SCIENTIFIC AMERICAN

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Vol. XCVIII.—No. 23.] ESTABLISHED 1845.

NEW YORK, JUNE 6, 1908.

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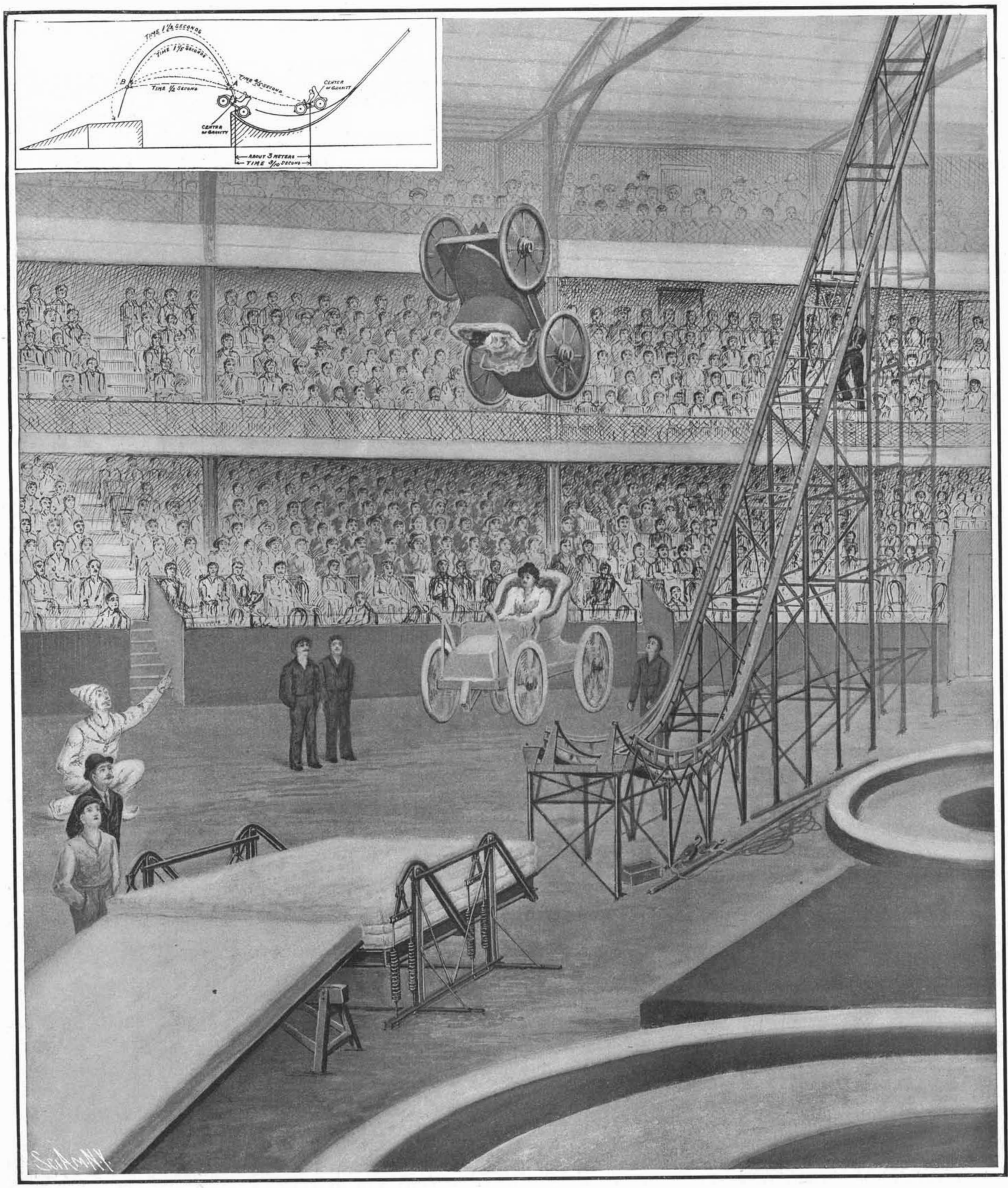

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"AUTOS THAT PASS IN THE AIR."—[See page 411.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO. - - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York

FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States or Mexico	$3.00
One copy, one year, for Canada	3.75
One copy, one year, to any foreign country, postage prepaid, 18s. 6d.	4.50

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845)	$3.00 a year
Scientific American Supplement (established 1876)	5.00 "
American Homes and Gardens	3.00 "
Scientific American Export Edition (established 1878).	3.00 "

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Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JUNE 6, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

BATTLE TEST OF A 12-INCH TURRET.

A battle which was not a battle but an expert test of war materials, took place on May 27 in the waters of Hampton Roads, between two modern monitors (if there can be such a thing as a modern monitor) the "Arkansas" and "Florida," when a 12-inch shell was fired at a distance of a few hundred yards from a 40-caliber gun of the "Arkansas" against the inclined turret port plate of the sister ship "Florida." The shell did not get through, neither did it cause any serious structural injury to the turret, its turning gear, or its interior.

The "Arkansas" and "Florida" belong to a class of four monitors which were authorized, in a moment of panic, by Congress during the Spanish war. The Scientific American protested strongly against the construction of these out-of-date craft, and predicted that it would not be many years before they would be regarded as practically useless. The prediction has come true. These four ships are to-day too low, too slow, and altogether too unsteady as gun platforms, to be reckoned as any serious part of the navy.

Hence the recent decision of the government to use the "Arkansas" as a target for modern gun fire, to determine how far the results obtained at the proving grounds could be duplicated on the sea, and incidentally to learn a great many other important things about the behavior of a ship under fire, was highly commendable. The practice of using obsolete warships as targets is not new. Some seven or eight years ago the British navy moored the old battleship "Belle Isle" in shoal water and hammered her until she sank; and recently the same thing was done with the British battleship "Hero." The French, moreover, are patching up the big battleship "Jena" with a view to putting her to similar hard usage.

A shell from one of the 12-inch guns of the "Arkansas," filled with high explosive, was fired at a range of about 350 yards, and with a charge so reduced that the striking velocity would be about the same as that at a range of 5,000 yards with a full charge of powder. It struck the inclined turret port plate, just to the right of the starboard gun, and the energy of the blow seems to have been entirely absorbed by the outside plate which was cracked but was not penetrated. Dummy men which had been placed inside were found to be in their original positions. The port gun was intact, the ammunition hoist and the various mechanisms were found in good condition. This result is particularly gratifying when we remember that this armor is not the Krupp steel now used on our ships, but the old Harvey armor of twenty to twenty-five per cent less resisting power. It is probable that Krupp steel would have defeated the shell entirely. Immediately after the blow was struck, it was found that the turret turning gear was in perfect condition. Altogether, the test is considered to have established the correctness of the design of this, the most important military element in a battleship.

At the after end of the superstructure there had been erected a tower, or skeleton mast, at the top of which was a fire-control platform. The mast consisted of a large number of hollow steel tubes, tapering from 2½ inches in diameter at the bottom to 1¾ inches at the top, which were laced or trussed spirally into a tower 150 feet in height and tapering from 25 feet at the base to 10 feet at the top. Against this was directed a fire of four 4-inch shots and one 12-inch. Although every shot got home, the tower, in spite of its being badly cut up, was still carrying its fire-control platform intact. After the attack a naval constructor climbed to the top of the tower and found that the speaking-tube leading down to the deck was workable, and this in spite of the fact that it had been somewhat damaged. The electrical wiring was also found to be in good order. As the result of this test the Board have agreed that the skeleton type of mast is greatly superior to the tubular type. It is gratifying to know that masts of this kind are provided for in our four 20,000-ton ships of the "Delaware" class. The next experiment carried out against the "Arkansas" will consist in firing torpedoes at her, first while she is protected by torpedo nets, and secondly, when she has no protection of this character. The test should throw some much-needed light upon the question of water-tight compartments and anti-torpedo bulkheads.

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THE CAPACITY OF THE SUBWAY.

The results of the exhaustive examination of traffic conditions in the Rapid Transit Subway made by B. J. Arnold have been embodied in a report to the Public Service Commission, which contains many valuable suggestions for increasing the traffic capacity.

It is believed that the present rate of train movement of thirty trains per hour in one direction upon each track can be increased to forty trains per hour, by installing automatic closing-door signals upon the cars; by providing speed control signals auxiliary to the present block signal system at the approaches to the stations; and by providing more doors in the sides of the cars. To make these changes effective the obstacle presented by the present cross-overs in the tracks at Ninety-sixth Street station should be removed, and the station should be double-decked so as to provide two additional express tracks in the station.

The train capacity of the Subway cannot be increased by increasing the speed of the trains, as the increased length of the signal blocks necessary for the higher speeds more than offsets the advantage of the increased speed. But a great increase in the capacity can be realized by lengthening the trains. Mr. Arnold suggests the running of seven-car local trains and ten-car expresses, both at the rate of 40 miles an hour. He estimates that if this be done, the capacity of the present Subway will be increased 75 per cent.

Although double-deck cars are considered to be impracticable for subway operation, the question of using wider cars should be carefully considered in planning future subways; and in order to secure the maximum possible capacity, tests should be made to determine more accurately the distance required to bring a train to rest from full speed when the emergency stop is used.

Finally, the report suggests that to secure maximum capacity, future subways should be designed with double-decked stations, provided with double tracks for each main line; this would permit of the operation of ten-car trains on a 60-second headway on each track, thus providing a carrying capacity of three times that of the present subway.

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RECTANGULAR LATTICED COMPRESSION MEMBERS IN BRIDGES.

If engineers had as certain knowledge of the strength of the built-up compression members of modern bridges as they have of that of the tension members, the fall of a Quebec bridge would be well-nigh impossible, and the last cause of anxiety about such structures would be removed. When the total load to be taken by a tension member is known, it is a simple matter to put into the eye-bars a sufficient section of steel to insure that the stress upon each square inch of the member cannot possibly exceed a certain figure, far below the known strength of that steel. Hence it is that properly designed modern steel bridges are never known to fail in the tension members. It is the compression members that are the first to go.

The uncertainty as to the actual strength of such huge built-up members as are found in bridges of the size of that at Quebec and Blackwell's Island arises from the lack of sufficient knowledge as to the resisting strength of the steel when, unlike the simple eye-bar, it consists of a complicated assemblage of plates, angles, splices, and stiffeners, depending for its strength upon an accuracy of workmanship which, in members of this huge size, it is almost impossible to obtain.

Thus the Blackwell's Island Bridge chords are made up of four vertical webs or built-up plates, four feet deep and, say, five or six inches in thickness. Now a solid plate, four feet deep, five inches thick, and forty feet long, if stood on end would carry a certain load, before it began to bend transversely to its plane. But if that web consisted of, say, seven or eight thin plates riveted together, it is evident that it would begin to bend under a much smaller load than the solid plate. How much smaller? No one can exactly say; and here is one of the elements of uncertainty affecting the design of large compression members.

Now let us suppose that instead of one built-up web we take four, and stand them up side by side in parallel planes, with intervals of eighteen inches between them. The total load they would carry without bending or buckling would be probably just four times as great as was carried by the one. The total, however, would be ridiculously small compared with the total section of 1,119 square inches of steel, which is the amount in the largest chord section of the Blackwell's Island Bridge.

If, however, these four webs were to be connected together throughout their whole height, so that instead of acting independently under the load, they would be held together, and must deflect, if they did so at all, as a whole and in the same direction, it is evident that they would carry a much greater load than when they stood up as four, unbraced, thin, and long plates, with nothing but their own very slight individual stiffness to hold them in their true vertical planes. Moreover, the amount of additional load the four webs, as thus braced together, would carry without buckling, would evidently depend upon the strength of this bracing, or stiffening.

The simplest and at the same time the weakest form of stiffening would be to rivet a series of flat plates across the four edges of the webs, at stated intervals, as was done between the edges of the two inner webs of the Blackwell's Island Bridge.

A better way would be to rivet a complete trusswork of light steel angles, or bars, across the edges of the four webs, as was done across the whole width of the Quebec chords, and across each outside pair of webs in the Blackwell's Island Bridge. (Although it should be remembered that the latter trussing, because of its slight depth, is, for a given weight of latticing, greatly inferior to latticing which extends the full width of the chord.) The webs, as thus stiffened, could be loaded, either until the lattice bars broke, or the lattice rivets sheared off, or the webs buckled between the points of attachment of the lattice trussing to them. However, the latticing would fail and the webs buckle at a load per square inch far below the maximum crushing strength of the steel in the webs.

If, however, steel cover plates, wide enough to cover the width of the four webs, were to be riveted down their full length, the rivets being driven but a few inches apart, and so tying the edge of each web securely to the cover plates, the four webs would be so securely held in their true planes, that the loading might be carried up far nearer to the maximum strength per square inch of a short length of steel of the same quality. It it were desired to develop the strength of the webs still further, internal transverse plates or webs might be riveted between them at their center.

The whole question of the strength of exceedingly large compression members of the rectangular three- or four-leaved type is in a most unsatisfactory state. Formulæ which seem to have been trustworthy for small compression members have failed for such large ones as those at Quebec. The cause for uneasiness about the Blackwell's Island Bridge lies in the fact that a new system of stiffening has been adopted which, theoretically, at least, is inferior to that used at Quebec. The combination of two shallow latticings, joined by a set of flat tie-plates, is essentially hybrid and its strength is difficult to determine. A bottom chord carrying the enormous loads of those at Blackwell's Island should have been stiffened by the third or cover-plate system of the three above referred to, and not by a combination of the first two.

There is only one certain way to determine whether these chords are able to take care of the enormous loads which will come upon them, and that is to build a model of, say, one-third full size, and test it to destruction in a testing machine. We care not how expert may be the Board that investigates the bridge—its findings with regard to these chords of novel and untested type will be based largely upon the theories which received such a staggering blow when the Quebec bridge fell.

As we go to press we are gratified to learn that Comptroller Metz has appointed a well-known firm of engineers, not in any way connected with the Bridge Department, to make a thorough computation of the strength of the bridge. An independent examination is also being made by Prof. Burr; and the Bridge Department will thus have the advantage of a double check upon the work. In any case we trust that a model will be made and tested. The cost would be but a few thousand dollars, a consideration that should have no weight in a bridge costing some twenty-three million dollars.

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Military experts are satisfied that the balloon offers an excellent means of locating the positions of the enemy and that the danger to the men in the balloon is not so great as had been heretofore supposed. By the aid of photographic apparatus and field glasses the enemy may be located at distances ranging from five to fifteen miles, according to the condition **of the atmosphere.**

PERMANENT PRINTED RECORDS ON LINEN.

BY DR. WILLIAM J. MANNING, OF THE GOVERNMENT PRINTING OFFICE.

Perhaps nothing can be more interesting in a way, to the general historian, scientific and literary man than the certain knowledge of the fact that his writings and printed records on all subjects, inclusive of even photographic reproductions in the form of "half-tones," may be handed down to those who will come after us thousands of years hence. In the course of a study of various materials suitable for the permanent preservation of valuable literary works, I investigated, among other fabrics, the linen wrappings used by the ancient Egyptians to incase the bodies of their dead. A specimen of such linen was obtained from the Metropolitan Museum of Arts, New York city, by the writer, and the age of the fabric is certified by the curator of Egyptian antiquities of the Museum. Of interest possibly to the historian and Bible reader as well as those who reverence and love the work of the ancients, is the fact that the wrappings in question were taken from the body of King Merenptah, whom the Bible mentions as being the Pharaoh who ordered the exodus of the Jews from Egypt. The age belongs to the Nineteenth Dynasty, which would approximate the age of 3,400 years, a tremendous space of time when one stops to consider the matter.

The writer, while obtaining the fabrics and looking over the various specimens submitted to him, was very fortunate to obtain by mere accident a piece containing pitch or bitumen spots, with which latter agent the Egyptians affixed the body to the inner coffin and which procedure is described by Pliny and Herodotus. The spots appealed rather strongly to the writer from the fact that they would seem to constitute conclusive proof of the lasting and non-fading properties of printing ink as manufactured and used to-day the world over.

The basis of all black printing ink is lampblack or carbon (soot) to which is added and blended boiled linseed oil, to serve as a vehicle, the oil being thoroughly mixed with the lampblack, or "milled," as it is known technically to the printing ink industry. Varnish, glycerine, and a volatile dryer are sometimes added to meet the various requirements of the printing trade, but the basis is, or should be, always carbon (lampblack) and boiled linseed oil for black printing ink. The lampblack is obtained from a resinous material similar to the bitumen of the ancients that left the spots or impression on the linen.

The manner of receiving the ink impression as obtained on paper or even linen fabric is made up of both a mechanical and a chemical union. By a chemical union I mean the fact that the linseed oil carries a certain proportion of the carbon or lampblack into the agent printed upon, thus staining the parenchyma of the cellulose cell. By a mechanical union, I mean the excess ink that may lodge on the surface of the agent printed upon by virtue of its adhesiveness.

In the Egyptian mummy wrappings to which I have already referred the bitumen stain or chemic union has remained unto this day, as would the stain or impression of printing ink had it been so received, beyond all doubt. As a further proof of this statement and the unchanging color of carbon (lampblack) note should be taken of the color of coal, almost pure carbon, which for ages has retained its color.

