Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, postage included $3 20
One copy, six months, postage included 1 60

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

Remit by postal order. Address
MUNN & CO., 37 Park Row, New York.

☞ To Advertisers.—The regular circulation of the SCIENTIFIC AMERICAN is now **Fifty Thousand Copies** weekly. For 1880 the publishers anticipate a still larger circulation.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, with handsome cover, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses, as desired.

The safest way to remit is by draft, postal order, or registered letter
Address MUNN & CO., 37 Park Row, N. Y.

Scientific American Export Edition.

The SCIENTIFIC AMERICAN Export Edition is a large and splendid periodical, issued once a month. Each number contains about one hundred large quarto pages, profusely illustrated, embracing: (1.) Most of the plates and pages of the four preceding weekly issues of the SCIENTIFIC AMERICAN, with its splendid engravings and valuable information; (2.) Commercial, trade, and manufacturing announcements of leading houses. Terms for Export Edition, $5.00 a year, sent prepaid to any part of the world. Single copies 50 cents. ☞ Manufacturers and others who desire to secure foreign trade may have large, and handsomely displayed announcements published in this edition at a very moderate cost.

The SCIENTIFIC AMERICAN Export Edition has a large guaranteed circulation in all commercial places throughout the world. Address MUNN & CO., 37 Park Row, New York.

NEW YORK, SATURDAY, NOVEMBER 29, 1879.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 204,

For the Week ending November 29, 1879.

Price 10 cents. For sale by all newsdealers.

THE HOLYOKE TURBINE TESTS.

One of the finest illustrations of the results of New England thrift and energy is to be found in the city of Holyoke, Mass., the great center of paper manufacture in this country—probably the greatest in the world. The city lies in a bend of the Connecticut River, below the Great Rapids, and is growing with astonishing rapidity in consequence of the unrivaled facilities the place affords for manufacturing enterprises, due to its magnificent, unfailing, and economical water power.

A dam, 1,019 feet long, 130 feet wide, and 30 feet high above the bed of the river, throws the vast volume of the Connecticut into a series of canals lying at three levels, with a total fall of 56 feet. Thus harnessed, the Connecticut yields at this point 30,000 horse power, with several miles of mill sites along its banks and beside the canals. The property is controlled by the Holyoke Water Power Company, who maintain the dam and canal, and lease the water power at a rate so low as to make Holyoke the most promising site for a great manufacturing city using water power this side of the Mississippi. As evidence that these promises are not likely to go long unfulfilled it may be noted that in 1861 the valuation of Holyoke was about two and a quarter million dollars, with a population of eight thousand five hundred. Now the valuation is about ten million dollars, while the population approaches twenty thousand.

In addition to the numerous paper mills there are already established many thread mills, cotton mills, manufactories of silk and woolen goods, extensive machine shops, cutleries, rubber works, besides establishments for the manufacture of screws, wire, and so on. On all sides the visitor sees new buildings going up, particularly new mills, factories, and machine shops, and extensive additions to old ones.

The general basis of the city's growth and prosperity being the utilization of water power, the importance of deciding by thorough competitive tests the relative values of the different styles of water wheels, to establish, if possible beyond a chance for doubt, the best turbine plans, is very naturally a matter of special local interest in Holyoke, apart from the great importance of such tests to all water power users throughout the country. Accordingly the city authorities united last spring with the Water Power Company in an invitation to water power companies, cities that pump their water supply, and all others interested in the matter, to take part in a series of tests of water wheels, at the expense of the Holyoke Water Power Company, with special invitations to the Locks and Canals Company, of Lowell, Mass., the city of Philadelphia, the National Millers' Association, the American Society of Civil Engineers, and the representatives of the owners of the turbines furnished, to send accredited engineers, as guests of the city, to witness and take part in the trials.

