

rado granite, the balance of Colorado brick. The interior will be constructed with steel beams and fire-proof tile arches. The building, together with the plot (125×200 feet), will cost \$1,880,000.

Messrs. Andrews, Jaques & Rantoul, of Boston and Denver, are the architects. The erection of the building is in charge of William M. Scanlon, manager of construction, and John S. Brisbrie, superintendent.

#### The Work of the Cooper Union.\*

The Cooper Union of Science and Art was not founded for science or for art, but for man. And it has been steadily directed with that purpose in view. While, on the one hand, there has always been a regular course, through which students might pass, obtaining what we all desire, if we are so fortunate as to have the necessary time and opportunity—a systematic preparatory training, such as the graduates of to-night have enjoyed—the facilities of special departments of the Cooper Union have been enlarged from time to time, to suit the needs of the workingmen and workingwomen of New York, not as those needs are conceived according to some profound theory of what they ought to be, but as experience has proved what they actually are.

The great mathematician and wit, Professor De Morgan, of Oxford, praised in one of his essays (reprinted after his death in that quaint and charming book "A Budget of Paradoxes") the practical common sense and individuality of a rheumatic old gentleman, who, finding no ready-made chairs that fitted him, just spread on a board a mass of shoemaker's wax, then sat upon it until it had exactly adjusted itself to his anatomy, and then took the wax mould to a cabinet maker, saying, "There! make me a seat like that!"

The illustration is a homely one; but it precisely represents the manner in which the operations of the Cooper Union, wisely adjusted to the public pressure, have been fitted to the public need. The relative usefulness of every department has been tested by its results. Everybody connected with the management knows how Peter Cooper used to welcome, year after year, the practical proof of this point—the evidence that so many men or women had gained, in the classes here, the power to earn increased wages; how this or that student in the Cooper Union had made himself more useful in the world by reason of the knowledge here obtained. These were the statistics he loved.

Another generous man, Ezra Cornell, gave to the institution he founded a motto, declaring in substance that it was to be a place where *any man could learn anything*. A noble charter, indeed, embracing at once all branches of human knowledge and all seekers after knowledge, without distinction of color, class, condition or sex. And Cornell University is a noble expression of this ideal—though necessarily imperfect still, because the ideal itself demands for its full realization yet vaster endowments in money, and, beyond that, the ripe results of time in the maturing of great scholars, and the appreciation of them. Money alone will not accomplish everything. If I am not mistaken, the richest university in the world to-day is the State University of Texas, the endowment of which is estimated, as I am informed, to be worth \$50,000,000. That is a grand provision for the future; and the future is never far off in the United States of America.

But meanwhile, even for the sake of the future, we have to deal with the present, and the prime purpose of the Cooper Union was not to establish a superfluous rival to Columbia, or the University of New York, but to aid the working people of New York—the class which will always exist, no matter what great universities may hold above its head the culture to which only a small part of the community may aspire. Thus this institution stands to-day, a University of the People, the type and model of many others of its class; and my old friend and schoolmate, the President of Columbia, never occupied a more dignified or consistent position than when he stood upon this platform last February to praise the character of Peter Cooper, and the institution which Peter Cooper created.

The proof that the Cooper Union supplies a great want with a great relief is overwhelming. One branch of it—and one branch only—is seen in such gatherings as that which our alumni organized in February last, to celebrate the centennial of Peter Cooper's birth. How the testimony of that meeting would have rejoiced his heart. What could be more glorious and grateful to any man, either before the tribunal of history or at the higher tribunal of the judgment day, than the glad witness of thousands who have received from him the one gift that neither impoverishes the giver nor pauperizes the recipient—the gift of knowledge, which is power!

#### The Speed of Electricity.

It requires about three seconds to transmit an electrical signal through the Atlantic cable. The speed at which electricity travels amounts to several thousand miles per second, but the electrostatic resistance of the cable reduces this speed to about 1,000 miles per second.

\* Abstract from the address of Dr. R. W. Raymond at the commencement of the Cooper Union, May 28, 1891.

## 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 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. \$5.00 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, JULY 11, 1891.

#### Contents.

(Illustrated articles are marked with an asterisk.)

