Mdvertisements.

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

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



FIRE-PROOF PAINTS, STEAM PACKINGS, BOILER COVERINGS, ETC.

Samples and descriptive Price List free by mail H. W. JOHNS M'F'G CO., 87 MAIDEN LANE, N.Y.

THE GREAT AQUEDUCT OF NEW York City.—Lengthy and very complete account of the great aqueduct nowbeing built by the tity of New York to increase its water supply. With 6 engravings. Concained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 5:58 and 566. Price 10 cents each. To be had at this office and from all newsdealers.



THE ECLIPSE OF ALGOL, WITH THE Latest Determinations of its Distance and Dimensions,

—By Royal B. Hill. An interesting account of recent
studies of the variations in intensity of the star Algol,
with a discussion of its orbit and that of its satellite.
How a cardboard model of the phenomena of its celipse
may be made. \\times ith 8 figures. Contained in SCIENTIFIC
AMERICAN SUPPLEMENT. NO. 558. Price 10 cents. To
be had at this office and from all newsdealers.



SINKING MINE SHAFTS .- DE scription of Mr. Pæisch's method of sinking mine shafts in watery earth by means of freezing. With 2 engrav-ings. Contain-d in Scientific American Supplement No. 537. Price 10 cents. To be had at this office and



POINTERS for Users of Steam Pumps.

POINTERS for Users of Steam Pumps.

Van Duzen's Patent Steam Pumps.

Hot or Cold.

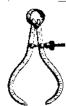
Can Pump Sandy or Impure Efficient.

Has no moving parts, consequently no wear, no repairs, no trouble. Furchasers assume no risks, as we guarantee every Pump. Above comparison with Jet Pumps. Bjectors etc., made of Iron.

Demand this Pump of your deaer and take no cheap substitute. We make Ten take no cheap substitute. We make Ten Sizes. Prices from \$7 to \$75. Capacities from 100 to 20,000 galloas per hour. State for what purpose wanted and send for Catalogue of "Pumps."

VAN DUZEN & TIFT. Cincinnati, 0.

THE SIEGE OF ALEXANDRIA BY Julius Cassar.—By Rear Admiral Serre, of the French Navy.—The Situation of ancient, as compared with modern, Alexandria Cassar's account of the siege of the city. Deductions to be drawn from the account. Illustrated with one engraving and two maps, Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 506. Frice 10 cents. To be had at this office and from all newsdealers.



Chandler & Farquhar, 177 Washington St., BOSTON.

Agents for Fay's "Yankee" CALIPERS

AND
Barnes' Foot Power Machinery,
AND DEALERS IN Machinists' Supplies of Every Kind. Send two stamps for illus. catalogue.

ORNAMENTAL DESIGN, PRINCIples and practice of .—By Lewis F. Day. The second of a series of lectures on this subject, discussing the lines upon which ornament can be distributed. With 5 illustrations. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, NO. 5589. Price 10 cents. To be had at this office and from all newsdealers.

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 apertence, and now have unequaled facilities for the preparation of Patent Drawings, Specifications, and the experience, and now have unequaled facilities for the preparation of Patent Drawings, Specifications, and 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 Intringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A numblet sent free of charge on application con-

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, Roissues, 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.

MIUNN & CO., Solicitors of Patents,

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

JENKINS BROS. VALVES.

THE ENDORSEMENT OF FIRST-CLASS ENGINEERS AND MECHANICS THROUGHOUT THE COUNTRY has fully demonstrated these valves to possess the following advantages over all other valves now in use.

1. A perfectly tight valve under any and all pressures of steam, odls, or gases.

2. Sand or grit of any kind will not in jure the seat.

3. You do not have to take them off to repair them.

4. They can be repaired by any mechanic in a few minutes.

5. The elasticity of the Disc allows it to adapt itself to an imperfect surface.

In Valves having ground or metal seats should sand or grit get upon the seat, it is impossible to make them tight, except by regrinding, which is expensive if done by hand, and if done by machine soon wearsout the valve, and in most cases they have to be disconnected from the pipes, often costing more than a new valve. The Jenkins Discs used in these valves are manufactured under our 1830 patent, and will stand any pressure of steam, odls, or acids. JENKINS BROS., 71 John St., N. Y. 105 Milk St., Boston: 13 So. Fourth St., Phila. 54 Dearborn St., Chicago



Mention this paper.

