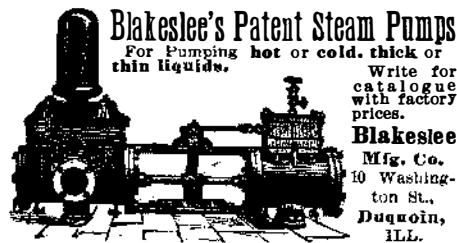


Advertisements.

Inside Page, each insertion --- 25 cents a line.
Back Page, each insertion --- \$1.00 a line.

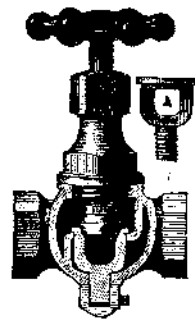
The above are charges per square line—about eight words per line. This notice shows the width of the line, and is set in square type. Engravings may be had advertisements at the same rate per square line by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.



Blakeslee's Patent Steam Pumps
For Pumping hot or cold, thick or thin liquids.

Write for catalogue with factory prices.
Blakeslee
Mfg. Co.
10 Washington St.,
Duquoin, ILL.

VELOCITY OF ICE BOATS. A COLLECTION of interesting letters to the editor of the SCIENTIFIC AMERICAN on the question of the speed of ice boats, demonstrating how and why it is that these craft sail faster than the wind which propels them. Illustrated with 10 explanatory diagrams. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 624. Price 10 cents. To be had at this office and from all new dealers.



LUNKHEIMER'S
Renewable Seat
GLOBE VALVE,
For High Steam Pressure.

This seat of this Valve is made of Phosphor Bronze, and, when worn, can be quickly removed and a new one supplied at small cost, thus saving labor in breaking joint and expense of inserting new valve body.

Cincinnati Brass Works,
CINCINNATI, O.

ICE-BOATS — THEIR CONSTRUCTION and management. With working drawings, details, and directions in full. Four engravings, showing mode of construction. Views of the two fastest ice-sailing boats used on the Hudsonriver in winter. By H. A. Horsfall, M.E. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 624. Price 10 cents. To be had at this office and from all new dealers.



IRRIGATING MACHINERY ON THE Pacific Coast.—By John Richards. An elaborate discussion of the modifications that have had to be made in irrigating machinery to meet the requirements of local conditions in California. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 624 and 625. Price 10 cents each. To be had at this office and from all new dealers.

STEEL BALLS.

For Anti-Friction Bearings, of Best Cast Steel. Hardened, Ground, and Burnished, from 3-16 in. to 4 in. diameter.

In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequalled.

See Samples and prices on application.

Simond's Rolling-Machine Co., Fitchburg, Mass.

THE MODERN ICE YACHT. — BY GEO. W. POLK. A new and valuable paper, containing full practical directions and specifications for the construction of the fastest and best kinds of Ice Yachts of the latest, most approved forms. Illustrated with engravings drawn to scale, showing the form, position, and arrangement of all the parts. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 624. Price 10 cents. To be had at this office and from all new dealers.

THE KODAK CAMERA

Makes 100 instantaneous pictures by simply pressing a button. Anybody can use it who can wind watch. No tripping. No tripod. Rapid Rectilinear Lens. Photographs moving objects. Can be used indoors.

Division of Labor—Operator can finish his own pictures, or send them to the factory to be finished. Morocco covered Camera, in handsome sole-leather case, loaded for 100 pictures.

For full description of "Kodak" see Sci. Am., Sept. 15, '88. Price, \$25.00. Reloading, \$2.00.

The Eastman Dry Plate & Film Co.
Rochester, N. Y. 115 Oxford St., London.
Send for copy of Kodak Primer with Kodak Photograph.

GUILD & GARRISON

BROOKLYN, N. Y., U. S. A.
Builders of Steam Pumps for Liquids or Semi-liquids. High Grade Vacuum Pumps, Filter Press Pumps, Air Compressors, Acid Blowers, Feed Pumps, Agitators, Condensers for Pans, Engines, Steam Pumps, Vacuum Apparatus, etc.

PATENTS.

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for inventors.

In this line of business they have had forty-one years' experience, and now have unequalled facilities for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business entrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, free of charge, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
115 N. 3rd St., New York.

BRANCH OFFICES—No. 622 and 624 F Street, Pacific Building, near 7th Street, Washington, D. C.

