Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

(Established 1845.)

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

(Established 1876)

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 of Scientific American.

(Established 1885.)

THE BUILDING EDITION OF THE SCIENTIFIC AMERICAN is a large and splendidly illustrated periodical, issued monthly, containing floor plans and perspective views pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To architects, builders and all who contemplate building this work is invaluable.

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

(Established 1878)

with 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.

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, APRIL 4, 1896.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF SCIENTIFIC AMERICAN SUPPLEMENT No. 1057.

For the Week Ending April 4, 1896.

Price 10 cents. For sale by all newsdealers.

THE VICTIMIZING OF INVENTORS.

The class of inventors has been selected by the framers of our Constitution and laws as one specially worthy of protection. The patent statutes are based on a clause of the Constitution especially providing for their encouragement, and the courts of the United States have devoted many sessions to adjudication of patent cases, the simple procuring of letters patent putting the humblest inventor in position to appeal to the highest class of Federal tribunals for the determination of his rights. The old time opinions of the judges in these cases are agreeable reading. They take the ground that the inventor requires special guardianship in his rights, the fact being recognized that the man of creative genius is often impracticable in business matters.

Unfortunately, there is another class of men who have adopted this opinion concerning inventors, and who try their best to exploit the community of patentees for their own benefit and to the accompanying detriment of their clientage. When letters patent are awarded, the drawings and claims of the patent and the inventor's name are published in the Official Gazette of the United States Patent Office. This appeals at once to a large number of sharks, calling themselves "patent agents," who see in the inventor a possible source of revenue. As soon as his patent is issued the inventor therefore begins to receive letters from various self-extolled concerns, recommending him to do various things, to apply for foreign patents, or to permit the correspondents to act as his agents for the sale of his patent on commission.

Many of these letters and circulars contain statements that are absolutely fraudulent. The inventor, for example, will be urged to apply for foreign patents in England, France and Germany and other countries, when the agent is perfectly well aware that after the patent has issued in the United States and been published in the Patent Office Gazette, valid patents cannot be procured in those countries, except under the international convention, which he is seldom able to avail himself of. The patent shark relies upon the ignorance of this fact on the part of the inventor to protect him in his nefarious traffic. He is also protected from detection by the fact that in many foreign countries there is no examination as to novelty, and, in due course, and after the payment of the government fees, the patent will issue and he will be provided with the letters patent certificate to present to his "client," who sleeps in blissful ignorance of the fact that the documents are not worth the paper they are printed on.

In many cases the fees upon examination will be found to be phenomenally low and the inventor will snap at what seems to him a bargain, simply to find that in Germany, perhaps, he has procured a Gebrauchsmuster, or model of utility patent, instead of a patent; or in Canada, he may be led to believe that he has procured a patent for one year when he has simply filed a declaration of intention, which affords no true protection.

It is after an inventor is enticed into correspondence with such firms that his troubles begin. He is probably told that his patent has been examined and found valuable, that otherwise the correspondence would never have been initiated. Perhaps he is told that the correspondent is the American representative of an "International bureau for procuring patents, with main offices in all the principal capitals of Europe," and that the foreign office has examined the patent, and has found it peculiarly well adapted for the old world.

The inventor, of necessity of sanguine temperament, has his hopes easily raised. His probably rather exalted idea of the merits of his invention is still further increased, and he is induced to put himself in the hands of the firm. He is then exploited to the best of the practiced ability of the "firm." He is advised to engage them as patent agents for foreign patents, and perhaps he is told that they have a purchaser for the patent, provided the inventor will take out a certain number of foreign patents. He is exhorted to invest capital if he has it, if not, to get money from his friends and to organize a company. Perhaps an alleged sale of his patent or of partial rights in it will be made and a check conveniently dated a month or more in advance will be shown him—a check which, of course, is never collected. These are no fancy sketches—precisely such lines of action are followed by numerous concerns. It has even gone so far that a similarity of name has been used to dishonestly impress the inventor with the idea that he is dealing with a firm of reputation.

The conservative patent agent who will give honest advice as to the patentability of an invention, but who will long hesitate before either approving or condemning its practical utility, and the probability of its success, is the one who can be trusted to conduct the business properly. The agent who has no conscience will urge the inventor to apply for a patent, even though he is aware that the device is not patentable.