Lehner has called attention to the lasting properties of linen fabrics as used by the ancients, and urges a better quality of printing paper containing a larger proportion of linen fiber. The objection to paper, whether it is composed of cotton, linen, or wood fibers, as concerns printed records for a long period of time might be thus summarized:

The fact that all paper is composed of very short fibers held together by a glue or size and the initial pressure given by the heated cylinders on the paper-making machine may be urged. Certain kinds of blotting paper may be mentioned as an unsized or glueless paper, the fibers being held together by pressure only. The best grade of book paper may be cited as an engine-sized or glued paper. Long periods of time or exposure to dampness may disintegrate the size or glue that holds or binds the fibers together. If you are sufficiently interested, wet a piece of paper and note how easily the printed sheet drops to pieces.

The bleaching process to which the paper stock is subjected would seem to form a very important feature in connection with the lasting properties of paper also. Chlorine and bleaching powders are used extensively for this purpose, and the difficulty seems to be that when the elements are removed which go to make up the various colorings, both natural and artificial, of the paper stock before being bleached, the chlorine probably combines chemically in the form of a chloride or a hypochlorous oxide indirectly, from the fact that the chlorine will unite with nearly all elements directly save oxygen and a few others. Very likely for this reason it later exists as a weak acid in the paper stock, probably as hypochlorous, when the finished paper is acted upon by the moisture of the atmosphere. It is known that hypochlorous oxide will unite with water to form hypochlorous acid. It is therefore a difficult matter to neutralize the bleached paper stock because of this chemical combination.

The effect of the process just described is noticed when the average book printing paper is exposed to the air, even under cover, for any length of time. Note, if you are interested, the light yellow tinge that makes its appearance, followed in due course of time by a dark yellowish green hue. This condition is followed later by an increasing brittleness to such an extent that one hesitates, in some instances, to turn a leaf down for fear of cracking the sheet. The yellow tinge is not noted so early in papers whose surfaces are sized, because the film of the size very likely protects the hypochlorous oxide from the air. Sooner or later it makes its appearance as a slight discoloration. This chemical action, as the result of bleaching, must necessarily go on until the sheet is disintegrated. Although we have no positive proof of this latter statement, yet it is known that the slow continuous chemic action, once in motion, must continue as long as there is material left upon which to perform its work.

The first paper makers used the sun to bleach their paper stock, and while they were never enabled by this method to obtain the extreme whiteness obtained by the use of chlorine by modern paper makers, yet their product does not show the chemic action just described and the bleaching appears to have been accomplished in a perfectly natural and harmless manner.

In linen fabric of a very fine mesh and texture and of an unbleached variety, the objections raised against the paper, it would appear, are easily overcome. The fact that one can be always sure of the absolute purity of the linen so used as compared with the uncertainty of even linen paper and its composition, is very important. The printing impression so received upon the fabric is beautifully clean cut, and stands out as distinctly as, if not more so than on paper. Even halftone cuts can be printed on linen.

There is also the added fact that the fibers of linen are very long, and as such are twisted into threads and these threads woven in such a manner that each succeeding thread locks the other in place in a mechanical manner, as in the ancient Egyptian wrappings which have defied time itself, even when exposed to the elements and the careless usages of ages.

The further fact that the linen may be used in its unbleached state unacted upon by chemicals used for bleaching purposes, and the very important feature that the printing ink impression cannot be removed from the fabric, which is possible with comparative ease even when parchment is used as the substance printed upon, are two excellent reasons why linen should be used for documents which are intended to be permanent.

It has been proposed, and the matter is now before the Joint Committee on Printing of Congress for action, to print upon linen sheets precisely the same as a sheet of paper, at the expiration of the regular paper edition, two copies of the more important government publications. It is further proposed to encase each volume so printed in a bath of paraffin wax and thus to seal the volume hermetically from extraneous or atmospheric influences.

Taking the year of 1907 as a basis it will cost, approximately, to print two linen copies of the revised edition of the Congressional Record, constituting some 5,000 pages, not over $65 for the fabric so utilized. No change in existing printing machinery is necessary and it is but the work of a few moments to produce the printed linen sheets.

AERONAUTICAL NOTES.

Subsequently to the successful 1,017-foot flight of the Aerial Experiment Association's aeroplane, described in our last issue, the aeroplane was demolished when a flight was attempted by Mr. J. A. D. McCurdy, of the association. The machine is being rebuilt, and further tests will soon be made. The builders will duplicate this machine for anyone desiring one for $5,000, delivery to be made within sixty days.

On March 30 last the Wright brothers were granted two French patents on improvements in the control of their type of aeroplane. These provide for the maintenance of lateral stability by the slight twisting of the outer ends of the surfaces, and for the correction of the twisting effect thus produced, which tends to turn the machine around its vertical axis, owing to the greater resistance at the end of the wings where the greater angle of incidence occurs. This turning effect is counteracted by the use of a vertical rudder and a stationary vertical plane in front, and also by the use of small vertical rudders between the planes at their ends. The latter are used to increase the resistance of the end having the least angle of incidence, while the vertical rudder is operated in conjunction with the rear vertical rudder, to correct the twisting motion and also to steer the aeroplane. The patent does not cover the application of a motor to the aeroplane, the machine shown being, like their former machine, apparently only a glider.

After the experiments of Farman and Delagrange above the parade ground at Issy, on May 2, during the course of which the latter's aeroplane failed to make a turn, made a sudden descent, and finally landed upon a taximeter cab, these two aviators decided to abandon their experiments in France on account of the interference of spectators, who crowded upon the parade ground in dangerous numbers, and also because this field had become too small, owing to the increased speed attained by Farman by the use of a motor of somewhat greater horse-power. The two aviators, who, as is well known, have similar machines, betook themselves to Ghent and to Rome respectively, and on May 25 Farman is reported to have begun his experiments and to have made a number of flights in a rather strong wind. On May 27 he is said to have made two flights of 1,600 meters (5,249 feet) each. On the latter day, Delagrange remained in the air nine minutes and twelve seconds, while trying to win the $8,000 prize recently offered in Italy for a fifteen-minute continuous flight. The latter performance was made in the presence of King Victor Emanuel.

The fourth congress of the International Federation of Aero Clubs assembled in London on May 27. There were representatives from the following countries: America, Austria, Belgium, England, France, Germany, Hungary, Italy, Spain, Sweden, and Switzerland. Among the questions discussed was that concerning the ending of a balloon race at the seaboard of a country, and it was decided that any balloonist who goes to sea so far that he requires assistance to get ashore will be disqualified as a pilot, and, if he does this in a race, the distance he covered above the land will not count. In view of the airship disaster in California on May 23, in which a gigantic dirigible, carrying sixteen men, exploded, it was thought best to take steps to control ballooning as much as possible and thereby add to the safety of inexperienced aeronauts.

Russia is the latest country to take up aeronautics, and there is a great popular interest in the subject shown among the people and by the government. The War Department has donated a $2,500 cash prize for an aeroplane race, the conditions of which are that, in case of war, the aeroplane owned by members of the club shall be placed at the disposal of the War Department. The distance to be covered in this race is given as 158 miles at an average speed of not less than 9 miles an hour. The new club has joined the International Federation.

That the plain balloon is not as safe as most enthusiastic balloonists assert, is shown by two serious accidents which occurred last month. On May 19, while participating in an international race, a Spanish balloon containing two men descended. The experienced pilot in charge was thrown out and the balloon reascended with the other man who had no knowledge of ballooning. After being in the air all night, the balloon came down the following day, and the man who was in the basket was seriously injured by colliding with various obstacles before the balloon reached the ground. The other accident resulted in the death of Lieut. Fonseca, a balloon expert of the Brazilian army. The lieutenant had just arrived from France with a new balloon and was making his first ascension before the Minister of War and a large number of officers and pupils of the military school. He was in the basket and was completing his final preparations, when a sudden gust of wind snatched the balloon away from the men who were holding it and it shot up in the air for a distance of 3,000 feet. It then collapsed and fell to the ground with great rapidity. This accident recalls a similar one which occurred in Italy about a year ago, when a captive military balloon was struck by lightning and exploded in mid-air and the officer in the basket lost his life as a result of the fall.

THE CURRENT SUPPLEMENT.

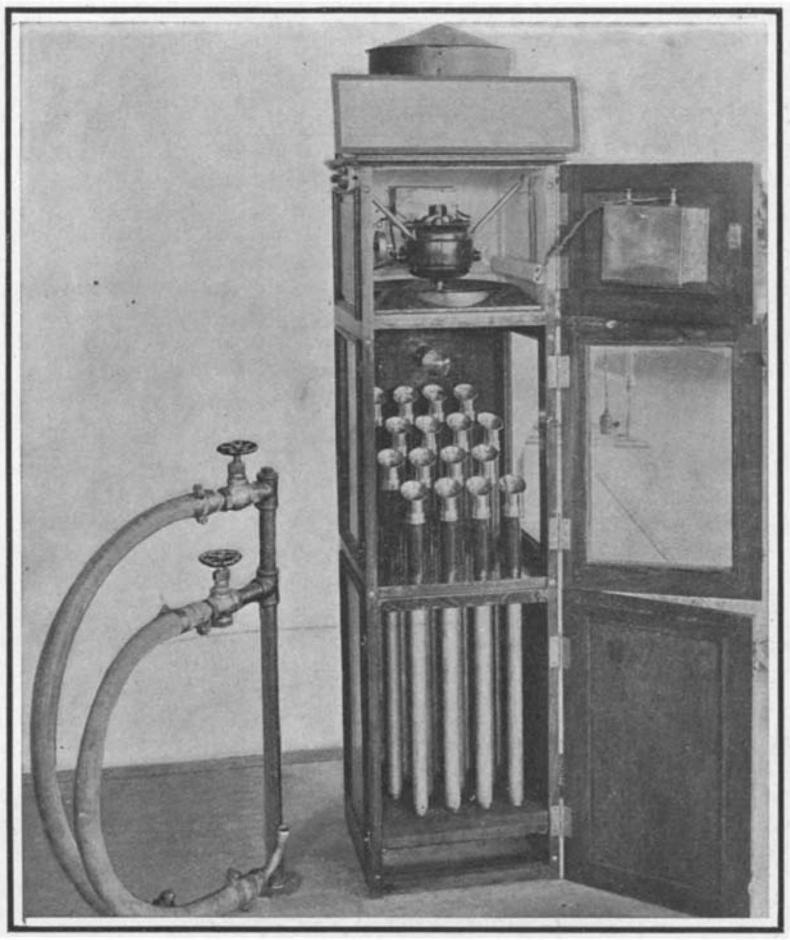
The current SUPPLEMENT, No. 1692, contains among other interesting articles a striking contribution by Herbert C. Ponting on photographing alligators, excellently illustrated. Mr. George N. Heath's paper on the fixation of atmospheric nitrogen in America is concluded. Carl G. Crawford writes on the treatment of timber and explains the tank method. In these days of prohibition agitation, Dr. A. R. Cushing's impartial review of the medical value of alcohol will prove instructive. In an article on Saturn and his rings the well-known French astronomer Abbé Moreux describes in a popular way the various aspects of this very curious celestial phenomenon. Prof. S. J. Holmes contributes an excellent article on the instinct of feigning death. Prof. Herbert Maule Richards gives a very lucid explanation of the mutation theory of Hugo de Vries. Otto Nairz describes clearly the Poulsen wireless telephone. Edward A. Martin discusses dewponds from the geological standpoint. The usual notes will be found in their accustomed places.

THE AWARD OF THE SCIENTIFIC AMERICAN MEDAL.

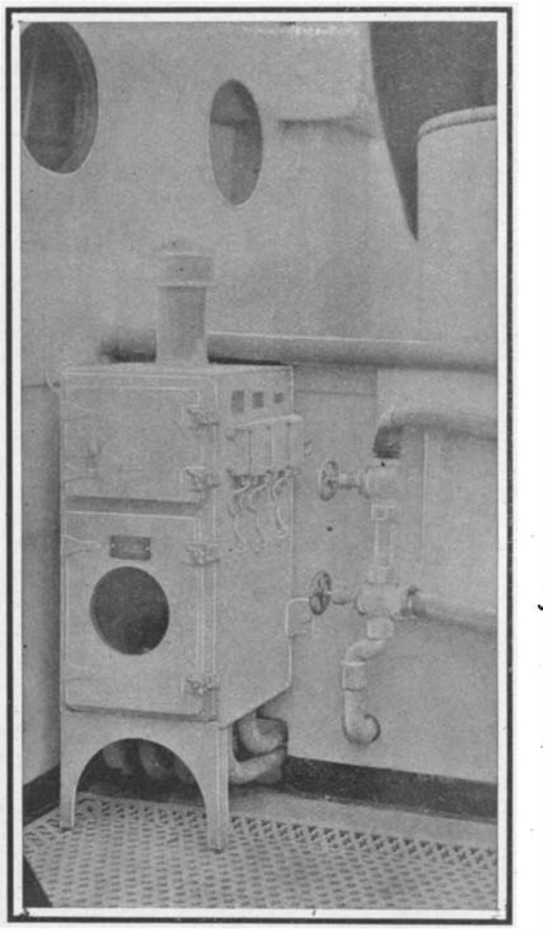
One of the most encouraging signs of the moral uplifting of the race is the unmistakable growth in these days of humanitarian sentiment. The dignity of the human body, the sanctity of human life, are swiftly emerging to their full and proper recognition. The report has lain too long at our doors that as a people we were so madly bent on the pursuit of wealth that we cared little who might fall by the wayside, if only the goal were swiftly achieved. To the question: "How much then is the life of a man worth more than a sheep?" we have made answer by rolling up a record which well exceeds the half million mark of annual maimings and killings that may well put us to the blush. In view of the fact that a very large percentage of accidents is absolutely preventable, the editors of the Scientific American decided last year to offer a gold medal annually for the best device for the protection of life and limb, exhibited at the expositions held under the auspices of the American Museum of Safety Devices, after a board of impartial experts had rigidly passed on the devices submitted, and our engraving shows the obverse of the medal, which is suitably inscribed on the reverse. It is 2⅜ inches in diameter and weighs 5½ ounces. For the past few weeks a most interesting exhibition has been held at the American Museum of Safety Devices, 231 West 39th Street, New York, N. Y. A large number of exhibits were on view and the jury was enabled to make a careful and unbiased examination. The result of their labors was made public at a luncheon given at the Engineers' Club on May 25, which was attended by about one hundred prominent industrialists and heads of great corporations. Mr. Charles Kirchoff, editor of the Iron Age, presided, and there were addresses by Mr. T. Commerford Martin, editor of the Electrical World, and by Dr. W. H. Tolman, director of the museum. A most interesting letter from the Rt. Rev. Henry C. Potter, D.D., bishop of the diocese of New York, who has accepted the chairmanship of the educational committee, was also read. The jury for ~~the~~ this year's award of the Scientific American medal was a most distinguished one, consisting of Prof. F. R. Hutton, chairman; Mr. H. H. Westinghouse, Mr. Stuyvesant Fish, Mr. George Gilmour, Mr. John Hayes Hammond, Prof. Samuel Sheldon, and Mr. Cornelius Vanderbilt. The findings of such an expert jury will certainly carry great weight.

The award of the gold medal for 1908 was made in the field of transportation. It was eminently proper that the first medal should be given for a device for safeguarding life at sea. What is more terrible than a fire at sea? The dreadful crash of collision is no worse than the sullen, angry roar of flames coming from a hatchway. To prevent fire by proper ventilation, to detect fire by purely mechanical means, and to put out fire in inaccessible places with the aid of live steam is the object of the successful device which has really been "tried by fire" in a number of instances.

Within the limitations of the rules adopted the jury decided that any devices, to claim consideration, must possess the following elements or attributes, and that that device which exhibited these qualities to the higest degree should receive the award.



THE RICH FIRE INDICATING AND EXTINGUISHING SYSTEM.



THE SYSTEM INSTALLED ON R. M. S. "LUSITANIA."

1. Applicability, wide or narrow. Does the device procure safety for a large number of persons, or in a great variety of conditions?
2. Practicability. It must be capable of being used successfully. It must not be too cumbrous or intricate to apply or to operate.
3. Simplicity. It must not be so complicated that experts are required to handle it or to keep it in repair and operation.
4. Reliability. It must not be liable to derangement, causing failure to work in emergencies.
5. Durability. It must not be so delicate, or require such fine adjustment that when installed it will not last in service.
6. Commercial availability. It must not be too expensive in first cost to install, or in operation to maintain.

