTS.—Nowhere has a greater saving of time been secured than in the machining of the small parts, such as triggers, sears, and the various other details of the breech mechanism. They have so many irregular curves and offsets, all of which have to be finished to gage within a variation of $\frac{3}{10000}$ to $\frac{5}{10000}$ of an inch, that to produce each one on the old method would make its cost equal to that of a dozen made on the present improved automatic milling machines.

Each of the two sides of the sear and trigger are finished to the proper thickness, with the desired offsets, at a single operation in the face milling jig, Fig. 11. The jig for the sear has six and that for the trigger five sprockets, and the offsets are made by a set of cylindrical telescopic cutters (detail 5), which admit of adjustment to secure the required relative depth of cut. A stud projecting from the arbor on which the mills are assembled passes through a hole in the jig and engages an adjustable stop in the table of the machine, which is set to give the required finished thickness to the work. In Fig. 7 is shown a machine for milling the perimeter of triggers, with a fixture which allows the opposite perimeter of two triggers to be finished in one operation by using compound cutters carrying eight different cutting faces. In Fig. 13 is shown a set of rotary files of special design as used in the armory. The cut shown in Fig. 5 was designed by George Kempater, one of the oldest employes in the shops. The Springfield Armory cut on the flat file is widely known and in great favor among the tool makers.



12.—Machine for Drilling Holes in Gate Simultaneously from Each End.

13.—Rotary Filing.

MACHINE AND TOOL SHOP.—In shops like these, where practically the whole of the work is done by automatic and semi-automatic machines, a large and well appointed machine and tool shop is a necessity. The machines are as a rule purchased on the outside, chiefly from the well-known firm of Pratt & Whitney; but the armory manufactures all of its own tools and designs, and makes the many improvements which are added from time to time in its purchased machines. Among many labor-saving improvements we noted the system of making profiling cutters introduced by Lieut. Dickson, in which the turret of a No. 3½ P. & W. screw machine is provided with tools: (*a*) for removing the scale and finishing the tip, (*b*) for roughing, and (*c*) finishing the taper shank; and when the head on which the teeth are to be cut is larger than the shank, (*a*), a box tool for finishing head. Where the head is irregular in shape, or smaller than the shank, it is finished by a formed back tool.

The tools for roughing and finishing the taper shank consist of two form cutters, each of which is secured

MANUFACTURE OF KRAG-JORGENSEN RIFLES.—II.

to the lower end of a lever; through the upper end of each lever is an adjustable set screw that bears against a bar which has the same taper that the cutter shank is to have. The upper end of the levers are connected by a spring to insure a constant bearing of the set screws on the taper bar, so that, as the taper bar is moved automatically, the cutters will be uniformly opened while cutting the taper. Opposite the form tool on the slide rest is a special tool post, pivoted in its center and operated by a lever, so that two form cutters and one cutting-off tool can be used. On this machine from sixty to eighty shank cutter blanks are made in eight hours.

When set up for any cutter, a year's supply of the blanks is made direct from 10-foot bars of round steel. The operation of setting up for any cutter is very simple. After leaving this machine, the operations are centering, cutting the teeth, tempering and grinding. This system has materially reduced the cost of all shank cutters, of which an unusual variety are rendered necessary by the irregular cuts required on some of the components, notably the receiver.

CASE-HARDENING AND TEMPERING. — Most of the working parts, such as the receiver, bolt, gate, side plate, sleeve, and cocking mechanism are case-hardened. They are packed in powdered burnt bone in cast iron boxes, and heated to a cherry red and then plunged into a bath of lard oil. It should be noted that in this operation a little cyanide of potassium is placed on the first locking joint of the bolt to give it special hardness. The lug receives the full shock of the recoil, and if it is not hardened it is liable to upset. This actually happened in the case of some of the Spanish Mausers, and by allowing the cartridge to project slightly beyond the breech, the upsetting resulted in the rupture of the walls of the cartridge shell where it projected beyond the breech. The extractor, firing pin, and striker and all small springs are tempered by heating to a cherry red, cooling in oil, and drawing to a spring temper.

BROWNING THE BARRELS.—The process of browning the barrels involves several distinct operations. After the bore has been oiled and carefully plugged at each end the barrel is boiled for 10 minutes in lime water. The lime is then brushed off, and a coat of browning material applied with a sponge, after which the barrels are put for 5 minutes in a cabinet, in which the temperature ranges from 80° damp to 90° dry. The barrels are allowed to cool in the cabinet and are then boiled again, this time for from 5 to 7 minutes. They are then put on a revolving wire brush. A second browning coat is applied and the barrels are again placed in the cabinet, where they are exposed for 4 hours to a temperature of from 80° to 70°. This is followed by a third and fourth coat which are repetitions of the second coat.

MAKING THE STOCK. —The stock is turned out of the best selected walnut, which is delivered at the armory sawn to the rough shape shown in Fig. 9. It is first rough-turned in a machine which carries a cast iron former, of the shape to which the piece is to be roughed down. The rotary cutters and the tracing wheel are carried on a swinging lever, the cutters being driven by a belt. The next operation is to slot out the stock for the insertion of the receiver preparatory to cutting out the longitudinal bed for the barrel, Fig. 10. The bedding is done in the machine shown in Fig. 3, which is provided with six vertical cutters, and two horizontal cutters. Each cutter is provided with its own former, so that the finished stock is certain to receive the barrel and receiver with a snug fit when they are clamped together. In the illustration the machine is shown cutting out the half-round groove for the barrel. The operator guides the cutter 7 to form the proper taper to match the barrel with his right hand, while he traverses the barrel by means of the crank handle shown in his left hand.

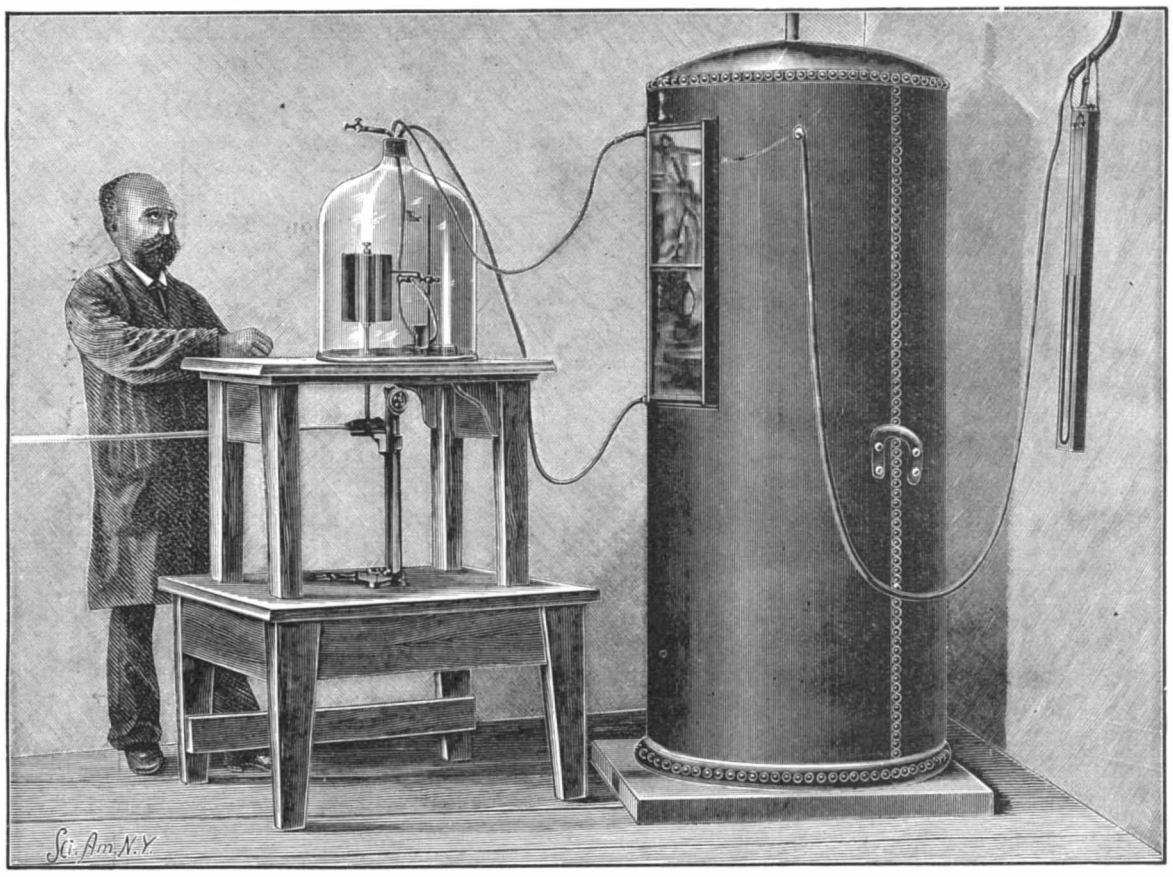


Fig. 1.—PNEUMATIC CHAMBER AND OTHER APPARATUS USED IN REGISTERING THE PULSATIONS OF THE BRAIN IN RAREFIED AIR.