The public is the final judge of the merit of inventions—directly or indirectly their value is settled at that tribunal—and the value of a patent can rarely be predicted with certainty. Every patent has to stand on its own merits; its exploiting must depend on the ground it covers, for a different clientele is to be reached by each invention.

The remedy for this state of things is simplicity itself: it is to be careful with whom you deal. The issuing of circulars tending to inflate the hopes of patentees is in itself a bad sign, as far as the standing of the firm issuing such circulars is concerned.

Deal only with attorneys of known integrity whose long record of service makes them well known and who have been tried and have not been found wanting.

THE LICK OBSERVATORY EXPEDITION TO OBSERVE THE TOTAL SOLAR ECLIPSE OF AUGUST, 1896, IN JAPAN.

BY DR. EDWARD S. HOLDEN.

It is proposed to send an expedition from the Lick Observatory to observe the total solar eclipse of August next in Japan. The necessary expenses of the expedition will be met from a fund provided by Col. C. F. Crocker, one of the Regents of the University of California and a member of the standing committee on the Lick Observatory.

The expedition will be under the charge of Prof. Schaeberle.

Its programme will be wholly photographic in character. Prof. Schaeberle will make large scale photographs of the corona with a lens of 40 feet focus (giving an image of the sun about $4\frac{4}{10}$ inches in diameter on a plate 18 × 20 inches) on the plan so successfully carried out by him at the Chile eclipse of April, 1893.

All difficulties in the mounting of so long-focused a lens are avoided by keeping the lens stationary and making the carriage for the sensitive plates movable. The lens is placed in the proper position for seeing the sun during totality. A large canvas tube (40 feet long) is stretched over a frame of gas pipe tubing. At the further end of this frame is an inclined railway carrying a holder for the negative plates (18 × 20). A clockwork drives the frame at the proper speed. The observer is stationed inside of his telescope, and makes the exposures according to a programme fixed beforehand. Some of the exposures will be very short, in order to obtain the finer details (only) close to the sun's edge. Others will be longer to obtain details further out, and these plates will sacrifice some of the details close to the edge, for these regions will be overexposed.

A study of all the plates obtained in this fashion will give a complete account of the whole corona, though no single plate will do so.

Mr. Charles Burckhalter, director of the Chabot Observatory, in Oakland, some time ago imagined a plan for giving the correct exposure for each part of every plate at an eclipse. He will accompany the Lick Observatory expedition to Japan and will make a trial of this plan, using a telescope of 4 inches in aperture and of 15 feet focus, specially made for the eclipse at the cost of Hon. W. M. Pierson, of San Francisco. (The image of the moon is about $1\frac{7}{10}$ inches in diameter.)

This telescope will be mounted equatorially and will follow the sun. The image of the eclipsed sun will fall on the negative plate, in front of which is a rapidly rotating diaphragm. (The plate has a hole in its center through which passes an axis driven by clockwork. On the end of the axis in front of the plate, and close to it, is a rotating fan or diaphragm.) The diaphragm is cut into the shape of a double cam, one cam being inverted, so that it is perfectly in balance, and it makes about five revolutions per second.

One of the double cams has such an outline that if the corona at the moon's edge has an exposure of one second, the exposures elsewhere will be:

At 26′ from the edge	4 seconds.
" 46′ " " "	9 "
" 66′ " " "	14 "
" 86′ " " "	20 "
" 108′ " " "	24 "

Other differently shaped cams are provided, each ready for operation, with its clock, in its special plate holder. When the plate holder is lifted, the clock starts automatically and runs for about 15 minutes. Five or six such plates will be exposed during totality. Each plate will be exposed much longer at the outer limits of the corona (where the light is weakest) than at the inner limit (where the light is strongest). It is therefore hoped to secure, in this way, a photograph of the corona on a single plate, every part of which has received the proper exposure. This single plate will then exhibit all the details of the corona, and it will no longer be necessary to build up, as it were, the real corona from a series of plates (each one of which is underexposed for one region, overexposed for another, and correctly timed for another).

Mr. Burckhalter's ingenious plan deserves a trial. The only difficulties in the way are mechanical ones, and these are now supposed to be conquered.