In applying their rules and requirements to the exhibits shown in the exposition of ~~1908,~~ the jury awarded the medal tendered by the Scientific American to the Rich Marine Fire Indicating and Extinguishing System. The jury was glad to make honorable mention ~~of~~ the Welin Quadrant Davit, and the Simmen Automatic Railway Signal. A brief description of the successful device will prove of interest. A 1-inch pipe runs to each hold, storeroom, bunker, or other inaccessible or dangerous place, where it terminates with a flat cap or smoke collector. There may be several of these collectors attached to each pipe. The pipes from the various holds and bunkers are assembled from fore and aft and are carried to the bridge or to the wheel house. Here they are arranged in banks in a case, which is practically air-tight. Each pipe has a removable smoke spreader bearing a number. Directly over the pipes is an electric fan which can be actuated continuously or at intervals. In front is a clock provided with means for making contact with an electric bell every fifteen minutes. It is the duty of the officer of the watch to set the motor in motion if it is not running continuously and to look through the glass front at the pipes. Very little suction is necessary to draw the smoke from any incipient fire and it is readily detected with the aid of the electric light which is inside the case. If no fire is found the officer "rings in" on a time clock like a watchman's detector, showing that he has made the proper inspection. It is customary when an officer comes on duty to make the same test and to enter it on the ship's log. If there should be any indication of smoke, the case is opened, the cap is removed, and a flexible hose is screwed to the end of the pipe and notice is given the engine room to turn on live steam, which is one of the best known destroyers of combustion. There are two lengths of hose provided, so that if necessary fire can be fought in two compartments at the same time. Several ships have been saved by the aid of this simple adaptation of what is known as the "plumber's smoke test." The device has been indorsed by Lloyds and other marine underwriters, and ships so equipped are given the advantage of a special rate. For the benefit of our readers we have had photographed the smoke-detecting device as installed on board the R. M. S. "Lusitania," where it will be situated back on the bridge. In the "Mauretania" it is housed in the wheel house, and the change will also be made on the "Lusitania." It will be seen that the apparatus is very heavily protected against the weather. There are eight pipes on the "Lusitania," as she was built primarily for heavy passenger traffic and cannot be regarded as essentially a freighter. The steamship "Coamo" of the New York and Porto Rico Steamship Company, having a plurality of holds and bunkers, has twenty-two pipes, and instead of being on the bridge, the device is located in the saloon where it can be seen by all. It is most gratifying to note that this invention has been thought worthy of installation on the two leviathans of the sea. The jury is to be congratulated for the faithful performance of their duties, and for so worthy an award.

The Scientific American Medal.

After the presentation of the Scientific American medal, the medal offered by Mr. Francis A. Richards for the best in the field of motor vehicles was awarded to the Non-Explosive Safety Naphtha Container Company, with honorable mention to the Rutherford Wheel Company. The medal offered by the Travellers' Insurance Company, for the best invention in the department of mines and mining, was not awarded. As soon as the committee of direction, which is composed of editors of nineteen technical papers, have decided on the field of industry for which the next Scientific American medal will be awarded, we will give ample notice to our readers and will give the conditions which will surround the competition.

* * *

The Amount of Rainfall Over the Surface of the Earth.

The discussion of observations on rainfall made first by Sir John Murray and later by Bruckner and Fritsche permits an estimation to be made of the mean rainfall on continents, which is found to be about 30 inches per year. The rainfall on the ocean is more difficult to measure, but it has been estimated by Supau; and Fritsche, taking account of all the known facts, estimates the mean annual rainfall for the entire surface of the earth at about 36 inches. Making use of this number, it is easy to calculate that the total rainfall amounts to 464 million millions of metric tons per year, 1,272 thousand millions of tons per day, 53 thousand millions of tons per hour, 883 million tons per minute, or 15 million tons per second.

* * *

According to a report issued by the German Colonial Department, the trade in cement in German East Africa is increasing, not only with the official houses and the railways, but also with the natives, particularly on the coast. Imports into the colony rose from 2,482 tons in 1905 to 4,437 tons in 1906, not including importations on behalf of the government. While this increased trade has chiefly benefited German houses, there is nevertheless a chance for other countries to take a share. Belgium, for example, has already obtained a footing. The latter country sends cheaper kinds in wooden barrels, while Germany supplies Portland cement in metal cylinders. Prices vary from 10 rupees per 400 pounds for cheap qualities to 14 rupees for the best. A rupee, in American money, is equivalent to nearly 50 cents

THE LARGEST REFLECTING TELESCOPE IN THE WORLD.

BY GRACE AGNES THOMPSON.

The astronomical observatory connected with Harvard University has just completed the mounting on its grounds at Cambridge, Mass., of a 5-foot reflecting telescope, purchased from the estate of Dr. A. A. Common at Ealing, England, which is at present the largest astronomical instrument in the world.

The biggest telescope in the world is an expression that has changed its meaning a number of times. A few years ago it was an instrument which we would call very small to-day—only a few inches in diameter. Gradually the size of each new instrument was increased, until people spoke of the 40-inch Yerkes telescope as the largest telescope in active use in the world, and indeed it is still the largest refracting telescope in the world. For until certain difficulties in the making of large disks of optical glass have been overcome, it is probable that no larger lens will be successful, and reflecting telescopes must do all the work required of a very large instrument. The Common telescope is 20 inches wider than the diameter of the Yerkes.

The largest telescope ever constructed was a 6-foot instrument made by Lord Rosse in 1842, and set up in the park of his castle in Ireland. But for various reasons this telescope was not long of any use, and it was abandoned many years ago. It is an interesting relic, still to be seen with its mirror of metal and its clumsy mounting at Parsontown, Ireland. The Common telescope has an excellent mirror of optical glass, and is mounted in a wonderfully ingenious and practical way. Only the principal portions of the original instrument have been used by the Harvard Observatory, and an entirely new system of control has been worked out, by which electricity has been called into a field heretofore untried. Even the mounting of this telescope is as remarkable as it is unusual. Instead of being supported by a pedestal or foundation pier of cast iron, cement, or masonry firmly built upon the ground, like all other large equatorial telescopes, it is held in position by a hollow cylinder that floats in a tank of water.

For this, a deep excavation was made on the spot where the telescope was to stand—the first sod being turned September 28, 1904—and a tank was constructed with thick walls of solid concrete, 15 feet deep at the farther end and 21 feet long, the bottom sloping upward from the deep end at an angle of about 45 deg. to the surface of the ground. In this tank the water-tight steel float or cylinder, which is 18 feet long and 7 feet 8 inches in diameter, is ballasted at the same angle as the bottom of the tank, this angle being that of the celestial pole as measured at Cambridge, and the cylinder acting as the polar axis of the telescope. The buoyancy of the water supports its weight, and delicate pivots at each end serve to steady it in position and allow it to turn readily. Above this, and securely attached to it by a strong fork and bolts, is the tube of the telescope, which is seen in position in the accompanying photograph. The tube is not circular, as in most other telescopes, but rectangular. Nor has it solid walls. The upper part of the tube, for a distance of 15 feet, is a skeleton framework of angle iron, with an inside measurement of 6 feet, which is now covered with heavy canvas. The lower end, which contains the mirror and is bolted to the iron fork just mentioned, is a hollow cube with sides 6 feet in length that are made of steel plates. The whole structure weighs over 20 tons, but is so delicately poised that it appears to have no weight at all, and it can be moved in any direction, up, down, or sidewise, without the slightest jar or slip. The telescopes in most observatories are handled by elaborate mechanical devices including clockwork that runs by a system of weights, but the Common telescope is moved and controlled entirely by electricity. However elaborate and ingenious, hand machinery must always be crude and inconvenient. Electricity insures a nicety and regularity in moving and guiding an instrument that can be fully depended upon, and at the same time it simplifies the mechanism. The Harvard Observatory has been the pioneer in demonstrating this fact. For several years all the clockwork required for following for the various instruments here has been driven by electric motors. The necessary mechanism for this is the result of much thought, invention, and experiment on the part of Mr. Willard P. Gerrish, of the observatory, under whose direction the Common telescope has been installed. Electric power is applied not only to the clockwork, but to the mechanism for handling the Common telescope. At no other observatory is electricity so employed. The eyepiece of the Common telescope, to which the image of the star is carried by a system of mirrors, is situated at a desk in the "observing room" in the second story of the small building shown in the photograph. Small switches located at the same desk control motors and clutches, by means of which the telescope may be swung at different speeds. A small motor synchronized by an accurate clock gives a uniform motion for following, while dials and indicators at the recorder's desk show at a glance the exact position of the telescope and the motion that is being imparted to it. Other dials register automatically the measures made by photometric apparatus used by the observer at the eyepiece. Thus observer and recorder may work together comfortably in a warm room, whatever the conditions in the open air.

On the first floor, under the observing room, is the silvering room, where the great mirror, which is a disk of glass 5 inches thick and 60 inches in diameter, weighing with its cell nearly two tons, may be rolled in over a kind of railroad on to the silvering table, when it requires a recoating of silver.

One other fact connected with this telescope is interesting. It has been mounted in the open air. This is a very unusual procedure, but is expected to prove as successful as convenient. It is an experiment made chiefly as a matter of economy, since in dispensing with any dome or shelter over so large an instrument, a very considerable expenditure has been saved without any injury whatever to the instrument.

The Common telescope is a modified form of the Cassegrainian type; that is, the light rays, after passing down the length of the tube to the great mirror, are reflected back to a second, convex in form, placed in the axis of the tube within the focal lengths of the rays, from this again toward the large mirror to a third placed diagonally, by which the image of the star is sent into the eyepiece. As has been stated, it is also an equatorial; in other words, a telescope mounted so that its motion is on an axis parallel to the earth's axis, an inclination which corresponds to the latitude of the observatory, while the telescope proper is attached to this polar axis by means of a second axis, called the declination axis. Since both the telescope and the polar axis rotate freely, by this double motion, when the image of a star has

The Observing Room of the Common Telescope. The Eyepiece of the Telescope is Under the Window.

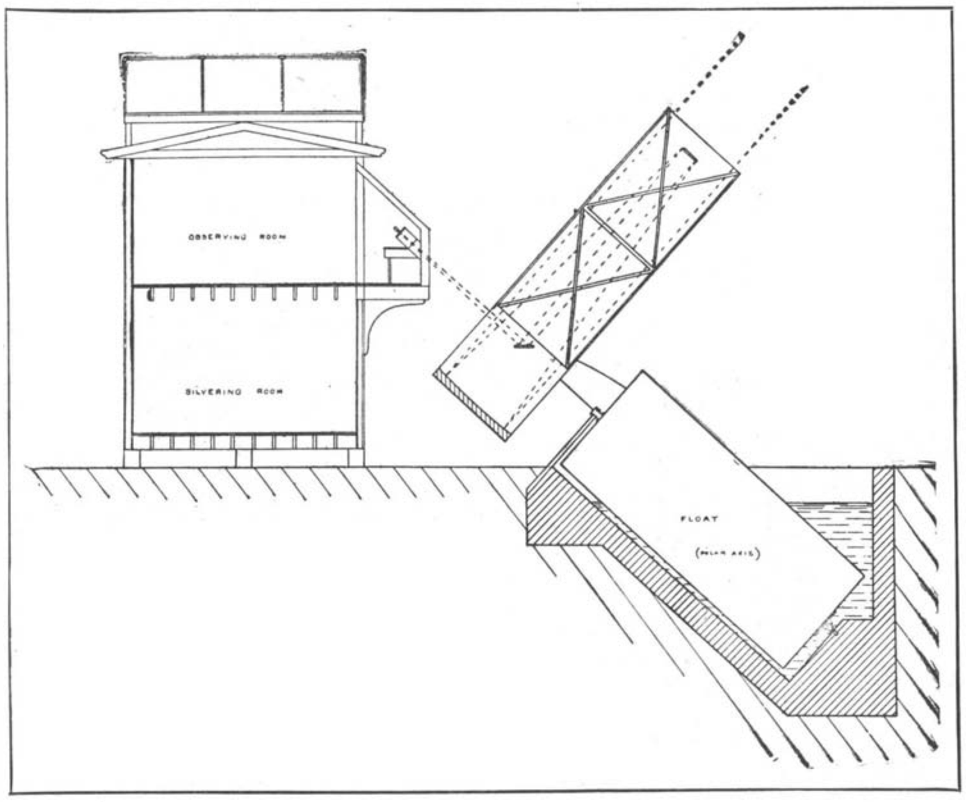
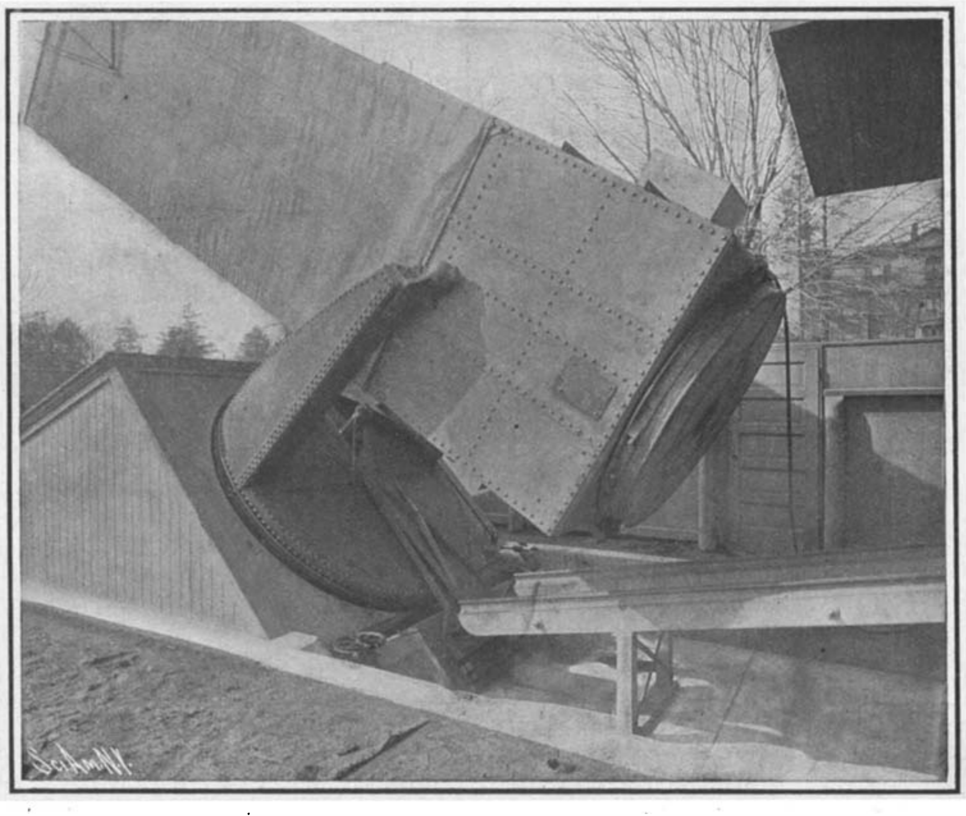


Diagram of the Common Telescope, Showing Manner of Mounting.



The Lower Part of the Common Telescope and Its Support on the Float. The Image is Reflected to an Eyepiece in the Building at the Right.

THE LARGEST REFLECTING TELESCOPE IN THE WORLD.

once appeared in the field of the telescope, a rotation of the polar axis east to west in sidereal time makes the telescope follow the apparent motion of the star, so that it remains constantly in the field until it has passed below the horizon. The Common telescope is, therefore, not only well adapted to photographic purposes, as intended by Dr. Common, but to the photometric work to which it has been assigned at Harvard Observatory.

This photometric work, or measuring the light of the stars, has been an important part of the routine in Cambridge for more than a quarter of a century, and is the chosen life work of Prof. Edward C. Pickering, director of the observatory, who devotes to it from two to four hours of each clear night. He has determined the light of over four thousand stars, and made more than one hundred thousand measures of them. But heretofore a 12-inch telescope is the largest instrument that has been available to him for the work, and only stars of the twelfth magnitude and brighter could be measured. The Common telescope, however, from its great aperture, is expected to show stars of the seventeenth or eighteenth magnitude or fainter, thus opening to astronomy a scientific possibility whose value can hardly be estimated.

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Disposal of Town Refuse.

Several short papers on the disposal of refuse in American cities were recently communicated by different authors to the New York section of the Society of Chemical Industry, and the papers have been published in the current issue of the Journal of that Society Hitherto, dumping of the refuse on low-lying meadowland has been the method of disposal most commonly adopted in American towns, although garbage furnaces have been used there to a certain extent for more than twenty years, and Mr. Rudolph Hering states that there is no city in the United States where all the city refuse is mixed and properly incinerated. Referring to the removal of garbage from hotels and restaurants in New York, Mr. Morse says that the quantity of garbage taken away by private agency amounts to from 15,000 to 20,000 tons per annum, but that the best hotels are now recognizing the advantage of a garbage destructor. At the new Hotel Astor a destructor equipped with a boiler for low-pressure steam is about to be installed. Some interesting information concerning the work of the New York Department of Street Cleaning is contained in the paper communicated by Mr. Edward D. Very. He says that the wastes of New York city are on the average proportioned as follows: Household ash, 47.5 per cent; steam ash, 18 per cent; street sweepings, 18.5 per cent; rubbish, 6 per cent; garbage, 10 per cent. The garbage received at the reduction plant in Jamaica Bay contains 71 per cent water, 6 per cent rubbish, 20 per cent tankage, and 3 per cent grease. The grease is extracted by digesting the garbage with steam and then passing the garbage pulp through hydraulic presses to express the grease and water. The grease is of a low grade and has a dark brown color. The greater portion is exported, and is used for making soap and candles. Tankage is the solid fibrous matter remaining in the presses, and is used as a fertilizer base or filler. It appears probable that in the largest American towns the European practice of incinerating the refuse in destructors erected within the towns will be generally adopted in the immediate future.