Fig. 2.—FROST ON THE REGINA MARGHERITA CABIN AFTER THE STORM OF AUGUST 13, 1894.

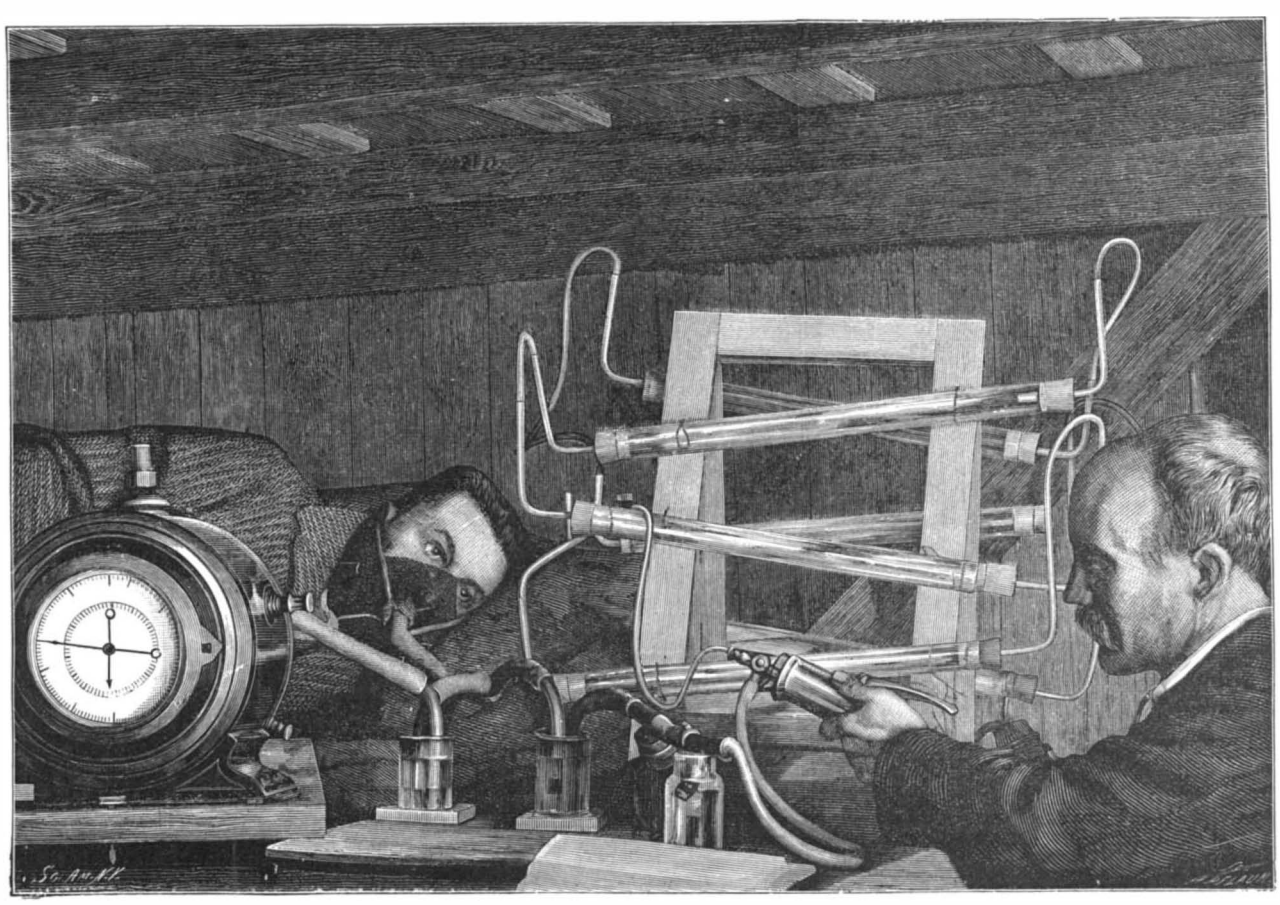


Fig. 3.—APPARATUS FOR MEASURING THE VOLUME OF AIR INHALED AND THE CARBONIC ACID EXHALED.

FINAL INSPECTION AND TEST. — After the various parts have been assembled into the finished rifle a final and very careful inspection is made by special experts. The bore is examined by means of the little mirror, Fig. 8, which is slipped into the receiver at the base of the barrel and presents a clear image of the bore as shown in the illustration. As we have stated, every barrel has already undergone a test of 70,000 pounds to the square inch in the chamber, and to determine the ultimate strength of the guns, ten or more rifles out of every lot made from a certain delivery of steel are tested up to 100,000 pounds to the square inch. This is two and a half times greater than the service pressure. Illustration Fig. 1 shows one of the very few rifles that have failed to stand this supreme test, and in this case the examination revealed a slight flaw in the stock.

THE KRAG-JORGENSEN IN THE WAR. —At the conclusion of the Spanish-American war, when the army was gathered at Camp Wyckoff, a special board of ordnance officers was ordered to assemble at the camp and gather statistics as to the behavior of our rifles, field artillery, etc. Every officer at the camp was requested to report any case of failure in guns or ammunition. It speaks volumes for the excellent workmanship put into our new rifle that not a single case of failure or even of miss-fire was reported.

THE PHYSIOLOGY OF MAN ON THE ALPS.

A short time ago a most interesting book on the Physiology of Man on the Alps ("Fisiologia dell' uomo sulle Alpi) appeared simultaneously in Milan, Paris and Leipsic, where it was published in Italian, French and German respectively, and it has now been translated into English. The author, Prof. Angelo Mosso, had already given much study to the subject, but was desirous of testing certain theories in regard to Alpine physiology which would require a residence of several weeks on the summit of Monte Rosa, and therefore, feeling sure that he could never accomplish his end with the assistance of only his guides and porters, he applied to the Minister of War for a detachment of ten soldiers under the command of a military physician, to stay with him on the mountain as long as might be necessary. His request was granted, and he went to

Ivrea, where several soldiers of the Alpine regiment volunteered to accompany him, and they proved a most efficient aid. After completing his arrangements, his first month, from June 19 to July 11, 1894, was passed in a preliminary study of his men for the purpose of becoming well acquainted with their physical condition. He divided them into two companies, one containing the most robust men and the other those of average strength; one division ascended the mountain slowly with Prof. Mosso, traveling at the rate of about 3,700 feet per week, while the other division took only three days to make the entire journey to the top of Monte Rosa, where they found the first section of the expedition established in the Regina Margherita cabin, 14,952 feet above the level of the sea. In this way Prof. Mosso ascertained the effect on the human organism of a sudden and of a gradual change from the atmosphere of a low level to that of a high mountain—from the atmosphere in which men ordinarily live, to air that is very much rarefied.

