SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class matter. Copyright, 1895, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

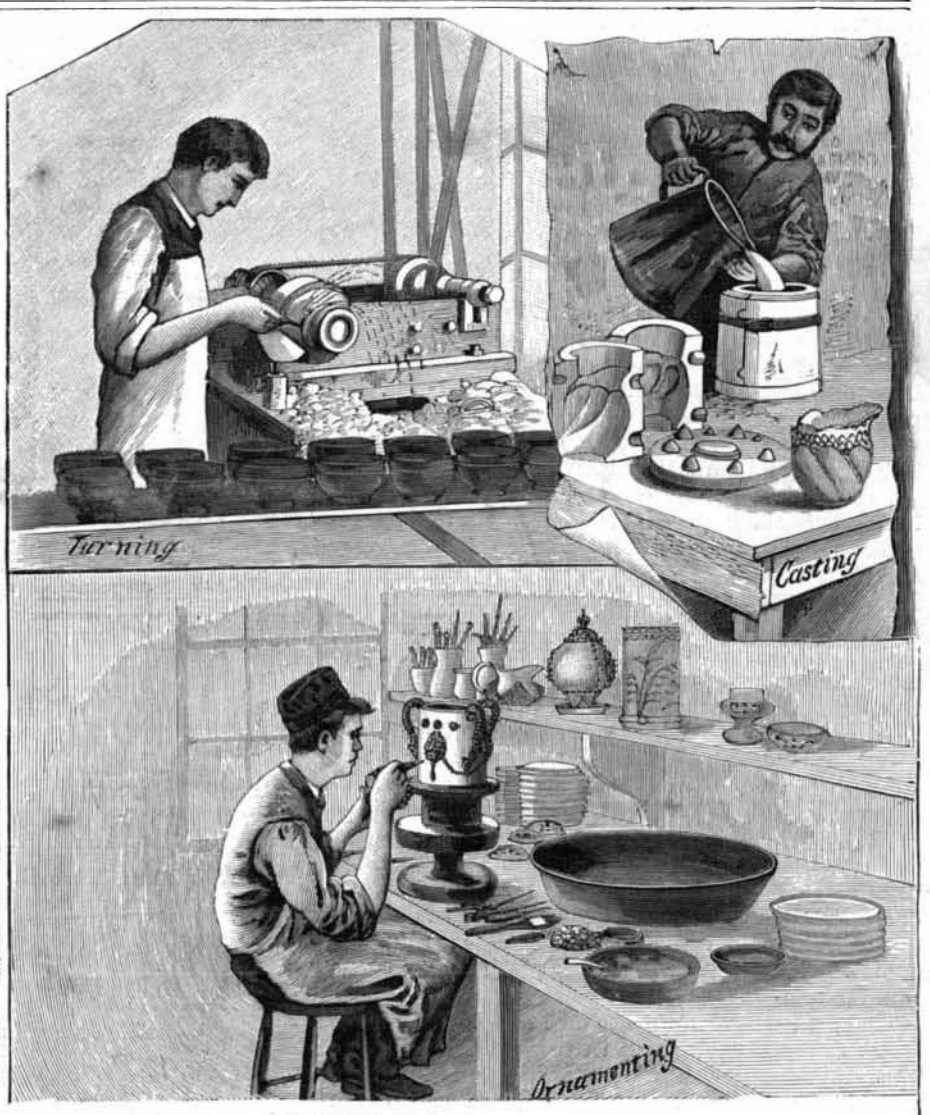
Vol. LXXII.—No. 13. ESTABLISHED 1845. NEW YORK, MARCH 30, 1895 $3.00 A YEAR. WEEKLY.