Barrel tapping device.....	20	Mercury, transit of.....	20
Ballooning, military, progress.....	18	Military dovescotes.....	22
Books and publications, new.....	27	Northrop, Dr. John I.....	17
Castrography.....	21	Notes and queries.....	26
Cement parchment paper.....	18	Pleuro-pneumonia, England.....	16
Dyeing recipes.....	16	Pump, electrical.....	18
Electricity, speed.....	17	Railroad, Pike's Peak.....	25
Electricity, antiquity.....	17	Residence, Riverside Park.....	25
Fastener, bedclothes.....	20	Sandstone industry.....	24
Gas, natural, Stockton.....	21	Science of old age.....	25
Germes of United States.....	19	Signaling, pneumatic.....	23
Hair growth after death.....	21	Sewerage, Shepherd.....	20
Hydrocarbon burner for stoves.....	22	Slide and screw cutting lathe, improved.....	19
Improved methods of building.....	15	proved.....	19
Improvements, steamship.....	16	Steamer Roman, steel.....	21
Inks, writing.....	20	Steamship, new French.....	20
Insects, loss by.....	18	Teredo remedy.....	21
International Congress, Geologists.....	16	Tone of currency.....	19
Inventions, recently patented.....	26	Tool, drawing, Jones.....	18
Jel, intermittent.....	21	Tunnel, important.....	19
Lake formed in Colorado desert.....	17	Wheel, rolling.....	21
		Work of Cooper Union.....	16

### TABLE OF CONTENTS OF SCIENTIFIC AMERICAN SUPPLEMENT No. 810.

For the Week Ending July 11, 1891.

Price 10 cents. For sale by all newsdealers

I. BOTANY.—Cocos Pynaerti.—A new dwarf growing palm.—1 illustration.....	12343
II. CHEMISTRY.—The Application of Electrolysis to Quantitative Analysis.—By CHARLES A. KOHN, B.Sc., Ph.D.—Applicability of these methods to poison determinations.....	12348
III. CIVIL ENGINEERING.—The Kioto-Fu Canal in Japan.—A Japanese canal connecting the interior of the country with the sea.—3 illustrations.....	12339
The Iron Gate of the Danube.—3 illustrations.....	12338
opening a channel in the Danube.—1 illustration.....	12338
The New German Ship Canal.—Connection of the Baltic with the North Sea.—Completion of this work.—1 illustration.....	12339
Transit in London, Rapid and Otherwise.—By JAMES A. TILDEN.—A practical review of London underground railroads and their defects and peculiarities.....	12335
IV. ELECTRICITY.—An Electrostatic Safety Device.—Apparatus for grounding a circuit of too high potential.—1 illustration.....	12344
Experiments with High Tension Alternating Currents.—Spark distance of arcs formed by a potential difference of 20,000 volts.—1 illustration.....	12344
Laying a Military Field Telegraph Line.—Recent field trials in laying telegraph line in England.—3 illustrations.....	12343
The Iron Gate of the Danube.—3 illustrations.....	12338
opening a channel in the Danube.—1 illustration.....	12338
The New German Ship Canal.—Connection of the Baltic with the North Sea.—Completion of this work.—1 illustration.....	12339
Transit in London, Rapid and Otherwise.—By JAMES A. TILDEN.—A practical review of London underground railroads and their defects and peculiarities.....	12335
V. GEOGRAPHY.—The Mississippi River.—By JACQUES W. REDWAY.—An interesting paper on the great river and its work and history.....	12348
VI. MECHANICAL ENGINEERING.—How to Find the Crack.—Note on a point in foundry work.....	12339
Riveted Joints in Boiler Shells.—By WILLIAM BARNET LE VAN.—Continuation of this practical and important paper.—10 illustrations.....	12336
VII. MEDICINE AND HYGIENE.—Influence of Repose on the Retina.—Important researches on the physiology of the eye.....	12345
The Relation of Bacteria to Practical Surgery.—By JOHN B. ROBERTS, A.M., M.D.—A full review from the surgeon's standpoint of this subject, with valuable directions for practitioners.....	12344
VIII. MINERALOGY.—Precious and Ornamental Stones and Diamond Cutting.—By GEORGE FREDERICK KUNZ.—An abstract from a recent census bulletin, giving interesting data.....	12342
IX. MINING ENGINEERING.—Mine Timbering.—The square system of mine timbering as used in this country in the Pacific coast mines and now introduced into Australia.—1 illustration.....	12335
X. MISCELLANEOUS.—Freezing Mixtures.—A list of useful freezing mixtures.....	12339
Sun Dials.—Two interesting forms of sun dials described.—3 illustrations.....	12346
The Undying Gm Plasm and the Immortal Soul.—By DR. R. VON LENDENFELD.—A curious example of modern speculative thought.....	12346
XI. NAVAL ENGINEERING.—The New British Battle Ship Empress of India.—A first class battle ship recently launched at Pembroke dockyard.....	12337
XII. TECHNOLOGY.—Composition of Wheat Grain and its Products in the Mill.—A scientific examination of the composition of wheat and its effect on mill products.....	12342
Fast and Fugitive Dyes.—By Prof. J. J. HAMMEL.—Practical notes from the dyer's standpoint upon coloring agents.....	12340