Besides the 40 foot lens Prof. Schaeberle will take with him a 5 inch photographic refractor (presented to the Lick Observatory by Miss Floyd) and a Dallmeyer portrait lens of 6 inches aperture (lent by Hon. W. M. Pierson).

The former instrument will be used to make small scale photographs (on 5 × 7 plates) of the corona and surrounding stars (and possibly comets); and at least two of these plates will be impressed with squares of 1s, 2s, 4s, 8s, 16s, exposure from a standard lamp before they are exposed to the light of the corona. When they are developed, the squares of standard intensity will appear at the same time with the image of the corona, and a photometric measure of the brightness of the latter is thus possible, in terms of the brightness of the standard lamp. This plan (first carried out by the Harvard College Observatory) has been followed at all the eclipses observed by Lick Observatory parties, viz., January, 1889; December, 1889; and April, 1893.

The portrait lens will serve to register the extension of the corona and a wide field of stars (and any possible new planet).

Messrs. G. E. Shuey and Louis C. Masten will go with the party as volunteer assistants and will be in charge of the smaller instruments. Prof. H. Terao, director of the Imperial Observatory of Tokyo, has kindly offered to select a member of the staff of his observatory to accompany the Lick Observatory expedition, as one of its members.

The Hon. Secretary of State, the United States Minister and Consul-General in Japan will do all in their power to forward our plans. It is to be hoped that the expedition may meet with good weather and return with results which will reward its labors.

THE MANUFACTURE OF PAPER.

Prominent among the greater industries of the United States, which have grown to large proportions during the past twenty-five years, is that which is devoted to the manufacture of paper. At a recent meeting of the American Paper Manufacturers' Association the president stated that the association was formed about eighteen years ago, and that the paper business had since taken on a rapid growth. At that time the manufacture of paper in the United States had grown to such an extent after the war that the capacity of the mills in 1878 in the production of paper amounted to nearly 3,000 tons of product per day. To-day the capacity of the mill product in this country is about 12,000 tons per day.

The general public has little idea of the size and cost of an average paper mill. The finished product, as we see it in our books and our daily newspaper, is so familiar, and the materials of which it is popularly supposed to be made are so cheap, and for most other purposes worthless, that to many it will be a surprise to learn that an average paper mill costs from $1,000,000 to $3,000,000 to build and equip. It is capable of turning out some 40 tons of paper per day, and to run the machinery requires boilers and engines of not less than 3,000 horse power. For washing the pulp, etc., there will be required 4,000,000 gallons of water per day, or enough to supply a city of 50,000 inhabitants, and the whole of that supply must be filtered by the most approved modern processes.

The manufacture of the paper may be broadly separated into two processes, consisting, first, in the preparation of the pulp, and secondly, in the formation of the paper from the pulp.

I. The Preparation of the Pulp.—The popular idea that paper is made from rags is true only of fine writing paper, which is made entirely from this material; but newspapers and most book papers are made entirely from wood. The better class of book paper is made from wood and a small percentage of rag. There are two kinds of wood pulp.

1. Ground or Mechanical Wood Pulp.—This is made by grinding the ends of spruce wood logs against revolving emery wheels. This is done under water, and the result is a finely divided wet sawdust. The wood retains all its natural gums and acids and has no fiber. It must be used with some more fibrous material, such as chemical wood pulp. This is the cheapest form of pulp, and it is therefore only used for newspapers and so-called manila wrappings.

2. Chemical Wood Pulp is made from spruce or poplar. The timber comes to the mill in barked logs, which are four feet long, and have had all the knots carefully bored out. The logs are fed into a "chipper," in which the knives are arranged at an angle of 45 degrees to the center line of the machine. These knives cut the logs diagonally to the grain into "chips" which are half an inch long. The chips are conveyed to "digesters," which are upright cylinders 7 or 8 feet in diameter and 30 feet long. If spruce wood chips are being used, they are treated by the acid process, the digesters being lined with acidproof brick. The acid liquor is obtained by mechanically combining sulphurous acid gas with milk of lime, and forming a bisulphite of lime. The digesters are filled with chips and liquor in proper proportions, and are then hermetically sealed. Live steam is introduced, and the chips are boiled for eight hours under a pressure of 110 pounds to the square inch.