In all his investigations Prof. Mosso took every precaution to avoid the mistake common to all scientists who had previously made a study of mountain sickness and kindred phenomena; that is, the failure to distinguish between the effects of fatigue and cold and those of barometric depression. He even invented instruments to assist him in his investigations, one of which was the ergograph, with which he measured and registered the contractions of the muscles, in order to ascertain the amount of mechanical work done by them and its connection with the weakness experienced at great altitudes. The results of his experiments seem to show that after a person has become acclimated and rested, his muscles are capable of performing quite as much work at an altitude of 14,960 feet as at a lower level, but that the nerve centers do not perform their part as well, causing difficulty in breathing, palpitation of the heart, etc., so that the functions of the muscles are seriously interfered with, although the barometric depression does not act directly on the muscles themselves. The Professor admits, however, that a certain poison is produced in the muscles by fatigue, which acts on the cardiac and respiratory centers, but he maintains that difficulty in breathing and palpitations are not due to contractions of the muscles. On account of the very complex nature of the closely related phenomena affecting the different organs, it is often extremely difficult to distinguish the cause from the effect.

It has often been stated that respiration was more frequent and deeper on the mountains, but Prof. Mosso proves the incorrectness of this theory, asserting that the experiments on which it is based must have been made on persons who were fatigued, not in a state of rest, so that it was impossible to determine the effect of the rarefied air alone. It has also been stated that the lungs did not take in the normal quantity of air, nor did they throw off the necessary amount of carbonic acid; and knowing that a candle burns with less light on the summit of Monte Rosa, Prof. Mosso and his brother determined to ascertain whether the flame of life was also less intense than at a lower level, but they found that there is very little difference in the quantity of air inhaled or of carbonic acid exhaled at a great height and at a much lower level; that is, if a person is in a state of repose. The instruments used in this experiment are shown in Fig. 3. The meter, seen at the left of the engraving, is similar to those used in houses for measuring illuminating gas, but is more sensitive and exact, being arranged to indicate the hundredth part of a liter. Prof. Mosso may have been the first to use such a meter in the study of the respiration of human beings, but the gutta percha mask shown in connection with it has been used for more than twenty years. Nevertheless, the Professor has found it more convenient than other means which have sometimes been substituted for it, and he, therefore, carried six such masks up Monte Rosa. As a rule, a mask must be provided for each individual, but in some cases, where faces are similar in shape, the same mask will serve for two or three persons. The mask is hermetically sealed to the face by cement which is applied along the edges of the mask. The person to be experimented upon lies down, his head being slightly raised on a rubber cushion. The tube which is connected with the mask is bifurcated, and the two branches lead to separate valves. The air inhaled passes into the meter, and then through the first valve, to the lungs; the air exhaled passes through the second valve, and if the quantity of carbonic acid is to be tested before leaving the apparatus, it passes to an elastic rubber bag, and then to a third valve. By means of a hand pump connected with the rubber bag a given quantity of the exhaled air is thrown through six glass tubes filled with aqueous solution of barium hydrate for fixing the carbonic acid, which was found by Prof. Mosso's brother to be about the same in quantity whether measured at a great height or on a lower level. It will, of course, be understood that the part of the apparatus last described will not be required in simply measuring the quantity of air inhaled. These experiments seem to show that the body is not an economic machine that adapts itself to circumstances; the chemical processes cannot be modified, and even in a rarefied atmosphere the organism demands the normal ration of oxygen. Dr. Loevy and Herr Zuntz found that the consumption of oxygen, when the muscles were at work, was greater on Monte Rosa than at Berlin, and also that the Alpine climate tended to cause a change in the substance of which the human organism is composed, but failed to find any effect that seemed to indicate a lack of oxygen, and therefore concluded that it is not lack of oxygen that incapacitates man for work at high altitudes. In rising to great heights a bird will, perhaps, use more muscular force, in proportion to its size, than any other animal would be capable of exerting even at sea-level, and yet birds require less oxygen than other living creatures.

Having satisfied himself that the disturbances in the performance of the functions of the organs of respiration and of the heart were due to chemical derangement of the nerve centers, Prof. Mosso undertook to show that the somnolence, hemorrhages, etc., often experienced by mountain climbers, were attributable to the same cause, for he could not accept the theories that they were caused by a disturbance of the circulation of the blood in the brain—either cerebral congestion or anemia, due to the atmospheric depression. For this purpose he was desirous of securing the presence on Monte Rosa of some one whose skull had been fractured, but was unable to do so, and therefore had to content himself with experiments made in a pneumatic chamber, like that shown in Fig. 1, which consists of a cylinder made as boilers are constructed, but with one end rounded and the other end open. The lower open end is provided with a heavy iron ring, over which is placed a rubber ring that rests on a slab of marble, thus closing the cylinders hermetically. The cylinder is large enough to allow a man to stand comfortably in it, having a capacity of about 36 cubic feet, and the interior is lighted by a window of very thick glass. The cylinder is counterbalanced so that it can be easily raised and lowered by means of the handles provided on the sides. Instead of an ordinary pneumatic pump, Prof. Mosso used a pump driven by a gas motor. While the air in the cylinder was being rarefied, it was being constantly renewed by the admission of a current of fresh air through a valve, which is not shown, in larger quantities than a man can use; but this did not interfere with the rarefaction, although the inflow was constant, because the quantity of air exhausted by the pump was greater than the quantity admitted. The pressure was registered by two manometers, one on the inside and the other on the outside of the cylinder. When necessary the air was cooled by being passed over a coil of pipe containing a cooling mixture.

In one of his experiments a boy who had a pulsating scar where his skull had been broken by a fall, was placed in the cylinder with a little cap of gutta percha over the wound. The edges of the cap were hermetically sealed by means of vaseline, and the pulsations of the brain were transmitted by means of air, through a rubber tube attached to the gutta percha cap, to a recording tympanum or diaphragm in a recording apparatus outside of the pneumatic chamber, shown at the left of the engraving. This latter apparatus consisted of a glass bell having a capacity of about two cubic feet, the edges of which were polished and hermetically sealed on the marble slab, on which it stood, by a little grease. Inside the bell there was a recording cylinder, the shaft of which was revolved from outside of the bell, the lower end of the shaft being provided with a grooved pulley carrying a cord that also passed over a similar pulley on the shaft of a clockwork, from which motion is transmitted to the cylinder. Where the shaft passes into the bell the latter is hermetically sealed by a metal tube lined with oakum coated with grease. By this arrangement, the recording apparatus can be controlled without the knowledge of the person in the pneumatic chamber. As the pneumatic chamber and the bell are connected by a rubber tube, the air is the same in both. The other rubber tube shown is the one which carries the pulsations of the brain to the recording apparatus. A water valve placed inside of the bell in connection with this tube permits the air in the cap and over the brain to expand gradually as the barometric pressure decreases. In this manner Prof. Mosso could follow the cerebral pulsations without entering the chamber, where his presence would have interfered seriously with the result of the experiment on account of the change in the air produced by the breath of two persons. As it was, the experiment was a success and proved that the vaso-motor center of the brain, as well as the respiratory and cardiac centers, is less active in rarefied air, again proving that disturbances caused by rarefaction of the air are not of a mechanical nature.

Prof. Mosso also used this pneumatic chamber in experimenting with artificial air—air which had been diluted by the addition of an unusual quantity of nitrogen—and found that when inhaled it produced the same effects as natural barometric depression, thus proving by still another method that it is not the mechanical action or diminution of the weight of the atmosphere that produces mountain sickness, but its rarefaction, which causes a change in the tissue of the nervous system. During these experiments he noted the same acceleration in the movement of the heart and the same change in the movements of the organs of respiration that he had so often noticed on Monte Rosa.

The conclusion drawn from all this investigation and study is that the characteristic changes observed in the sensitiveness, the intelligence, and the manner in which the physical organs perform their functions when people ascend to a great height, whether as aeronauts or as mountain climbers, cannot be explained by the existence of cerebral anemia or congestion. There is a sufficiency of blood in the brain, and, in fact, the circulation is almost normal even at a height of 18,000 feet.

