bottom of its excavation two trenches, 10 feet wide and 6 feet deep, are carried, into which the masonry descends, thus giving the great structure a definite resistance to horizontal thrust. The breadth of the masonry in some parts of the base is 185 feet. It is faced with cut stone. Its inner face slopes a little; the outer face, while varying in degree, has a general slope of 2 vertical to 1½ horizontal.

The dam proper is to be 1,200 feet long. Next to it comes the spillway, 1,000 feet long, over which the overflow takes place. This portion is built in a series of steps, and its level of crest determines the height of water in the dam. This crest is 24 feet below that of the dam proper, thus giving a margin of safety beyond any catastrophe.

In general construction the spillway is a masonry dam faced on the inner side with cut stone. The outer wall sloping outward is broken into a series of steps about 4 feet width and 5 feet rise. It is based upon the bed rock in exactly the manner described for the dam proper. It curves around as shown, and presents quite a striking appearance. Its peculiar shape enables a bridge to be carried over the gap to give passage to the highway.

The dam along its outer edge has a cornice of arches, an idea of whose appearance may be derived from the cut.

The work to be done by the dam is the formation of a larger reservoir than the present and the impounding of a quantity of the water which now at many times goes to waste, pouring over the crest of the present Croton dam. It will increase the storage capacity of the Croton Lake in round numbers from 2,000 millions to 30,000 millions of gallons. The main intake into the new aqueduct will be at the new gate house near the old dam. With the old aqueduct a connection will be made almost on a line with the new dam. Whether the section of old aqueduct intercepted will be preserved or not is still an open question. It may be used to deliver water back to the new gate house and thence into the new aqueduct.

The present Croton dam, and far back of it, Muscoot dam, will be submerged. The latter dam will cut off all water above it from the reservoir. Such water it is intended to use only in emergencies. The object of Muscoot dam is to preserve a uniform level of water as far as possible, in order to satisfy the desire of the residents of the region which surrounds its reservoir. Below the Muscoot dam 24,000 millions of gallons is the capacity of the new reservoir.

The watershed of the region feeding the new dam is 376·3 square miles. The estimated cost of the dam proper, as per engineer's report of October 8, 1890, is $3,650,000, to which must be added for roads, bridges, railroads, etc., $1,075,000, and for Muscoot dam $300,000. Six and one-half years are allowed for its construction. The dam, estimated to cost $400,000 less than Quaker Bridge dam, has only 4,000 gallons less storage. Its extreme height above the river bed is 159 feet, its extreme depth below the same is 80 feet, giving a total of 239 feet maximum height.

Estivation.

A rarer and even more curious phenomenon than hibernation, or winter sleep, is the estivation, or torpidity during the dry season, of certain animals. As one of the mammals which is most sensitive to heat and dryness, M. L. Cuonot mentions the tanrec, of Madagascar, an insect-eating creature resembling the hedgehog. It is very active during the rainy season, but lies torpid in a shallow burrow for nearly six months in the dry period. The most remarkable summer sleepers, however, are found in the group of dipnoids, intermediate between the batrachians and fishes, and comprising at present but three animals—the *Lepidosiren paradoxa* of the affluents of the Amazon, the *Protopterus annectens* of Gambia and Senegal, and the *Ceratodus Forsteri* of Australia. Their anatomical structure resembles that of the fishes, and a bronchial apparatus allows them to breathe in the water, while a pulmonary apparatus enables them to absorb the oxygen of the air. A careful study of the protopterus shows that during the entire dry season, lasting about nine months, it remains buried in the dried-up mud at a depth of five feet, and is surrounded by a sort of cocoon, which incloses it hermetically. Air penetrates through a narrow channel to the animal, which in this state breathes, not only through a lung into which the swinning bladder is transformed, but through its wide membraneous tail. On the return of the rainy season, the dried mucus covering the animal dissolves, and the creature straightens out from its doubled-up position, and swims in the water for three months.—*Mediterranean Naturalist.*

THE tide tables for the Atlantic coast of the United States, together with 206 stations on the Atlantic coast of British America, for the year 1893, published by the U. S. Coast and Geodetic Survey, are now ready for issue, and copies can be obtained at the agencies of the Survey in this city, or by addressing the office at **Washington. Price twenty-five cents.**

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 pape 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. $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, JULY 9, 1892.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 862.