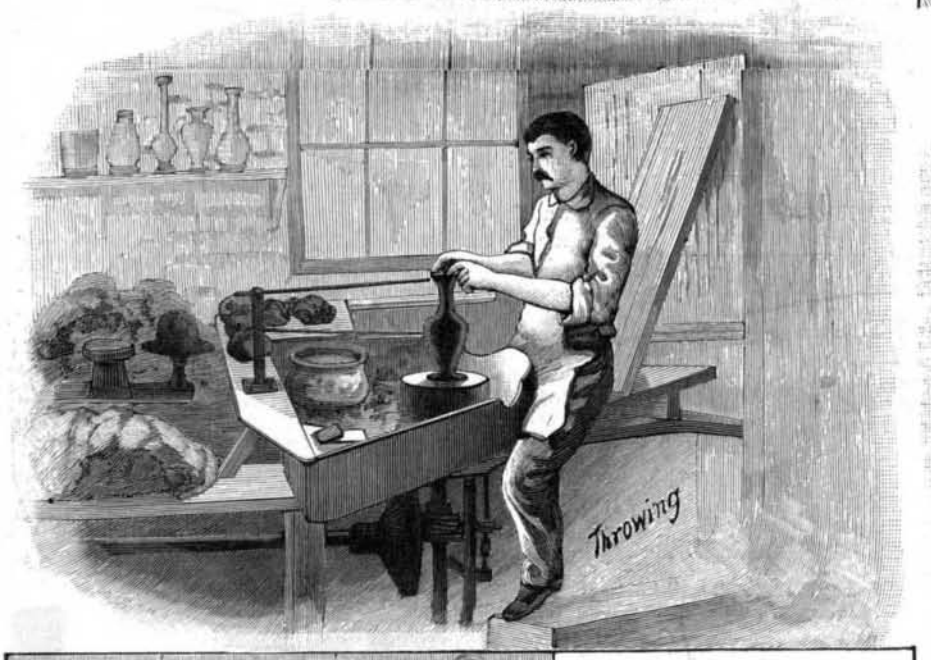
THE MANUFACTURE OF PORCELAIN.

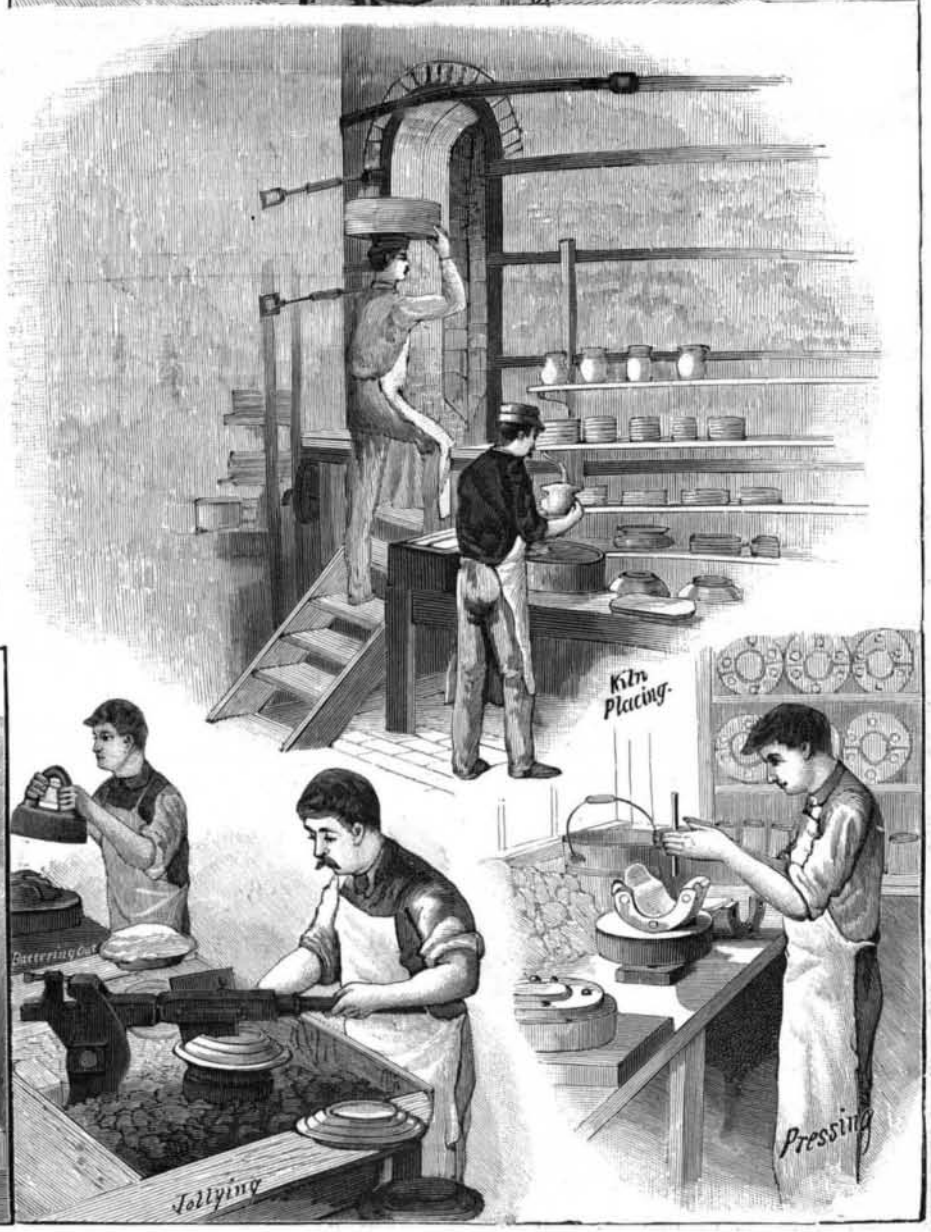
The manufacture of porcelain and earthenware is one of the most interesting of the technical processes. The illustrations we present in this issue were taken in the works of the Knowles, Taylor & Knowles Company, East Liverpool, Ohio, the parent company of that city and the largest manufacturing concern of its kind in the United States, its business dating back to the year 1854.