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The work of partially reconstructing the wooden lattice-work pillars and supporting platform, on which will rest the shear legs, derrick, boiler, winch, etc., for raising the 160-ton Rammerhead crane at the Keyham Extension, Devonport, is nearing completion, and the mounting of the lifting appliances will coincide with the delivery of the components of the great crane. While the test load was being lifted, the breaking of the supporting pin of the shear leg caused it to collapse and fall to the ground, carrying with it the boiler, winch, and a portion of the platform, and also damaging the pillar nearest the edge of the basin. This accident has necessitated the partial reconstruction referred to, also the retiring and strengthening of the remaining pillars. The complete structure rests on a trolley, with bogie wheels, having a lateral movement parallel to the crane pit.

PANAMA CANAL: FINAL PLAN AND PRESENT CONDITION OF THE WORK.

During the past year it has been our pleasure to record the satisfactory progress which has been made in the development of the final plans, and in the prosecution of the actual work of construction of the Panama Canal. In the present article we give a description of the plans of the canal as revised and finally approved, and statements of the work done by the French company, of the total excavation required for the whole canal, of the amount of work completed since American operations commenced, together with a summary of the appropriations made for the canal and of the money so far expended.

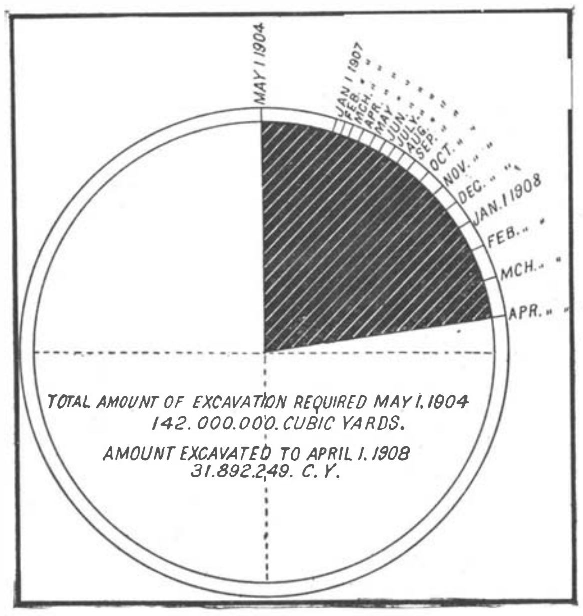

DIAGRAM SHOWING IN BLACK SHADING THE AMOUNT OF EXCAVATION COMPLETED BY APRIL, 1908, ON THE PANAMA CANAL.

Type of Canal.—The canal will have a summit elevation of 85 feet above the sea, to be reached by a flight of three locks located at Gatun, on the Atlantic side, and by one lock at Pedro Miguel and a flight of two at Miraflores, on the Pacific side; all these locks to be in duplicate, that is, to have two chambers, side by side. Each lock will have a usable length of 1,000 feet and a width of 110 feet. The summit level will be maintained by a large dam at Gatun and a small one at Pedro Miguel, making the great Gatun Lake, which will have an area of 164.23 square miles. A small lake, about two square miles in area, with a surface elevation of 55 feet, will be formed on the Pacific side between Pedro Miguel and Miraflores, the valley of the Rio Grande being closed by a small dam and the locks at Miraflores.

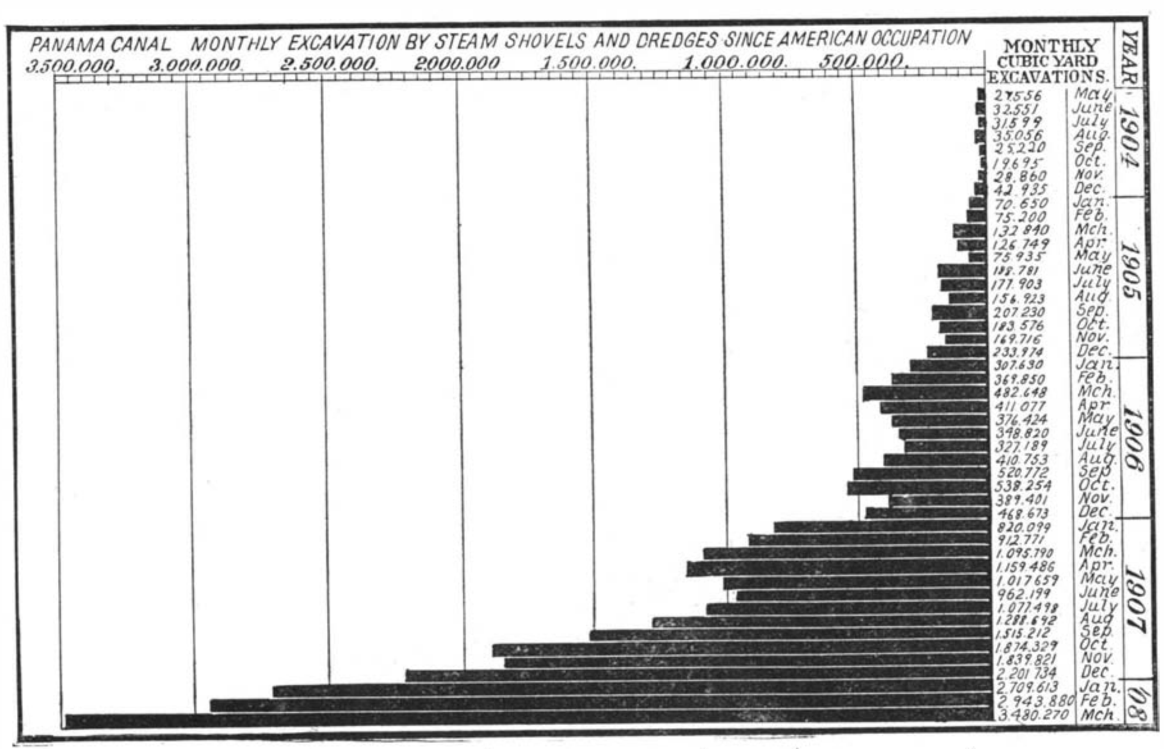

DIAGRAM SHOWING EXCAVATION DURING EACH MONTH AT PANAMA BY STEAM DREDGES AND SHOVELS SINCE AMERICAN OCCUPATION.

Length, Width, and Depth of Canal.—The canal is to be about 50 miles in length from deep water in the Caribbean Sea to deep water in the Pacific Ocean. The distance from deep water to the shore line in Limon Bay is about 4½ miles, and from the Pacific shore line to deep water is about 5 miles; hence the length of the canal from shore to shore will be approximately 40½ miles.

The bottom width of the canal will vary from 200 feet in Culebra cut to an indefinite width in the deep waters of the lakes. The approaches from deep water to land on both sides of the canal are to be 500 feet wide, and the cuts in the shallow parts of the lakes from 500 to 1,000 feet wide. The canal will have a minimum depth of 41 feet.

Amount of Work Done by the French.—The amount of material excavated by the old and new Panama Canal companies was 81,548,000 cubic yards. It was estimated in the report of the Commission for 1901 that 36,689,965 cubic yards of the prism excavated by the French would be useful in the main line of the new canal, to which must be added the prism excavated by the company since the date of that report, 3,510,231 cubic yards, making a total of 40,200,196 cubic yards. This amount will be reduced by the submergence of the channel between Gatun and Bohio, which would have been utilized by the plan of the Commission of 1901, but not in the present project.

Total Amount of Excavation.—The following is the total estimated excavation required, for the whole canal based on the present working plans:

	Cubic yards.
In canal prism	106,931,849
Excavation for locks, regulating works, diversion channel, and sea level channel, from La Boca to Miraflores.......	28,363,400
Dredging entrance to old canal at Colon for wharf purposes, and to aid in construction of Gatun works; and at Panama to keep channel open to La Boca........	7,039,607
Total	142,334,856

For purpose of comparison, it may be stated that the estimated amount of excavation required in the canal prism for a sea-level canal, as recommended by the majority of the Board of Consulting Engineers, was 231,026,477 cubic yards.

Steam Shovel Equipment.—Thirty-two 95-ton, twenty-eight 70-ton, three 45-ton, and one 38-ton steam shovel, or a total of sixty-four steam shovels (of which three have been assigned to the Panama Railroad), are now in commission; six 95-ton, fourteen 70-ton, and seven 45-ton steam shovels are either *en route* or have recently been delivered, and will soon be in use; and in addition, ten 95-ton steam shovels will be delivered in the near future.

Force Employed.—In the month of February, 1908, there were approximately 44,000 employees on the Isthmus on the rolls of the Commission and of the Panama Railroad, about 5,500 of whom were Americans. There were actually at work on February 26, 1908, 32,318 men—25,888 men for the Commission, and 6,430 for the Panama Railroad.

Material Excavated by the United States.—The two accompanying diagrams show with great clearness both the amount of work already completed on the canal and the steadily growing rate of increase month by month, since actual work was commenced by the United States in May, 1904. It will be seen that in the first month, and, in fact, during the first twelve months, the amount of material taken out was insignificant, ranging from 19,695 cubic yards to a maximum of 132,840 cubic yards a month. In the spring of 1905, however, monthly progress began to show a more or less steady increase. This was due to the fact that the preliminary work in the way of reconstructing the Panama Railway, laying new track, and providing suitable dumps, was making headway, and the excavating plant was being placed in position for doing effective work. The largest excavation in any one month in 1905 was 233,974 cubic yards, which was taken out in December of that year. In 1906 the monthly excavation for the first time passed the half million mark, the maximum monthly output being 538,254 cubic yards in October of that year. In 1907 the rate of excavation began to advance by leaps and bounds, rising from 820,099 cubic yards in January to 2,201,734 cubic yards in December. This rate of progress was maintained steadily in January, February, and March of the present year, the highest figure being reached in March, when the enormous total of 3,480,270 cubic yards was excavated in a single month. The amount of excavation in April was somewhat less than this, but it was sufficient to bring the total amount of material taken out under American operation up to about 35,000,000 cubic yards, or about one fourth of the total of 142,000,000 cubic yards, which must be excavated to complete the canal. If the present rate of excavation be continued, the excavation of the canal could be completed in about three years time. Indeed, the question of the date of completion depends now upon the time it will take to build the great Gatun dam and the flight of double locks, between 3,000 and 4,000 feet in total length, at Gatun. If no unforeseen difficulties are encountered, the canal will probably be ready for opening in seven or eight years' time.

Appropriations for Canal.—In addition to the $40,000,000 paid to the French company for its property and rights of all kinds on the Isthmus, and the $10,000,000 paid to the Republic of Panama for the rights granted under the treaty between that republic and the United States, there have been appropriated by Congress the following amounts to continue the construction of the canal: In June, 1902, $10,000,000; in December, 1905, $11,000,000; in February, 1906, $5,990,786; in June of the same year, over $25,000,000; in March, 1907, over $27,000,000; and in February of the present year, over $12,000,000, making a total appropriation to date for construction of the canal of $91,787,468. Of this sum, $5,333,367 was loaned and advanced to the Panama Railroad Company to pay for its re-equipment. The gross sum appropriated to date, including the payment to the French company and to Panama, is $141,787,468.

Canal Expenditures.—The expenditures for canal work with the exception of some disbursements, such as purchasing material, etc., which it will not be possible to locate through a specified account until their use has been finally determined, are as follows, up to and including January, 1908: For civil administration, $1,844,819; for sanitation, $5,966,501; for construction and engineering, $22,109,757; for municipal improvements, $5,106,056; for purchase, construction, and repair of plant, $25,422,637; making a total expenditure for construction of the canal up to January, 1908, of $60,449,770.

Present Organization of the Commission.—The present Commission is presided over by Lieut.-Col. George W. Goethals, of the Corps of Engineers of the United States Army, as chairman and chief engineer. With him are associated Major David D. Gaillard and Major William L. Sibert, both of the Corps of Engineers of the United States Army; Civil Engineer H. H. Rousseau, United States Navy; Col. W. C. Gorgas, Medical Corps, United States Army, who has charge of sanitation; Hon. J. C. S. Blackburn, and Mr. Jackson Smith. The work is organized into the eight Departments of Construction and Engineering; Civil Administration; Law; Sanitation; Purchasing; Disbursements; Examination of Accounts; and Labor, Quarters, and Subsistence. The chairman has general supervision of the work of all departments. Each commissioner is in charge of some special department, and all seven are now residing on the Isthmus.

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THE MECHANICS OF "AUTOS THAT PASS IN THE AIR."

In our issue of February 9, 1907, we described a somersaulting automobile apparatus which was popularly known as the "auto-bolide" and which was one of the most thrilling attractions of the Barnum & Bailey circus in that year. Exciting as the "auto-bolide" undoubtedly was, the exigencies of novelty demanded something new for this season, and if possible something even more startling. The inventor of the apparatus, Mr. Maurice Garanger, a civil engineer by training, therefore set about the task of eclipsing his previous effort. The result is a novel apparatus, which from the fact that it necessitates the employment of two cars instead of one, is called "Autos That Pass in the Air."

The actual mechanism for projecting the two cars into the air is exactly the same as that of the "auto-bolide." One car is made to describe a somersault, while the other flies beneath it, and safely lands before the somersault is completed. To understand the mechanical principle involved, a brief recapitulation of our previous article is necessary.

Upon an inclined chute a pair of broad tracks are carried. Only the front wheels of the somersaulting car rest on these tracks; the rear of the car is carried by two rollers mounted directly on the rear axle and riding on the tops of two rails placed between the two broad tracks for the front wheels. The two rails on which the rear rollers travel terminate in a much sharper upward curve than the broad tracks. Hence, while the forward end of the car, traveling on the front wheels, follows the main track, the rear end is pitched upward by the rails. The car therefore describes a forward somersault. The second car does not somersault, but travels in an upright position along a curve from the end of the chute to the landing platform. All four wheels travel on the broad tracks previously mentioned; the rails play absolutely no part in the second car's performance.

Now, in order that the first car may describe its somersault and the second travel along its path without colliding, the travel of each must be nicely timed. How this problem was solved, the diagram on the front page clearly explains.

If the two cars are started together they will collide at the point *A*; if the second car is started after the first car by an incorrect interval it may collide with the first car at the point *B*. The time between *A* and *B* in a straight line is ½ second. In somersaulting the first car requires 1 1/5 seconds to pass from *A* to *B*. Hence, we have the problem: If the somersaulting car travels from *A* to *B* in 1 1/5 seconds, and the second car in ½ second, how much later must the second car start in order that it may not collide with the first car at *B* and may roll off the landing platform in ample time to permit the somersaulting car to alight? It was mathematically possible to calculate how much later the second car ought to start; and this Mr. Garanger did. The computation gave him a theoretical interval of 3/10 of a second as the time which must elapse before the second car should start. This value, however, did not take account of the friction of moving parts which was supposed to be the same for the two cars. The second car was automatically released by the first car by the tripping of a lever at a predetermined point in the chute. Time was necessarily consumed in transmitting the power from the releasing device to the latch which held the second car. In order to ascertain how much time was consumed Mr. Garanger ingeniously resorted to the moving picture machine. He took photographs of the cars at the rate of twenty a second. Thus he discovered their exact relative positions for each twentieth of a second, and ascertained how far the second car was from its true position. In one of these moving picture experiments the cars actually collided at the point *B*, and tumbled together on the landing platform because no allowance had been made for the time lost in transmitting the power from the lever released by the first car to the catch by which the second car was held. That lost time, from the moving picture film, was found to be 1/5 of a second. Hence, by starting the first car only 1/10 of a second before the second car, and allowing 1/5 of a second for the operation of the release, the exact interval of 3/10 of a second was obtained, on the maintenance of which the safety of the performance depends. Hence, when the first car is at *A*, 1 1/5 second distant from *B*, the second car is $1/2 + 3/10 = 4/5$ of a second from *B*. The interval of 3/10 of a second allows not only for the time lost in power transmission, but also for the entire automobile bodies to avoid each other at *B*, and not merely for their centers of gravity to clear.

The chute is 27 meters (88.56 feet) long. Since the cars travel at the rate of 12 meters a second, at the end of the curve, the entire performance lasts just 5 seconds.

In conclusion, it should be stated that the second car rolls off the landing platform, while the first or somersaulting car drops on all four wheels on the platform and remains there. The enormous living force of the car is taken up by twelve powerful coiled springs carrying a platform, each spring absorbing a shock equivalent to a weight of 2,200 pounds (1,000 kilos) and compressing one foot when the somersaulting car lands.

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Leather Shoes for Horses.