**The TRENTON ENGINE**

THE COPYING PAD.—HOW TO MAKE and how to use; with an engraving. Practical directions how to prepare the gelatine pad, and also the aniline ink by which the copies are made; how to apply the written letter to the pad; how to take off copies of the letter. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 438. Price 10 cents. For sale at this office and by all new dealers in all parts of the country.

Barnes' Foot-Power Machinery
Complete outfits for Actual Workmen Business. A customer says: "Considering its capacity and the accuracy of your No. 4 Lathes, I do not see how it can be produced at such low cost. The velocipede foot-power is simply elegant. I can turn steadily for a whole day, and at night feel as little tired as if I had been walking around." Descriptive Price List Free.
W. F. & JOHN BARNES CO.,
1899 RUBY ST., Rockford, Ill.

THE PHONOGRAPH.—A DETAILED description of the new and improved form of the phonograph just brought out by Edison. With 8 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 632. Price 10 cents. To be had at this office and from all new dealers.



PETROLEUM BOAT. DESCRIPTION of a petroleum motor devised by Mr. Lenoir for the propulsion of small boats. With 2 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 637. Price 10 cents. To be had at this office and from all new dealers.

H.W. JOHNS' ASBESTOS STEAM PACKING

Boiler Coverings, Millboard, Roofing, Building Felt, Liquid Pans, etc., etc.
DESCRIPTIVE PRICE LIST AND SAMPLES SENT FREE.
H. W. JOHNS MFG. CO., 87 Malden Lane, N. Y.

INVENTORS and others desiring new articles manufactured and introduced, address P. O. Box 88, Cleveland, O.

25% SAVING THE MACKAY AUTOMATIC SPRINKLER

Thermodynamic Fire Alarm operated by Electricity. Positive in its action. Easily tested. No attendance required. Endorsed by Underwriters. The J. C. Mackay Co., 70-80 So. Water St., Syracuse, N. Y., U. S. A.

WIRE ROPE

Address JOHN A. ROEBLING'S SONS, Manufacturers, Trenton, N. J., or 117 Liberty Street, New York. Wheels and Rope for conveying power long distances. Send for circular.

THE AGE OF THE STARS. — BY Prof. JANSEN. History of the discoveries that have led to the introduction of the doctrine of evolution in the science of astronomy. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 630 and 631. Price 10 cents each. To be had at this office and from all new dealers.

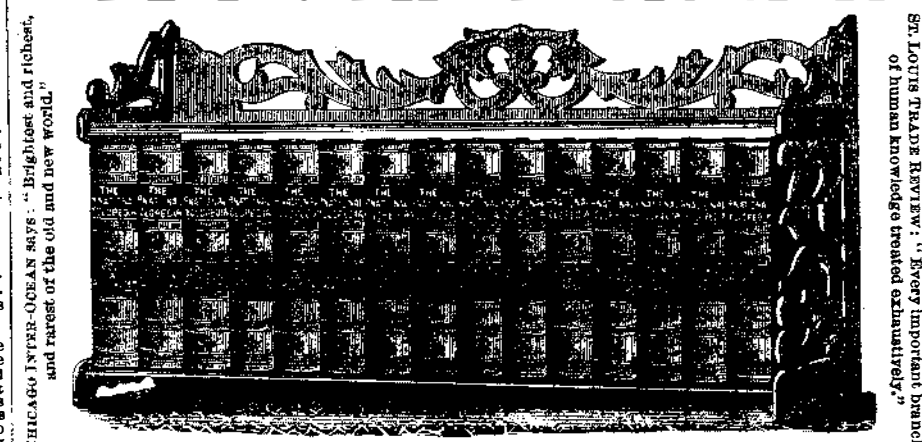
DELAFIELD'S PAT. SAW CLAMP

With saw for cutting metals. Saves all the broken back-saw blades. In use over two years in all parts of the country. The new clamps have the edges beveled that hold the saw. By mail, with one blade, 50 cents. Extra blades 10 cents each. "Star" 70 cents each. 70 cents per dozen by mail. Blades 8" x 11", "Stub," 30 cents each, by mail. Discount to dealers.

NOROTON MFG. WORKS, Noroton, Conn.



A 10 or 12 in. Perfect Screw Wrench, also 1 Perfect Pipe Wrench. 2 Perfect Wrenches sent, express paid, for \$2.00. H. W. A. WATKINS, Mfg., 38 Warren St., N. Y.