These tests have been in progress during the past two months at the testing flume of the Holyoke Water Power Company, which had been enlarged and put in excellent condition for the purpose, making it the most perfect flume of the kind ever constructed. The apparatus used in testing the wheels and the methods employed are those of Mr James Emerson, whose tests at the same flume during recent years have done so much to determine the actual practical efficiency of the different styles of water wheels.

In the course of a month or so the reports of the testing and supervising engineers covering the whole series of tests will be officially promulgated, and will promptly appear in the SCIENTIFIC AMERICAN. In the meantime we shall begin a series of special reports of the tests of the more important wheels, with full details, and a more particular description of the methods, apparatus, and conditions of the tests than is possible at this time.

COLLISIONS AT SEA.

On Friday, November 7, occurred two remarkable collisions at sea, one between the coasting steamer Champion, of the New York and Charleston line, and the English ship Lady Octavia, off the Delaware Cape, resulting in a heavy loss of life; the other between the Arizona, of the Guion line, and an iceberg, while crossing the northern edge of the Newfoundland Banks, no lives being lost. On the following day another steamer, the Falcon, plying between Baltimore and Charleston, was run into by a large three masted schooner laden with ice, and quickly sank, the passengers and crew escaping in life-boats.

These three collisions, occurring almost simultaneously, give terrible emphasis to the ever-imminent risk of such disasters, and the vital importance not only of keeping a good look-out at sea, but of the need of improvements in ship-construction which shall make all vessels practically unsinkable.

The Champion was an iron steamship, 234 feet long, 31 feet beam, and 18 feet in depth of hold. She was built in four compartments, and was lightly laden; yet she filled and sank within five minutes after striking the Octavia. The Lady Octavia was slightly smaller, but much more substantially built. She was one of the first sailing vessels built exclusively of iron, and her plates were much thicker than those now used in shipbuilding. She was struck abaft the stern on the port side, smashing her bows and cutting two great holes in her side, one of them three feet under the water line. The fore compartments filled almost instantly, the watertight bulkhead alone saving the vessel from foundering. Four passengers and twenty of the Champion's crew were picked up, the most of them having clung to floating fragments, or taken refuge on a life raft and in one of the boats which broke away as the steamer was sinking.

The disaster was due wholly to the absence of a proper look-out on board the steamer. The night was clear, the moon was shining brightly, and the captain of the Octavia reports that the Champion was in sight ten minutes before the collision occurred.

The Arizona's mishap was equally inexcusable. With a clear sky and a smooth sea the ship was run head on against a huge iceberg, while going at a rate of fifteen knots an hour. Her entire bow was literally smashed, but fortunately the collision bulkhead was staunch and the vessel was saved It will be remembered that the Arizona was launched only last spring, when a full description of her magnificent appointments was published in this paper

Except in the face of a disaster of this sort it would be impossible to believe that a ship built and run as the Arizona was for superiority in every particular, could have been so recklessly navigated. Her escape from instant sinking, with the loss of every one on board, was almost miraculous. Had the blow been a quartering one, the ripping open of her side would have been all but inevitable, and we should simply have had to record another disappearance of a great ship at sea.

In the case of the Arizona, as in that of the Octavia, the vital importance of collision bulkheads is most impressively illustrated; and indirectly also the value of the compartment system when the partitions are strong and the ports closed. They are not all the conditions requisite for safety, but they go a long way to lessen the risks incident to seafaring—not the least of which would appear to be the criminal carelessness of ship commanders and their assistants.

