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 seen 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.

Frederick E. Sickles.

By the death of Mr. Sickles a vacancy occurs in the engineering world of no small consequence. The following interesting tribute to the deceased inventor and engineer, from the Engineering Record, will recall to the minds of our older readers the excitement created at the time Mr. Dickerson was endeavoring to induce the Navy Department to introduce the Sickles cut-off on all the government vessels:

Mr. Sickles was an inventor of world-wide reputation, and who for the past seven years was the chief engineer of the National Water Works Company, of Kansas City, Mo. He died of heart failure March 9, at the age of 76 years. Born in 1819, on a farm near Camden, N. J., after receiving a common school education young Sickles started in his professional career as a rodman for the Harlem Railroad, and then, at the age of 17 years, was apprenticed to the Allaire Machine Works in New York City. He showed at this time his taste for mechanics by close attention to the study of physics, and while in the Allaire shops noticed a defect in a small stationary engine. In devising a means of overcoming this he invented, in 1842, the well known Sickles cut-off, which was the first drop cut-off to be practically successful.

Although Sickles has been given the credit of inventing the drop cut-off and dash-pot principle, now one of the principal features of the so-called Corliss gear, Mr. Thomas Rowland, president of the Continental Iron Works, informed us that Sickles was antedated by a man named Barber, who invented the first positive releasing gear and employed a dash pot to catch the valve as it descended. Barber's valve was actuated by a single eccentric, and hence the cut-off could only take place between zero and one-half stroke. The mechanism Barber employed was crude and gave little satisfaction. Mr. Rowland said that Mr. Sickles then improved the Barber cut-off by introducing what he called a "wiper," which, operated by a separate eccentric or by attachment to a pin on the working beam, allowed the cut-off to occur at any point from zero to full stroke. Corliss, at a still later date, improved the Sickles cut-off by making it automatic by connecting it to a governor.

From other sources we learn that Corliss was said to have infringed upon the patents of Sickles, and then began one of the most famous suits in history and after years of litigation Sickles obtained a favorable decision. Mr. Sickles then asked for injunction against the users of the engines, but it was denied by the courts on grounds of public policy.

In connection with the right of Sickles to claim the invention of the drop cut-off it will be of interest to know that Sickles, who had a very interesting exhibit of his inventions at the Centennial, was recommended to receive an award for his invention of the drop cut-off by the board of judges, of which our informant on this point, Mr. Charles T. Porter, was a member. This recommendation, the only one so treated of the vast number handled by the judges, was not passed upon by the committee on revision, and of this committee Mr. Corliss was the chairman.

The first marine engine to operate with the Sickles cut-off was, Mr. Rowland states, on the steamer Champion, a vessel belonging to Commodore Vanderbilt and plying upon Long Island Sound in 1844.

Mr. E. N. Dickerson, a patent lawyer of considerable reputation, who had always been interested in steam engines and their improvements, associated himself with Mr. Sickles about this time for the purpose of exploiting such inventions as either might make, Mr. Dickerson being an inventor of no mean consequence. Some time in 1850 the steamer Bay State was constructed for the Fall River Company, and the Novelty Iron Works, under the direction of its president, Horatio Allen, made some changes in the valve gear of her engine that were decided to be an infringement on Sickles' patent. Messrs. Dickerson & Sickles thereupon sued the Fall River Company for infringement, and the suit, which attracted the greatest attention because of Mr. Dickerson's ability, was decided in favor of Dickerson & Sickles. It was not so much for the monetary interest to Sickles that the suit was begun, as to establish his reputation and the priority of his invention.

About the time the Collins Steamship Company had constructed the Adriatic, Horatio Allen, of the Novelty Iron Works, applied some patented valve gear of his own invention. These valves were ordinary plug cocks, but of massive proportions. These proving a failure, Sickles was engaged by Allen to remove the Allen gear and steam chests and replace them with his own inventions. This work Sickles gave to the Allaire Works, of which Mr. T. F. Secor was then president and Mr. Rowland the chief of the draughting room and in charge of the mechanical details. After the changes were made in the valve gear the Adriatic started on her maiden trip, during which her engines worked very successfully.