Ajax Anti-Acid Metal.

We guarantee 100 per cent longer service than ordinary composition metal and our prices are reasonable.

HARRISON BROTHERS & CO.,

MANUFACTURERS OF

HARRISON BROTHERS & CU.,

MANUFACTURERS OF

WHITE LEAD. COLORS AND CHEMICALS.

OFFICES (Philadelphia: 35th and Gray's Ferry Road.

OFFICES (Philadelphia: 35th and Gray's Ferry Road.

PHILADELPHIA, April 21st, 1887.

ATAX METAL CO., 2040 No. 16th St., City

Gentlemen: Your favor of the 14th Irst, is at hand. In answer to your question I have to say that we had your anti-acid me'al bibook on our said pipe, through which a constant stream of chamber said heated to about 10s deg. F. runs; and I am pleased to say that up to the present time we can dissover no perceptible wear in the metal. I hink that you will have a perfect right, therefore, to recommend this matal for use in chamical works in connection with acid pipes.

Respectfully yours,

C. SyllPER, Supt.

Manufactured by Ajax Metal Co., Philadelphia. Ps.

ALKALOIDS AND OTHER CRYSTALline Bodies.—Identification of by the Microscope. By A. Percy Smith, F.C.S. With 50 igures of microcrystals. Contained in Scientific American Supplement, No. 54.5. Price III cents, To be had at this office and from all newsdealers.



Ainsworth's Patent Improved BELT CLAMP

This clamp is light and strong pair will last a lifetime; are a pair will last a lifetime; are made of the best cast steel. No tool or wrench is needed, as it is complete in itself. Can be used on any size belt, from one inch to size of clamp.

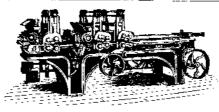
E. Ainsworth, Mfr., 323 Washington St., Wilmington, Del.

COMPRESSED AIR FOR TRAMWAYS —A paper by Norman Selfe, discussing the comparative merits of compressed air under high and low pressures, as a motive power for street cars. Contained in SCIEN-TIFIC AMERICAN SUPLEMENT, NO. 553. Price 10 cents. 'To be had atthisofficeand from all newsdealers.

AGENTS WANTED (Samples FREE) for Dr. Scott's beautiful Electric Corsk, and St. Brushes, Belts, Etc. No risk, quick sales. Territory given, satisfaction guaranteed.

DR. SCOTT, S43 Broadway, N. Y.

EXAMINATION QUESTIONS IN GENeral construction. Copy of the last examination papers given to candidates who are desirous of employment in the constructive departments of the membershipty of New York. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 561. Price, 10 cents. To be had at this office and from all newsdealers.



WITHERBY, RUGG & RICHARDSON. Manufacturers of Patent wood Working Machinery of every descrip-tion. Facilities unsurpassed. Shop formerly occupied by R. Ball & Co., Worcester. Mass. Send for Catalogue-

COLORS COMMON AND POISONOUS A table showing the composition of some of the pigements in common use, with a classification of the latter based upon poisonous properties. Contained in the ScriENTIFIC AMERICAN SUPPLEMENT, NO. 546. Price in cents. To be had at this office and from all newsgeairs.

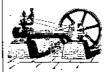


THE TEST OF THE ROADS
FOR TEN YEARS,
By the majority of American riders
of first-class machines, proves the

NOLUMBIA BICYCLE & TRICYCLES SUPERIOR TO ALL OTHERS.

Illustrated catalogue sent free. POPE MFG. CO., Boston, New York, Chicago, Hartford.

