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 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 any address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries within Postal Union, *nine dollars 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, $5.00 a year; combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN and SUPPLEMENT, $9.00 a year. To foreign countries, $11.50 a year.

Spanish Edition of the Scientific American.

LA AMERICA CIENTIFICA E INDUSTRIAL (Spanish trade edition of the SCIENTIFIC AMERICAN) is published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number of *La America* is profusely illustrated. It is the finest scientific, industrial trade paper printed in the Spanish language. It circulates throughout Cuba, the West Indies, Mexico, Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. $3.00 a year, post paid to any part of the world. Single copies 25 cents. See prospectus.

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 7, 1891.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 792.

For the Week Ending March 7, 1891.

Price 10 cents. For sale by all newsdealers

COLUMBIAN FAIR PROGRESS.

The managers of the International Exposition to be held in Chicago in 1892-93, after many disagreements as to the site and other particulars, seem now to have come to sufficiently definite conclusions to permit of the actual commencement of work. It is decided that all the main buildings of the fair shall be at Jackson Park on the lake front, near the south end of the city, this park being connected by the Midway Plaisance with South Park, and together forming a large, unobstructed, and already improved site. The attempt to divide the fair, and put a portion of the buildings in the small but beautiful park at Lake Front, near the center of the city, has been definitely abandoned, although the latter park is to be adorned with statuary as a lounging place for tourists.

The plans for the buildings in Jackson Park have been very carefully considered by a commission of architects, which met in Chicago, February 20, and, although all details are not yet finally determined, the main features are fully laid out. Richard M. Hunt, of New York, presented three sketches for the Administration Building; George B. Post, of New York, had sketches for the Liberal Arts Building; C. F. McKim, of New York, for the Agricultural Building; R. S. Peabody, of Boston, for the Machinery Hall; Henry Van Brunt, of Kansas City, for the Electrical Building. Adler & Sullivan, S. S. Beman, W. L. B. Jenney, Henry Ives Cobb, Burling & Whitehouse, the local members of the commission, had designs for the Transportation Building, the Mines and Mining Building, Horticultural Hall, Fish and Fisheries Building, and the grand entrance and triumphal arches. Olmsted & Co., the landscape architects, of Boston, were present with landscape designs, and Augustus St. Gaudens, of New York, advised in reference to decorative statuary. It is said the buildings will surpass any previously seen at former international expositions, and that they will also cost more. It is expected that there will be in all "about two miles of frontage and an average height of sixty feet, in which domes, cupolas and minarets will arise from the groups, while canals will wind about the base of the buildings." Iron, steel, brick and glass will be used, but the materials will be so treated as to give the effect of granitic solidity, a classic style of architecture prevailing, and stone and granite of different colors being imitated with marvelous exactness.

It is estimated by the directory that the expenditures will be $17,625,453, divided as follows: For construction, $12,766,890; administration and organization, $3,308,563; operation, $1,550,000. On these estimates the work has been commenced, and is to be energetically pushed, now that the location of the buildings has been finally decided upon and the plans virtually approved. The resources, believed to be available as fast as needed, are, from popular subscriptions pledged $5,000,000, from proceeds on Chicago city bonds, $5,000,000. In addition to this ten millions, it is believed there will be ultimately realized—from gate receipts, $7,000,000; from concessions, $1,000,000; from salvage, $3,000,000—or a total of $21,000,000. The members of the directory consider these estimates extremely conservative, and do not believe that there will be any further hitch in the progress of the work, from financial or other considerations.

ANOTHER FARADAY WANTED.

Among the scientific problems that await solution was that described at the recent meeting of the National Electric Light Association by Prof. Elihu Thomson, to wit, a direct method of obtaining electricity from fuel. The present method necessitates the interposition of the steam engine, in which even under favorable conditions scarce more than ten per cent of the theoretical energy of the coal is recovered in mechanical power, this suffering diminution again at the wire end of the dynamo. "It almost seems," said Prof. Thomson, "from all that we who are actively engaged in looking up matters in this connection can say, it almost seems to us that we must wait for some new discovery, for another Faraday to come forward and show us principles which are not now known, some relation between electric energy and heat energy whereby we can convert even 35 to 40 per cent—we will be satisfied with that—of the heat energy into electric energy. Look what it means, should such a thing come about. The steam engine would disappear. The steam locomotive would disappear. The steamship would be propelled no longer by the steam boiler and the burning of fuel under a steam boiler. Fuel would be burned, but burned to produce currents. The apparatus to propel the steamship would not be a steam engine with its reciprocating motions and its racking strain, but would have that quiet rotary motion which characterizes the modern electric motor."