So long as men, even those in the most responsible positions, are liable to relaxations of vigilance; so long as men in subordinate positions find it less easy to take trouble than to take the chances that no harm will come from their shirking of duty, just so long may we expect the repetition of those preventable disasters, miscalled accidents, which add so many needless terrors to seagoing. For an endless variety of reasons that are no reasons, look outs will fail to look out, and collisions will occur after every provision has been made for preventing them by the use of electric lights, sound-signals, and other contrivances. All these are useful and desirable, no ship should go to sea without them; no officer should be retained who neglects them. But more than these is necessary. The ships themselves must be made with such elements of buoyancy that they will not sink under any probable condition of things at sea. With the enormous actual and prospective increase in shipping, particularly in the department of passenger traffic, the heavy annual losses by shipwreck, and the increasing thousands always at sea and subject to its dangers, the need of unsinkable ships must every year grow more and more urgent. There is no field in which the inventor can more directly contribute to the welfare of men than in this; nor is there any which holds out more generous promises of reward to the men who shall solve the problem involved. The closing years of this century are likely to see as grand an advance in the scope and magnitude of American commerce as recent years have shown in the advancement of agriculture and the mechanic arts. It lies with our inventors to determine whether the commerce of the future shall be secure as well as great.

THE AMERICAN PUBLIC HEALTH ASSOCIATION.

The seventh annual meeting of the American Public Health Association will be held in Nashville, Tenn., November 18 to 21. The principal subjects for discussion will be the sanitary condition of cities and towns, especially those of the Southern States, and the proper treatment of actual or threatened outbreaks of yellow fever. Under the former head will come subjects relating to water supply, drainage and sewerage, disposal of garbage and excreta, slaughter-houses and abattoirs, public school-houses, public health laws, regulations, etc., expenses of municipal sanitation, and the like. In the discussion of yellow fever the following points will be specially considered.

1. How to deal with a city in the yellow fever zone in order to prevent the appearance of a first case. 2. How to prevent the importation of a first case. 3. How to deal with a first case and early cases generally when, in spite of precautions under first and second headings, it has made its appearance. 4. The duty of local boards of health, or other health authorities, to report such cases promptly, even though there may be some doubt as to the diagnosis. Whether the knowledge that such reports would be faithfully made would not have a tendency to allay apprehensions, and give confidence to other communities while warning them of the importance of making preparations for contingencies. 5. Under what circumstances may it become necessary or expedient to remove the unacclimated portion of the population from an infected place? How may this be effected for the poorer classes of the population, and how should the people thus removed be cared for and supported? 6. Measures for isolating a dangerously infected place. 7. Organizations for the relief and treatment of the sick in an infected city. 8. Measures for preventing the spread of the disease from an infected place by railroads, including the management of transfer stations. 9. Inspection of steamboats at an infected place and at intermediate stations between the port of departure and their final destination. Should stations of observation be established by the National Board of Health? If so, what should be their relations to the health authorities of the

States within whose territorial limits they may be established? 10. Results of the co-operation and aid given by the National Board of Health to State and municipal boards under the provisions of the act approved June 2, 1879. What suggestions may be made to render this system more efficient?

During the sessions of the association the National Board of Health will be officially convened. On the 22d the Sanitary Council of the Mississippi Valley will convene, and on the 19th a conference of railway and steamboat managers will consider questions relative to rules and regulations calculated to arrest the spread of infectious diseases through the movement of passengers and freight. On the 17th the Medical Society of Tennessee will meet in special session, and will act as committee of reception. The State Board of Health, the Nashville Board of Health, and the Citizens' Auxiliary Sanitary Association will also contribute to the membership of the committee.

THE USE OF STEEL FOR BRIDGES.

The adaptability of steel as a material for bridges has become a prominent topic of discussion among engineers and bridge builders. In view of the frequency with which pieces of steel of a guaranteed high tensile strength and superior quality have unexpectedly broken, and this in positions that iron has filled much better, has naturally made many engineers skeptical upon the propriety of using it in bridge construction. On the other hand, there are some who are sanguine enough to believe that all that is now necessary, in reference to the introduction of this material, is merely to proceed to use it. The problem, however, is not a simple one; and there are several difficulties to be surmounted, one of the greatest being the want of uniformity of production, the homogeneity of the material. It seems to be understood that high carbon steel, made at the same works from the same materials, differs materially, day by day, in its strength and elasticity, and as a sample out of every bar cannot well be tested, there can be no certainty of just what strength the bridge will possess when the various bars are placed side by side.