CONCRETE.—BY JOHN SLATER, B.A. Apaper on the means to be adopted in order to render buildings stable, and on the use of concrete as a material for that purpose. Early use of concrete as a building material. Value of concrete. Materials of which concrete is composed. Cement concrete. London concrete. Artificial stones. Concrete buildings. ("entained in SCIENTIFIC AMERICAN SUPPLEMENT. No. 539. Price 10 cents. To be had at this office and from all newsdealers.



Horizontal and Vertical.

Dredging Machinery, Flour. Powder, Slate and Flint Mill Machinery, Tur-bine Water Wheels. York Mfg Co., York, Pa. U.S.A.

PURIFICATION OF. - BY AIR, Prince, M.D. An experimental study in relation to the removal from the air of the dust or particulate material, supposed to produce yellow fever. small-pox. and other infectious disease. Illustration. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, NO. 5649. Price 10 cents. To be had at this office and from all newsdealers.

HARRISON CONVEYOR! For Handling Grain, Coal, Sand, Clay, Tan Bark, Cindare Orac Constitution of the Constitution of the Converse of the Conve Handling Grain, Coal, Sand, Clay, Tan Bark, Cinders, Ores, Seeds, &c.

Send for Circulars. | BORDEN, SELLECK & CO., { Sole (Manu'Fers,) Chicago, III.

TEST RECORDING APPARATUS.—Description, by J. H. Wicksteed, of a new testing machine, with autographic recording apparatus, and an explanation of its mode of operation. With 4 engravings Contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 5.3%, Price 10 cents. To be had at this office and from all newsdealers.

Manufacturers, Agriculturists, Chemists, Engineers, Mechanics, Builders, men of leisure, and professional men, of all classes, need good books in the line of their respective callings. Our post office department permits the transmission of books through the mails at very small cost. A comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has just been published for free circulation at the office of this paper. Subjects classified with names of author. Persons desiring a copy, have only to ask for it, and it will be mailed to

MUNN & CO., 361 Broadway, New York.

A SYNOPSIS OF ALL THE KNOWN A SYNUPSIS UP ALLE THE ARROWS Anæsthetics, with their physical and physiological properties, and anæsthetic value. By B. W. Richardson, M.D. Contained in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 515 and 516. Price 10 cents each. To be had at this office and from all newsdealers.

SAWS Wanted 50,000 Sawyers and SAW S full address for a copy of Emerson's IP Book of SAWS. We are first to introduce NATURAL GAS for heating and tempering Saws AL GAS for heating and tempering Saws with wonderful effect upon improving their quality and toughness, enabling us to reduce prices. Address

SEMERSON, SMITH & CO. (Ltd.), Senate of Saws and Saw

HISTORY OF THE ELECTRICAL ART in the U.S. Patent Office.—By C. J. Kintner. An interesting history of the growth of electrical science in this country, and notices of some of the more important models in possession of the Patent Office. Contained in SCIENTIFIC AMERICAN SUPPLEMENT No. 544. Price 10 cents. To be had at this office and from all newsdealers.

WATERBURY MALLEARLE IRON COMPANY, WATERBURY, CONN.

MALLEABLE AND GRAY IRON CASTINGS.

FITTINGS for STEAM, GAS & WATER.

HOW TO GRAFT.—A VALUABLE PA-HOW TO UKARTI.—A VALUABLE IAper, giving complete directions for making various
kinds of grafts in fruit trees.—Cleft grafting, slig
grafting, bear's mouth grafting, wired grafting, slog
grafting, whip grafting, soddle grafting, tongue
grafting. split grafting, crown grafting. Grafting-wax.
Waxed cloth. With 11 figures. Contained in SCIENTITIC AMERICAN SUPPLEMENT NO. 540. Price 10 cents.
To be had at this office and from all newsdealers.

To Business Men.