Edison has been working on the problem. If only he could solve it! Davy, after years of unrewarded study and observation, put two wires together tipped with carbon, drew them apart and got the flame which now we call the electric arc. We put together a mechanism which has made the generation of such light commercially practicable. Faraday discovered the principle which underlies the generation of current by the dynamo, being the first to move armatures in magnetic fields. We have profited greatly also by that. If only now we could repay these free gifts by the discovery of a principle by which the energy of coal could be directly obtained!

INTERESTING NAVAL INFORMATION BY THE SECRETARY OF THE NAVY.

The impression prevails in the popular mind that there has been a falling off in the speed of our new war ships, and that they are incapable of the velocities with which they were credited on their original trial trips. It is claimed they were unduly pushed and strained on those occasions, to benefit the contractors, and neither have nor can ever again attain an equal speed. This impression has been confirmed by the slow performances of several of the vessels since they were accepted by the government.

A representative of the SCIENTIFIC AMERICAN recently had a special interview with the Hon. Benjamin F. Tracy, Secretary of the Navy, respecting the above matters, and at the same time requested his views upon the new fast cruiser No. 12; also upon the proposal to employ fast naval vessels as mail carriers.

Secretary Tracy said: "The statements recently made concerning the cruisers of the new navy, namely, that they have fallen off in speed from the records established on the measured mile, and that they have never since approached in general efficiency and sea-going qualities to the standard set up on the trial trips, are untrue statements and misleading in the extreme. These statements are particularly untrue of the Chicago, the Boston, the Atlanta, and the Yorktown; as will be seen by comparing the speeds registered by these vessels on the trial trips with the speeds they have attained on more recent cruises. It is true, however, that the cruiser Charleston has not maintained the speed of her initial trip, and on her return to San Francisco, where she is assigned as flagship to the Pacific station, I propose to investigate the matter and find out the cause of her apparent deterioration. The reason for the falling off in this case is, I have no doubt, the same as in all former cases where there has been an apparent deterioration in speed—poor coal and foul bottoms. The statement, I say, is not true of the Yorktown, built by Cramp and now attached to the squadron of evolution. At the series of trials held at Newport on August 21, 1889, her performance as regards general sea-going qualities was as good as ever, while the speed she attained on that occasion was even greater than that developed on her trial trip.

"It is not true of the Boston, which has been in commission many years, and is now also one of the squadron of evolution. She can to-day make as good speed as she has ever made. Look at the recorded speeds of the vessels of this squadron under the command of Admiral Walker, in Narragansett Bay, during the autumn of 1889. In this series of trials the Chicago registered a speed of 15·328 knots; the Boston reached a speed of 15·58 knots; the Atlanta recorded a speed of 13·45 knots; while the Yorktown, built by Cramp in 1887, showed an increase of 0·35 knot over the speed of the trial trip. Now, on ordinary occasions, there is no necessity for a quick run, and the cruisers are, accordingly, not put to their best speeds. The initial or contractor's trips show us what the vessel is capable of doing, and this is confirmed by subsequent special trials. If, then, the cruisers do not invariably maintain the maximum speed, it is not because of any inefficiency of the cruiser, but simply because there is no necessity of stretching every nerve, of using forced draught, of striving to reach a speed which we know the vessel has reached, and can at any time reach again, when the occasion calls for it. The conditions that obtain in a ship under forced draught are not conducive to the continued efficiency of the engines or machinery, and it is my opinion that no ship can be put to this great strain for any considerable time without detriment to the vessel as a whole. This maximum speed should be kept as a reserve power, in case of great emergency in warfare, and it should not be constantly exercised.

"It is in accordance with this theory that the vessels of the new navy are not, as a rule, run up to their best records. But I think it can be shown that whenever great speed is a desideratum, the vessels of the new navy are, class for class, equal to and superior to the English vessels in maintaining and retaining their initial speeds.