Prof. Mosso's book treats of the effects of cold, wind, sleep, and in fact all that may cause a change in the human organism when so far above the ordinary levels of the earth, and the space he gives to nourishment, fasting, disturbance of the digestion, etc., giving the scientific reasons for following certain hygienic rules, makes it especially useful to Alpinists. It met with such a warm reception from the general public, as well as scientists, that the first edition was exhausted in a month, but the second edition was delayed until last year on account of the author's desire to include the results of further investigations, so that the book as it now appears might almost be considered a new work. Something has been added to each chapter, and there are three entirely new chapters, the last of which is devoted to the stations and the new observatory on Monte Rosa, which latter he compares with the observatory built by France on Mont Blanc at a much greater expense. The Italian observatory will owe its existence to Queen Margherita, of Italy, who, having followed the investigations of Prof. Mosso and others with the greatest interest, and knowing that scientists felt the need of a suitable observatory for the study of the Alps, the heavens, physical phenomena, and life above the line of perpetual snow, took the initiative by contributing 4,000 lire (about $780) toward the new observatory, which will be constructed by enlarging the Regina Margherita Cabin on Point Gnifetti—a height of 14,952 feet—in which Prof. Mosso made many of his experiments described in this book, and which was visited and inaugurated by the Queen on August 18, 1893. Her great love of science has prompted her to consecrate this mountain to the study of nature, and doubtless Prof. Mosso and many others will give to the world much useful and interesting information, the results of investigations which have been rendered possible by her beneficence.

Congress of Journalists.

A congress of journalists was recently held at Rome on the Palatine Hill, amid the ruins of the palace of the Caesars. The tables for the banquet was spread beneath an enormous tent. Antique amphoræ laden with flowers were placed about, and on the tables themselves were urns, antique statuettes, etc. The banquet was carried out under the directions of Sigñor Baccelli, the Minister of Public Instruction, who has recently done so much for archæology by the excavation of hitherto untouched parts of the Forum. Prince Ruspoli, the Syndic of Rome, in his speech called to mind the fact that journalism originated at Rome in the person of Julius Caesar, who was the first to make public the debates in the Senate by means of the Acta Urbis.

A GREAT manufacturing concern of Dayton, O., has notified its employés that henceforth preference will be given to young applicants for employment who have had a kindergarten training, and after 1915 no applications for employment will be considered unless the applicant has had a kindergarten training. The company has conducted kindergartens for the benefit of children of their employés for a number of years and has observed the results. The educational classes and other enterprises which have been carried on for the benefit of the employés has resulted, in six years, in completely transforming a poor factory suburb into a pretty residence district. If corporations would emulate the Dayton experiment, they would find that in a few years all the money they had invested was returned to them. It does not need a statesman to see that social disorders which are liable to cost so much in the end can be cured at the root by properly educating the less fortunate citizens.

A CURIOUS invention for the protection of bank checks has recently been patented. It consists of a number of disks, so that any combination of numbers may be formed. The characters are heated to branding temperature by means of electricity, and, on being pressed to the surface of a check or similar paper, the amount named thereon is burned by a process which defies the usual methods resorted to by check raisers. Devices are provided so that the work can be done quickly.

AN INGENIOUS REVERSING MECHANISM FOR MACHINE TOOLS.

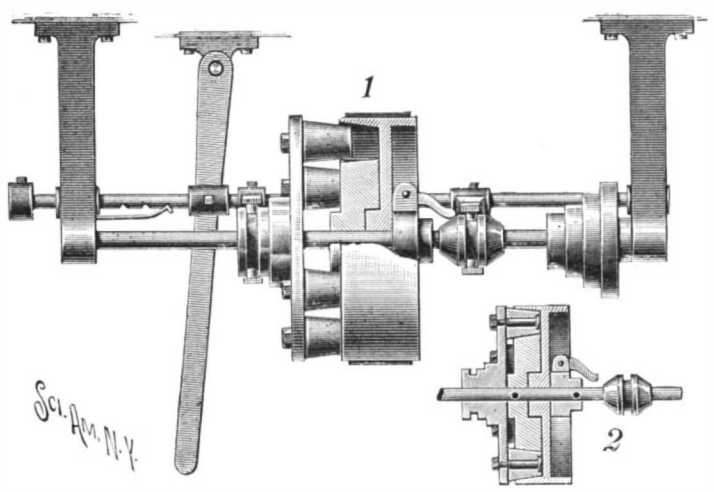
The reversing mechanism usually employed in machine tools consists of two pulleys, one driven by a straight belt and the other by a crossed belt, a movable clutch being used to shift the one or the other pulley into gear, according to the direction of the motion desired. In order to dispense with this cumbersome arrangement, Eugene E. Norton, of Bridgeport, Conn., the mechanical engineer of the American Graphophone Company, has devised an ingenious mechanism in which but a single belt is employed running continuously in the same direction.

Of the accompanying illustrations, Fig. 1 is a view of the reversing mechanism with parts in section; Fig. 2 is a section showing the operative parts in a position different from that illustrated in Fig. 1.

Upon the power shaft a disk is rigidly secured which is provided with a conical periphery. Loosely mounted on the shaft is a pulley having an interior conical flange. By means of a clutch of any desired form, the pulley can be locked to the shaft, so that the motion of the pulley is communicated to the shaft. A second disk loosely supported on the shaft is provided with a circular series of rollers which can be shifted into engagement with the periphery of the first mentioned disk and the internal surface of the conical flange of the belt pulley. The clutch and the roller disk are so connected by a movable rod that they may be simultaneously operated by a shifting lever.

When it is desired to turn the shaft and the belt pulley in one direction, the shifting lever is swung to the left, thus causing the clutch to bind the pulley to the shaft. When it is desired to reverse the motion of the shaft, the operator, by means of the lever, shifts the movable rod to the right, and thus changes the positions of the clutch and roller disk from those shown in Fig. 1 to those shown in Fig. 2. The clutch is thereby made to disconnect the pulley from the shaft; and the roller disk is reciprocated so as to throw the rollers into engagement with the pulley flange and the first mentioned disk. These rollers receive motion from the pulley and communicate that motion in the reverse direction to the shaft, through the medium of the first mentioned disk.

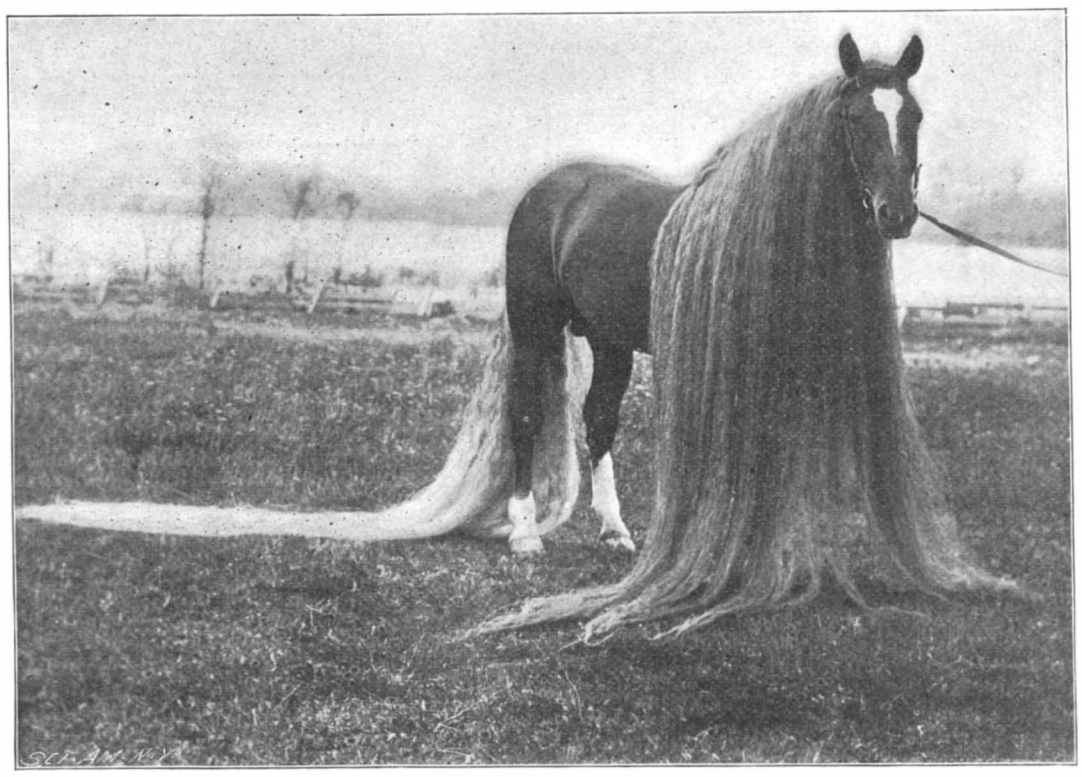
In order to lock the clutch and roller disk in place when they are in engagement with the pulley, a simple locking device is employed consisting of a spring catch which engages one of three notches in the movable rod referred to, and thus prevents the slipping of the clutch or roller disk.