Some of the facts that would seem to govern the successful introduction of steel for bridge construction have recently been given in a paper read by Mr. Theodore Cooper before the American Society of Civil Engineers. Mr. Cooper insists on the fact that the engineer who proposes to use steel should not attempt to specify to the manufacturer either its chemical constituents or its manipulation, but should chiefly concern himself with the physical characteristics that the material should possess to best perform its desired work. The most important of these are the tensile strength and elasticity, and which largely represent its suitableness for engineering purposes. The fact is well known that great ductility is accompanied by a low tensile resistance, and *vice versa*. The author points out the importance of requiring a ductile metal regardless of what its tensile strength may be, this ductility to be that of the actual rolled material, and not that of the ingot metal, or samples of the latter worked in a different manner from the material to be used. The amount of tensile strength that can be obtained in connection with a specified percentage of elongation is dependent upon two factors. The first of these, the chemical composition, is only of importance to the user of the material, as it may impart new physical attributes; but even with a knowledge of its accurate composition he is still compelled to depend upon his physical tests to be assured of its quality. The second factor, or amount of work put upon the metal, will be governed by the capacity of the plant by which it is to be worked. Therefore, so large a tensile strength cannot be expected in the heavy sections as in the smaller ones. Competition will soon develop the capabilities of our manufacturers of steel, when a sufficient demand has been created for a steel with definite characteristics suitable for bridge purposes. The following requirements for bridge steel should, in the author's opinion, be the *maximum* as to tensile strength, and *minimum* as to elongation demanded, until increased experience proves the safety of changing them: For plates, angles, channels, and other shapes, an ultimate strength between 65,000 and 70,000 per square inch; elongation not less than 20 per cent in 8 inches; limit of elasticity above 35,000 pounds per square inch. For small bars and rods, an ultimate resistance between 75,000 and 80,000; elongation not less than 20 per cent in 8 inches; limit of elasticity above 40,000 pounds per square inch. For large flat bars, an ultimate resistance between 70,000 and 80,000; elongation not less than 15 per cent in 8 inches; limit of elasticity above 38,000 pounds per square inch. In addition, the steel must be satisfactory as to its hardening tendency, bending tests, etc., with such other practical conditions as may insure a certain and reliable material for the required purpose. He would not deem it advisable to increase the customary working strains used for iron bridges more than 50 per cent. As to the kind of steel, as regards make, that will prove most suitable for bridges, the question must be decided by the relative cost of such material as will fill the requirement; and the latter can undoubtedly be filled by either the crucible, Bessemer, and open hearth processes. The additional cost of smelting would apparently rule out crucible steel, leaving the competition between the two latter processes. Mr. Cooper's paper does not definitely indicate what economy and what advantages may be expected to result in bridge construction from the substitution of steel for iron; but it is, perhaps, impossible to reach any very positive conclusions at present in regard to these matters, owing to the absence of information as to the adaptability and homogeneity of the material. The attitude of engineers on the subject of steel for bridges appears to be one of expectancy, and they seem inclined to put the burden of the proof on the manufacturers, and to require them to furnish evidence of its adaptability and economy before they will consent to use it.

EDISON'S ELECTRIC GENERATOR.

To the Editor of the Scientific American:

A communication in No. 20, page 305, of this volume of your paper, headed "Edison's Electrical Generator," requires a few words of explanation.

Special pains are there taken to imply that the writer of an article on this machine in No. 18 either had been deceived or was trying to deceive others by statements which were made regarding the machine. The writer of the account simply stated that the machine was so constructed that when used at its normal capacity the external resistance should be nine times as great as the internal, so that ninety per cent of the power in the current could be used outside. No fuller statement was made, since Mr. Edison preferred to wait until he had made some improvements that his experiments had shown were necessary. Yet all that was claimed in the article was perfectly true, and has been carefully verified.