If the chips are made from poplar, the process is the same, except that the liquid is made from caustic soda ash and water.

After the boiling is completed, the contents of the digesters are blown out into a receiver, where it presents the appearance of a mass of soft pulp. The liquor is then washed out; and after the pulp has been bleached, it so closely resembles the rag pulp, which is used in the manufacture of fine book paper and writing paper, that only an expert can tell the difference, both being a pure vegetable cellulose. The pulp is now subjected to a process of beating and macerating, to reduce it to the proper consistency; and at this stage coloring may be added to give any desired shade. A certain amount of sizing is also introduced—the sizing being made from resin "cut" with soda ash—for the purpose of giving impermeability to moisture and a firm surface; otherwise the product would be a simple blotting paper.

The pulp is now ready to go to the paper machine. It should be noted here that newspaper pulp is formed of 80 per cent ground pulp and 20 per cent chemical pulp. Book paper is formed entirely of chemical pulp.

II. The Paper Machine.—If he bear in mind the frail nature of the article which it is designed to handle, the visitor to a paper mill will be astonished at the great size and weight and the massive strength of a paper mill.

At first sight, the massive cast iron and steel frame, from eight to ten feet wide, and from one hundred and fifty to one hundred and seventy-five feet long, appears to be better fitted to manufacture iron and steel than to handle the thin, milky fluid which stands ready for manipulation at the upper end of the machine. The wet pulp, of which 95 per cent is water, first passes through a screen, where it is cleaned. It then flows into a vat, at the further edge of which is provided an outflow, which consists of a true, level, edge or lip which forms a kind of weir, over which a broad, thin stream of pulp flows onto the paper machine proper. This stream is the full width of the machine, and its depth has to be kept perfectly true and even throughout. The pulp falls onto what is known as the Fourdrinier wire. This is an endless wire cloth, seventy meshes to the inch, which is the full width of the machine, and travels continuously over a set of parallel rolls, passing around an end "couch roll," and returning again under the machine. In addition to its forward motion, this wire cloth or screen has a lateral rocking motion across the machine. As the pulp flows onto this wire a large portion of the water, assisted by the shaking, strains through and passes away, leaving a thin film of pulp, which is the future sheet of paper. This film is picked up off the "couch roll" by an endless woolen felt, which carries the wet sheet between several gun metal "squeeze rolls" or "press rods," which force out a sufficient amount of water for the sheet to be able to sustain its own weight.

At this point the sheet is transferred to an endless cotton felt, which supports it while they both pass over and around a dozen or more driers, which are hollow cylinders 3 feet in diameter and extending the full width of the machine, through which a constant flow of live steam is maintained. These thoroughly dry out the paper.

At this stage of the process the sheet is rough and uneven, presenting very much the appearance of a sheet of paper that has been wetted and allowed to dry out again. It now has to be ironed out, as it were, and the desired finish imparted to its surface. For this purpose it is passed through the calenders, which consist of two vertical standards which carry usually 11 superimposed chilled steel rolls of the very highest possible polish. The paper is inserted between the upper two and passes down through the whole set, the desired pressure being obtained by means of powerful screws. This process is repeated in a second stack of rolls, after which the finished paper is wound into a large roll. It is then passed through the cutters and cut to the required width and length.

If a highly finished surface is desired, the paper is passed through what are known as super-calenders, which consist of 7 rolls, 4 of chilled steel and 4 of pressed paper, arranged alternately, the combination of the two materials in the rolls giving a high finish. The whole machine is run at a very high speed, 300 to 350 feet per minute being common. There are some machines that run the paper out at the rate of 400 feet per minute, or between 4 and 5 miles per hour, and such a machine will frequently run an entire day without a break in the paper.

These speeds are only possible in the manufacture of common news paper. In making the finer grade of paper, with high finish, such for instance as is used for the SCIENTIFIC AMERICAN, the mill can only be run at about one-half the above speed.

The whole machine has to be adjusted with the greatest care and nicety. It runs at so high a speed, and the material upon which it operates is so frail, that any unevenness in the rolls, or an irregularity in the speed of any particular part of the machine, would break the sheet, and throw the work into confusion.