Some time in 1856 Dickerson & Sickles contracted with the city of Detroit to furnish a pumping engine in which a duty of 100.000 foot pounds was guaranteed. Although the engine was not a success, it was a move in the right direction, for Sickles expected to obtain this duty, which was high for those days, by carrying a high steam pressure, 115 pounds, and by expanding ten times. Mr. Warren Hill, who was present at the time of the trial, states that the pump failed to take water and ran away, to the great alarm of the water commissioners, who had assembled to witness the starting up of the engine. The city of Detroit then sued Dickerson & Sickles to recover the money paid them for the pump, but was beaten.

Between the years 1840 and 1842 Sickles received six patents, the most famous of these being granted for the theory of what is now known as differential motion, and which was applied to steam hammers and to steam steering gear, the latter being the first steering gear to be operated by steam, and which, moreover, is in use in almost all of the large steamers at the present day. This patent, as well as that on the cut-off, was extensively infringed upon, and failing to get relief through the courts, Mr. Sickles turned his attention to civil engineering. Going West, Mr. Sickles helped to build the Union Pacific Railway and the large bridge at Omaha. At about that time he patented a device for anchoring bridge piers.

Mr. Sickles was a member of the Engineers' Club of Kansas City, and was beloved by all for his modest and gentle bearing and his charity toward all.

Cause of the Gulf Stream and Similar Ocean Currents.

They are produced by the rotation of the earth and by the land, with its peculiar formation; by the tidal wave, with the trade winds.

If the earth were a true sphere and evenly covered with a layer of water, the tide would follow the moon around the earth with a broad, gentle swell and not exceed three feet in height directly under the moon, and there would be no Gulf Stream or any other ocean currents.

Now, if there were a narrow belt of land reaching from pole to pole, it would act on the principle of a dam, and would stop the natural course of the tides, and would raise them from three to twenty feet at least. To cause a very high tide, form a bay one hundred miles long and fifty miles wide at the mouth and gradually coming to a point at the extreme end located on this belt of land that reaches from pole to pole, directly under the moon. The tide would rise at the extreme end of the bay one hundred feet at least This formation gives the tide a very good opportur to enter the bay and force the water upward. To make this better understood, I call your attention to the Bay of Fundy. It is the principle that causes the tide to rise sixty feet or more at the head of that bay; it is the form of the bay that causes the tide to rise so high. Now let us change ends of the bay and see what the effect will be, the location being the same and the mouth of the bay only fifty feet wide and one hundred miles long and fifty miles wide at the extreme end or head, there would be no tide at the extreme end, the opening being so small at the mouth and the demand for water so large, as it made its way up the bay, that it would lose its force long before it reached the head. But every flood tide would make a fall into the bay and every ebb tide would make a fall into the ocean. There would be no possible chance for a sufficient quantity of water to get into this bay to make a tide at the extreme end. The Gulf of Mexico is a representation in part of this formation, so much so that the tide is quite small on the west shore.

The course of the Gulf Stream could be changed by cutting across at the Isthmus of Panama a channel of sufficient size to admit the passage of the water forming it. The stream would then flow into the Pacific Ocean and no longer cross the Atlantic to warm the shores of Europe, as it now does. The Gulf Stream is an equalizer of water as well as heat. If the water remained equally distributed, there would be no ocean currents. The land, with its varied formation, together with wind and tide, the great forces which move or displace the water of the sea, is continually causing inequalities of water. The moon and sun, by their attraction, draw the water from the poles to the center directly under the moon at the tropics, and is brought by the tide waves from the east to the west shore, where it is held by the moon, sun, and trade winds, and forced along the shores north and south. The islands forming the Caribbean Sea act on the principle of a breakwater or dam. They hold the water that has been forced into the Caribbean Sea by the tides and trade winds, which causes the water to be higher in that sea and turn it into the Gulf of Mexico, which becomes the reservoir or fountain head, and whence the Gulf Stream flows like a river from a lake. It is the equalizer of water as well as heat, and makes its way in the direction of the greatest deficiency of that element.