Porcelain and earthenware are made from clay, which, while moistened with water so as to be of doughlike consistency, is shaped and is then baked or partially vitrified by firing in a furnace. On removal from the furnace it may be coated with a fusible glaze and refired so as to fuse the glaze. This completes it, unless it has to be decorated by painting, which, if done, involves a third firing to fix the color.

The first operation is the preparation of the clay. Kaolin, feldspar, flint and sand are the principal constituents which enter into the composition, all being finely ground and the feldspar sometimes being calcined. The different ingredients are weighed so as to secure the proper proportions and are then mixed in a pug mill, which is a cylinder containing a vertical shaft carrying mixers, which shaft rotates and forces the thoroughly mixed clay out at the bottom in a long prism. One of our cuts shows this machine at work. Mixed with a quantity of water, the material from the pug mill is introduced into a large tank containing a grinding apparatus. After grinding, the material is run off into a large tank, and is then passed through bolting cloths, termed by







THE PORCELAIN AND EARTHENWARE INDUSTRY.

the workman the "lawn." It is finally passed through a filtering press.

As a majority of pottery articles are circular in section, the turning process in one form or another enters largely into the manufacture. One of our illustrations shows a thrower making a vase on the historic potter's wheel. This apparatus is a horizontal table kept in rapid rotation. The mass of clay for the article is weighed out, is placed on the center of the table, and by the fingers of the workman is rapidly brought to the required shape. This is almost pure handwork, but in another phase of operations special shaping tools are used, as shown in the cuts, representing "battering out" and "jollying." These processes are shown as applied to plates. A mould representing the contour of the one side of the plate is laid upon the table and on it the clay is placed. The workman, or "batterer," then brings down upon the clay an approximate mould of the other side of the plate and passes the partly shaped article to the "jollier." The latter places it on a potter's wheel, a profile mould or scraper is brought down upon it as it rotates, which shapes the surface to the exact contour required. The cut is self-explanatory.

Another phase of the shaping process is shown in the cut representing "turning," where the clay is turned off on a species of lathe. The operation of "pressing," another phase of the system, is also shown in one of the cuts as applied to the manufacture of pitchers Here sectional moulds are employed, in which the object is made in three or more pieces. The workman then rolls a lump of clay between the palms of his hands so as to form it into a cylinder and, laying this along the joints, brings the moulds together to form the completed article. Another very ingenious way of forming articles of complicated shape is the casting process. It should be said in advance that plaster of Paris is used universally for the moulds. This substance being very absorbent, the surface moisture is removed from the clay by capillarity, and this action is especially invoked in the casting process. The moulds for a pitcher corresponding to its exterior surface are placed together and held by a strap. The workman uses a mixture of clay and water of the consistency of cream. After thoroughly mixing it, he pours it into the mould; as the latter absorbs the moisture from the clay a film is soon formed which thickens gradually, and when the workman finds the operation is complete, the surplus material is poured out of the mould, leaving in it the proper thickness of clay dried by capillarity, of the precise shape of the interior, reproducing every detail.