NORTON'S REVERSING MECHANISM.

AN ABNORMAL GROWTH OF HAIR ON A HORSE.

Our engraving represents a remarkable growth of mane and tail on a horse. His name is Linus II., and is the son of Linus, a celebrated horse in his day. No picture can do adequate justice to his great beauty, for he has a double mane which sweeps the ground on both sides, a tail which trails far in the rear. The mane is very thick and measure 11 feet in length; the tail is even more remarkable than the mane, measuring 16 feet from tip to tip. It is, of course, impossible to account for this remarkable freak of nature, and while there are undoubtedly other cases of similar abnormal growth on record, we do not know of any horse which has been bountifully blest with such a beautiful growth of hair. We are indebted to Mr. James T. Rutherford, of Waddington, N. Y., for our photograph.



LINUS II. AND HIS PHENOMENAL GROWTH OF HAIR.

The Smell of Metals.

Prof. W. E. Ayrton says that there is a generally accepted idea that metals have smells, since if you take up a piece of metal at random or a coin out of your pocket, a smell can generally be detected. But I find that, as commercial aluminum, brass, bronze, copper, German silver, gold, iron, silver, phosphor-bronze, steel, tin, and zinc are more and more carefully cleaned, they become more and more alike in emitting no smell, and, indeed, when they are very clean it seems impossible with the nose, even if it be a good one, to distinguish any one of these metals from the rest, or even to detect its presence. Brass, iron, and steel are the last to lose their characteristic odors with cleaning, and for some time I was not sure whether the last two could be rendered absolutely odorless, in consequence of the difficulty of placing them close to the nose without breathing on them, which, as explained later on, evolves the characteristic "copper" and "iron" smell. But experiment shows that, when very considerable care is taken both in the cleaning and the smelling, no odor can be detected with iron or steel.

Metals, then, appear to have no smell per se. Why, then, do several of them generally possess smells? The answer is simple; for I find that handling a piece of metal is one of the most efficient ways of causing it to acquire its characteristic smell, so that the mere fact of lifting up a piece of brass or iron to smell it may cause it to apparently acquire a metallic odor, even if it had none before. This experiment may be easily tried thus: Clean a penny very carefully until all sense of odor is gone: then hold it in the hand for a few seconds, and it will smell—of copper, as we usually say. Leave it for a short time on a clean piece of paper, and it will be found that the metallic smell has entirely disappeared, or, at any rate, is not as strong as the smell of the paper on which it rests. The smell produced by the contact of the hand with the bronze will be marked if the closed hand containing it be only opened sufficiently for the nose to be inserted, and it can be still further increased by rubbing the coin between the fingers.

All the metals enumerated above, with the exception of gold and silver, can be made to produce a smell when thus treated, but the smells evolved by the various metals are quite different. Aluminum, tin, and zinc, I find, smell much the same when rubbed with the fingers, the odor, however, being quite different from that produced by brass, bronze, copper, German silver, and phosphor-bronze, which all give the characteristic "copper" smell. Iron and steel give the strong "iron" smell, which again is quite different from that evolved by the other metals. In making these experiments it is important to carefully wash the hands after touching each metal, to free them from the odor of that metal. It is so necessary to wait for a short time on each occasion after drying the hands, since it is not until they become again moist with perspiration that they are operative in bringing out the so-called smell of metal.

That the hands, when comparatively dry, do not bring out the smell of metals is in itself a disproof of the current idea that metals acquire a smell when slightly warmed. And this I have further tested by heating up specimens of all the above mentioned metals to 120° Fahrenheit, in the sun, and finding that they acquire no smell when quite clean and untouched with the hands.—Chem. News.

A New Primary Battery.

A young Frenchman has invented a primary cell, says The Electrical Review, which is said to give 13 amperes at 2 volts for a longer time than the ordinary bichromate cell or the Bunsen cell. Its essential characteristic is that a vanadium salt or vanadic acid is contained in the exciting fluid or in the substance of the negative or positive electrode. Such an element consists preferably of an external vessel containing a solution of 20 parts of Na Cl to 100 parts of water, in which an amalgamated zinc rod is dipped; an inner porous jar for the reception of a carbon plate, and which is filled with a mass of powdered manganese oxide and fused vanadic acid. This jar contains also a solution of sulphuric acid, vanadic acid, and hydrochloric acid. Ten per cent of sulphuric acid may also be added to the Na Cl solution in the external vessel. The depolarization is very energetic on account of the combined action of the hydrochloric acid, the oxygen, and the chlorine. Moreover, the reducing effect of the hydrogen is regulated by the presence of the vanadic acid, since this passes into hypovanadic acid, and is immediately again oxidized to vanadic acid by the hydrochloric acid, while the hydrochloric acid liberates an equivalent of chlorine and four equivalents of oxygen. An addition of ten per cent of bichromate of potash to the acidified solution increases the output. Special cells have been designed for application to motor cars.

ACCORDING to The American Architect, the city government of Boston is considering the question of establishing a public crematory much after the model of the one in Père la Chaise, in Paris, where the bodies of persons who die in public institutions, leaving no friends or relatives, are, as a rule, incinerated, and where cremation can also be performed for other persons whose families desire it.

A Royal Arctic Explorer.

The Duke of Abruzzi, the nephew of King Humbert, of Italy, has started for the Polar regions. He proposed to go straight to Franz Josef Land on the steamer "Star of Italy," to penetrate as far as possible, and finally when frozen in to make a rush for the Pole with sleighs. He hopes to be back in Rome in June, 1900.

End of the Keely Motor.

Mr. Kinraide, of Jamaica Plains, Mass., has abandoned all work on the Keely motor, and will ship back to the Keely Motor Company all the machines and manuscripts left by Keely. Mr. Kinraide was on terms of some intimacy with Keely, and it was thought that he might discover, if possible, some virtue in the motor. The exposure of the frauds which Keely perpetrated in his Philadelphia laboratory, which we have already illustrated, has helped to induce Mr. Kinraide to abandon the whole matter.

The Current Supplement.

The current SUPPLEMENT, No. 1220, has many most valuable and interesting articles. Prof. Wilson's important work entitled "Prehistoric Art" is reviewed at considerable length and the conclusion will be published in the next issue. "The New Treptow-Stralau Tunnel under the Spree" is described. The Maxim Smokeless Powder Controversy includes interesting letters by Dr. Schüpphaus, Hiram S. Maxim, Hudson Maxim, and F. H. McGahie. "The Extermination of the Mosquito" is an important article. "Toilet and Medicinal Soaps," with processes and formulas, completes the number.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

THRESHING-MACHINE.—Harold A. Rands, Forest Grove, Ore. The frame of this machine is a metal truss-frame, light, yet strong. The machine has a metallic separating-rack made in two sections driven directly from a crank, the rack being so constructed that the metal part at a predetermined portion of its length will be raised in such a manner as to spread the straw evenly. A simple and readily-operated device is also provided, whereby the concave can be lowered to enable access to be had thereto and to the cylinder.

Bicycle-Appliances.

BACK-PEDALING BRAKE.—Antone A. Zalondek, Oklahoma, Oklahoma Territory. The rear-wheel hub rotates upon an axle and is provided with a sleeve. A disk is fixed to the axle, and the sprocket is mounted loosely on the sleeve between the disk and hub. A swinging dog carried by the sprocket is adapted to engage a shoulder on the sleeve. Balls are arranged in recesses of diminishing depth in the disk. When the rider backpedals, he causes the balls to move within the shallow portion of the recess in order to force the sprocket against the hub, and thus to stop the wheel.

BRAKE.—Otto O. Zimmerman, Manhattan, New York city. This invention consists of two principal parts—the brake-mechanism proper, located upon the forward portion of the lower rear braces, and the operating mechanism, consisting of a roller adapted to engage the front tire. A steel ribbon connects the roller and the brake-mechanism, so that when the roller is made to engage the front wheel, the brake-mechanism operates upon the rear wheel, the principal braking action being upon the rear wheel.