A new market for leather, according to Le Franc Parleur, is to be found in Australia, concerning which this French journal says:

In districts of Australia the horse is shod with leather instead of iron. The feet receive better support. This novelty is employed only in regions where the ground is permanently covered with grass or fine sand. In a country like Australia, where stocks are sometimes scarce and a horseman may experience great difficulty at a critical moment in finding a horseshoe, such an innovation is a useful novelty. With extra shoes whose weight is a trifle, and which can be fitted without trouble, it is practicable to travel without fear of the horse losing its shoe and being injured. Though the leather shoe is more expensive than the iron shoe, the higher price is repaid by the advantages gained.

In some quarters the horses were never shod with iron. Probably shoes, like drivers, will be supplied before long, thus avoiding the disagreeable experience of a horse's hoof wearing too rapidly. It is not impossible the innovation will soon extend to every country where the nature of the soil permits it to be used.

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The new experimental furnace at the Noble electric iron smelter at Heroult, on Pitt River, near Redding, Cal., has been run continuously for some time, turning out 2,400 pounds of pig iron every twenty-four hours. The new furnace is the design of Prof. Dorsey Lyon, of Stanford University, who superintended its construction and is directing its operation. A recent test run was very satisfactory, the furnace being tapped regularly every four hours. The Lyon furnace differs from the Heroult electric furnace in that it is operated by a single-phase current, the other being of the three-phase type.

Correspondence.

Prof. Newcomb and Aeronautics.

To the Editor of the Scientific American:

In the North American Review of March, 1908, Prof. Newcomb applies the one, two, three dimension rule to aerial navigation by airship and by aeroplane, much to the disadvantage of the latter. If one of two similar airships has one dimension twice that of the other, it has four times the surface, and eight times the contents. The weight of its envelope is little over four times as great, but its gas has a lifting capacity eight times as great. It may carry an eight times heavier engine, whose eight-fold power more easily overcomes the fourfold resistance of its surface, and it carries its eightfold load faster. These principles are applied with the same results to water navigation. The lifting power of an aeroplane depends, however, not on its contents, but on the surface of its planes. If one of two similar aeroplanes has one dimension twice that of the other, the surface of its planes or its lifting power is four times as great, while its weight is eight times as great. The smaller machine is therefore the more efficient. There is a practical limit to size; this is about reached in the Farnam machine, etc.

The author is applying the principles of physics to the problem, but has he applied them to his statement that the fourfold area will have but a fourfold lifting power? Consider two such planes falling with their surfaces perpendicular to the force of gravitation. Air must pass from beneath each more or less equally and horizontally in all directions, and must close in from above in something of the same way. To get around the larger surface, air must travel practically twice as far, and if the two surfaces fall at the same rate, the air must travel twice as fast. The falling planes furnish energy for this movement of the air. Kinetic energy $= \frac{1}{2} m v^2$. Fourfold energy is therefore required to drive each molecule of air at this double rate, and as there are four times as many molecules to be driven from under the larger surface, sixteen times the energy is required to make the larger one fall at the same rate as the smaller. But it weighs only eight times as much, therefore the advantage is in its favor. It is twice as efficient.

According to these principles, the larger the parachute the more slowly it should descend with a proportionate load. This should be tried, and perhaps has. Only large birds soar. The humming bird or the bumble bee probably could not. It is true that the smaller ones rise more easily and manipulate themselves better, but it is generally true that small animals are proportionately stronger than large ones. The large bird has strength for but a moderate rate of wing vibration, but this accomplishes the same result as the more rapid vibration of the wings of the small bird. According to this fourth power of the dimension rule, the air below the large wing is in effect more solid. If the large bird had strength proportionate to the small one, neither could he flap his wings as fast, nor would he need to.

Does this apply to aerial navigation as well as to a body falling through the air? Evidently the beating of the wing of a bird or an orthopter is equivalent to the falling of a plane, and it applies to them. But the case of the aeroplane or helicopter is somewhat different. The aeroplane moves over the air in but one direction, instead of the air under it in all directions. These cases are, however, not essentially different, and the moment the plane begins to fall, they become similar. Again, the plane affects not merely the surface of air in contact with it, but affects the air to some depth, the larger plane proportionately deeper, and the matter is after all a three-dimension one.

There are too many unknown factors in the problem of aerial flight for even so eminent an authority as Prof. Newcomb to argue the subject *a priori* and without further experimental data.

Elbert E. Chandler, Ph.D.

Chemical Department, Pomona College, Claremont, Cal.

"Rail-less Tramways."

A short description is given in the Practical Engineer of a number of "rail-less tramways" now in operation in different parts of Germany, for the conveyance of both passengers and goods. The cars consist of dirigible vehicles, propelled by electric motors, which receive their current from an overhead conductor, supported on trolley poles. The cars have sufficient freedom of movement to enable them to turn aside about 12 feet in either direction from their wires. When two cars, traveling in opposite directions, meet, the contact rods of one are removed from the wires, and replaced when the other car has passed by. The first tramway on this system was constructed in Saxony, in 1901. Many systems of this kind have been described in these columns.

KNUDSEN'S PROCESS OF TRANSMITTING PICTURES BY WIRELESS TELEGRAPHY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

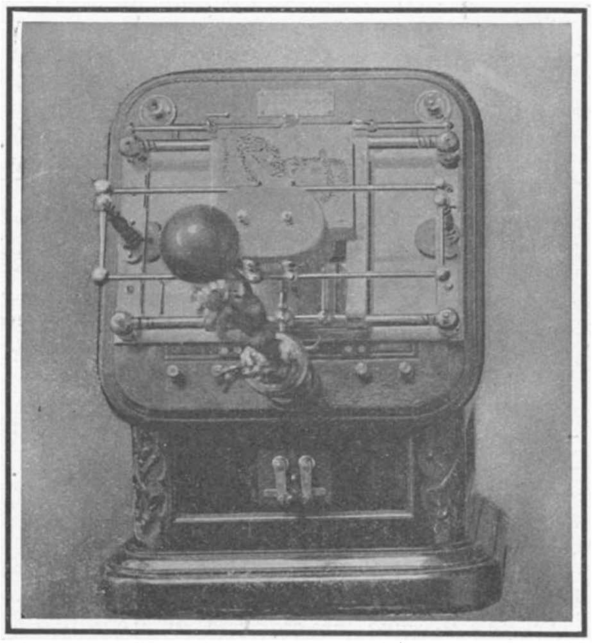
Interesting demonstrations were recently made in London with a new invention for the transmission of pictures, an invention which not only indicates a new development in such work, but marks a novel application of wireless telegraphy. The device and process have been evolved by Mr. Hans Knudsen, a well-known Danish inventor resident in England. Its principal characteristics are the simplicity both of the apparatus and its operation, the speed with which illustrations of all kinds can be transmitted, the omission of selenium cells, and the lack of dependency upon sources of light in any form.

The accompanying photographs illustrate the transmitting and receiving stations respectively, this particular apparatus being devised for dealing with pictures up to 4 x 5 inches. The transmitting station consists of a traveling table, upon which the illustration to be dispatched is carried, and which travels in two horizontal directions only—longitudinally and transversely. The transmitter comprises a finely-balanced needle or stylus, carried at the apex of an inverted cone suspended from a thin strip of steel, which constitutes a spring, supported at either end by suitable holders, and which is capable of tension adjustment by means of a small screw. Above the stylus is a small contact, which, when the needle and its cone are forced upward and establish contact therewith, completes the electrical circuit. The impulse is passed through the coil carried in the box forming the baseboard of the table, thence to the three spark balls shown at the back of the instrument. The carriage carrying the imprint of the picture to be transmitted moves to and fro beneath the stylus, making a continuous series of contacts in a manner explained later, the impulse passing to the aerial from the uppermost spark ball, to which it is connected at one terminal, while the negative wire is earthed from an opposite terminal on the spark ball.

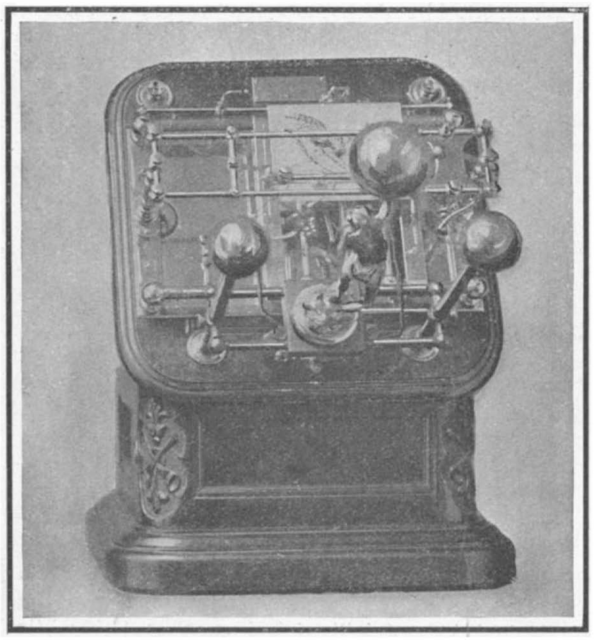
The receiving station comprises an instrument similarly provided with a traveling carriage and table, moving synchronously with those of the transmitter. Above this table is carried a small box containing a very sensitive relay working in conjunction with the coherer, and actuating a slender lever-movement stylus or needle. The stylus or needle also moves longitudinally and laterally in a horizontal direction over the plate fixed to the table and records the impressions as indicated by the electric contacts. Thus a negative impression of the transmitted picture is produced, from which positive imprints can be secured by ordinary photographic contact printing.

The picture, a photograph, drawing, or painting, must be especially prepared for the transmitting apparatus, an operation, however, which occupies not more than an hour. The picture is photographed through a screen, as in the half-tone process, the only difference being that in this instance the screen is ruled in straight lines about 60 to the inch. Each line is broken up into little dots, numbering about 200 to the inch. The positive secured in this manner is recorded upon a collodion plate, upon which the image stands out slightly embossed. Those parts which are perfectly clear, and consequently easily soluble in the developing solution, are naturally the deepest, the insoluble portions or dots projecting above the level of the plate to the greatest degree, the height of other projecting dots varying according to the gradation of the halftones.

At present the negative plate used for the receiving apparatus is covered with a film of lampblack, which has been found excellent for the purpose. Both plates are fixed securely to their respective tables, and the carriages set for operation. Each instrument is connected at either end with the terminals of the Morse keys, by which etheric messages are sent.



Plan View of Receiver Showing Negative Received.



Plan View of Transmitter Showing Traveling Carriage Carrying Picture.

In actual operation, the carriage of the transmitter is set so that the transmitting needle rests at the beginning of the first line of dots, the receiver being also similarly set. The transmitter then automatically proceeds. The needle in transversely passing over the plate along the line of dots is so set that it must engage with the rough surface dots. As it comes into contact with each dot, the needle is naturally lifted in order to surmount the obstacle, which action establishes connection with the electrical contact immediately above, and completes the circuit momentarily. An electric impulse is thus dispatched. Those parts of the picture which are quite clear, and consequently the deepest indentations on the collodion surface, allow the needle to pass along without forming any contact. Because the dots lie so close together, they seem like straight continuous lines.

At the receiving station the process is reversed. The receipt of an electric impulse indicating the passage of the transmitting needle over a dot causes the sensitive needle connected with the delicate relay to depress and strike the smoked negative plate on the table, piercing the lampblack film and thereby leaving a pinhole of clear glass. A succession of continuous signals, indicating a dark part of the picture, is reproduced in such a series of sharp dots that practically a continuous line of film is removed or scratched, while similarly, when the lightest part of the picture is being traversed by the transmitter, the receiving needle does not depress, thereby leaving the film intact.

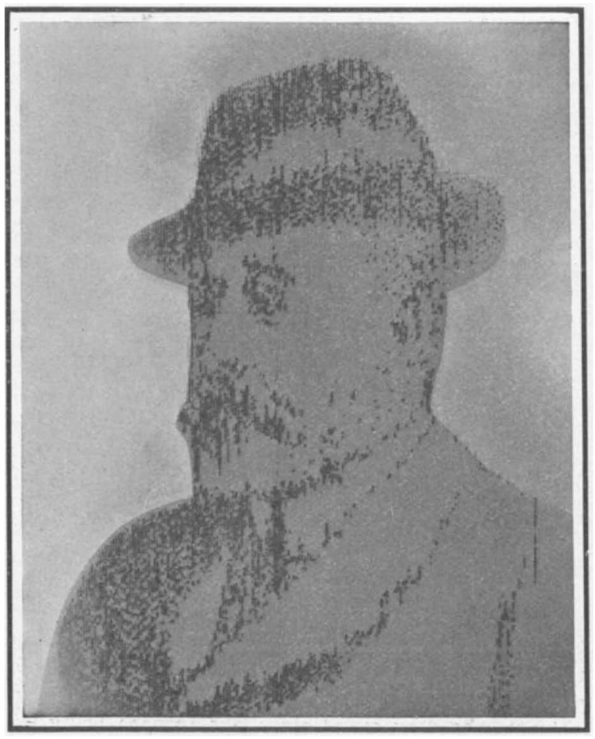
When the transmitting needle has reached the limit of the line across the plate, the carriage is stopped and held fast by a small electro-magnetic brake. It then moves forward a space to the end of the succeeding line. A clock movement then establishes contact, the brake is released, and the transmitter restarted. Simultaneously an impulse is dispatched to the receiver, which affects a separate coherer and thereby moves the receiving carriage forward a distance corresponding with that of the transmitter ready for printing the next line of dots. This cycle of operations is continued until the whole picture has been dispatched.

The smoked-glass negative thus produced has somewhat a stippled effect, because the picture is broken up into lines of dots, but this appearance is appreciably removed upon reduced reproduction. To a certain extent it facilitates halftone reproduction. As a matter of fact, it is quite possible to make a printing plate directly if a copper plate is used instead of the ordinary glass negative at the receiver end, and if immediately upon the completion of the picture it is subjected to development in the usual manner.

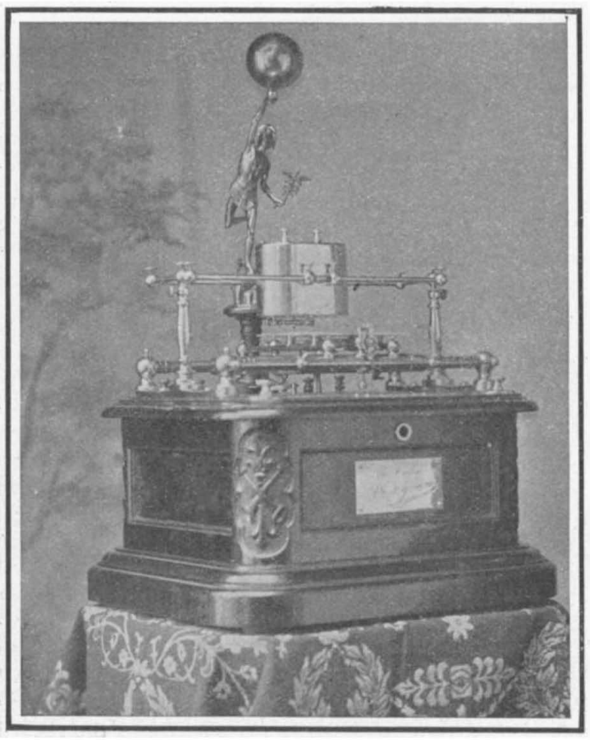
Owing to the limitations of the apparatus shown in transmitting and receiving pictures up to only 4 x 5 inches, the inventor has now completed a larger machine, taking illustrations up to 8 x 12 inches, but there need be no limit in the size, since the machines can be constructed up to any dimensions required. One great advantage of the larger machines, however, will be the possibility of securing more clearly defined and better tone-graded pictures, which upon reproduction yield a striking photographic effect.

The machine works at great speed. A photograph up to 8 x 12 inches can be transmitted and received in about ten or twelve minutes. With drawings and sketches a more accelerated pace can be attained, the complete operation occupying approximately three minutes for the same dimensions. The apparatus can be used with any system of wireless telegraphy. It can also be used on ordinary telegraphic wire or cable circuits.

The Transmitting Apparatus.



Photograph of Edward VII. Transmitted by Wireless Telegraphy.



The Receiver Showing Relay to Which Recording Needle is Connected.

KNUDSEN'S PROCESS OF TRANSMITTING PICTURES BY WIRELESS TELEGRAPHY.

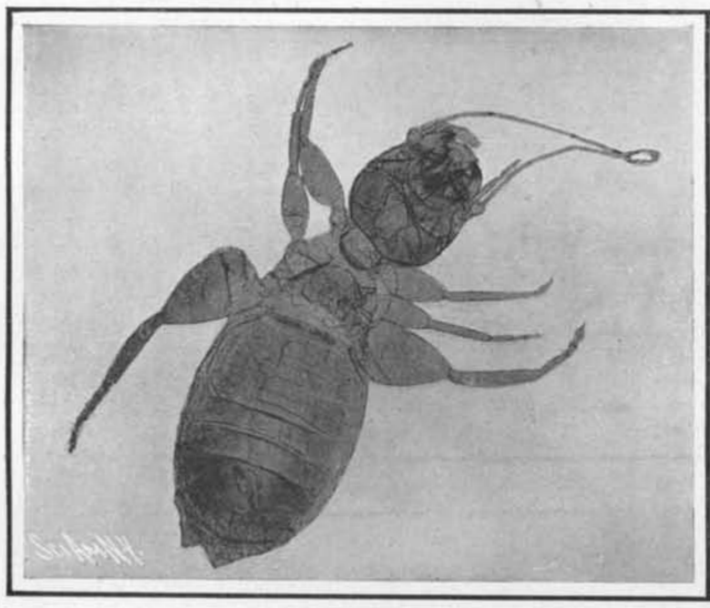
THE INSECT ENEMIES OF BOOKS.

