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.

NEW YORK, SATURDAY, SEPTEMBER 27, 1890.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 769.

For the Week Ending September 27, 1890.

Price 10 cents. For sale by all newsdealers.

AN EVENING ELECTRICAL SCHOOL.

A contemporary has made the suggestion that there is need of a place in this city where instruction in electricity and the kindred sciences could be obtained in the evenings. Many young men enter the service of the electrical companies and are thrown entirely upon their own resources as regards future advancement in technical knowledge. We are in constant receipt of inquiries as to the best means of obtaining a knowledge of electrical engineering. Many who are anxious to become electrical engineers cannot afford the time and expense incurred by pursuing a college course. For such aspirants an evening school of electrical science would have an incalculable value. The equipments and general laboratory appliances should be of the best. The instructors should be thoroughly competent. It is not going too far to say that such an institution could be filled with the most earnest class of students at once. There are many young men who are obliged to be self-supporting, yet who by every intellectual qualification are well fitted to take the highest standing if they could but obtain an education.

The lesson of the day in this city seems to be that our electrical systems are not properly cared for. The numerous deaths that have occurred show the need of intelligence in administering electrical systems of distribution. There is no doubt that there is room for a better class of men in the electrical profession than have hitherto filled its ranks. It is also safe to say that there are a very large number in those ranks who long for technical instruction and who are in a position to profit by it. Occupied during the daytime with practical electrical work, without facilities for investigating its theory, they inevitably become empirics. This they become in the face of the fact that they are the best material for our future electrical engineers. It is not right that advancement should be denied to any one really worthy of it. No more convincing proof of such worthiness could be given than the willingness with which young men accept the lower grade of positions in electrical works.

TESTING ARMOR PLATES FOR OUR WAR VESSELS.

One of the most thorough trials of heavy armor plating ever made in this country was conducted at the naval ordnance proving grounds, at Annapolis, September 18. Three plates of foreign manufacture were tested, each plate eight feet by six, and ten and a half inches thick. They were (1) a compound steel and wrought iron plate, made by Cammell & Co., of Sheffield, England; (2) a steel and nickel plate, the nickel alloy being about four per cent, made by Schneider & Co., of La Creusot, France; and (3) an all-steel plate from the same makers. The latter plate was similar to those now being made at the Bethlehem Iron Works for use on our new war vessels, and both that and the nickel-steel plate proved themselves greatly superior to the Cammell compound plate, which has been used in the construction of the new English armorclads.

The targets were arranged on the arc of a circle, with the gun in the center, the muzzle of the gun being 28 ft. from the face of each plate, and the plates being set upright in a backing of heavy oak timbers, flanked on the sides by steel posts, all solidly bolted to the oak backing. The gun was a 6 in. rifle, the usual length of which is 16 ft., but this gun had been specially made with a length of 17½ ft., to give the projectile a higher initial velocity. The initial speed of a 100 pound projectile from a 6 in. gun in the English trials was 1,976 ft. per second, but in these tests the initial velocity was 2,075 ft. per second, the chamber pressure being 15 tons to the square inch, using 44¼ pounds of powder to the charge. The projectiles weighed 100 pounds each, and were made by Holtzer & Co., at Unieux, France; they were of forged steel, with points of chrome steel, and each 17 in. long.

Four shots were fired at each plate, striking respectively in order near the right and left hand corners at the bottom and top. At the first shot on the Cammell compound plate there were many flying fragments, and the projectile went entirely through the plate and eleven inches into the backing, the metal around the hole being crushed into many small pieces, and the plate being considerably cracked. The second shot also pierced the plate and increased the size and number of the cracks, scaling off the steel face in places and wrecking the lower half of the target. The third and fourth shots on the upper half of the Cammell plate were attended with similar results, the projectile each time piercing the plate, which was badly shattered and almost completely dismantled.

In the first shot at the all-steel plate, the projectile embedded itself in the plate to the depth of about fourteen inches, its point just penetrating, but there were no cracks. At the second shot the projectile barely made a hole through the plate, and was itself forced back, falling on the ground. The third and fourth shots were similar, except that in the latter case the projectile was broken up. The first shot at the nickel-steel plate barely pierced it, but the projectile was broken into fragments. By the second and third shots the projectile was almost entirely embedded in the plate, but did not go through it, and by the fourth shot the projectile was broken up, its point having just pierced the plate, in which, however, no cracks were made.

