Scientific American.

ESTABLISHED 1845.

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.
(Established 1845.)

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, postage prepaid, £0 16s. 5d. 4.00
Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

The Scientific American Supplement
(Established 1876)

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, or £1 4s. 8d., 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 one address in U. S., Canada or Mexico, on receipt of *seven dollars*. To foreign countries, *eight dollars and fifty cents a year*, or £1 14s. 11d., postage prepaid.

Building Edition of Scientific American.
(Established 1885.)

THE BUILDING EDITION OF THE SCIENTIFIC AMERICAN is a large and splendidly illustrated periodical, issued monthly, containing floor plans and perspective views pertaining to modern architecture. Each number is illustrated with beautiful plates, showing desirable dwellings, public buildings and architectural work in great variety. To architects, builders, and all who contemplate building this work is invaluable.

Single copies 25 cents. By mail, to any part of the United States, Canada or Mexico, $2.50 a year. To foreign countries, $3.00 a year, or £0 12s. 4d. Combined rate for BUILDING EDITION with SCIENTIFIC AMERICAN, to one address, $5.00 a year. To foreign countries, $6.50 a year, or £1 6s. 9d. Combined rate for BUILDING EDITION, SCIENTIFIC AMERICAN, and SUPPLEMENT, $9.00 a year. To foreign countries, $11.00 a year, or £2 5s. 2d., postage prepaid.

Export Edition of the Scientific American
(Established 1878)

with which is incorporated "LA AMERICA CIENTIFICA E INDUSTRIAL," or Spanish edition of the SCIENTIFIC AMERICAN, published monthly, uniform in size and typography with the SCIENTIFIC AMERICAN. Every number contains about 100 pages, profusely illustrated. It is the finest scientific industrial export paper published. It circulates throughout Cuba, the West Indies, Mexico, Central and South America, Spain and Spanish possessions—wherever the Spanish language is spoken. THE SCIENTIFIC AMERICAN EXPORT EDITION has a large guaranteed circulation in all commercial places throughout the world. $3.00 a year, or £0 12s. 4d., postpaid to any part of the world. Single copies, 25 cents.
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, FEBRUARY 27, 1897.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

Scientific American Supplement

No. 1104.

For the Week Ending February 27, 1897.

Price 10 cents. For sale by all newsdealers.

THE ECONOMIES OF CONCENTRATION.

If those columns of the daily and weekly press which are devoted to a recital of the current news of the world are a sure indication of the tastes of the majority of readers, the age in which we live must have a profound admiration for the element of bigness as such. Descriptive writing, whatever may be the subject matter, seems never to be so acceptable as when it can revel in superlative terms, and apparently the highest credentials with which a subject can be offered to the reader are that it shall be certified as the "longest," "tallest," "widest," "heaviest," or otherwise biggest and most superlative thing or event of its kind "in the world."

How comes it that mere bulk or bigness should be regarded as such a commendable quality, especially in the great works of construction which are characteristic of the present day? This is a practical age, and we have a way of judging of the value of things on a very practical basis. It is not likely that men would make the heavy investment of capital which is necessary for these mammoth constructions for any but sound economic reasons. The only bigness that warms the heart of the capitalist is that which occurs on the right side of the annual balance sheet, and it is certain that no mere announcement that a projected scheme would be bigger than anything of its kind in existence would enlist his active support.

Why is it then that the great industrial corporations and the plants which they lay down are steadily increasing in size; why does each successive creation of the engineer and architect outstrip the dimensions of its predecessors? The answer is to be found in the fact that in concentration of material and in concentration of wealth certain economies can be realized which are obtainable in no other way; and it is the same considerations of economy that have led to the enormous size of our modern constructions and led us to plan and build on a scale which our fathers may have dreamed of, but never dared to attempt. Instances of this may be found in every corner of the industrial world, and for the purpose of illustration we will mention briefly one or two cases from the general field of transportation, particularly as it is concerned with the transport of freight.

The railroad companies have found that the larger the individual freight car and the more powerful the locomotive, the cheaper will be the cost of carrying a unit of freight for a unit of distance. The larger the car the larger the proportion of paying to non-paying load, and in a comparison of a train of twenty 10-ton cars with one of ten 20-ton cars it will be seen that there is a further economy in first cost of production and in the current operating expenses, the 20-ton car train having only half the number of axles to lubricate and half the number of parts to keep in repair. Hence it is for sound economic reasons that the capacity of the freight car has risen from 12 tons in 1876 to as high as 40 tons in 1897.

The same considerations have produced the same results in the locomotive. Of two locomotives, one of which can haul twenty loaded cars and the other forty, the larger machine will do double the work for much less than double the coal consumption, at about the same expense for oil, and practically no extra expense for labor. We have, accordingly, seen an increase in the weight of locomotives from 45 tons, in 1876, to 100 tons in 1897, the giant machine of the present day being capable of hauling as high as four thousand tons on a level grade.