For the Week Ending July 9, 1892.

Price 10 cents. For sale by all newsdealers.

THE NICARAGUA CANAL.

The assertion is sometimes made that the Nicaragua Canal will not benefit us in regard to the increase of the number of our ships, and this assertion is based on the fact that France failed to add a single ship to her carrying fleet by the completion of the Suez Canal, built by French engineering, French enterprise and French capital. This fact is brought forward as a lesson in history which we must bear in mind when we are asked to consider the Nicaragua Canal question as an element in the development of our commerce.

At the present day the Suez Canal is chiefly devoted to the carrying trade of England, and England owns a fighting interest in the stock.

We hold in regard to the Nicaragua Canal that the United States will, no matter who builds it, take the same position that England could not fail to attain in the use of the Suez Canal. England possesses an immense, flourishing and steadily increasing commerce in the East, while the commercial possessions of France there are comparatively small.

Like England in the East, we have extensive possessions in the West on our Pacific shore, California, Oregon, Washington and Alaska, all very flourishing, while their productiveness is steadily increasing. It must, without fail, stimulate our shipbuilding trade when by a shorter and safer transit the mutual commerce will receive a most powerful impulse. All the European ocean-faring nations are even more interested in the Nicaragua Canal than in the Suez Canal, because by passing it they will avoid the stormy ocean of the extreme southerly coast of South America, the sailing round which is a great deal worse than sailing around the Cape of Good Hope.

There ought to be no doubt that our government will assist the enterprise. It is in duty bound to do so. Even in the view of national defense we must have a shorter waterway for more rapid and safer navigation between our extensive eastern Atlantic and western Pacific shore, and so dispense with the delay and danger of a long, roundabout way of sailing around the whole South American continent over the two grand oceans of our globe.

OF INTEREST TO ELECTRICIANS.

By years of exposure to atmospheric temperature, hardened steel loses hardness.

Steel magnets lose their permanent magnetism at the boiling point of almond oil.

Steel not only loses its magnetism, but becomes non-magnetic when heated to an orange color.

Silvanus Thompson says that the sudden slamming on of the armature of a permanent magnet is liable to deteriorate the magnetism; and that the sudden detaching of the armature is of advantage to the magnet.

In the storage battery the plates intended for the positive are pasted with red lead and dilute sulphuric acid (acid 1 part, water 9), and those to be used for negatives with litharge and dilute sulphuric acid.

The positive plates of a storage battery when fully charged should look like wet slate, nearly black; when partly charged they are dark red, chocolate or plum color. The negative plates are always much lighter than the positives and have a pale slate color.

Too quick a discharge buckles the plates and a very sudden discharge draws the paste out of them. When fulled charged plates which have been removed from the electrolyte are to be replaced, the liquid put in should have the same specific gravity as it was before.

According to Silvanus Thompson, a simple tangent galvanometer may be made to read as an ampere meter when constructed as follows: "Take a piece of insulated copper wire of a gauge not less than No. 10 B. W. G., or say than three millimeters in diameter, and of this wire wind five turns only, so as to have a mean radius for New York, Cleveland and Chicago of 6·72 inches; for Philadelphia, 6·37 inches; Washington, 6·18 inches; San Francisco, 4·85 inches; New Orleans, 4·42 inches; then such a coil when traversed by one ampere deflects the needle exactly 45°, that is, to the angle whose natural tangent = 1, and the natural tangents of the deflections will therefore read amperes directly. The radius has to be inversely proportional to the intensity of the horizontal component of the earth's magnetic force at the place where the ampere meter is to be used. It may be further noted that a current of one ampere strength will cause the deposition in one hour of 1·174 grammes or 18·116 grains of copper in an electrolytic cell. It will in one hour deposit 4·024 grammes or 60·52 grains of silver in a silver cell.