BY JACQUES BOYER.

More books and manuscripts have been destroyed by insects than by fire, water, rats and mice combined.

For many centuries librarians had observed depredations due to insects without knowing their precise cause. In 1721 Frisch of Berlin found in a crust of dry bread the larva of an insect (probably *Anobrium*) which bored holes in books, manuscripts, and paintings. In 1742 Prediger suggested methods of protecting books from the ravages of insects, and in 1754 the Gentleman's Magazine of London recommended dusting the shelves and the fly-leaves of books with pepper, pulverized alum, and other insecticides. These palliatives proving insufficient the Göttingen Academy of Sciences, twenty years later, offered a prize for the discovery of injurious species and methods of destroying them. The subject has been thoroughly investigated by modern entomologists but no universal remedy has been discovered.

One of the most formidable of the insect pests is the bread borer (*Anobrium paniceum*) which is found in all climates, not only in libraries but in rye bread, whence its specific name. The beetle is one-twelfth inch long, downy, light brown, and striped lengthwise. The eggs are laid between the edges of the leaves, in scratches in leather bindings, chinks due to imperfect



***Psoque* or Book Louse.**

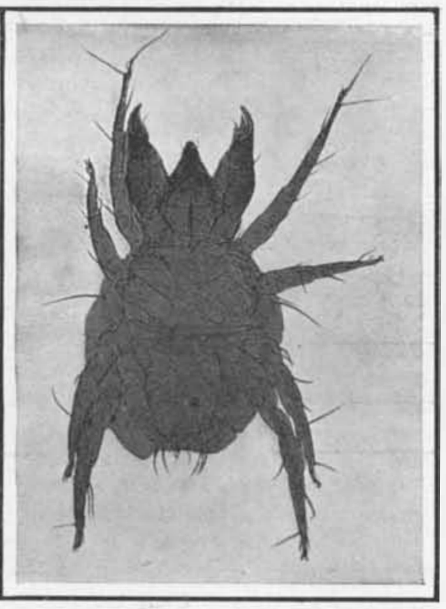
(Magnified about 60 times.)

Bread Borer (*Anobrium paniceum*).

(Magnified about 4 times.)

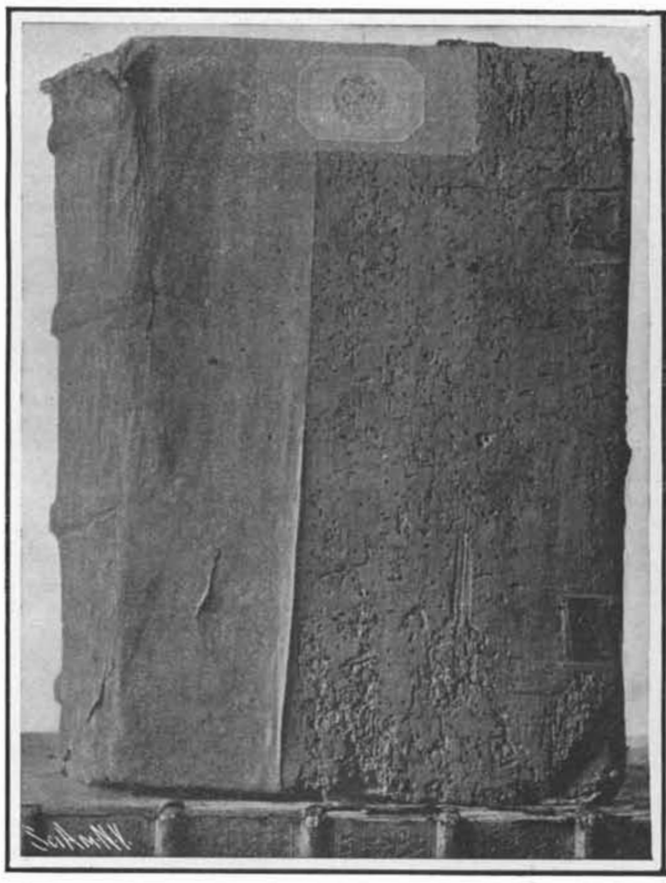
Silver Fish (*Lepisma saccharina*).

(Magnified about 3 times.)

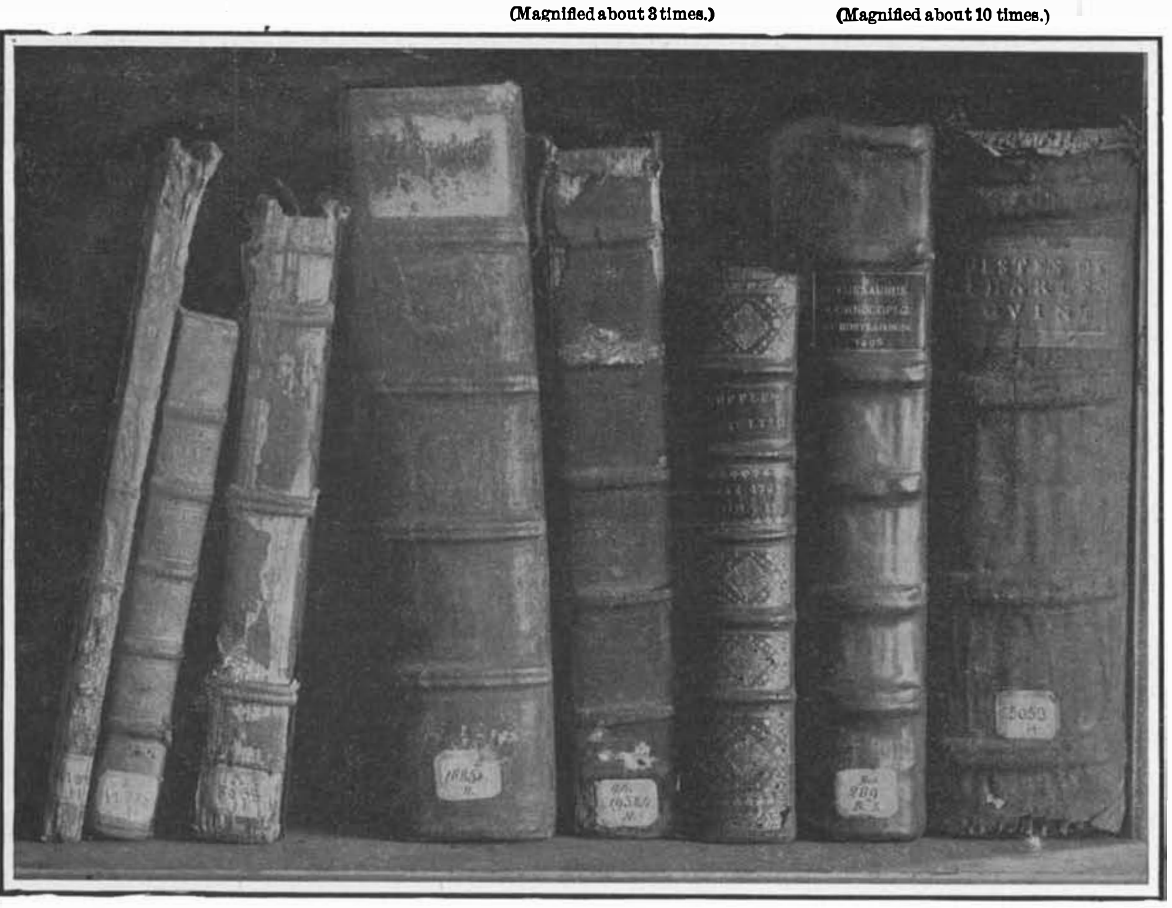


***Chyletus eruditus*, a Useful "Book Worm."**

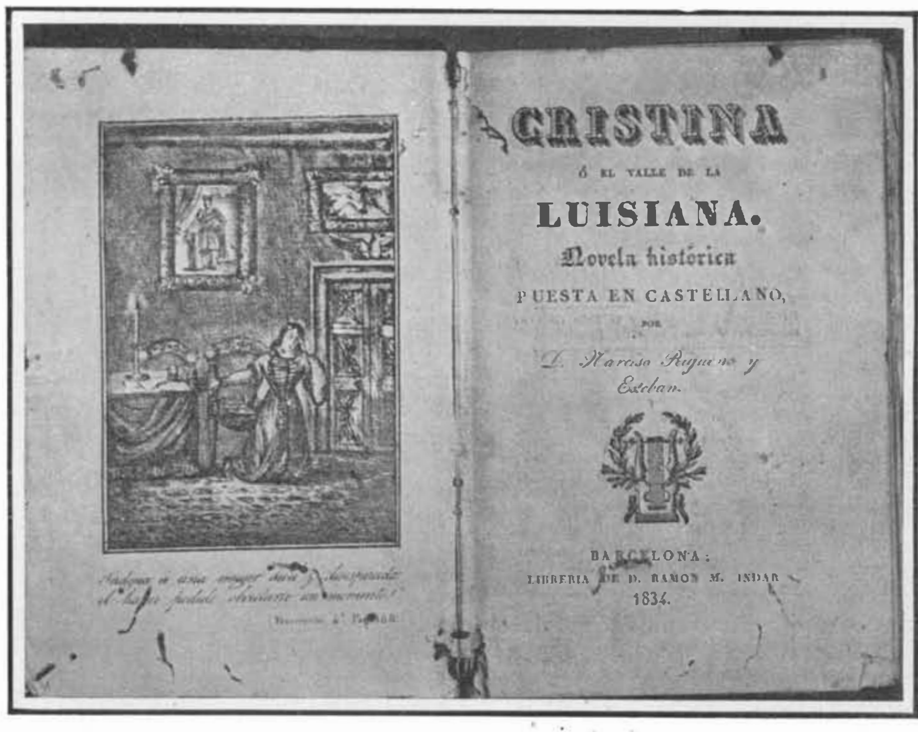
(Magnified about 10 times.)



Wooden Binding of Sixteenth Century Riddled by Larvæ of Borers (*Anobrium*).



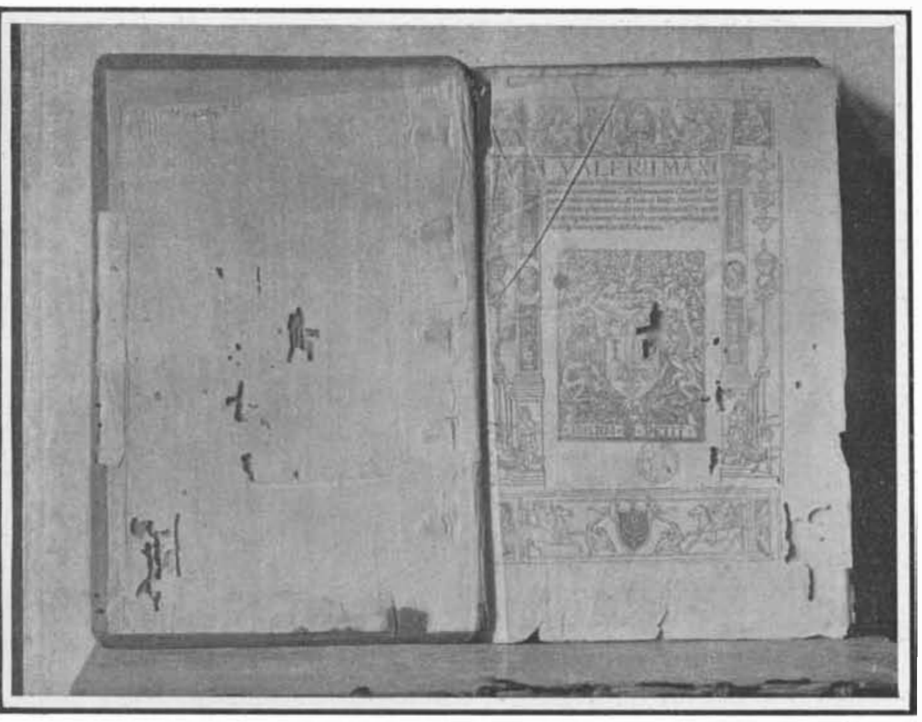
Books Injured by Book Lice, "Silver Fish," etc.



CRISTINA
ó EL VALLE DE LA
LUISIANA.
Novela histórica
PUESTA EN CASTELLANO,
POR
D. Narciso Requeno y
Esteban.

BARCELONA:
LIBRERIA DE D. RAMON M. INDAR
1834.

A Recent Book (1834) Injured by Destructive Insects.



Fly Leaf and Title Page of a Valerius Maximus in the Library of the Arsenal, Paris, Ruined by Insects.

THE INSECT ENEMIES OF BOOKS.

pasting of backs and fly leaves, etc. They hatch in five or six days, in summer, and the larvæ at once bore through the bindings, following the lines of paste. The worm is brownish white, cylindrical, slightly arched and has thirteen segments. The head is brown, scaly, and armed with mandibles which "only cast iron can resist," according to one naturalist. The worm bores long narrow tunnels through paper, leather and wood, leaving a trail of sawdust mixed with white excrement. The sixteenth century beechwood cover, herewith illustrated, is a fine specimen of this bookworm's work. Growing rapidly and molting repeatedly, the worm finally enlarges its tunnel to the size shown in the cardboard covers of the Valerius Maximus. Pupation occupies twenty days and takes place in enlargements of the tunnels very near the surface so that the perfect insects have to bore through only a thin shell, leaving the large round holes so common in old bindings. Pairing takes place in early summer in the tunnels which are not abandoned until the supply of food fails, when other quarters are sought. Sometimes not a single worm or beetle is found in a volume riddled with holes—a fact that has puzzled many a librarian.

Of the various methods that have been recommended for ridding libraries of borers the only effective one consists in exposing the infested volumes to the vapor of carbon disulphide, by putting them in an airtight metal-lined box with a saucer of that liquid. Thirty-six hours of this treatment suffices to kill beetles, pupæ, larvæ, and eggs. The unpleasant odor of the disulphide disappears after brief exposure to the air and the only objection to the use of this substance is its inflammability and the explosive character of its vapor when mixed with air. Hence the fumigation should be done in the daytime in a well ventilated room and the box should not be opened near a flame. On the other hand, the process possesses the merit of cheapness, as the disulphide costs only 9 cents a pound and an ounce suffices to fumigate a box of 70 cubic feet capacity.

Another species of *Anobrium*, the striped borer, found commonly in houses, bores through the shelves and furniture of libraries but does not injure the books directly, unless they are bound in wooden boards.

The larva of the *Dermestes*, on the other hand, has a particular fondness for bindings of leather and parchment. In May or June the females enter the library and lay their eggs, usually, on the edges of books in contact with the wall. As soon as the larvæ are hatched they begin their work of destruction, not making long regular tunnels like the borers but going in all directions and gnawing and disintegrating the bindings in an extraordinary manner. Sprinkling with benzine and fumigation with carbon disulphide have been recommended for their destruction.

Dr. Hagen, of the Museum of Cambridge, Mass., has found traps baited with cheese very efficacious.

Another beetle, the *Anthrena*, is occasionally very destructive to books, though it prefers skins, furs, and "stuffed" animals.

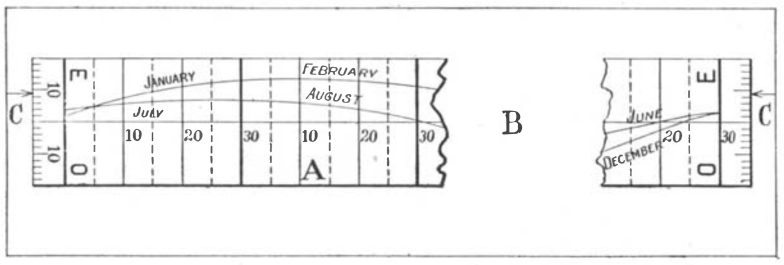
Far worse is the *Lepisma*, or "silver fish," so-called from its shape and shining scales. It is a little wingless insect of the order *Thysanura*, which undergoes no metamorphosis, and infests wardrobes and kitchen pantries as well as libraries. The most destructive species may often be seen scurrying away from a book suddenly opened in summer. It has a large head, from which the body tapers to a pointed tail, terminating in three bristles. Its favorite food is paste or glue, to obtain which it destroys titles, labels, and heavily sized paper, respecting only the parts that are covered with ink. It may be caught by cutting notches in the edge of a small box, and inverting the box on a plate containing paste spread on paper. This trap should be placed in the darkest corner of the room. The insects enter through the notches and are easily surprised and destroyed at their banquet. Pyrethrum powder also destroys or stupefies them, but perhaps the best way to get rid of them is to move and air the books frequently, and kill every insect discovered.