Although further tests are to be made of the all-steel and nickel-steel plates, using an eight-inch gun, the compound plate was so badly damaged that it was decided not to risk another trial of it hereafter. The trial described was conducted under the direction of a board of officers, with Rear-Admiral Kimberly as president, and Secretary Tracy was present, giving it his personal attention.

Dancing to Music from Afar Off.

An interesting and really notable musical and vocal entertainment was given recently from New York to a very large audience assembled at the Grand Union Hotel, Saratoga.

As our readers will conjecture, the audience, which numbered at times no less than 800 people, was brought *en rapport* with the performers by means of a "long distance" telephone circuit running a distance of 180 miles from 18 Cortlandt Street, New York, to Saratoga. From Cortlandt Street a circuit had been run to the Madison Square Garden, and the concert being given by the Strauss orchestra was taken in alternation with the other numbers of the programme, which comprised selections by the long distance orchestra, flute and cornet solos, a whistling song, and glees by members of the technical staff, one of whom also recited Tennyson's "Charge of the Light Brigade." The orchestral music was listened to at Saratoga by means of sets of hand telephones, and every note was heard distinctly, even to the applause of the audience gathered at Madison Square. Some of the songs and solos and the recitation were heard all over the room at Saratoga by means of a single loud-speaking receiver provided with a large funnel-shaped resonator to magnify the sound. Great delight was expressed by the audience at Saratoga with the evening's entertainment, and the exhibition was considered one of the best and most successful that has yet been given over the Long Distance Company's system.

A very novel and striking use was made of this telephonic concert by Mr. A. S. Hibbard, who happened to be entertaining a number of his friends at his residence in Morristown, N. J., the same evening. Mr. Hibbard's private telephone line was connected at Cortlandt Street with the circuit running to Madison Square Garden, and the strains of the famous orchestra were heard so plainly in the house at Morristown that dancing was carried on to the accompaniment with perfect ease and comfort by the guests there assembled.

If some one had told Herr Strauss that his orchestra was playing for dancers who were enjoying themselves at Morristown, some twenty or thirty miles distant, the information would probably have been received with sheer incredulity, yet such was actually the case. Two Strauss waltzes were enjoyed by Mr. Hibbard's guests, and afterward the orchestra at Cortlandt Street was switched in, and dancing was continued by the music of the less ambitious band of performers.

We believe this is the first instance recorded of the transmission of music by telephone with sufficient volume and clearness for dancing to be indulged in by the listeners.—*Electrical Engineer.*

Waste of Water.

The Review and Record, a paper devoted to real estate matters over in Brooklyn, concludes that few people have any conception of the amount of water which escapes from faucets left running during cold weather where there is danger of freezing over night. In the annual report of the Zanesville, Ohio, water works, recently issued, there is a table published which is sufficient to astonish the unthinking who indulge freely in the water waste business. The table given gives various sizes and pipes, head and pressure, and commences with an aperture the diameter of which is one sixty-fourth part of an inch, equivalent to that of a cambric needle. Under a head—we will say of 150 feet—equivalent to a pressure of almost 65 pounds to the square inch, the quantity of water which would escape during the year, if always open, would reach 26,280 gallons, or through an orifice the size of a pin, equal to one thirty-second of an inch, the quantity escaping in the same time and under the same pressure will be 115 632 gallons. Where so large a quantity as that will escape from a small orifice it is only a question of figures to ascertain how much water is lost through the winter months during the prevalence of frost.

THE average yearly wages of men, women, boys, and girls in the United Kingdom and in the United States in the following classes of mills are:

	United States.	Great Britain.
Cotton	$329.33	$179.50
Woolen	364.34	165.00
Worsted	361.99	151.00
Linen	305.44	126.00

These estimates are given by Consul Brown, of Glasgow, and Mr. Wadlin, chief of the Massachusetts Bureau of Labor Statistics, in his latest report.

© 1890 SCIENTIFIC AMERICAN, INC.