#### INTERNATIONAL CONGRESS OF GEOLOGISTS.

Official notice has been given of the approaching sessions of the Fifth Geological Congress in time to enable foreign delegates to arrange for their attendance. It has been wisely planned to have several important scientific bodies meet successively in the rooms of the Columbian University, Washington, D. C. From August 19th to 22d, there will be meetings of the sections and various allied societies of the American Association for the Advancement of Science, of which the foreign delegates will be honorary members. The Geological Society of America will be convened August 24th and 25th, in whose discussions foreign guests may also participate. The International Congress will be in session from August 26th to September 2d. The daily hours will be for the council, 10 A. M., and for the congress 11 A. M. and 2.30 P. M., with lectures, receptions, etc., in the evening. Besides the consideration of reports and other routine business, the following subjects will be made special topics for consideration:

1. Time correlation of the Clastic rocks by structural data, *e. g.*, stratigraphical, lithological, and physio-graphical; and correlation by paleontological data, *e. g.*, by fossil plants, and animals, marine and terrestrial.

2. General geological color schemes and other graphic conventions.

3. Genetic classification of the Pleistocene rocks.

Reduced rates on the Inman, Red Star, N. German Lloyd, and Netherlands-American lines of ocean steamers have been arranged for with Thos. Cook & Son, varying with location of stateroom and number of occupants, the range being, for return tickets, from \$85 to \$122 and upward. Return tickets will be good for six months from date of sailing. The principal United States railroads will make a reduction of one-third on regular rates. Hotel rates at Washington will also be reduced one-third to delegates and members. A number of delightful excursions will be made after the congress adjourns, through the Appalachian coal fields, the copper and iron regions of Lake Superior, the Southern iron region, the Devonian beds of New York, *etc.* A grand Western excursion, covering more than 6,000 miles in length, and traversing 39 degrees of longitude, and crossing twenty States and Territories of the United States, and a portion of Canada, will be taken from September 2d to 26th, at a cost of \$265, including transportation, lodging, meals, and coaches in Yellowstone Park. Branch excursions will be made to Shoshone Falls and to the Grand Cañon of the Colorado—the latter under guidance of Major J. W. Powell; while competent geologists will likewise accompany all the various excursion parties. Inquiries as to details of final arrangements should be addressed to Prof. S. F. Emmons, Secretary of the Committee of Organization, 1330 F Street, Washington, D. C.

#### STEAMSHIP IMPROVEMENTS.

The latest plan to improve the draught of the funnels of ocean steamers is to increase the height of the smoke pipes. The new steamer Scot, of the Cape Mail Line, is provided with smoke stacks 120 feet high above the grates, being the loftiest pipes ever put into a steamer. A draught of  $\frac{3}{4}$  inch water pressure is thus obtained, all the steam needed is easily secured, and the use of fans is dispensed with. Her speed is 19 knots.

The Scot is 502 ft. long over all, 460 ft. on the water line, 54 ft. 6 in. beam, 37 ft. 6 in. deep. Tonnage 7,000. Built of steel. Fourteen watertight compartments. Draws 23 ft. with 2,800 tons of coal on board. Twin screws, 8,000 h. p. engines, two sets of triple expansion engines,  $34\frac{1}{2}$  in.,  $57\frac{1}{2}$  in., 92 in. by 60 inch. Six double ended boilers, pressure 170 lb.; 36 furnaces. The success of the tall chimneys of the Scot will probably lead to the trial of even higher pipes. The above vessel could clear the floor of our Brooklyn bridge, which is 119 ft. above high water. If our great war steamers should be piped in accordance with the latest and best engineering practice, they will be debarred from the Brooklyn navy yard, unless they approach from the Hell Gate side of the great bridge. It was an error on the part of the Secretary of War to allow so low a floor for the bridge. At present all the larger ships are obliged to dismantle and lower their topmasts in order to pass under the Brooklyn bridge.

#### Pleuro-Pneumonia in England.

The outbreak of this disease in the herds of the East Riding and the action taken by the Agricultural Department have caused quite a stir among the agriculturists of Yorkshire. The number of animals ordered to be slaughtered is 170. The slaughter is expected to occupy ten days in all, and the value of the beasts destroyed and to be destroyed is estimated at fully \$15,000, which will be paid by the Agricultural Department of the Privy Council. The outbreak of the malady, which is on a scale unprecedented in so small an area, will probably affect the cattle show of the Royal Agricultural Society at Doncaster.