"The statement that the coal bunkers are of insufficient capacity is an unreasonable one. Every vessel, it has been said, is a compromise. In the designing of a vessel there are many features to be considered, and to a certain extent each must be modified by all the others. And so the speed of a cruiser must be considered in connection with the enduring capacity and with the weight of battery. As we, unlike most European powers, have no intermediate coaling stations, it is particularly essential that the vessels of our navy have a large coal capacity; indeed, in my opinion, speed and coal capacity rather than weight of battery are the important qualities to be sought for in a modern cruiser. It is with this end in view that the vessel now known as "Protected Cruiser No. 12" has been designed. It is expected that this cruiser when completed will be the fastest in the world and at the same time have a great coal enduring capacity. Among the things which we expect of her is to be able to steam around the world and return to her station without the necessity of once recoaling.

"She cannot, of course, owing to the lightness of her battery, take her place in battle against such vessels as the Chicago or the Yorktown. It is hoped that she will be able to overtake the fastest merchant ships and to destroy them, to remain one hundred days in the seas, and to outsail and sink any of the fast passenger steamers. All this is expected with the same fire-room conditions that prevail on the transatlantic vessels. Although this cruiser is not a fighting ship, she is nevertheless well protected, and has a coal capacity of 2000 tons, with 750 tons at normal draught. Together with the regulation coal bunkers there will be along the length and next to the side of the vessel a cofferdam in bunkers, to contain fuel which will serve as a wall, and will not be used as fuel except in a case of emergency. At the very ordinary speed of 10 knots per hour the coal capacity is such that the vessel will have an endurance of 107 days.

"The proposition to carry the United States mails in the cruisers in order to keep the engines and men up to the standard of efficiency is, so far as the purpose in view is concerned, not a bad one; but if carried into execution it would be an enormously expensive method. The great difficulty which the navy has to cope with at present is the great lack of efficient sailors. But with the improvement and development of our merchant marine it is to be hoped that we will have a more fruitful and satisfactory field for recruiting than we at present possess."

Bursting Charges for Shells.

A great many experiments have been made to determine the proper kind of powder to be used in cannon, and, as a result of these experiments, the powder used has gone through a gradual change and development, from the fine grain of early use to the large, regular grains of the present day.

Projectiles may be either solid or hollow. In the latter case they must contain a bursting charge.

While experiment has determined the best form of grain of powder to propel these projectiles, the question of the proper grain to be used as a bursting charge for shells seems to have been quite neglected.

The "Manual of Heavy Artillery, U. S. Army," by General Tidball, which is officially adopted for use in the United States army, designates musket and mortar powder as the proper powder for a bursting charge. The United States army (light) artillery tactics, speaking of a shell, says: "It is loaded with a bursting charge of rifle or musket powder, which gives great force to the fragments."

Musket and rifle powder have about 1,000,000 grains to the pound, and mortar powder about 32,000.

The reasons for selecting these powders are not given, but each authority seems to have based his statements on those of the preceding authority.

A shell may be used for two purposes, viz., demolition and against animate objects.

The proper bursting charge for the first object can easily be determined, as a shell buried and exploded would produce almost the same result as if fired from a cannon.

The proper bursting charge for use against animate objects is not as easily determined. The fragments of the shell must not be too small, or they will not disable a man, nor must they be too large, for the number of fragments being diminished, the number of possible casualties will also be diminished.

To disable a man, the fragments should not weigh less than 1 ounce, and should have a velocity of about 500 feet per second, which would be equivalent to an energy of about one-eighth of a foot ton. The velocity of the fragments is due mostly to the remaining velocity of the shell at the instant of explosion, though some of it is incidentally obtained from the bursting charge. The latter's proper function, however, is to burst the shell, since the rotation of a rifled projectile gives sufficient dispersion to the fragments.

What kind of powder, then, will burst the shell into the greatest number of fragments one ounce or but slightly greater—say between one and two ounces—in weight?

With this object in view, some experiments have been made at West Point, N. Y. The bursting pit consists of a large chamber, 5 feet in diameter and 5 feet long, made of one-half inch boiler steel. On top is a manhole and chimney, through which the projectiles, fixed with electric primers, are lowered. This manhole also gives access to the interior for the purpose of collecting any fragments of shell that may not have been removed by the tools used for that purpose, and also for repairing the pit and allowing the smoke of the explosion to escape.

