Scientific American.

ESTABLISHED 1845.

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

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

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(Established 1845.)

One copy, one year, for the U. S., Canada or Mexico.....$3.00
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(Established 1876)

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NEW YORK, SATURDAY, FEBRUARY 27, 1897.

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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

class of work, for which at the commencement of the task we possessed but few tools and less experience. We had to manufacture the tools, lay down the plants, and gain the experience as we proceeded. The result has been the creation of a compact and homogeneous navy which in quality is second to none in the world. We have not been content to follow closely in the beaten track of foreign designers, but have introduced many original features which render some of our ships the most effective in the world. The fact that the work was new, and that the designs were many of them original, rendered it morally certain that some mistakes would be made; but our ships have developed only such defects as have appeared from time to time in those of other countries, and are inseparable from such difficult and experimental work as that of warship construction. If the defects exist, it is best they should be made known. The over-sensitiveness to criticism which has been displayed is altogether unreasonable, and indirectly may work much harm to the interest of the navy.

If the department is going to discredit and discourage such practical tests and such frank criticism as are contained in the report in question, it will be guilty of the blindest folly. There is everything to gain by encouraging the line and staff officers in giving a frank expression of opinion as to the merits or demerits of the ships which are turned over to their care. It would be absurd, in dispatching a fleet for its annual maneuvers, to tell the officers that their vessels are delicate toys to be handled with a gentle touch. There is nothing delicate about actual war; it is rough from beginning to end, and the mimic warfare of naval maneuvers should represent some of its rough conditions if the maneuvers are to have their full practical value

THE BROOKLYN BRIDGE IMPROVEMENTS.

The trustees of the New York and Brooklyn Bridge have received the report of the Board of Expert Engineers, consisting of Virgil C. Bogue, L. L. Buck and George H. Thompson, regarding the feasibility of running through cars from the Brooklyn elevated and electric railways across the bridge. According to the plans submitted by the committee, the surface railways will have a single track on each of the present roadways. At the Brooklyn end all the west bound cars will go down Washington Street to the roadway for west bound traffic, and all east bound cars on the other roadway will turn into Fulton Street. Vehicles using the roadways will not have to cross any car tracks at the bridge entrance. There will be a loop terminal with sidings for the cars of the various routes at the New York end of the bridge. The cars will stop on the siding to load and unload, and will then continue from the siding on to the main track and around the loop to the other side of the station. The platforms will be at the same level as the present platforms for the bridge cars. These tracks in the station will be over the present roadway, the sides of the station being altered so as to widen the building. For the elevated railroads two of the four tracks at each station and one of the stub switching tracks at the New York terminal will be given up to the through trains.

At the Brooklyn terminal the Brooklyn Elevated will connect with the Kings County elevated railroad, and all trains will use the Fulton Street line of the latter road, turning off at Tillary Street, and having one track on each side of the elevated yards of the bridge railway, thus avoiding all interference with the yards. The cars of the elevated railways will have to be provided with cable grips and side doors, and one car of each train must be a motor car for switching at the terminals and for propelling the train if necessary. It is at present intended that the bridge authorities will handle the elevated train during its trip over the structure. It is estimated that there will be one local bridge train to three elevated railway trains, as most of the traffic would consist of through passengers. The report has been favorably received by the bridge trustees.

The electric motors for switching the trains in the station of the bridge have been found to be very successful, and, when necessary, the motor cars can propel the trains over the bridge. All of the tracks in the terminal are now in use, and the crowding and confusion which resulted from the too severely taxed service is now in a great measure done away with. It is estimated there will be an annual saving of $10,000 over the use of steam.

THE NEW YORK ELEVATED'S NEW POWER.

At a meeting of the Executive Committee of the Board of Directors of the Manhattan Railway Company, held on February 16, the General Manager, Mr. W. J. Fransioli, presented a report on the electrical system of operating the elevated railroads of Chicago, which he has spent considerable time in investigating. He also indorsed the report of the engineers who have been commissioned to inspect the Chicago roads. The general manager's statement was so favorable that by unanimous action the executive committee decided to give the same system a practical trial in New York City. The general sentiment seems to indicate that a similar system will finally be adopted on all of the Manhattan Railway Company's lines.

This company has for a long time been considering the advisability of changing their form of motive power. It is now operating 1,117 cars by 331 locomotives, but it will be readily seen that this system could not possibly be as economical as one in which the power was generated at one or two central stations. As the mileage of the Manhattan Railway Company is not very large, the power can be transmitted by electricity without the loss being very great. The system which it is proposed to adopt is essentially the same as that which has been in successful use at the Brooklyn Bridge terminals for a few weeks.

The Chicago elevated road uses the same system, using four car trains with a one and one-half minute headway, which is one-half the headway allowed on Third Avenue, at a slighter greater speed than that at which the Manhattan trains run, and in Chicago the stations are about the same distance apart as in New York. Mr. Fransioli finds that the operating expense is considerably less than where locomotives are in use. In Chicago the motor cars, which haul three cars, are also passenger coaches, a motor being placed on each truck, the current being taken from a third rail, and the operator stands at the controller, which is in a little cablike compartment built on the car platform; but in New York this arrangement will be modified by placing the motorman just inside the car at the end, the controller and other apparatus occupying about the space of three seats. Air for brakes is compressed by a pump operated by another small motor also under the car.

Mr. Russell Sage, the president of the company, states that the electrical system will be tried first on the Second Avenue line, where the travel is the lightest, and, as the system is extended, it will be applied to the other lines. No contracts for the equipment have been made as yet, but it is said that one large electrical company has been for a long time developing a system to meet the needs of the elevated lines in New York, so as to include power, light and heat for trains, light and heat for stations and power for elevators to be constructed at stations. The selection of the system will rest with a special committee of Manhattan directors composed of Messrs. Gould, Sage and Gallaway.