The statement that one man could maintain the arc of a Jablochkoff candle was made after trial. It was found by careful tests with a Prony dynamometer that a man could exert for a short time about one-half a horse power, and that for the same time he could maintain an arc equal to that from a Jablochkoff candle. This test was made for the purpose of showing beyond all question that the power requisite for a good light need not be very great.

In illustrating the action of electricity in the circuit, Dr. Seeley wisely remarks and kindly explains how that "beasts of burden and other rational creatures redouble their efforts when their burdens are increased, while electricity behaves very differently, as there are no moral suasions or reserved forces behind it." Yet the learned doctor of philosophy, in saying this, reminds one of the bright scholar he mentions, "whose vision, though very clear, is not so wide, who is quick to spy out a thing, yet does not observe its environments." It seems never to have occurred to the doctor that it is in the power of the maker of the machine to exert this "moral suasion" on the wire covering the armature, so that it shall be more effective and redouble its exertions when greater resistance is offered for it to overcome.

Suppose, for example, a machine was made so as to run on short circuit having one unit of resistance within the machine from, which was given off a certain amount of energy. If the wire on the armature could be made four times as efficient, three units of resistance could be placed outside, and yet each unit would give off the same energy as did the one in the machine in the first case. If the wire could be made nine times as efficient nine times the resistance could be placed in the circuit and still have each unit as active as in the first case. Mr. Edison, by using large magnets, has done this; that is all he claimed, and all that the writer of the article which provoked this discussion expressed. He was perfectly aware of the fact that the friction of the machine and local action counted more in proportion as the resistance in the circuit was increased. Yet he felt contented so long as the tests which I made for him showed that less was lost than in any other machine in transferring mechanical into electrical energy. His machine is so made that it would be impossible to use it with the same resistance outside as inside, as it would heat the wire on the armature so as almost to burn it, by carrying a current so much in excess of that for which it was intended.

The reader, whom Dr. Seeley advises so glibly to wrestle with Ohm's law until he has mastered it, may when he begins take the doctor as a pupil and show him that he has wrongly applied the simplest equation, expressing it $C = E R^{-1}$. "I am grieved to observe that many people who talk and write glibly about electricity do not understand it," and no better illustration can be found than in a doctor of philosophy deliberately stating that current and foot pounds are the same, or that energy is directly proportional to the current. Foot pounds are always measured by the square of the current, and the method of measuring is analogous to that employed for measuring the energy in a stream of water. For if twice the amount of water flows from a given sized jet against a turbine, it will be able to do four times the work, for each particle of water will be moving twice as fast and thus be twice as energetic, and there will be two times as many of them. Although Dr. Seeley has used the water analogy he has failed to see its "environment."

Dr. Seeley's distinction of outside from inside current seems to me ridiculous, for it is exactly similar to saying that an endless wire rope running from a building out of doors has an outside and an inside velocity. The current means the rate of flow of electricity, and must be the same for the whole circuit, so that the "outside and inside currents" must always be the same.

In conclusion, I may state that the methods which are employed for testing Mr. Edison's machines were fully described in a paper read by me at the Saratoga meeting of the American Association. At that time, as now, full results were withheld until Mr. Edison was fully satisfied with the performance of his machine.

To show the line of experimenting he has chosen, it may be mentioned that he hopes soon to have a machine with only one-eighth of an ohm in the armature, which he will use with an external resistance twenty times as great, and which shall give with less than one-tenth of a horse power on the magnets an electromotive force of 100 volts.

FRANCIS R. UPTON.

Laboratory of T. A. Edison,
Menlo Park, N. J., Nov. 11, 1879.

HOW FAR CAN WE HEAR WITH THE TELEPHONE?