At the bottom of the pit a tube, 5 feet long, gives a second access to the interior, and through it, by means of hoe-shaped tools, the fragments are removed.

Sliding plates close the manholes, so that the projectiles are fired with perfect safety, and no fragments can be lost.

To strengthen the steel chamber, a heavy granite house is built over it, and the space between the stone and the chamber is tightly packed with sand, so that it can safely be used to explode any shells and any explosive. The large size of the pit renders the conditions under which the projectile is exploded about the same as those in air.

The shells used in the experiments were the 3 inch shells, similar to the ones used in the civil war for field service.

As bursting charges were used: Mortar powder, having, as before stated, 32.000 grains to the pound; the I. K. powder, with 2,200 grains to the pound; and the E. V. powder, with 72 grains to the pound.

The results are tabulated below:

FIRST SERIES.

Weight of shell before firing....	8½ lb.	8½ lb.	8½ lb.
Kind of powder..................	E. V.	I. K.	Mortar.
Weight of fragments............	7 lb. 14 oz.	7 lb. 8 oz.	7 lb. 6 oz.
Loss in weight..........	10 oz.	16 oz.	18 oz.
Number of fragments greater than 1 oz..........................	26	22	14
Weight of fragments less than 1 oz	2 lb.	2 lb. 6 oz.	4 lb.
Number of fragments from 1-2 oz.	15	12	8
" " " " 2-4 oz.	6	5	4
" " " greater than 4 oz..........................	5	5	2

SECOND SERIES.

Weight of shell before firing.....	8½ lb.	8½ lb.	8½ lb.
Kind of powder....	E. V.	I. K.	Mortar.
Weight of fragments	8 lb. 1 oz.	7 lb. 6 oz.	7 lb.
Loss in weight...	7 oz.	1 lb. 2 oz.	1 lb. 8 oz.
Number of fragments greater than 1 oz......................	35	23	13
Weight of fragments less than 1 oz...	1 lb. 6 oz.	2 lb. 6 oz.	2 lb. 13 oz.
Number of fragments from 1-2 oz.	21	13	6
" " " " 2-4 oz.	6	8	2
" " " greater than 4 oz..........................	8	2	5

The loss, which is principally due to a portion of the shell being reduced to dust, which could not be collected, was much less for the E. V. than for the mortar powder. As fragments less than 1 ounce are not considered dangerous, that amount of weight of the projectile is counted as loss as well as the dust. The loss for the E. V. is just one-half that of the mortar. The number of fragments between 1 and 2 ounces given by the E. V. is three times that of the mortar.

Suppose each fragment of shell greater than 1 ounce to strike and disable a man, the number of men placed *hors de combat* would be as follows:

	E. V.	I. K.	Mortar.
First series..	26	12	14
Second series..........................	35	23	13

The "Ordnance Manual of 1861," and Robert's "Handbook of Artillery," 1860, which were the authorities for the United States army at the time of the civil war, designate rifle or musket powder for bursting charges. Had a powder of the E. V. grain been used, the probable effect would have been much greater.

While up to date the experiments have not been extensive enough to determine the best kind of powder for a bursting charge, still they show that the E. V. powder is much superior to the mortar, which is the kind still designated for use. The explanation for this would seem to be fonnd in comparing the actions of the powders.

The mortar powder is much finer grained, and would be completely transformed into gas much more quickly than the E. V. Its action is much more violent, and consequently it would pulverize or reduce to fine fragments a large portion of the envelope, and so reduce the number of fragments over 1 ounce in weight. The E. V., being more progressive, would give a larger number of effective fragments. Powders finer than the mortar would pulverize the envelope still more, and larger grained powders would give a greater number of large fragments.

The theoretically perfect powder would be the one that would reduce the entire shell to fragments 1 ounce in weight. It will require many experiments to ascertain the powder that approaches nearest to the theoretical; but from the tables given above it will be seen that, of the three powders tried, the E. V. is the best for a bursting charge.

Refuge and Observatory on Mt. Blanc.