THE exposition is deriving quite a revenue from the visitors whose curiosity prompts them to see the grounds and the wonderful buildings now approaching completion. An admission of twenty-five cents is charged, and on single days the number of visitors has exceeded 14,000. With cooler and more pleasant weather, it is believed, the visitors will be much more numerous. Without exception all are enthusiastic in their admiration and wonder at the magnificent spectacle.

Stevens Institute.

We recently presented a series of engravings illustrating some of the special departments of this important institution of learning. The following abstract from the remarks by Mr. S. B. Dod, President of the Board of Trustees, at the commencement of the Stevens Institute of Technology, June 23, 1892, contains an epitome of the use, progress, and prospects of the establishment :

The question with us is, not how to get students to come, but how to take care of those who crowd at our doors for admission.

It was easy to provide for the first class which graduated in 1873, for it was composed of only one man; it is harder to meet the requirements of the 120 men who will seek entrance to Stevens next fall. But the trustees are planning to do this, and, with the help of our friends, they will do it. They propose to raise the roof of the extension on the north and add two stories to it, and so take care of the class that will come to us next fall. The alumni have generously contributed $17,000 toward the new chemical laboratory, and, when the balance of $33,000 is subscribed, the trustees will go on with that building; and so we shall be able to take care of future classes.

What we have done in the past assures us of the future. We have graduated nineteen classes of men who are able to take their places in the world with such credit to themselves and their alma mater that I have been repeatedly assured by men in management of large and important industrial works that they need no higher commendation of a man than the diploma from Stevens.

And now this twentieth class comes to us for their degrees, a solid phalanx of high standing, a class of thirty-nine, without a single condition.

We want our friends to know that we are ready and anxious, if the means are placed in our hands, to give to all who ask it this thorough education.

And I have the pleasure of announcing that, at the recent meeting of the trustees, President Morton presented to the institute the sum of $20,000 for the further endowment of the chair of engineering practice.

This is not the first of President Morton's gifts to the institute. He gave $10,500 toward fitting up the workshop; $2,500 for the department of applied electricity; $10,000 for the endowment of the chair of engineering practice, and now this $20,000 to the same chair.

The sum total of these gifts amounts to nearly $50,000, and perchance exceeds that sum if we reckon the many smaller but constant gifts, not set down in the books, with which he tided over this or that minor deficiency in the various departments.

But generous as he has been in his gifts of money, he has given far more than these—he has given his brains. his heart, himself, to Stevens, with untiring devotion.

This is oftentimes more value than all else—of a value, indeed, that cannot be measured by the lower standard of dollars and cents.

What Stevens is to-day, she owes to Henry Morton. The course of education which is to be for you, young men, a priceless blessing through your life, you owe to him.

If I seem to violate the ancient maxim that it is not fitting to sacrifice to heroes until after sunset, my excuse is this: that, in the literal sense, it is after sunset; but in the metaphorical sense, I do not want to see the day when it shall be sunset for our honored president.

I know that I voice the sentiment of every loyal son of Stevens when I say: "Long live Stevens!" and long live Henry Morton, her first and foremost president!

The Peary Relief Expedition.

As was contemplated last year, when Lieutenant Peary set out on his Greenland exploring expedition, a relief party, taking further supplies for the explorers, or with the design of bringing them home if their work was completed, sailed from New York June 27. The relief party includes Professor Angelo Heilprin and Henry G. Bryant, of the Philadelphia Academy of Natural Sciences; V. W. Stokes, artist; Dr. Jackson M. Mills, surgeon; Albert W. Vorse, William E. Meehan, botanist; C. E. Hite, taxidermist, and Samuel J. Entriken. The party, with all manner of stores useful for Arctic travel, left by steamer for St. Johns, Newfoundland, expecting to sail from there for Greenland on July 5, making the voyage on the Kite, a small and staunch steam vessel, which took out the Peary party last year.

The first stop will be made at Godhaven, Disco Island, from there the vessel proceeding to Melville Bay, and thence to Inglefield Gulf, at the head of Whale Sound, which was the base from which Lieut. Peary intended to start out upon his overland explorations. It was Lieut. Peary's intention, it will be remembered, to winter comfortably in well established quarters in this neighborhood, starting northward in the early spring on snow shoes and sledges over the inland ice to Humboldt Glacier, thence to the head of Peterman Fjord, to Sherard Osborn Fjord, to De Long Fjord, and to such further northern limit as possible, to define the coast line of northern Greenland, supply depots being left on the route for assistance on the return journey.