Psoques or book-lice are often dislodged from old books kept in damp places and may be seen on library shelves in summer. They are almost omnivorous but especially fond of paste and mold, in search of which they perforate bindings. Their depredations are often erroneously laid to the charge of the bookworms. Pulverized camphor has some effect in driving away the book-lice, and they have a natural and formidable enemy in the *Cheyletus eruditus*. This blind acarian, or mite, which Latreille unjustly denounced as a bookworm, has an oval body, a soft skin, relatively large jaws, and long legs terminating in hooked claws. It swarms in old volumes but it destroys the book-lice, not the books.

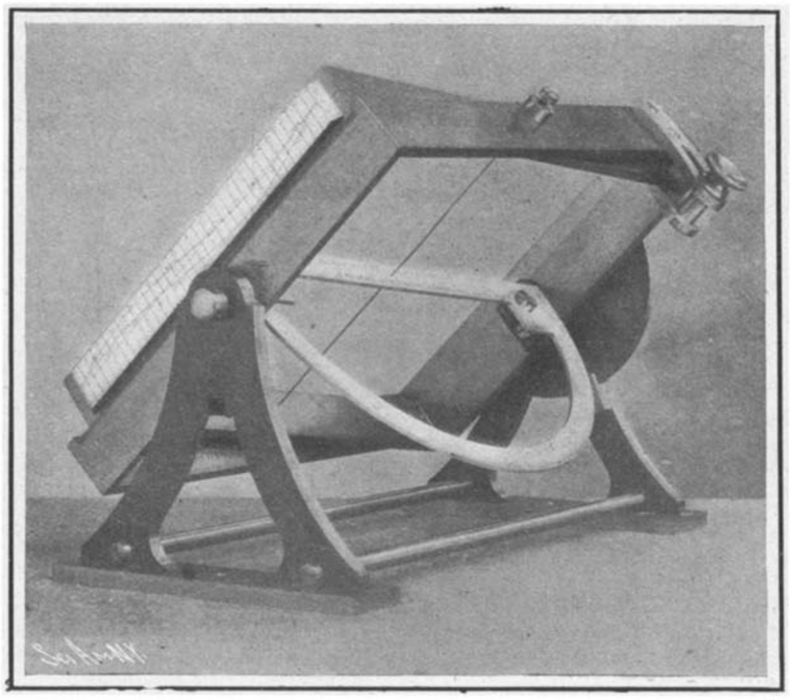
The familiar cockroach attacks and devours in its nocturnal raids the paper and bindings of books as well as flour, sugar, and other provisions. The species best known in Europe is the Oriental cockroach (*Blatta orientala*) of Asiatic origin. In the male the true wings are well developed but the wing cases do not cover the abdomen. In the female both wings and elytra are rudimentary. The head is short and bent sharply downward. As in all Orthoptera the larva closely resembles the perfect insect, but is wingless. The female lays her eggs in April or May, and then dies. The larvæ grow slowly, undergoing six or seven changes of skin. Although the cockroach produces only one brood a year it increases rapidly, especially in the tropics. In the State library at Albany, N. Y., the bindings of a hundred volumes were destroyed by cockroaches in a short time.

Another species, the American cockroach, has become acclimated chiefly in hothouses and well heated dwellings in France and England, but it has long ravaged libraries in Brazil, Peru, and Mexico, where its depredations were mentioned by a missionary friar as long ago as 1654.

Among substances inimical to cockroaches we may mention, first, pyrethrum powder. The powder, in as fresh a condition as possible, is strewn on the shelves. In the morning the cockroaches are found paralyzed, and may be swept up and burned. In Germany the gases produced by the combustion of gunpowder are used. The process, as described by Pergaude, consists in compressing slightly moistened gunpowder into cones like those used for Bengal lights, and igniting them, when dry, in the fireplace—a favorite resort of cockroaches. The poisonous gases drive the insects out of the cracks in which they pass the day, and suffocate them, so that they can be gathered and cremated. The process was devised for the purpose of destroying the cockroaches that infest fireplaces and chimneys but it has also been applied, with excellent results, to libraries with cracked walls.



The Adjusting Scale of the Sun Dial.



A NEW SUN DIAL.

Traps for cockroaches have long been in use. They are of various forms but all are based on the same principle. The simplest is a glass tumbler or other vessel with smooth vertical walls, baited with a little flour. The insects easily reach the edge of the vessel from the floor by crawling up inclined flat strips of wood, placed there for that purpose. Then they fall into the vessel, from which they cannot escape by climbing its smooth walls. In the south of France regular cockroach traps are used. These are square boxes about two inches deep with the outside painted roughly to facilitate the ascent of the insects, the inside finely polished, and the edge curved inward. A saucer of flour and sugar is placed in the box as bait, and a hole in one side, closed by a cork, permits the game caught during the night to be emptied into the fire or a bucket of water in the morning. The destroyers of books that we have described have been selected, as the most important, from the sixty species which, according to Dr. Houlbert, live upon the productions of the human brain.

A NEW SUN DIAL.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

In former times sun-dials were much in use, but in modern times no one has the idea of consulting a sun-dial for regulating his watch, and these apparatus are now looked upon as simple ornaments. The reason of this disfavor is easy to find; formerly the time which was universally adopted was the true or solar time, and as this is the time which is necessarily given by the sun-dials, these latter were in good repute and could be even used to regulate clocks. At present, on the contrary, the time which is used is the mean time, and it differs from the solar time by a quantity which is variable each day, this being called the "time equation," so that in order to deduce the mean time from the hour shown by the sun-dial, it is necessary to make a calculation. This is not a complicated one, but at any rate cannot be done in practice. In addition, nations have adopted a uniform time which differs from the local time according to the longitude of the place. In America four of these standard times have been adopted, and it is easy to see why sun-dials are considered as instruments of a former age. However, the sun's movement, while regularly variable, is known to within a fraction of a second, and is always reliable. A member of the French Astronomical Society, Vicomte d'Aurelle Montmorin, had the idea of constructing an improved form of sun-dial by which the time can be read with considerable precision and which is arranged to give mean time.

As seen in our engraving, the new apparatus is formed of an equatorial dial to which is given each day a small angular displacement designed to correct the solar time as shown on the dial, at the same time for the time equation and the local longitude. This is done quite mechanically so as to pass from the solar to the legal time. He uses a stretched wire and a half-circle whose center is crossed by the wire. The half circle has a time scale in five-minute intervals, and the whole is carried by a set of two rectangular frames fitted one into the other and turning about two axes which are perpendicular to each other. One of these axes is horizontal and by means of a graduation on the small half-circle seen in the rear, it is made to incline the wire in the direction of the earth's axis. The second axis lies along the wire itself and gives the main graduated half-circle a small displacement for the correction. This latter is regulated as follows: One of the edges of the outer frame is cut in bevel and gives an edge which is exactly parallel to the wire. The inner frame carries a scale lying opposite the former. On this scale are traced two curves showing the time equation for the different days of the year. One of the curves serves for the first six months of the year, and the second for the remainder. A set of points show the day of the month in spaces of five days each, and the ordinates of these different points with relation to a base line traced on the scale are proportional to corresponding values of the time equation. At each end of the scale are placed two graduations in minutes of time marked *E* and *O*. They serve to give the correction for longitude. To do this, we use the two fixed points *C C*, and make the scale slide up and down, fixing the figure corresponding to the local longitude according to scales *E* and *O*, and then screwing down the scale piece. In this case the ordinates of the two curves with relation to the standard line formed by the edge of the other frame represent the amount of angular movement which is used to correct for the time equation and the longitude at the same time.

In practice the apparatus is placed once for all by giving the wire the proper inclination for the latitude, then the scale is used as just stated to give the correction for the longitude. Lastly the wire is placed exactly in the meridian plane. When this has been done we find the hour as follows: Bring the point of the curve for the day in question exactly to the height of the standard bevel edge and fix the frame in this position. Then we read the hour upon the scale of the half-circle. Generally this latter regulation needs only to be done once in two or three days. In principle, for placing the instrument we must trace the meridian line on the plane surface which serves as the base, but as this is somewhat difficult we can use a watch which is regulated within a few seconds of the standard time. We place the instrument as if we wish to determine the time on this particular day, in adjusting, for the latitude, and we correct for the longitude and fix the scale and curve as before. This done, we displace the instrument until the indications are as nearly as possible in accord with the time of the watch. Thus we can give the proper position once for all. Although the present instrument is not designed as an instrument of precision, it can very well be used to regulate watches within one minute, which is sufficient for most cases.

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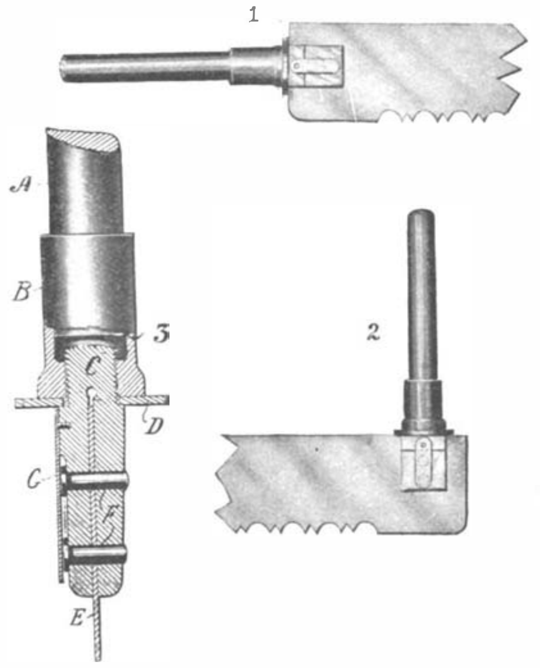
AN IMPROVED SAW HANDLE.

In the accompanying engraving we illustrate a handle particularly adapted for use with a saw, though it will be evident that it may be used for other tools as well. The handle is so arranged, that it may be adjusted at right angles to or in alinement with the saw blade. This adjustment permits the saw to be carried without difficulty through the woods, because the handle may be so set as not to project beyond the main body of the saw. The details of the handle are best shown in Fig. 3. The handle proper is indicated at *A*, and fits into a socket *B*. The lower end of the socket is threaded to receive a member *C*. The latter is slotted, and in the slot the saw blade *E* is fitted. Between the member *C* and the socket piece *B* a washer *D* is mounted, and when the socket piece *B* is firmly screwed on the member *C*, it presses the washer *D* into engagement with the back of the saw blade. The saw blade is secured to the member *C* by means of a pair of pins *F*, which pass transversely through this member and the usual holes provided in the saw blade. The pins are prevented from slipping out by a retaining piece *G*, which is pivoted to swing over them. The usual holes in the saw blade are placed at different distances from the edge in various makes; but as the slot in the retaining member *C* is quite deep, these differences will not prevent the handle from being secured to any blade. Figs. 1 and 2 show how the handle may be attached in alinement and at right angles, respectively, to the saw blade. The inventors of this handle are Messrs. E. A. Patterson and E. F. Dickinson, Box 218, Morgan City, La.



AN IMPROVED SAW HANDLE.

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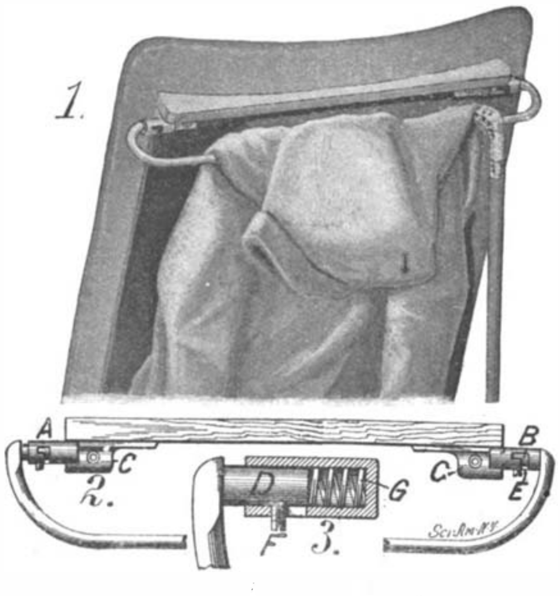
RACK FOR COATS, WRAPS, AND OTHER GARMENTS.

Pictured in the accompanying engraving is a rack that should be found serviceable in a great variety of uses. Secured to the dashboard of a carriage or automobile, it will serve as a rest for lap robes and wraps; in railroad and Pullman cars, and in theaters, it may be secured to the backs of the seats to support coats, canes, umbrellas, and the like; while in the home and office it will be found useful as a towel or clothes rack, or a support for newspapers. The device is very simple in construction, and its chief merit lies in the fact that it may be secured firmly in extended position, and when desired may be folded back against its support, so as to offer no obstruction. The details of the rack are shown in Figs. 2 and 3. Two bearings, *A* and *B*, are provided, which have flanges or extensions *C*, whereby they may be secured to any support. The bearings are each in the form of a socket or tube, closed at the inner end but open at the outer end. These socket bearings are adapted to receive the inwardly facing trunnions *D*, formed on the ends of the rack bar. Each socket is provided with a double bayonet slot *E*, engaged by a pin *F* projecting from the trunnion. In other words, each socket is formed with a circumferential slot provided with an axial offset at each end, and according as the pins *F* engage the upper or the lower offsets, the rack bar will be secured in extended or folded position. The spring *G* in the socket *A* presses the rack bar toward the left, and holds the pins *F* in engagement with the offsets. When it is desired to change the position of the rack bar, the bar must first be moved toward the right to disengage the offsets, after which it may be swung on its trunnions until it snaps into engagement with the other pair of offsets. A patent on this rack has just been secured by Messrs. John Boyle and Daniel T. Wilson, of 406 to 412 Broome Street, New York.



RACK FOR COATS, WRAPS, AND OTHER GARMENTS.

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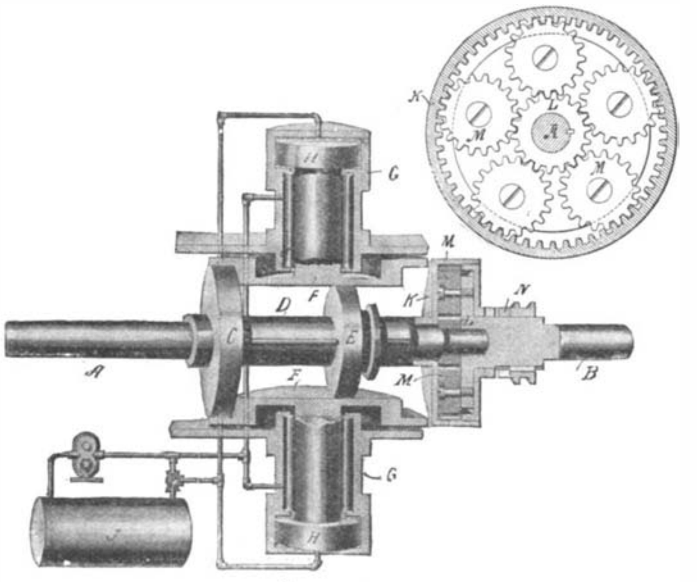
POWER TRANSMISSION MECHANISM.

The mechanism illustrated herewith is adapted to transmit power from one member to another at varying speed in either direction of rotation. In referring to the accompanying engraving, we will consider the shaft *A* as the driving member and the shaft *B* as the driven member, although it will be evident that their office may be reversed. Keyed to the shaft *A* is a friction wheel *C*, and mounted to rotate on the shaft *A* is a sleeve *D*, on which a second friction wheel *E* is carried. The wheel *E* turns with the sleeve, but is free to slide axially thereon. Power is transmitted from wheel *C* to wheel *E* through a pair of idlers *F*. The idlers, it will be observed, are provided with two friction surfaces, one for each friction wheel, and the surfaces which engage the wheel *E* are nearer the shaft *A*, so that if desired the wheel *E* may be driven at the same speed as wheel *C*. In order to hold the idlers in proper contact with the friction wheels, they are mounted on stub shafts fitted in roller bearings in casings *G*, and provided at their outer ends with pistons *H*. From the cylinder *J* oil under pressure is fed to the pistons *H*, to press the latter inward and bring the idlers *F* into frictional engagement with the wheels *C* and *E*. Some of this oil will leak past the pistons, and serve to lubricate the roller bearings of the idler shafts. The sleeve *D* terminates at one end in a casing *K* formed with an internal gear. The end of shaft *A* projects into this casing, and secured thereon is a pinion *L*. An extension of the shaft *B* also enters the casing *K*, and carries a series of pinions *M*, which mesh respectively with the internal gear of the casing *K* and the teeth of the pinion *L*. As the wheel *E* moves from the center of the idlers *F* toward the wheel *C*, its speed will vary from zero to that of the wheel *C*, and it will rotate in the same direction as this wheel. As the wheel *E* moves from the center of the idlers *F* in the opposite direction, its speed will vary similarly, but its direction of rotation will be reversed. This variation of speed between wheels *C* and *E* will be further modified by the planetary gearing just described in the casing *K*, and the shaft *B* will take the resultant of these motions. When it is desired to rotate the shafts *A* and *B* at the same speed, the oil pressure may be shut off, as it will be unnecessary to use the idlers *F*, and the shaft *B* may be coupled to the casing *K* by throwing in the clutch *N*. The inventor of this mechanism is Mr. Norman Ruland, of Rome, Italy (care of Thomas Cook & Co.).