The articles have now to be filed, and kiln placing is the next operation. The articles are put in proper receptacles called saggers, and are stacked up in the kiln, which is a dome-like receptacle connected with which is a furnace. When the kiln is full it is closed and the furnace is started, and for a number of hours, the period depending upon the goods to be produced, the firing is continued. When cold, the ware is removed from the furnace, and is then termed biscuit ware.

Before the glazing is applied all rough pieces are removed from the goods by an operation termed "fettling." Each piece is carefully inspected and smoothed over if required. It is at this stage that it may be ornamented in relief. This is done by an India rubber bag syringe. The bag is open at one end and has a nozzle at the other. It is filled with mixed clay and water of proper consistency, and the workman ejects it by squeezing upon the surface of the object, producing various designs, as shown in one of the illustrations.

The glazing process comes next in order. The glaze consists of a special glass pulverized to the utmost degree of fineness, and mixed with water to a cream-like consistency. The articles are dipped into this and are removed with a quantity adhering. They are put into a glazing kiln in saggers and are heated until the glaze enters into a perfect fusion. After cooling, they are removed and are complete, unless they have to be decorated.

Decoration consists in painting or imprinting designs upon the glazed surface with special paints.

After the decorating, the article is again fired, so as to fuse the paints into the enamel, and the article is finished.

The Knowles Works have been selected by our special artist, owing to the fact that they are the largest works of the kind in the United States.

They have 19 regular kilns in operation, in addition to 12 decorating kilns, which, with other kilns, bring up the total to 93 kilns. Over 700 employes are occupied at the works.

Preserving the Color of Flowers.

The following method of preserving the colors of dried flowers, applicable to even the most delicate poppies, has been discovered by Herr Nienhaus. Ammonia in the air is the main cause of flowers losing their tints; so Herr Nienhaus presses his specimens between paper which has been previously saturated with a solution of one per cent of oxalic acid in water.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S., Canada or Mexico.....$3 00
One copy, six months, for the U. S., Canada or Mexico..... 1 50
One copy, one year, to any foreign country belonging to Postal Union. 4 00
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for the U. S., Canada or Mexico. $6.00 a year to foreign countries belonging to the Postal Union. Single copies 10 cents. Sold by all newsdealers throughout the country. See prospectus, last page.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to one address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries within Postal Union *eight dollars and fifty cents a year.*

Building Edition.

THE ARCHITECTS AND BUILDERS EDITION OF THE SCIENTIFIC AMERICAN is a large and splendid illustrated periodical, issued monthly, containing floor plans, perspective views, and sheets of constructive details, pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To builders and all who contemplate building this work is invaluable. Has the largest circulation of any architectural publication in the world.

Single copies 25 cents. By mail, to any part of the United States, Canada or Mexico, $2.50 a year. To foreign Postal Union countries, $3.00 a year. Combined rate for BUILDING EDITION with SCIENTIFIC AMERICAN, to one address, $5.00 a year. To foreign Postal Union countries, $6.50 a year. Combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN and SUPPLEMENT, $9.00 a year. To foreign Postal Union countries, $11.00 a year.

Export Edition of the Scientific American,

in which is incorporated "LA AMERICA CIENTIFICA E INDUSTRIAL," or Spanish edition of the SCIENTIFIC AMERICAN, published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number contains about 50 pages, profusely illustrated. It is the finest scientific, industrial export paper published. It circulates throughout Cuba, the West Indies, Mexico, Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. THE SCIENTIFIC AMERICAN EXPORT EDITION has a large guaranteed circulation in all commercial places throughout the world. $3.00 a year, post paid to any part of the world. Single copies 25 cents.

☞ Manufacturers and others who desire to secure foreign trade, may have large and handsomely displayed announcements published in this edition at a very moderate cost. MUNN & CO., Publishers,
361 Broadway, New York.

☞ The safest way to remit is by postal order, express money order, draft or bank check. Make all remittances payable to order of MUNN & CO.