Engineering Improvements.

VAPOR-ENGINE.—Edward L. Lowe, Astoria, Ore. The improvements in this invention are found in a peculiarly-constructed fire-chamber, in which a fire may be built from fuel other than that of the oil employed in driving the motor, and in which a coil or other retort is arranged for the passage of the oil which drives the motor, so that such oil is vaporized, as is usual in this class of apparatus.

PISTON-PACKING.—Gregory M. Mullen, Baltimore, Md. The inventor has devised an improvement in the class of pistons for steam-engines in which a "bull-ring" is employed to hold the spring-packing, which bull-ring is constructed of two annular sections adapted to be placed on the piston-head and having radial flanges between. On the outer sides of the flanges the packing-rings are arranged to form a perfect steam-tight joint.

Mechanical Devices.

TYPE-WRITER.—William C. Chapman, Gracewood, Ga. The present invention provides a means for automatically returning the carriage at the end of the line to commence a new line, and also provides a paper-feeding mechanism actuated at the return of the carriage to feed the paper forward for a new line. The invention furthermore comprises mechanism by which the carriage is returned with a step-by-step motion corresponding with the step-by-step forward feeding motion, so that the carriage may be run back in order accurately to place the carriage for any letter previously struck.

PROPELLING MECHANISM FOR VESSELS.—Thaddeus Murphy, Manhattan, New York city. The hull of the vessel has two parallel keels, one located on each side of the longitudinal center of the vessel. The keels converge upwardly into the hull to connect with each other and to form a cavity in the hull-bottom. A rotary shaft extends longitudinally in the cavity and has propeller-blades. A gear-wheel is attached to the shaft between the ends, and meshes with another gear-wheel carried by a second shaft. The second shaft is a power-transmitting shaft, and actuates the propeller-shaft to drive the vessel, the power exerted, it is claimed, being less than that ordinarily required, owing to the peculiar mounting.

MOTOR-WHEEL FOR VEHICLES.—Julius W. Walters, Manhattan, New York city. Within the vehicle-wheel a motor is mounted which is connected with the wheel by mechanism whereby the wheel can be started, stopped, or reversed, while the motor is still running. The mechanism has an outwardly-extending portion concentric with the wheel, by means of which the mechanism is operated. The motor, it will be observed, is carried within the wheel itself, and the power is directly transmitted, and undue loss, it is said, is thereby prevented.

RIBBON-FEED REVERSING MECHANISM FOR TYPE-WRITERS.—George A. Seib, Manhattan, New York city. This invention is an improvement on a similar device patented by the same inventor. In the present improvement, the axle of the ribbon-spools has an arm pivoted therein carrying two shafts, one bearing two pawls adapted to engage ratchet-wheels on the ribbon-spools and having arms extending therefrom, and the other shaft being notched, the notches having differing angular relation to the shaft and being adapted to receive the pawl-arms to carry them, on the rotation of the notched shaft, alternately in and out of engagement with the ratchet-wheels on the ribbon-spools. A stop is provided to limit the extent of the release movement of the pawls.

Railway-Contrivances.

THROTTLE-LEVER.—Lorin W. Canady, El Paso, Tex. Instead of employing the ordinary rack and dog arrangement to hold the throttle-lever in position, the inventor employs a spring-pressed cam which holds the lever in any position. By this device the engineer is enabled to regulate the position of the throttle-lever as he chooses; whereas, in the former arrangement, the engineer was limited by the teeth of the rack

FEED-WATER HEATER AND PUMP FOR LOCOMOTIVES.—Lucius D. Copeland, Phœnix, Arizona Ter. The water-heater is located in the smoke-box of the boiler. An exhaust-steam pipe, provided with a check-valve, opens into the heater to discharge the steam into the water. A small pump is provided, having a suction-pipe connected with a water-supply, and a discharge-pipe connected with the heater. A larger pump has a suction-pipe connected with the heater and a discharge pipe connected with the boiler and provided with a check-valve. By means of the heater and pump, heated water is fed to the boiler in a very simple manner.

Miscellaneous Inventions.

WEIGHING-APPARATUS.—Leonard D. Orr, Pegram, Ill. The apparatus embodies a scale-beam with a counterpoise adjustable thereon by means of a suitably driven gearing, the movement of which is controlled by the position of the beam. The gearing also serves to drive a numbering apparatus for indicating the weight of the article. The beam when balanced is stopped with machine-precision; and the result is indicated by the numbering apparatus in a manner which renders fraud impossible.

TAG-HOLDER.—Marie Z. Villefeu, Babylon, N. Y. The holder is designed to hold shipping or address tags on bicycles and packages, and is composed of spring-pressed jaws and of a pin carried by and movable longitudinally of the jaws. In use on a bicycle, the jaws are to be engaged around the handle-bar or some other portion of the frame, the pin being then forced through the tag or cord.

SUSPENDER-ATTACHMENT.—George H. Tuthill, Brooklyn, New York city. The improvement devised by this inventor is designed to hold the suspenders together and to prevent them from sliding off the wearer's shoulders, and also to hold the necktie in place and to support the drawers. The attachment comprises a cord having a number of clips slidable thereon, and a central plate securing the ends of the cord and slidably engaging the cord between the clips. The plate and clips act together to perform the functions mentioned.

STAIRWAY.—George C. Tilyou, Coney Island, Brooklyn, New York city. The present invention provides a stairway constructed in two longitudinally-slidable, inclined sections, arranged snugly against each other and furnished with means by which they may be driven simultaneously in parallel lines and in opposite directions, thus causing confusion to a person seeking to ascend or descend the stairway, the purpose being to afford amusement to the persons using the stairway.

NON-REFILLABLE BOTTLE.—Edmund West, Vallejo, Cal. In the neck of the bottle a cylinder is inserted open at the top and at the bottom. A weighted plug is adapted to close the bottom of the cylinder. A float-supported rod is passed through the cage, serves normally to hold the plug from the bottom opening in the cylinder, and pulls the plug into the bottom opening when the bottle is empty.

THREAD-BOX.—Mattie J. Edwards, Los Angeles, Cal. A receptacle is provided by this invention in which the thread is always kept in place ready for use. The box is formed with grooves extending inside of the front face. On opposite sides of the grooves clasp-springs are arranged which distend the thread across the grooves so that it may be easily grasped between the fingers. There is no projection on the front face of the box to injure the fingers.

PNEUMATIC PROPULSION MEANS.—James C. Walker, Waco, Tex. The inventor has sought to apply currents of air to aid the propulsion of ships or boats and to adapt the form of the ship to this mode of propulsion. The invention comprehends generally a construction of the hull of the vessel whereby air is capable of being so distributed as to produce a cushion on which the vessel is to float as much as possible instead of directly on the water, and means whereby cavitation on the rear of boat and of the propeller is reduced to a minimum.

CATTLE-SHED.—William Heaton, Allerton, Ill. The shed is composed of sections which have open ends, and which are adapted to be abutted end to end. The sections have inner and outer walls, and their roofs are provided with hinged doors. Feeding-troughs extend longitudinally within the sections to the ends, whereby the ends of the troughs of the abutting sections may register with supply-chutes leading from the outer walls of the sections to the troughs. Gates in the outer walls control access to the chutes. The inventor claims that by thus arranging the shed, more stock can be fed than would be possible otherwise.

SHADE-FINDER.—George K. Henderson, Coshocton, Ohio. This invention is a device for blending colors, showing over one thousand four hundred shades composed of yellow, red, and blue, with the proportions of each single or blended color by weight and by comparative scale. The device consists of three sheets of gelatin mounted so as to pass one over the face of the other, the base of the blender having a scale giving the proper proportion of each color on each sheet. The device will be of considerable service to the process-worker, lithographer, printer, or anyone concerned with the mixing of colors.

SPECTACLES.—John McLernon, Pottsville, Pa. This invention consists of a U shaped spectacle-frame which passes over the ears and around the back of the head. A movable frame holding a pair of lenses slides forward or backward in the projecting ends of the U-frame and allows the lenses to be focussed. The lenses may also be moved nearer together or farther apart in order properly to center them. This invention will be of service to watchmakers, jewelers, and engravers, as it will enable them to make use of both eyes in their work.