THE INTERNATIONAL CYCLOPEDIA

Latest in the Order of Time, but First in the Order of Excellence.

FIVE EDITIONS IN FIVE YEARS. BETTER than any words of praise from us are the testimonials of 315 late buyers of the INTERNATIONAL CYCLOPEDIA, which we have just published. The verdict is pronounced with great unanimity—that the INTERNATIONAL CYCLOPEDIA serves its high purpose with efficiency in the Home, the Library, the Office, or wherever used.

SUCH IS THE INTERNATIONAL CYCLOPEDIA. The Minister is ministered to by it; the Lawyer takes counsel of it, and the Schoolmaster goes to school to it.

SOLD ON EASY MONTHLY PAYMENTS. DODD, MEAD & COMPANY, Publishers, 755 BROADWAY, NEW YORK.

Agents wanted, and good commissions paid.

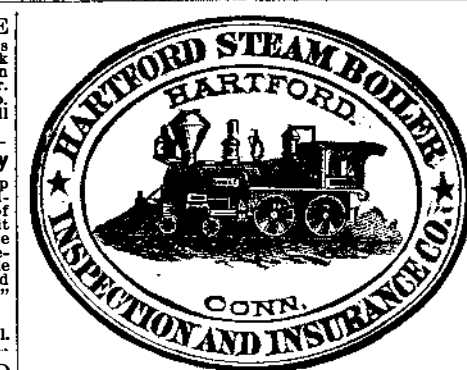
The Original Unvulcanized Packing.

CALLED THE STANDARD—As it is the Packing by which all others are compared.

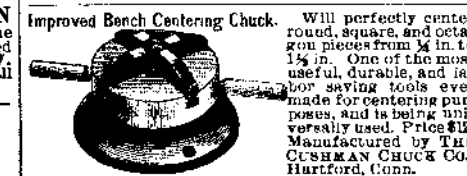
Accept no packing as JENKINS' PACKING unless stamped with our "Trade Mark."

JENKINS BROS. 171 John Street, N. Y. 105 Milk Street, Boston. 91 North 5th St., Phila. 54 Dearborn St., Chicago.

AUTOMATIC CUTOFF VALVE Highest duty, economy, and durability guaranteed. Phenix Iron Co., Trenton, N. J., Mfrs. F. VAN WINKLE, Agt., 91 Liberty St., N. Y.



THE DEVELOPMENT OF THE MERCURIAL AIR PUMP.—By Prof. Silvanus P. Thompson, D.Sc. An interesting historical paper in which the various mercurial air pumps in use from early times up to the present are classified and described. I. Upward driving pumps. II. Downward driving pumps. III. Upward and downward driving pumps. IV. Combination pumps. V. Injector pumps. VI. Mechanical mercurial pumps. With 26 engravings. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 629, 630 and 631. Price 10 cents each. To be had at this office and from all new dealers.



Improved Bench Centering Chuck. Will perfectly center round, square, and octagonal pieces from 1/4 in. to 1 1/2 in. One of the most useful, durable, and labor saving tools ever made for centering pumps, and is being universally used. Price \$12. Manufactured by THE CUSHMAN CHUCK CO., Hartford, Conn.

Scientific Book Catalogue

RECENTLY PUBLISHED. Our new catalogue containing over 100 pages, including works on more than fifty different subjects. Will be mailed free to any address on application.

MUNN & CO., Publishers Scientific American, 361 Broadway, New York.



SAWS Wanted 50,000 Sawyers and Lumbermen to send us their full address for a copy of Emerson's Book of Saws. We are first to introduce NATURAL GAS for heating and tempering saws with wonderful effect upon improving their quality and toughness, enabling us to reduce prices. Address: **EMERSON, SMITH & CO. (Ltd.),** Beaver Falls, Pa.

PETROLEUM FUEL.—AN ACCOUNT

of the Pennsylvania Railroad's experiments with the Urquhart system of burning petroleum on locomotives, and also of the experience of the Great Hartin Railroad with coal oil as a fuel. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 615. Price 10 cents. To be had at this office and from all new dealers.

ERIE ENGINE WORKS

WANT STREET, ERIE, PA. MANUFACTURERS OF STEAMBOILERS, PORTABLE AND VERTICAL BOILERS, STATIONARY AND PORTABLE ENGINES, PUMPS, ETC.