☞ Readers are specially requested to notify the publishers in case of any failure, delay, or irregularity in receipt of papers.

NEW YORK. SATURDAY, MARCH 30, 1895.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 1004

For the Week Ending March 30, 1895.

Price 10 cents. For sale by all newsdealers.

THE ELECTRIC TRANSMISSION OF ENERGY.

The complexion of the world and the phases of our existence, owing to the astonishingly rapid progress in the arts, are undergoing grave changes. The cruder animal powers are being put aside in favor of mechanical ones. A few years ago ferryboats were propelled across the rivers about New York City by horse power, as commemorated by Fitz Greene Halleck in one of his poems. To-day a horse boat, as they were called, would appear as much of an anomaly and as archaic as a horse car will to our descendants. The introduction of the trolley has almost abolished what was perhaps the greatest single field for the employment of horses. And lately man has found that he can, on a bicycle, propel himself far better than any horse can. The bicycle is possible simply because of the mechanical perfection of the machine.

Coal is now the great source of power. A ton of coal represents eight or ten thousand man power hours, and perhaps over one thousand horse power hours. It can be produced for so small a price that in the regions of its production it is the smallest element in the expense of power production. There would be little choice in the Pennsylvania coal regions between a steam plant or a water power plant for the production of power. But given the power, the expense only begins. The turbine or steam engine is the first step that costs; the subsequent ones involving the distribution of the power require the expenditure of money for their maintenance. Shafting and distribution apparatus in general have to be kept up, belting wears out, lubricating material has to be used, buildings must be kept in repair, and the labor and material charge for all this counts up rapidly.

The phenomenal success of the trolley system of electric railroads is due to the electrical distribution of power, and only incidentally to any cheapening in its original production. It is perfectly true that steam can be produced more cheaply in large than in small units, but the soul of the trolley system is in the trolley wire. A mechanical substitute for it, and the only one in extensive use to-day, is the cable in its subway conduit. The contrast in simplicity between the two and in the requisite capitalization is most striking. It is fair to say that electricity depends for its greatest operations on its adaptability to simplify distribution of power.

This being the field of electricity's triumphs, and a field as yet imperfectly explored, it would appear that it would give great scope to experiment and invention. The dynamo builder prides himself on turning out a generator of ninety-eight per cent efficiency. The electric motor has its efficiency tested just as rigorously. But how much do we hear of the efficiency of the transmission processes? An immense quantity of power is lost between station generators and car motors on all trolley lines and between the station and consumers in electric lighting systems. The price of copper is so high that a balance has to be struck between the interest charge on conductors and the loss incurred by different sizes, in order to determine how large or how small the conductors should be. The problem is made more tantalizing by the fact that with a high enough potential small wires could transmit a comparatively great power, while the great danger of high potentials prohibits their use in most cases.

Accordingly the process of producing power in stations by the best steam plant and of there converting mechanical energy into electric energy with scarcely any loss goes on, and is coincident with the transmission of power over a circuit of resistance high enough to destroy the original economy, which, at the same time, is a circuit of high original cost and high interest charge. To reduce this cost the rails are used as a return, and a branch circuiting of the current follows, in some cases to the injury of neighboring water mains and gas pipes.

In nearly all cases of electric distribution, although the conductors may be insulated, there is inevitable waste and a balancing of interest account on the original cost of conductors against the absolute waste of power. There is obviously a chance for some of the greatest improvements yet effected in the electrical science in the development of a radically new, or at least radically improved, system of delivering electrical energy to the distant motor or lamp.

Interesting Rifle Test.

An interesting test of the new Krag-Jorgensen rifle has been made recently at the United States engineer ground at Willets Point. In order to determine the penetrative power of the gun a number of pine boards were fastened together till a thickness of fifty inches was obtained. Two of the shots fired at this target at short range passed entirely through it and none of the bullets fired penetrated less than three feet. The same test tried with oak planks also gave highly gratifying results, the penetration in this case being thirty-two inches Iron plates two-thirds of an inch thick were also pierced. A very curious result was obtained by firing a bullet at a series of thin iron plates placed an inch apart. The bullet was found to pass through one plate after another till it melted.