The increase in the size of ocean steamers, both for freight and passenger traffic, is due to the same considerations of economy, and this is particularly true of the huge cargo boats, of which the Pennsylvania, illustrated in the present issue, is the latest and largest. This huge freighter, which has a loaded displacement of 23,400 tons, has been built of such large dimensions because it has been proved that the larger the boat the less per mile does it cost to carry a ton of freight. There is every economy to be gained in the operation of one 10,000 ton ship as against two smaller ships of 5,000 tons each. The big ship carries not much more than half the crew and engineer staff that are necessary to man the two smaller boats, and she would show a large economy in coal consumption, the latter item in the case of the Pennsylvania amounting to only 80 tons in twenty-four hours. In dockage dues, pilotage and other operating expenses she would also show a considerable economy.

Great as are the dimensions of this ship, they are soon to be eclipsed by another marine giant whose keel is already laid in the Belfast yard in which the Pennsylvania was built. When the new ship is launched, it will be seen that the Great Eastern has at last been exceeded in length, though not in her other dimensions. We are reliably informed that the new boat, which is being built for the White Star line, will be 705 feet in length, or 25 feet longer than the Great Eastern, 70 feet in beam and deep in proportion. She is to exceed every Atlantic liner, including those now building in Germany, in every point of comparison, including that of speed. Some time during the year 1899 she will probably make her maiden voyage to New York.

THE LESSONS OF THE RECENT NAVAL MANEUVERS.

Naval maneuvers, such as have recently been carried out by a fleet of United States warships under Admiral Bunce, play an important part in the creation of a modern navy. The operations are designed to test the efficiency of the ships, and the conditions are made to approximate as closely as possible to those which will exist during a naval war. As a means of determining the value of the individual ships the maneuvers are as necessary as the contractor's trial trip, perhaps more so, and it is certain that the experience which is gained during a cruise of several weeks with a squadron, in every kind of weather and in every kind of service, will bring out good and bad points in a warship which could never be learned from a trial trip in sheltered waters.

At the close of the recent maneuvers Admiral Bunce sent in a report to the Navy Department, which speaks of the behavior of the ships during the heavy gale which overtook the fleet off Cape Hatteras, when, it will be remembered, several seamen were injured or carried overboard by the heavy seas which swept over the decks. It was just such a storm as might overtake a fleet at any time when it was engaged in active operations, and the admiral naturally determined to maintain the fleet formation and give the ships the kind of a test they would have to endure in time of war. The result is given in the report, and it shows that, while the admiral has the highest praise for the seamanship and bravery of the officers and men, he is of the opinion that certain alterations must be made in at least three of the ships before they can be rendered thoroughly seaworthy in such a gale as the fleet passed through.

The changes suggested relate to three ships: the battleship Maine, the monitor Amphitrite and the cruiser Montgomery. The alterations are all in the direction of the removal of top hamper and dead weight. The admiral says that the Maine has too much superstructure, and suggests that a part of it be removed. This was the ship from which several seamen were washed overboard, and from the information at hand it would appear that they were upon the main deck when the fatal wave came aboard. Presumably the portion of the superstructure which the admiral would have removed is that which is built up amidship between the 10 inch gun turrets. It is also recommended that the superstructure be removed from the Amphitrite, and presumably from the vessels of her type, the object of this change being to get rid of any obstacle which would tend to bank up the seas which roll over the decks of a monitor in stormy weather. It is stated that the admiral's opinion is based upon the behavior of the monitor Monadnock in the heavy gales which she encountered off Cape Horn during a voyage to the Pacific coast. He attributes her good weatherly qualities to the fact that her decks were flush throughout, and that the seas rolled harmlessly across them without meeting with any obstruction. The changes suggested for the Montgomery are that her heavy armament shall be replaced by guns of a lighter caliber, the excessive weight of the present battery of nine 5 inch guns causing her to labor heavily in rough weather.

The above recommendations, based upon practical experience, and forwarded to the department by an officer of such long experience and undoubted ability, are of the greatest value, and should be welcomed by the Construction Department, where, of necessity, theories as to the behavior of warships are so plentiful and facts so few. It seems, however, that the communication of the gallant admiral is having a very cold reception, and that the gentlemen of the desk and the draughting board are disposed to resent the criticisms and call in question the judgment of the critic. It is complained that he is an officer who insists on pushing a fleet through the heaviest weather, with a view of thoroughly testing the sea qualities of each ship and the seamanship of the officers and men. It seems also that he is criticised for insisting that fleet formation should be maintained when, had each ship been left to make her own way, the chapter of accidents which included the smashing of one of the ship's bulkheads might have been avoided.

We must confess that it looks to us as though the admiral was as clearly in the right as the Construction Department is distinctly in the wrong. Our ships are not built for show, or to make phenomenal speed under specially favorable conditions or to creep cautiously from port to port over smooth seas and under favorable skies. They are built to withstand just those hard knocks and blows to which they were purposely and for the best of reasons exposed in the recent ordeal. It may not be gratifying to the Construction Department to learn that some of its ships have shown more stability and endurance upon paper than they do upon the high seas; but if such is the case, it is best the department should know it. Warship design is largely a matter of experiment, and it is no discredit to the naval architect if a practical test in all kinds of weather reveals details in which his design might be improved.

The United States have every reason to be proud of a navy whose construction has been carried out in the brief period of a dozen years. It was an entirely new