POWER TRANSMISSION MECHANISM.

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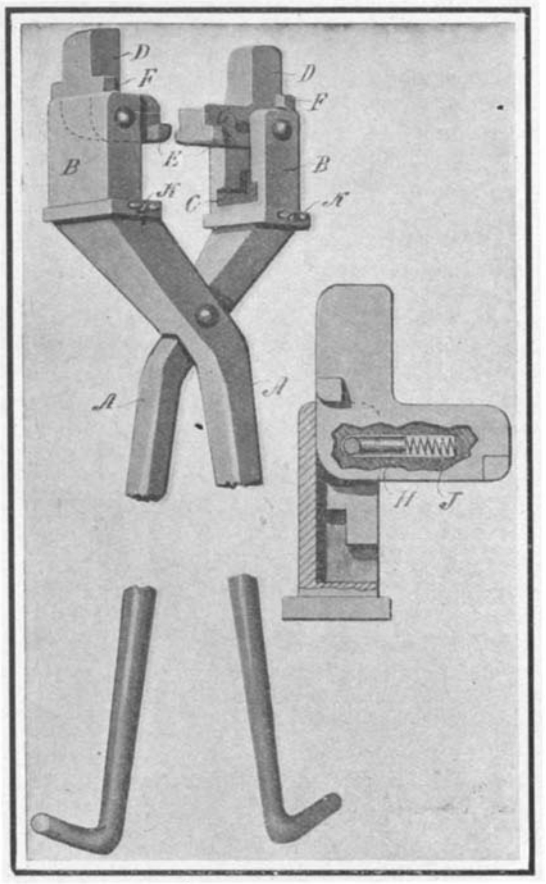
While practically all the schemes of electrification so far discussed in Prussian railway circles have included only urban and suburban traffic, it is now intended to electrify two important trunk lines, viz., the Leipzig-Bitterfeld-Magdeburg, and the Leipzig-Halle railways. Extensive investigations as to the comparative economy of electric and steam operation are at present being made. The choice of these lines is dependent mainly upon the lignite beds situated between Halle and Leipzig. While the lignite is useless as a locomotive fuel, it will be employed advantageously for the boilers of the single power station, from which both lines will be operated. This station is located in the middle of the lignite fields. The aggregate length of the lines is 102 miles, the Leipzig-Magdeburg line being 80 miles, and the Leipzig-Halle 23 miles in length. The single-phase alternating current system is to be adopted, short trains being run in rapid succession. The potential of the current will be 10,000 volts.

◆

TONGS WITH ADJUSTABLE JAWS.

The object of the invention herewith illustrated is to provide tongs that may be used in smaller spaces, and that will grasp and hold articles of greater dimensions than is possible with tongs of like weight and of the usual design. The tongs comprise the ordinary handle members *A*, which are pivoted together and terminate beyond the pivot in bars *B*. These bars are recessed, as shown in the illustration, and the side faces of each recess are undercut, as indicated at *C*. Pivoted in the upper end of each bar is an L-shaped jaw *D*. These are provided at their inner ends with lugs *E*, which are adapted to enter the offset recesses *C* when the jaws are swung on their pivots. When the jaws are open, lugs *F* engage the outer ends of the bars *B*. The pivot pins which hold the jaws in the bars pass through slots *G* in these jaws. Bearing against each pivot pin is a small block *H*. The latter is kept in contact with the pivot pin by means of a spring *J*. In grasping an article with the jaws open as illustrated, contact is made with the transverse arms, causing the jaws to revolve about on their pivots, thus bringing the other arms of the jaws into active position. Now, on drawing on the article the springs *J* will be compressed, permitting the lugs *E* to engage the undercut parts *C* of the recess, thus locking the jaw against further pivotal movement. It will be evident that the tool in picking up an object may be used without separating the jaws to the extent required in the ordinary tongs, since the ends of the jaws as they revolve and engage the object are separated only the thickness of the object between the points engaged. Should it be desired to use the tongs in the ordinary manner, the arms are locked with the lugs engaging the undercut parts *C*, by means of bands which are carried on the bars. These bands are moved over the ends of the jaws, and secured wherever desired by means of thumb screws *K*. The inventor of these tongs is Mr. James Veno, of Vancouver, B. C., Canada.



TONGS WITH ADJUSTABLE JAWS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

DRAWERS.—M. GALLAND, Wilkes-Barre, Pa. The object in this case is to provide a woman's drawers, arranged to fit snugly at the waist of the wearer without giving undue fullness, and insuring a proper hang of the garment, at the same time presenting a skirt-like appearance and providing simple means for convenient attachment of catamenial sacks.

TAILOR'S PATTERN.—G. MADEO, New York, N. Y. This invention pertains to patterns such as used by tailors for cutting out garments. The object is to provide a pattern having a system of base lines corrected so as to adapt them especially to the degree of erectness of the model. The construction of the pattern is based upon the relation of certain dimensions taken on the model. A further object is to provide a pattern for laying out the sleeve of a garment, which improves the manner in which the finished sleeve hangs, and to improve the pattern of the collar.

Electrical Devices.

ELECTRIC HEATER.—H. WAHLQUIST, Philadelphia, Pa. The invention relates more particularly to those of a type suitable for heating liquids in small receptacles, such as tea-kettles, drinking cups and the like. The heat generated may be regulated to a great extent without affecting the electric current. It may be constructed to act as a sterilizer.

Of Interest to Farmers.

FRUIT-CUTTER.—H. ALL, Cutter R. R. Station, Cal. The invention is an improvement in cutters employed for gathering grapes or other fruit, and comprises a cutting blade and a handle secured thereto in such manner that it may be held in the same hand used to seize a bunch of grapes or other fruit, the use of both hands for gathering fruit being therefore unnecessary.

HOEING-MACHINE.—W. A. HARRIS, Greenville, S. C. The invention is especially designed for chopping cotton, and belongs to the class of such machines, illustrated in a former patent granted to Mr. Harris. The present invention relates to means for gaging and regulating the depths of the hoes, means for securing the regulation of the size of the stand left by the hoeing devices, means for shifting the carrier frame laterally along the drive shaft and other improvements.

Of General Interest.

ABDOMINAL SUPPORTER.—MARGARET DONALDSON, Oklahoma, Okl. One of the several purposes in this case is to provide a construction of a supporter that embodies an elastic belt and lapped bandages connected therewith, including shoulder straps and front and rear crossed sections, that invariably have a lifting tendency and at the same time exert backward pressure upon the safe section of the body above the hip bones and which in no instance exert downward pressure upon the body. It is intended also for use in kidney, obesity, and other troubles.

APPARATUS FOR ELEVATING GRAIN AND OTHER GRANULAR OR PULVERULENT MATERIALS.—L. G. ROHDE and H. J. ROHDE, 9 Rue Caumartin, Paris, France. Means are provided for regulating the admission of the material to be sucked in, consisting essentially in tubes provided with a series of orifices the area of which is adapted to be regulated by means of a sliding cover which can be displaced with regard to the orifices in such manner as to open or close completely or partially all the orifices together.

Hardware.

CLOSER FOR DOORS, SHUTTERS, GATES, AND THE LIKE.—C. TRUDE, St. Mary's, Kan. The inventor's aim is to provide a closer, which can be easily and rapidly mounted in position and by means of which the gate or door is automatically returned to the closed position after being opened. It operates firmly to close without slamming or jarring a door or gate.

SLIDING DOOR-FASTENER.—C. A. MOLINE, Bancroft, Iowa. The fastener is operated from the outside or inside. From the inside the handle is seized and the fastener rotated one quarter around whereby the plates are brought to vertical position, then the fastener is pulled toward the operator so that the outer plate is drawn back into a recess in the woodwork. It is requisite that the bolt connecting both plates should be adapted to slide and rotate in the recess, in order to engage it with or disengage it from the door, as required for fastening or releasing the same.

SAFETY ATTACHMENT FOR LINEMEN'S CLIMBERS.—J. D. O'CONNELL, 8 Margerey Street, Utica, N. Y. The object of the inventor is to provide a device for a climber that can be applied to any form thereof, and one that will eliminate most of the disadvantages of the safety belt and like appliances. He provides a device that will constitute a portion of the stirrup extension, thus being always at hand and ready for use. It does not interfere with walking or climbing and will not strike the ground when walking.

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.

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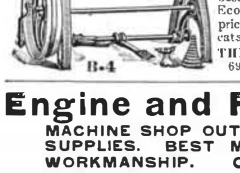

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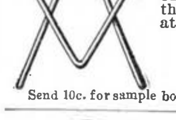

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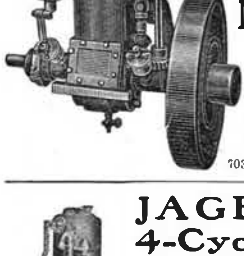

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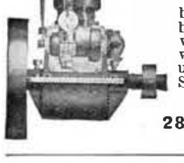

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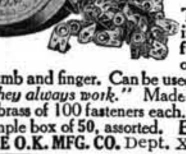

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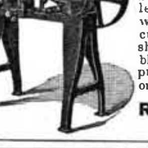

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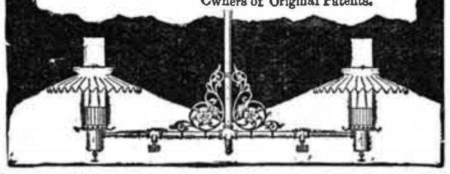

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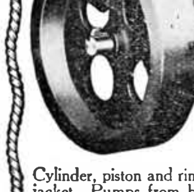

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Fertilizers, Birmingham Fertilizer Co	69,236
Fertilizers, Virginia-Carolina Chemical Co	69,246
Flour, wheat, Claflin Mill and Elevator Co	69,237
Flour, wheat, J. Quirk	69,244
Fruit juice, carbonated, M. Wineburgh	69,234
Furnaces, Kelsey Heating Co	69,212
Game, card, D. C. Mitchell	69,166
"Gas" for disinfecting and medicinal purposes, D. D. Richardson	69,202
Hair pins, Bachmann Brothers	69,223
Harness hardware, certain, Covert Manufacturing Co.	69,177
Hats and caps, Frank P. Heid & Co	69,197, 69,198
Insulating material, electrical, Rail Joint Co.	69,168 to 69,171
Jams, marmalades, flavoring extracts, etc., H. P. D. Kingsbury	69,227
Kinematographic apparatus and pictures for use therewith, C. Urban	69,173
Medicinal preparations, certain, Home Remedy Co.	69,210
Medicinal preparation, certain, A. M. Goldstandt	69,209
Medicine, veterinary, C. Lageman	69,213
Metal, casting, Klewe & Co	69,182
Metal polish, Evalang Chemical Co	69,179
Metal polish, M. Loewenstein	69,229
Metal polishes, W. Hutter	69,180
Metallic fabrics, Mattatuck Manufacturing Co.	69,185
Music rolls, perforated, Standard Music Roll Co.	69,232
Newspaper, Sporting Life Publishing Co	69,203
Oil, gun, Marshall Oil Co	69,230
Oil, hoof, A. M. Newman	69,216
Packing, rod and piston, Charleston Metallic Packing Co.	69,196
Paper and typewriter ribbons, carbon, Pen-Carbon Manifold Co	69,241
Perfumes and perfumed toilet powders, E. Palmer	69,217
Pharmaceutical preparation, certain, Farbwerke vorm. Meister Lucius & Bruning	69,208
Pianos, Kohler & Campbell	69,228
Postal cards, souvenir, T. Liebman & Sons	69,183
Razors, A. Strauss & Co	69,192
Remedies for certain diseases, Actien-Gesellschaft fur Anilin-Fabrikation	69,205
Remedy for certain diseases, Sharp & Dohme	69,218
Remedy for nervous diseases, R. A. Smith	69,219
Rubber boots, shoes, and overshoes, American Hand Sewed Shoe Co	69,206
Rules, folding, Stanley Rule and Level Co.	69,172, 69,191
Sewing machine needles, Illinois Sewing Machine Co.	69,181
Soap, Barclay & Barclay	69,175
Spectacles, eyeglasses, and their mountings and parts, Bay State Optical Co	69,164
Stockings, W. F. Taubel	69,204
Stone, artificial, Deutsche Steinholzwerke, Langguth & Platz	69,178
Sugar, beet, American Beet Sugar Co	69,222
Sugar, grape, Corn Products Refining Co	69,224
Tobacco, chewing and smoking, A. J. Livingston	69,184
Tops, whirling, Paris Novelty Co	69,167
Waterproofing solution, certain, American Cement Waterproofing Co	69,235
Wicks or night lights, floating, J. G. Hebart	69,199

LABELS.

"Derby," for cigars, C. H. Stout	14,212
"Especiales," for cigars, G. Dottling	14,214
"Esquisitos," for cigars, G. Dottling	14,215
"Gold Seal," for cantaloups, Strachan Fruit Co.	14,221
"Golden Gem Brand," for cantaloups, Strachan Fruit Co.	14,222
"Golden Rule Brand," for cantaloups, Strachan Fruit Co.	14,220
"Imperiales," for cigars, G. Dottling	14,213
"Jacob Ruppert's Extract of Malt," for extract of malt, J. Ruppert	14,219
"Jacob Ruppert Metropolitan Beer," for lager beer, J. Ruppert	14,218
"McClure and Berman's Typhoid Fever Remedy," for typhoid fever remedy, McClure & Berman	14,224
"Selectos," for cigars, G. Dottling	14,216
"Target Rock Whiskey," for blended whisky, S. Lefkowitz	14,217
"Yo-Yo," for a medicinal beverage, Yo-Yo Co.	14,223

PRINTS.

"O'Sullivan's Heels of New Rubber," for rubber heels, Massachusetts Engraving Co.	2,281
"Reckitt's Blue," for bluing for laundry use, Reckitt & Sons	2,280
"Thanks for the Artgum," for artgum, a cleaning composition, A. Sommer	2,279

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.

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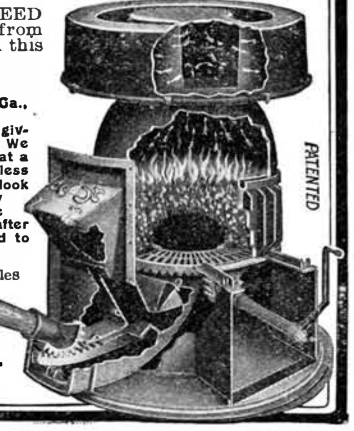

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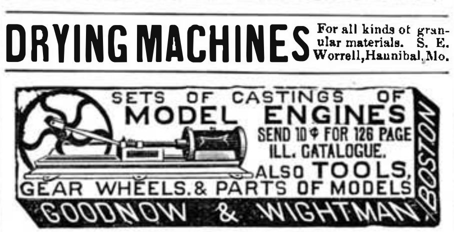

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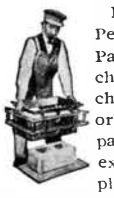

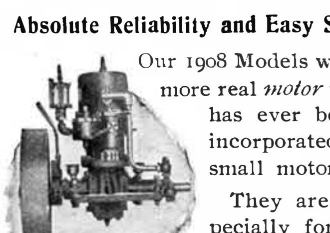


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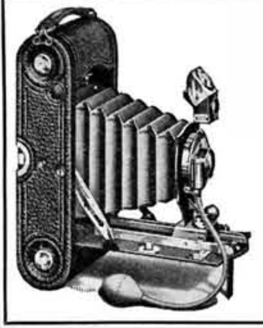
1 TO 6 CYL

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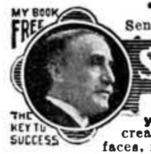
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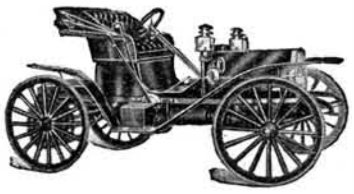

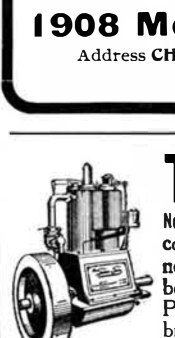


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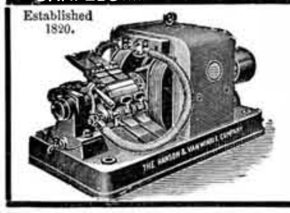

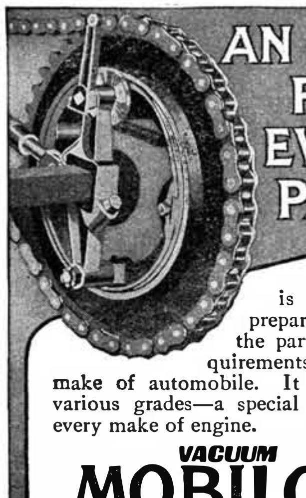


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