The warmth of the stream is accounted for by the fact that its waters are supplied from the tropics, the tide waves acting on the principle of an eddy, so it has counter currents also. This theory rests upon the assumption that the water is higher on the east than on the west side of the Isthmus of Panama. The continent of America is the great dam in the ocean that forms the Gulf Stream. Place the continent of America so it will lie east and west, there would be no Gulf Stream. If there were no other land on the globe than America, there would be no ocean currents except those connected with America; but such is not the case. Africa has her nose in the way, Australia and New Zealand intervene, and Asia is there to stop tides and make ocean currents in the Pacific Ocean. So when we find large bodies of land directly in the path of the tides, we find ocean currents also. All large oceans have their counter currents or eddies. The water that has been carried west by the tides has to return as currents to supply the deficiency, thus imparting the eddy motion. The tides and the winds, with the land and its formations, will produce every circumstance connected with the ocean currents.

The peculiar formation of the land has a good deal to do about getting up the Gulf Stream.

Some of the trade winds are caused by the rotary motion of the earth. The sun constantly warming the air at the surface of the earth, making it lighter by day, while the night cools it and makes it heavier, so the cool air follows the sun around the earth, and that is the cause of its keeping one direction. We have some proof to establish this theory taken from the United States coast survey. Perhaps the most valuable item is the discovery that the stream changes in velocity daily and monthly, and that prediction can be made of the time of those changes. It will be remembered that the tides rise and fall daily, and the motion of the stream depends chiefly upon the position of the moon in its revolution around the earth, and in the same manner the current change takes place, which follows the moon in its journey north and south of the equator. When it was first proposed to open the Panama Canal the scheme was strongly opposed on the ground that it would endanger millions of lives. It was asserted that the waters of the Pacific were more than one hundred feet higher than those of the Atlantic, and that if they got headway in the ditch they would drown the country all around on the Atlantic side. It now turns out that the Atlantic is the higher of the two, and that the difference is about six and a half feet.

JOHN P. WHIPPLE.

Milwaukee, Wis.

Sodium in the Streets.

A very remarkable discovery has been made by Major Cardew, the Electrical Adviser of the Board of Trade, in connection with the recent street conduit box explosions in the St. Pancras district; and it has been communicated to the newspaper press. The state of the St. Pancras electrical distributing plant had already been adversely criticised by Major Cardew; and now he finds that the deposit on some of the insulators, suspected of being instrumental in causing the recent explosions, contains "a considerable quantity of the metal sodium." The gravity of this discovery is obvious. The Board of Trade think that "the presence of this metal, which is highly inflammable by contact with water, appears to be so grave a source of danger, and to afford so reasonable an explanation, in connection with the accumulation of escaped coal gas, of the several explosions which have recently occurred," that the department must look into the whole matter forthwith, in conjunction with the Royal Society and the Institution of Electrical Engineers. In the meantime, the Vestry are urged to take practical steps to reduce the risk of explosions. The Electricity Committee of the Vestry had a special meeting to consider the statement of the Board of Trade; and they offered sundry observations thereupon, concluding with an expression of the "hope that the Board of Trade would bring pressure to bear on the gas company to remedy the defective state of gas mains and services in this district, and thus remove the primary cause of the explosions." Of course, the vestrymen know very well it is impossible for either themselves or the Board of Trade to increase the sense of responsibility felt by the gas company for the condition of their mains and services. If the gas distributing plant in the St. Pancras district is old, and open to suspicion of general weakness, the company will doubtless have it relaid at the earliest possible moment. But it is beyond human power to prevent occasional escapes of gas from a distributing network maintained constantly under pressure beneath the surface of roads and street pavements in use for all sorts of other purposes; and it is for the owners of electrical culverts to see to it that these do not increase the ordinary hazards of the streets.—Jour. of Gas Lighting.

Electrified Paper.

Mr. F. L. Stevens, North Hoosick, N. Y., states that in the paper mills in that place they are sometimes troubled with static electricity. In some cases sparks six to eight inches in length are produced as the paper leaves the calender. A steam damper is used to prevent this, or a copper wire, well grounded, is made to rest on the web as it passes from the calenders to the reels.