LEVELING-ROD.—John S. Millikin and W Eugene Bowen, Ontario, Ore This device consists of two independently-movable, endless tapes located side by side in the same face of the rod and scaled from zero in opposite directions. The tapes pass over rollers in each end of the rod; and each has a sighting-target attached to it at zero. By means of this rod differences in elevation between two points may be read directly without making the computation ordinarily required.

ACETYLENE-GENERATOR.—Ernst A. Meyer, Memphis, Tenn. The carbid-tray in this apparatus is placed in a compartment in the bottom of the gasometer. In its center is a small receptacle for water, which has perforations at different heights to allow the water to reach the carbid. Immediately above this receptacle is a valve-chamber having in its top a tubular valve and casing. The valve tube has openings near each end so placed that, when in its middle position, water can pass into the valve-chamber; while in extreme positions one or the other openings is closed. A float attached to the end of the valve tube regulates the supply. As the gasometer bell falls, it sinks the float and opens the valve, which soon closes again as the gas evolved causes the bell to rise.

AUTOMATIC SIPHON.—Charles F. L. McQuistion, Butler, Pa. This siphon is so constructed as to empty a tank at stated intervals as soon as it becomes full. It consists of an inverted U-shaped discharge pipe, the longer arm of which terminates in a water-seal or trap below the tank. A second S-shaped tube placed beside the siphon is connected with it above the bevel of the water in the trap. The lower bend in this tube is above the bottom of the siphon pipe; while the upper bend is above the bend in it. As the tank fills, the air is compressed in the two pipes, causing the water level to fall in both ends of each. When the level falls to the lower bend in the small tube, the compressed air blows out the water-seal, and the water, rushing in from above, starts the siphon flowing.

SELF-WEIGHING SCALE.—Alva W. B. Johnson, Mount Vernon, Ill. This scale consists of a pivoted scoop having a small inclined bucket-elevator, similar to a grain elevator, arranged in the back end. The elevator is operated by an electric motor. The weighing scoop rests on a balanced platform the same as with an ordinary scale. After setting the weight at the proper point on the scale arm, the operator fills the scoop till the beam rises, when a connection is made, and the elevator carries away the surplus. The operator then dumps the scoop; and the scale is ready to weigh again.

INCANDESCENT VAPOR-BURNER.—James A. Yarton, Kansas City, Kan. This apparatus for burning vaporized hydrocarbons comprises essentially an oil or naphtha tank having a vent, and a generator. A pipe leads from the generator and is connected with the tank at top and bottom, whereby the gases escaping from the generator can pass into the tank at the top, without impeding the flow of the oil. One of the novel features of the invention is the construction of the generator. This generator comprises a tube bending down immediately over the burner or at the point of greatest heat whereby a pocket is formed to which the oil drains and is then vaporized. Traps are provided in the apparatus to collect sediment.

THAWING-DEVICE FOR MINES.—Cary Wright, Salmon City, Idaho. This invention consists of a rotatable cylinder horizontally mounted on a movable platform and having a hinged cover through which fuel may be introduced. The cylinder is perforated on its front side to allow the heat to escape. The rear side also has perforations through which an air blast is maintained for the purpose of aiding combustion.

PIPE-SCRAPER.—Samuel Crawshaw, Oamaru, New Zealand. The scraper consists of a main stem attached to which are spring arms, having at their ends laterally-curved scrapers, which conform to the surface of the pipe. Spreader-plates adjust the spring-arms for any size of pipe. A leather scraping piston is at the forward end of the stem, and a centering block at the handle end.

TOASTING AND BROILING APPARATUS.—Abraham Lurie and Louis Biloon, 179 E. 107th Street, New York. The toaster consists of a U-shaped wire netting frame fitted with a handle and arranged to slip into a special holder attached to a gas jet. The holder has two flat side pieces, which act as reflectors. A sheet of flame plays between each of the side pieces and the wire holder, thus toasting the slice of bread on both sides at once. The broiler is similarly constructed and is provided with the necessary drip-pans.

CORSET-FASTENER.—Anna Leeson, Quatsino, Canada. One of the two busks of the corset is notched to receive lugs on the other busk when both are made to overlap. A clasp engages each lug, which is properly bent to receive it, and holds the two busks firmly together.

TEMPORARY FASTENER FOR BOXES, ETC.—Hialmer B. J. Andrus, Winooski, Wis. This fastener consists of two long, narrow, U-shaped, flexible, wire prongs, which are driven into the top and side of the box near the edge. The upper one, which is a little wider than the lower, is bent out horizontally and the lower one passed vertically upward through it. The top wire is then bent down against the side of the box, and the wire, passing through it, is bent down over it, thus securely fastening the cover.

PNEUMATIC TIRE.—John J. Farrar, Rapid City, S. D. An outer containing tire has within it a small inflation-tube with rigid walls. This inflation-tube is inside what corresponds to the inner tube of an ordinary double tube tire, this inner tube being, however, firmly bound to the outer tube at short distances, thus forming bulb-shaped compartments. A valve in the inflation-tube in each compartment admits the air, and a puncture in any part of the tire will only cause the deflation of one compartment.

SKYLIGHT.—Willey J. P. Kingsley, Rome, N. Y. The skylight has longitudinal grooves cut in the flanges supporting the panes, and the top or lapped-over edges of the panes are cut at a wide, obtuse angle. By this arrangement, the water which may condense on the under surface of the glass runs to one side and down the groove out to the roof.

MAIL-BOX.—S. A. and F. J. Bragunier, Topeka, Kan., and P. J. Bragunier, Denver, Col. This box is adapted to be fitted to a door or door casing, and is fitted with a vertically-sliding door having lugs projecting through slits in the sides. One of the lugs passes under a catch on the door (supposing the box on the casing) and thus locks the door of the mail-box. When the door is opened, the catch is disengaged from above the lug and, consequently, the mail box door may be raised.

HAMMOCK-SLING FOR INFANTS.—Ira M. George, Kingsbridge, New York city. This invention provides a small hammock swung from davits fastened to the bedposts at the foot of the bed. The arms of the davits project toward the head of the bed and are held rigid by an adjustable brace rod. When making the bed the hammock and brace may be easily detached and the arms swung facing each other directly over the foot board.

Designs.

LACE FASTENER.—William H. Pardee and Fenton E. Judson, Antigo, Wis. The leading feature consists in a fastener having a hook arched from the eye with a lateral trend at the arched portion, the end beyond the arch running downwardly and inwardly and then outwardly to give the free end a trend in a direction opposite the lateral trend at the arch.

PINCUSHION.—Corry Jones, Long Island City, New York. The cushion consists of a head, formed with a cap, on the side of which are bands above a head from which depends a tapering shank, designed to enter the hole of a spool of thread.

LEGGING.—Charles S. and A. S. Huntington, Omaha, Neb. The legging has its instep portion offset from the body portion, the inner ends of the instep overlapping the instep end of the body and having a binding extending from one side to the other of the body, following the line of the instep. Upon the heel portion of the body a curved stiffening band is secured.

METAL STOCK.—Robert Dulk, Bronx, New York city. The leading feature of the design consists in a spray of holly and a smooth border extending along the edge of the spray. The stock is to be used on picture-frames, the smooth border serving to prevent the pricking of the fingers which has hitherto resulted from its omission.

LAMP.—Louis C. Tiffany, Manhattan, New York city. The body of this lamp is formed by the shell of a pearly nautilus, pivotally mounted on a stand. Within the shell the bulb of an incandescent electric lamp is arranged.

ACETYLENE GAS BICYCLE-LAMP.—Charles Kelly, Passaic, N. J. The lamp in appearance is very compact, and gives, for the amount of carbid used, an exceedingly bright light. The brilliancy of this light depends largely upon the use of a parabolic reflector.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC.

The Locomotive. New Series. Vol. XIX. Hartford, Conn.: The Hartford Steam Boiler Inspection and Insurance Company. 1898. J. M. Allen, Editor. Pp. 191. 12mo.