This is a question frequently asked, but we believe has not yet been definitely settled. The longest distance that we have seen mentioned is given in the item below, namely, two thousand miles. But perhaps Mr. Edison has had more extended experiences. If so we should be glad if he would let our readers know.

An exchange states that Mr. Robert A. Packer, superintendent of the Pennsylvania Railroad, is at present hunting with a party of gentlemen in Nebraska. A few days ago he for two hours conversed pleasantly with his wife and friends at Sayre, Pa., his brother at Mauch Chunk, Pa., and friends along the line. The medium was the railroad and Western Union Telegraph wires and Edison's telephone. At the office in Bethlehem, Pa., connection was made with the Easton and Amboy wire, and at Perth Amboy with a Western Union wire, and thence to Chicago and North Bend, Nebraska, where the party are. The distance was about two thousand miles, and every whisper was audible.

Professor Proctor's Lectures.

In the first two of his series of lectures on astronomy, at Chickering Hall, Prof. R. A. Proctor has amply sustained the favorable impression made both by his previous lectures here and by his numerous writings. His manner is pleasing, and he has a happy faculty for incorporating in his lectures the latest and most interesting of astronomical observations, deductions, and theories. In his first lecture, Nov. 10, he dwelt upon the beauty and glory of the heavens, the subject as announced being the poetry of astronomy. The second lecture—Nov. 13, on the immensity of space—gave opportunity for a very interesting and instructive review of the dimensions and characteristics of the solar system, the transit of Venus, and the evidence it afforded as to the distance of the sun, and the dimensions of the members of the solar system, cometic theories, the milky way, star distances, and other aspects of astronomical observation and speculation. The third lecture will be on the vastness of time as revealed by astronomy; and the last will treat of other worlds and other suns. The excellent stereopticon illustrations accompanying these lectures add materially to their value and interest.

Crude Petroleum as a Remedy in Consumption.

Dr. M. M. Griffith, of Bradford, Pa., reports some astonishing results obtained by the administration of crude petroleum to consumptives. He claims that out of twenty-five cases of well marked tuberculosis so treated twenty are to all means of diagnosis cured; the rest have been materially benefited; and none have been under treatment more than four months. The nausea attending the use of ordinary crude petroleum led him to adopt the semi-solid oil that forms on the casing and tubing of wells. This, made into three to five grain pills by incorporating any inert vegetable powder, was administered from three to five times a day in one pill doses. The first effect, he says, is the disappearance of the cough; night sweats are relieved, appetite improves, and weight is rapidly gained.

It is to be hoped that Dr. Griffith has not mistaken some self-limiting phase of throat or bronchial disorder for true consumption of the lungs; also that continued trial of the alleged remedy will justify the high opinion he has formed in regard to its efficacy.

The Highest Inhabited Houses in the World.

In this country, a miner's house on Mount Lincoln, Colorado, is 14,157 feet high. In Peru, a railway village, called Galera, is 15,645 feet high. Near this place is the celebrated railway tunnel of La Cima, which is being bored through the peak of the mountain. The tunnel is 3,847 feet long, and is located 600 feet above the line of perpetual snow.

A Proposed Offer of $10,000 Reward.

With reference to ginning and spinning in the Southern States, a resolution was lately adopted by the State Agricultural Society and Grange, of Chester, N. C., to ask the State Legislature for a reward of $10,000, to be paid for an invention which will enable farmers, upon their plantations and at paying rates, to convert their crops from the seed into yarns.

The principal object in view is to direct the attention of farmers and inventors to the want of such a machine, as well as to the practicability of perfecting it. Such machines can be had even now, but they are too costly and large for farm use, and this it is desired to remedy.

THE British Consul at Panama reports that India-rubber has almost ceased to be an article of export from the isthmus, mainly in consequence of the great difficulty and expense of getting at the trees in the remote districts of the interior. Those nearer the coast have been destroyed by the wasteful system pursued by the natives in cutting down the trees to procure the sap.