The value of the SCIENTIFIC AMERICAN as an advertising medium cannot be overestimated. Its circulation is many times greater than that of any similar journal now published. It gees into all the States and Territories, and is read in all the principal libraries and reading rooms of the world. A business man wants something more than to see his advertisement in a printed newspaper. He wants circulation. This he has when he advertises in the SCIENTIFIC AMERICAN. And do not let the advertising agent influence you to substitute some other paper for the SCIENTIFIC AMERICAN, when selecting a list of publications in when you excide it is for your interest to advertise. This is frequently done, for the reason that the agent gets a larger commission from the papers having a small circulation than is allowed on the SCIENTIFIC AMERICAN.

For rates see top of first column of this page, or address

MUNN & CO., Publishers,

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

AN IMPROVED ARMY FILTER -DE-ATM INTOVED ARMIT FILTER.—DEscription of a very effective portable filter devised by
Mr. Maignen for army use. but likewise adapted for the
use of wine and spirit merchants and brewers, and for
laboratory purposes. Illustrated with 8 engravings,
Contained in Scientific American Supplement, No.
436. Price 10 cents. To be had at this office and from
all newsdealers.



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.

ENGINE. aau

The safest, most reliable and economical Motor in existence. Independent of Gas Works and Machines.

2 to 25 H. P. So it can be used anywhere. Makes its Own Cas AT COST OF ABOUT

Chicago Agent: H. H. LATHAM, 42 Dearborn Street. New York House: 12 Cortlandt Street.

Williams & Orton Mfg. Co. P. O. Box 148. STERLING, ILL.

SHAFTING DEPARTMENT Couplings, Hangers, Shafting, Pulleys, PRINTING INKS. EDISON MACHINE WORKS. Salesroom 19 DEY STREET New York. THE "Scientific American" is printed with CHAS.

SEND FOR CATALOGUE. THE "Scientific American" is printed with CHAS.

SEND FOR CATALOGUE. THE "Scientific American" is printed with CHAS.

The "Scientific American" is printed wi

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.

Water Wheels New and Second Hand Address FLENNIKEN TURBINE CO., Dubuque, Iowa.

-THE-

Scientific American Building Edition,

THE SCIENTIFIC AMERICAN ARCHI-TECTS' 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, practically, a large and splendid Magazine of Architecture, richly adorned with elegant plates in colors, and with fine engravings; illustrating STEAM ENGINES. Architectural Construction and allied the most interesting examples of modern 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, Costs, Bills of Estimate, and Sheets of Details.

Architects, Builders, and Owners will find this work valuable in furnishing fresh and useful suggestions. All who contemplate building or improving homes or erecting structures of any kind, have before them in this work an almost endless series of the latest and best examples from which to make selections, thus saving time and money.

Many other subjects, including Sewerage, Piping, Lighting, Warming, Ventilating, Decorating, Laying Out of Grounds, etc., are illustrated. An extensive Compendium of Manufacturers' Announcements is also given, in which the most reliable and approved Building Materials, Goods, Machines, Tools, and Appliances are described and illustrated, with addresses of the makers, etc.

The fullness, richness, cheapness, and convenience of this work have won for it the Largest Circulation of any Architectural publication in the world. Sold by all newsdealers.

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

Building Plans and Specifications.

In connection with the publication of CHLORINATION OF GOLD ORES.—A paper by G. W. Small, E.M., detailing the method of the BUILDING EDITION of the SCIENTIFIC of the Plynouth Consolidated Gold Mining Co. Contained in Scientific American Supplement, No. 545. Price 10 cents. To be had at this office and from all newsdealers. every kind, including Public Buildings, Churches, Schools, Stores, Dwellings, Carriage Houses, Barns, etc. In this work they are assisted by able and experienced architects.

Those who contemplate building, or who wish to alter, improve, extend, or add to existing buildings, whether wings, 65 cents per M Feet. porches, bay windows, or attic rooms, are A Saving of 25 to 85 per cent invited to communicate with the under-guaranteed over all other Gas signed. Our work extends to all parts of signed. Our work extends to all parts of the country. Estimates, plans, and drawings promptly prepared. Terms moderate. Address

MUNN & CO., 361 Broadway, New York.