The exploration was undertaken upon the assumption that the interior of Greenland is covered with an uninterrupted ice cap, which the explorer thought might be thus traversed in one season, the party returning to Whale Sound in time to be taken up and brought home by a vessel reaching there by July or August of this year, although the possibility of a further stay of the explorers over another year was contemplated. Should the conditions prove favorable, the scientists of the relief party intend to examine the Humboldt Glacier, and hope to fall in with Lieut. Peary and his party early in August. The return cannot be delayed much beyond this date, in any event, the relief party not expecting to be away later than the last week in September. If Lieut. Peary and his party are not brought back, fresh supplies will be left for their maintenance in their northern exile another winter, should this be unavoidable.

The Old and New Scientific Spirit.

A writer in *Industries* of June 3, under the initials "W. M. M.," writes as follows:

"About 200 years ago a young man, whose name is still held of some account, was engaged in the work of verifying by calculation a theory of his own respecting the curve of the moon's motion in its orbit. There was a discrepancy of 14 or 15 per cent between the observed and calculated results, and consequently he laid aside at that time any further consideration of the matter. Recently the members of the Physical Society assembled in force to hear another young man, whose name is now held of some account, give a statement of the evidence for and against the theory that the earth carries the ether with it in its motion round the sun. The lecture was illustrated with many diagrams of experiments, mostly negative or inconclusive in their results. *Inter alia* there was a diagram of observed and calculated results, showing a discrepancy of about 99 per cent. But science has advanced since Newton's time, and the last thing any modern scientific man would think of doing is to 'lay aside all further thought of this matter' on account of a trifling discrepancy of this sort. There is a good deal to be said for this modern view. Newton was right after all, and a too scrupulous delicacy might have caused him to miss his greatest discovery and the *kudos* attached to it. Adams first calculated the position of Neptune, but Le Verrier published first; and your modern man does not mean to be caught napping so, even if he has to publish before finishing his calculation. Does not Mayer share with Joule in the opinion of half the world the credit of the theory of the conservation of energy, and who would have heard of him if he had stopped to verify? We are even told that it is little short of a crime to 'hide the light that is in us,' no matter how feeble and flickering it may be, lest haply some one greater should waste his strength collecting and arranging the uncompleted work, as Maxwell did for Cavendish. And yet—and yet—the *Principia* will endure for all time: will 'Modern Views of Electricity,' with its choice of inconsistent hypotheses, or 'Electro-magnetic Theory,' with its *rational* (?) system of units, its uncouth phraseology, and its petulant contempt for whatever is not brand new, stand such a test? A bigot for classical education, with an insufficient appreciation of Newton's genius, attributes his superiority in part to the fact that he published in Latin. 'You may think any scientific nonsense you please,' says this misguided person, 'and you may write it down readily enough in English; but you can't put it into Latin, nor, easily, into French. If it goes readily into German, it is probably more scientific and worse nonsense than usual.' But that, of course, is absurd. In these days it is often almost as good a deed to kill a false hypothesis as to establish a true one; and for this purpose the publication of negative results is most useful, nor is it contrary to precedent. Kepler gave his failures to the world, but only after he had arrived at the truth; Faraday gives his negative results, but he draws the logical inference from them. In each case we could ill spare the insight obtained into the mind and method of a genius. A reasonable rule might be laid down that only those who succeed are entitled to show where they have failed; but then how meager would be the reports of our scientific societies!"

Desert Mirage in the Class Room.