The following material is consumed every month in a paper mill of 40 tons per day, or 1,000 tons per month capacity:

Coal	15	tons.
Wood	2,432	cords.
Bleaching powder (chloride of lime)	142	tons.
Sulphur	77	"
Lime (milk of lime)	57	"
Resin (sizing)	17½	"
Soda ash	125	"
English clay	200	"

Many a paper mill is run continuously from 12 P. M. Sunday night until 12 P. M. on the next Saturday, two sets of operatives being employed. From the time the log of wood is put into the chipper to the time the paper is cut up into sheets, the material is never handled, but passes through a continuous mechanical process.

Obituary.

DEATH OF GENERAL CASEY.

Brigadier-General Thomas Lincoln Casey (retired), late Chief of Engineers, United States Army, died at his residence in Washington, on March 25. General Casey was the son and grandson of soldiers. His father was General Silas Casey. General T. L. Casey was born at Madison Barracks, Sackett's Harbor, N. Y., in 1831. In 1848 he received an appointment to the United States Military Academy. Four years later he graduated at the head of his class. He entered the engineer corps as second lieutenant in 1852. He was assigned to duty in connection with works of improvement on the Delaware River and Bay. When the civil war broke out he was sent to New England, as superintending engineer of the permanent defenses and field fortifications on the coast of Maine. In March, 1865, he was breveted lieutenant-colonel for faithful and meritorious services during the war. He was then appointed superintending engineer of public buildings and grounds for the District of Columbia. He had charge of the Potomac Aqueduct, and to him also was committed the completion of the State War and Navy Department building, in Washington, the Washington Monument and the construction of the Medical Museum and Library. He was president of the Board of Engineers for fortifications and other public works at New York from 1886 to 1888, when he was appointed brigadier general and chief of engineers by President Cleveland. In 1889 he was charged by an act of Congress with the construction of the new Congressional Library building, and in recognition of his integrity and ability, Congress continued him in charge of the work after he was retired in 1895. The death of General Casey removes one of the best known and active government officers. He took great pride in the progress and economy of the work on the new library building, and was to have completed it within the time limit and for less than the original estimates, which speaks well for his ability. He always directed in person the contract work for which he was responsible.

The Strength of Ice.

The army rules are that 2 inch ice will sustain a man or properly spaced infantry; 4 inch ice will carry a man on horseback, or cavalry, or light guns; 6 inch ice, heavy field guns, such as 80 pounders; 8 inch ice, a battery of artillery, with carriages and horses, but not over 1,000 pounds per square foot on sledges; and 10 inch ice sustains an army or an innumerable multitude. On 15 inch ice railroad tracks are often laid and operated for months, and 2 foot thick ice withstood the impact of a loaded passenger car, after a 60 foot fall (or, perhaps, 1,500 foot tons), but broke under that of the locomotive and tender (or, perhaps, 3 000 foot tons). Trautwine gives the crushing strength of firm ice as 167 to 250 pounds per square inch. Col. Ludlow, in his experiments in 1881, on 6 to 12 inch cubes, found 292 to 889 pounds for pure hard ice, and 222 to 820 pounds for inferior grades, and on the Delaware River, 700 pounds for clear ice and 400 pounds or less for the ice near the mouth, where it is more or less disintegrated by the action of salt water, etc. Experiments of Gzowski gave 208 pounds; those of others, 310 to 320 pounds. The tensile strength was found by German experiments to be 142 to 223 pounds per square inch. The shearing strength has been given as 75 to 119 pounds per square inch. The average specific gravity of ice is 0·92. In freezing, water increases in volume from 1·9 to 1·18, or an average of 1·11; when floating, 11·12 is immersed.—Engineering Mechanics.

Earthquake in Maine.

Reports from Machias and Calais, Me., state that a violent shock of earthquake was felt on the evening of March 22 at 8 o'clock. The direction of disturbance was from the south toward the north at Machias and from west to east at Calais. At Machias houses trembled, dishes and windows rattled, and clocks were stopped. People rushed from their houses in alarm. At Calais the shock lasted from four to five seconds. No damage was recorded.

DEEP and rapid breathing is recommended as a means of stopping hiccough.