Mr. J. Vallot, a member of the French Alpine Club, succeeded last summer in erecting a permanent structure on Mt. Blanc, to be used as a refuge and observatory. Plans of a small structure best adapted for withstanding high winds were drawn, and the building was constructed at Chamonnix. The house was then taken apart, and each timber was marked properly, so that the parts could be put together readily on the mountain top. One hundred guides volunteered their services to carry the parts of the building to the point fixed upon as the site. The dismantled structure was tied up into 111 loads, and the work of transportation was begun. It was a tedious undertaking carrying the heavy packages up the ascent. Three days were consumed in conveying each load to its destination. The work commenced on June 15, and on July 31 the last section of the building and the last of the ninety packages of scientific instruments had reached the site of the refuge observatory.

Six days before the last date Vallot selected five of the hardiest mountaineers as masons and carpenters, and set out for the mountain top to build the foundation. Two tents were set up for the temporary shelter of the party. The temperature was rather low for summer; the mercury dropped to 9 deg. below zero at night, and did not rise much above zero at noon. The men were clothed in regulation Esquimaux costume, with huge woolen gloves and heavy mountain caps. The style of dress was not conducive to rapid work, but the men labored vigorously from seven in the morning till seven at night. In two days the foundation was completed, and on the third the framework was in place, in spite of the persistent attempts of the wind to overthrow it. On the fourth day the last plank was nailed on the roof, and at night the workmen were able to sleep in a less windy chamber than their tent.

The work, however, was extremely exhausting in the rare atmosphere. At the end of the second day one of the men was disabled. He was given a few whiffs from the oxygen bag which Mr. Vallot had taken the precaution to include in his supplies, and recovered sufficiently to start down the mountain. The following day a second mountaineer was exhausted, and a third weakened on the third day.

Although the house was not entirely finished on the fourth day, it was thought inadvisable to remain longer on the summit, especially as the weather had become unfavorable. All hands, therefore, descended and took a brief rest.

On August 31 the party reascended the mountain, accompanied this time by Mr. Vallot's wife, an enthusiastic Alpinist. The refuge was properly braced with masonry, and the finishing touches were added. Lightning rods were put in position, after which colors were flung to the breeze to celebrate the completion of the work.

The building is divided into two apartments, one designed for the use of travelers and the other for scientific observers. The latter room is a private compartment. The public room is supplied with all the conveniences needed by the tired tourist. Nine beds are placed in the room, and a supply of provisions and of oil for light and fuel is always kept on hand. The observatory, which is said to be the highest in the world, is 14,350 feet above the sea level. It contains automatic registering devices and the most approved appliances for making scientific observations in high elevations.

Prof. Winchell.

Prof. Alexander Winchell, an eminent American geologist, died at Ann Arbor, Mich., February 19, in the 67th year of his age. He was graduated at Wesleyan College in 1847, and taught school in several places until 1854, when he was called to the chair of Physics and Civil Engineering at the University of Michigan, and a year later was transferred to that of geology, zoology, and botany, which he held until 1879. In 1866–69 he filled a similar office in connection with the University of Kentucky. Meanwhile he made a survey for a railroad from Ann Arbor to Manchester, and in 1859 was appointed director of the Geological Survey of Michigan.

This last work was practically finished when the civil war broke out, although Professor Winchell made paleontological researches in the material thus accumulated and in his publications established seven new genera and 304 new species, most of which were fossil. In 1869 the survey was renewed under his direction, but he resigned charge of it in 1871.

He accepted the chancellorship of the University of Syracuse in 1873, but at the close of that year retired from that office to become professor of geology, zoology, and botany in that same school. From 1873 to 1878 he filled a similar place in Vanderbilt University.

In 1879 he was recalled to his old place at Ann Arbor, which he filled until his death. In 1886–87 he was connected with the geological survey of Minnesota. He received the title of Doctor of Laws from Wesleyan in 1867, and last year was elected vice-president of the Geological Society of America. His name has been given to fourteen new species. By his labor he has established the Marshall group in American geology.

A NOVEL combination was recently exhibited in Chicago. A Fairbanks, Morse & Co. steam pump was driving an Erwin water motor which was coupled directly to a Thomson-Houston dynamo. The results showed economy of fuel. The advantages of such a system are first cost is less and the cost of operating is reduced. Pumps may be used for pumping water during the day and then used for light at night. It would seem that the system would be of especial application at railway stations.