SYSTEMS OF DISTRIBUTION OF Electricity. A lecture by Elihu Thomson, delivered in the Sibley College course. The series on multiple arc, series multiple and multiple series, accumulator and induction systems described, and their advantages and disadvantages discussed. With 18 figures. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 603. Price 10 cents. To be had at this office, and from all new dealers.



The most successful Lubricator for Loose Pulleys in use. **VAN DUZEN'S PATENT LOOSE PULLEY OILER.** Highly recommended by those who have used them for the past two years. Prices very reasonable. Every user of machinery should have our "Catalogue No. 55" sent free.

VAN DUZEN & TIFT, Cincinnati, O.

SYRACUSE MALLEABLE IRON WORKS

JAMES B. EADS.—AN ACCOUNT of the life and labors of this eminent engineer. With a portrait. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 592. Price 10 cents. To be had at this office and from all new dealers.

AUTOMATIC CUTOFF ENGINES

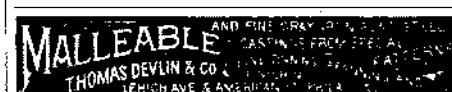
ERIE PA. BALL ENGINE CO.

THE AMERICAN BELL TELEPHONE CO.

95 MILK ST., BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30th, 1877, No. 186,787.

The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones not furnished by it or its licensees responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

**Scientific American**

ESTABLISHED 1846.

The Most Popular Scientific Paper in the World.

Only \$3.00 a Year, including Postage. Weekly, 32 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions, Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc. Complete List of Patents each week.

Terms of Subscription.—One copy of the SCIENTIFIC AMERICAN will be sent for one year—12 numbers—postage prepaid, to any subscriber in the United States or Canada, on receipt of three dollars by the publishers; six months, \$1.50; three months, \$1.00.

Clubs.—Special rates for several names, sent to Post Masters. Write for particulars.

The safest way to remit is by Postal Order, Draft, or Express Money Order. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to

MUNN & CO., 361 Broadway, New York.

THE Scientific American Supplement.

This is a separate and distinct publication from THE SCIENTIFIC AMERICAN, but is uniform therewith in size, every number containing sixteen large pages full of engravings, many of which are taken from foreign papers, and accompanied with translated descriptions. THE SCIENTIFIC AMERICAN SUPPLEMENT is published weekly, and includes a very wide range of contents. It presents the most recent papers by eminent writers in all the principal departments of Science and the Useful Arts, embracing Biology, Geology, Mineralogy, Natural History, Geography, Archaeology, Astronomy, Chemistry, Electricity, Light, Heat, Mechanical Engineering, Steam and Railway Engineering, Mining, Ship Building, Marine Engineering, Photography, Technology, Manufacturing Industries, Sanitary Engineering, Agriculture, Horticulture, Domestic Economy, Biography, Medicine, etc. A vast amount of fresh and valuable information obtainable in no other publication.

The most important Engineering Works, Mechanisms, and Manufactures at home and abroad are illustrated and described in the SUPPLEMENT.

Price for the SUPPLEMENT for the United States and Canada, \$5.00 a year, or one copy of the SCIENTIFIC AMERICAN and one copy of the SUPPLEMENT, both mailed for one year for \$7.00. Single copies 10 cents. Address and remit by postal order, express money order, or check.

MUNN & CO., 361 Broadway, N. Y., Publishers SCIENTIFIC AMERICAN.

Building Edition.

THE SCIENTIFIC AMERICAN ARCHITECTS' AND BUILDERS' EDITION is issued monthly. \$2.50 a year. Single copies, 25 cents. Forty large quarto pages, equal to about two hundred ordinary book pages; forming a large and splendid Magazine of Architecture, richly adorned with elegant plates in colors, and with other fine engravings; illustrating the most interesting examples of modern Architectural Construction and allied subjects.

A special feature is the presentation in each number of a variety of the latest and best plans for private residences, city and country, including those of very moderate cost as well as the more expensive. Drawings in perspective and in color are given, together with full Plans, Specifications, Sheets of Details, Estimates, etc.

The elegance and cheapness of this magnificent work have won for it the Largest Circulation of any Architectural publication in the world. Sold by all new dealers. \$2.50 a year. Remit to

MUNN & CO., Publishers, 361 Broadway, New York.

PRINTING INKS.

THE "Scientific American" is printed with CHAS. ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Phila., and 47 Rose St., opp. Duane St., N. Y.