The annual volume of this little periodical is always a welcome visitor, and will prove valuable to all steam users and those who are in any way interested in the subject. Each number contains one or more high class technical articles, besides a full record of boiler explosions of a preceding month. There is also a collection of well selected reprint matter. Where necessary the subject is well illustrated by half-tone engravings, showing explosions, etc., and by clear diagrams. The Locomotive is read by steam users all over the country.

Materialistisch-Hypothetische Sätze und Erklärung des Wesens und der Kraftäusserungen des elektrischen Fluidums. Von F. Ph. Stögermayr. With 88 illustrations. Vienna: A. Hartleben. 1899. 2 vols. 8vo. Pp. 431. Price, paper, $2.

The Elements of Practical Astronomy. By W. W. Campbell. New York: The Macmillan Company. 1899. Pp. 264. Price $2.

The time is ripe for a new text book on astronomy, and Prof. Campbell, who is an astronomer in the Lick Observatory, is well qualified for the task. It should be said, however, that this is the second edition, the former having been published in 1891. The author's experience in presenting the elements of practical astronomy to large classes of students has stood him in good stead, and the volume before us is an admirable text book for classes.

Defective Eyesight. The Principles of its Relief by Glasses. By D. B. St. John Roosa, M.D., LL.D. New York: The Macmillan Company. 1899. 12mo. Pp. 193. Price $1 net.

The author is one of the most noted specialists in diseases of the eye in the world, and anything which emanates from his pen is sure to be authoritative, and the volume before us is filled with valuable material which cannot but prove of the greatest possible value to all who deal with defective eyesight. It is accompanied by many excellent illustrations and test charts.

La Spécificité Cellulaire. Par L. Bard. Paris: Georges Carré et C. Naud. 1899. Pp. 100. 12mo. Price 50 cents.

La Sexualité. Par F. le Dantec. Paris: Georges Carré et C. Naud. 1899. Pp. 98. 12mo. Price 50 cents.

La Théorie de Maxwell et les Oscillations Hertziennes. Par H. Poincaré. Paris: Georges Carré et C. Naud. 1899. Pp. 80. 12mo. Price 50 cents.

The three little volumes which lie before us form part of a series of scientific monographs which the publishers have termed "Scientia." The volumes in the series are written by well known French savants and offer to the reader a philosophic exposition of recent discoveries and of the development of the sciences in general. The clearness of the descriptive matter and the scholarly way in which the subjects have been treated should earn for the series a place in the library of every student of science.

Twenty-first Annual Report of the State Board of Health of Connecticut. Pp. 197.

We acknowledge the receipt of this valuable annual book of 197 pages for the year 1898, compiled by Prof. Charles A. Lindsley, M.D., of New Haven, Conn. It contains reports from the several county and town health officers, and numerous statistics graphically arranged.

Business and Personal.

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(7662) J. S. R. asks: When does the 19th century end? A. The 19th century closes with December 31, 1900. The 20th century begins January 1, 1901. Reasons: 1. There never was a year numbered 0 in chronology, though astronomers have called the year before the Christian era the year zero. The reckoning in chronology is B.C. 3, 2, 1, A.D. 1, 2, 3, etc. The year 1 B.C. was followed directly by 1 A.D. in all historical reckoning. See Ency. Brit., under Chronology. In astronomical reckoning the year 0 preceded the Christian era. The first year A. D. was the "year 1." The year 1 was completed on December 31, twelve months after the beginning of our present reckoning. There is much confusion on this point; but it is just as simple as reckoning the years of a baby's life. When is the year 1 of a baby's life finished? Who ever heard of a baby's 0 year? 2. The year 100 belonged to the first Christian century. The reason for this is the same as for putting the 100th article into a package which is to contain 100 articles. The 2d hundred articles begin with No. 201. In counting articles by hundreds we proceed as follows:

1st	hundred	Nos.	1	to	100 inclusive.
2d	"	"	101	200	"
19th	"	"	1801	1900	"
20th	"	"	1901	2000	"

Dollars, years, or centuries follow the same law. A man is 100 years, a century, old when he has completed a full 100 years. Not when his 100th year begins, but when it ends. Its full twelve months belong to him. The writer remembers very well, though only 9 years old, the discussion of this question in 1850 and the conclusion that 1850 belonged to the first half of the 19th century. It will certainly be premature to write centennial sermons or lectures or articles for 1899. If this is done, it will be found necessary to repeat them in 1900, as not a few did in 1849 and 1850 for the half century. This view accords with the statement of both the Century and Webster's Dictionaries. We quote from the former; "The first century of the Christian era began with the year A. D. 1 and extended to the end of the year 100; the 18th century began with 1701 and ended with 1800, the year completing the hundred year period in each instance giving name to the century. The centuries before Christ are reckoned backward in their order from the Christian era, as the 4th century B.C. from 301 B. C. backward to 400.

(7663) L. S. T. writes: I have ascertained the theoretical horse power of a stream under a given head to be 1000. I wish to transmit that power by means of electricity five miles for use as a motive power in two mills. Will you please inform me how much of the 1,000 horse power may be safely relied on for practical use, from motors at terminus of the line? Will you tell me, also, what is the percentage of loss in practice at the several stages of conversion and transmission of the power: (1) Loss in making the 1000 available by means of turbines, (2) the loss in generating the electricity, (3) the loss under ordinary conditions in transmission, and (4) the loss at the motors? A. We can only give a general answer to these inquiries, since the conditions peculiar to the special case affect results. The efficiency of turbine wheels is from 75 to 87 per cent at full gate. For anything less the figures drop off rapidly. The dynamo will return from 85 to 93 per cent of the power of the turbine. The loss in transmission depends on the size of the wire used, but may be put down at from 5 to 10 per cent, so that from 90 to 95 per cent of the current delivered by the dynamo will reach the transformers. The transformers will turn about 95 per cent of the current they receive to the motors, which will in turn give 85 to 90 per cent of this to the machinery. As a total then about 60 per cent of the power of the waterfall will be received by the machinery. This is based on the supposition that everything works at full load. Much depends on the machines used, and only an engineer on the spot can give reliable figures.

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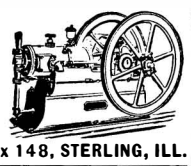

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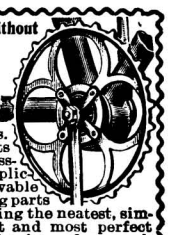

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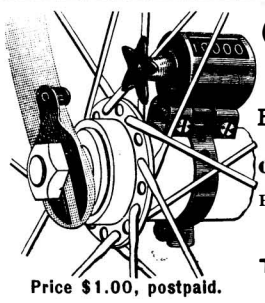

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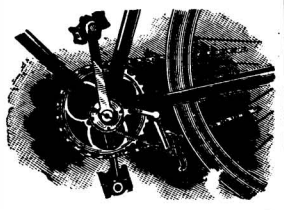

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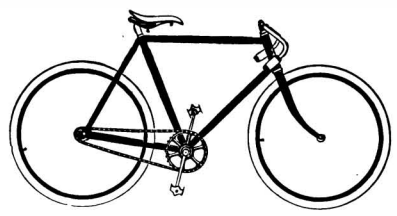

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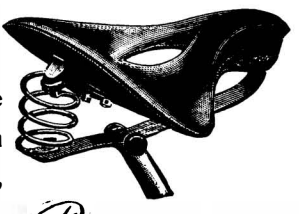

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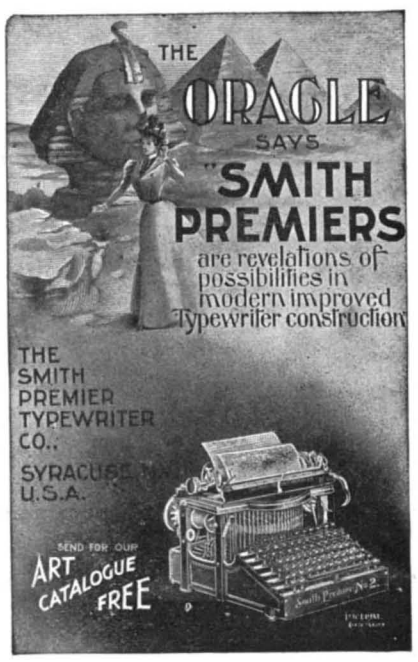

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