R. W. WOOD.

Some days since, I noticed a remarkably striking example of true desert mirage on a smoothly paved sidewalk, on which the hot afternoon sun was shining. The walk was perfectly level, paved with smooth white slabs of artificial stone, extending in a horizontal direction along the top of a steep hill. On coming up the ascent the eye could be brought nearly on a level with the sidewalk, by standing just below the brow of the hill. A curious phenomenon presented itself. The walk appeared to be flooded with water, on the smooth surface of which could be seen the reflected images of lamp posts, pedestrians, etc. A small poodle dog trotting along above his inverted image presented an amusing spectacle. So perfect was the illusion that, for a moment, I could hardly believe that the walk was not wet. I have since noticed the phenomenon every day, and find that whenever the eye can be brought nearly on the plane of a smooth, level surface of stone paving or asphalt, on which the sun shines brightly, these refracted images can be seen.

It occurred to me that possibly the effect could be produced in the class room. A preliminary experiment with a hot kitchen stove convinced me that the plan was feasible, and I found that if a strip of thick sheet iron, five or six feet long, four or five inches wide, supported so as to be perfectly level, be heated by a number of Bunsen burners from beneath, a miniature mirage can be seen by bringing the eye on a level with one end of the strip, and viewing a candle flame that burns on a level with the other end. The candle should be held below the strip, so that only the flame is visible above the edge. If the cold iron shows a reflection due to its polished surface, it may be sprinkled with fine sand. Obviously the surface of the sand must be made level. The effect can be heightened, if the apparatus works well, by using a small palm tree an inch or so high cut from paper and colored to life, which is more realistic and suggestive of the desert. The cause of the phenomenon is, of course, apparent to any one versed in the laws of optics. The rays of light, on striking the layer of warm (and consequently less dense) air, are refracted upward without striking the ground at all. This gives the appearance of a reflected image, and the natural inference would be that it was due to water. On the desert the layer is hot enough and thick enough to bend up the rays sufficiently to enable a person standing upon level ground to see them, but under the less favorable conditions offered by the city sidewalk, the refraction is so slight that the eye has to be lowered considerably to observe the effect.

San Francisco, June, 1892.

Relief from the Mississippi Floods.

W. J. Smith, civil engineer, of Toronto, Canada, has proposed a novel way of diverting the flood waters of some of the great affluents of the Mississippi. His plan is to cut a channel from the Red River near Shreveport to the nearest available point on the Sabine River, a distance of about 25 miles, with a water area of 1,000 feet, with an estimated flow of 7,200,000 cubic feet per hour. Estimated cost, $3,000,000. A further relief by a channel 125 miles long from the Arkansas to the Red River, near the boundary line of the Indian Territory, and 300 miles further on through the eastern border of Kansas, to tap the Missouri River near Kansas City. On the eastern side of the Mississippi the scheme is to connect the Tennessee with the Gulf through the Tombigbee River and the Yazoo through the Pearl River, and thus divert 20,000,000 cubic feet of flood water per hour from the Lower Mississippi, at an estimated cost of about $85,000,000.

The scheme is a grand one, with the exception that it does not deal with the topography of the country through which the great waterways are to flow, nor the relative elevation of the rivers to be connected. There are large areas of elevated land between the Missouri and Arkansas, with a mountain divide, and a ridge of hills between the Arkansas and Red Rivers. The divide between the Red River and the upper waters of the Sabine indicates deep and costly cutting with the uncertainty of the required flow through 150 miles of the Sabine River. The connecting waterways on the east side of the Mississippi are of the same vague character as to the topographical difficulties.

The New York Building at the World's Fair.

The board of managers for the State of New York has decided upon the plans and ordered work to be immediately commenced upon the New York building at the Columbian Exposition. The accepted design was made Messrs. McKim, Meade & White, and is in the style of the Italian Renaissance, three stories, with porticoes at each end, to be surmounted by two campaniles. The building will be 60 feet high, 200 feet long and 105 feet deep. The material used in the construction will be staff, a composition of plaster of Paris, cement and hair, which gives the general effect of marble.

Government Aid for the Fair.

In the U. S. Senate an appropriation bill for the Fair has been favorably reported, and its passage and approval by the President is virtually assured. It is practically the same as that agreed upon by the House of Representatives, and makes an aggregate appropriation of $5,541,495, including an issue of 10,000,000 silver half dollar souvenir pieces, and appropriations for the procurement of medals and diplomas, expenses of the government exhibit, additional employes, etc. The committee included in the bill an amendment requiring the Exposition to be closed on Sundays.