Electrical traction is particularly adapted for use on elevated roads, owing to the freedom from dust and smoke and the comparative noiselessness. The Manhattan Railway Company is certainly to be congratulated on their new move, and the results cannot fail to be satisfactory, both to the public and to the stockholders.

RECENT PATENT AND TRADE MARK DECISIONS.

Brush Electric Company v. Western Electric Company (U. S. C. C. A., 7th), 76 Fed., 761.

Double Carbon Electric Lamps.—In this case the Brush patent, No. 219,208, was held not to be void as being for a function or result, but that the claims are not to be construed as covering the arc-forming separation of each set of carbons as it begins to burn. The claims are limited to the mechanism, of which an essential feature is the dissimultaneous initial separation of the carbons, and, therefore, it is not infringed by the lamp shown in the Scribner patents, No. 418,758, 502,535, 502,536, in which the initial separation is simultaneous.

Effect of Interlocutory Decree on a Subsequent Suit.—A decree awarding a perpetual injunction in a patent suit with the order of reference to a master to ascertain the damages is interlocutory and not final, and, therefore, does not operate as an estoppel in a subsequent suit.

Construction of Claims.—When a device designed as an improvement in a well advanced art is described as having features of construction adopted accomplish specific results or mode of operation and the claim of the patent is for that device, the features so described and covered by the claims cannot be rejected or treated as of secondary importance in order to extend the patent over other forms or features not described.

Standard Elevator Company v. Crane Elevator Company (U. S. C. C. A., 7th), 76 Fed., 767.

Elevators.—The Reynolds patent, No. 436,122, for an improvement in means for controlling the operation of elevators in which the characteristic feature is the use of two cables, the ends of which are attached to the car, whereby they counterbalance each other and secure substantial steadiness and uniformity of force in the movement of the controlling device by the attendant, is held to be valid and not anticipated by elevators with only a single coil or cable.

Elevators.—The Reynolds patent, No. 328,614, for combinations constituting improvements in hydraulic apparatus, construed and held valid and infringed.

Form of Assignment of Error on Appeals.—In this case an assignment of error asserted that the claims of two or more patents involved in the suit were valid and infringed. While such assignment must in strictness be overruled if any one of the claims is valid or infringed, the court may consider the questions involved as if the assignment had been distributive or separable, on the ground that the court on appeal in an equity cause may reverse the case for an error not assigned.

Appeal from Decrees in Patent Cases.—In this case a decree was made adjudging that the complainant was the owner of the patents sued upon, that the claims of some of the patents were valid and that the defendants had infringed them, and a perpetual injunction was granted. It was held on appeal that such decree was final upon the matter so adjudicated and, therefore, was appealable under section 6 of the act establishing the Circuit Court of Appeals, and that it was not an interlocutory decree under the amended section 7, Act 1875, although the decree refers the cause to a master for an acccunting of profits.

Final Appealable Decrees.—A decree may be a final appealable one, although, if no appeal be taken, a rehearing or bill of review will be available in the lower court. In patent cases on the equity side the primary and essential contention relates to the ownership of the patent, the validity of the claims, and the infringement; and final adjudication in favor of the complainant on this contention is a perpetual injunction. One portion of the decree may be final, and for that reason appealable, while the remainder may be interlocutory and not appealable.

Affirmance of Decree.—There is no power in the Court of Appeals to affirm a decree of the lower court, and thus give a finality to that decree which it did not have when it was entered of record below.

Proof of Assignment of Patents.—Certified copies of the assignments of patents in the Patent Office is prima facie evidence that the original assignments were made in terms as shown in the record, that such assignments were subscribed as shown, were delivered, the signatures were genuine, and that the assignor had an assignable interest.

The force of the above points in this case, however, is greatly weakened by dissenting opinions.

BRITISH MINERAL INDUSTRY.

The report to the Home Office on the mineral industry of the United Kingdom shows that coal mining gave employment in 1895 to 687,371 persons above and below ground; that 16,087 persons are employed at iron mines, and 30,199 persons at other mineral mines. In 1895 there were 189,661,362 tons of coal raised, a slight advance on the figures for 1894; but the value of the product at the mines fell to £57,231,213, from £62,730,179. Iron ore comes next, with 12,615,414 tons raised, worth £2,865,709. As with coal, the quantity raised was larger than in 1894; the selling value was less. Lead ore was of higher value in 1895, although the amount raised was less. Tin ore shows a decline under both headings. There were 13,266 tons of gold ore raised, with a value of £16,584, as against 6,603 tons in 1894, worth £13,573. The increase in the amount of coal raised was entirely due to the greater activity in the Scotch mines. But in 1894 nearly all the Scotch collieries were idle for some months in consequence of a strike.

It is an interesting question how long the enormous drain on our coal mines can go on without exhausting the supply, says the London Times. The late Professor Jevons, assuming that the average annual rate of growth of our coal consumption would be 3½ per cent, calculated that by 1970 we should have exhausted the whole available coal in the country. Since 1873, however, the actual output of coal has never been as great as it would have been at the assumed rate of increase. There are, too, other factors in the problem. Sir Robert Giffen has shown that for the finer industries, and with improved manual skill, a small amount of coal will do the full work which, under other conditions, it would need a much larger amount to do, so that a shrinkage in our coal supply and a decline in our industrial progress will not necessarily come together. Nor is it certain as yet what our coal resources may prove to be. In 1895 there were 1,016 fatal accidents in and about the mines and quarries of the United Kingdom, causing a loss of 1,198 lives. There was an increase of 62 in the number of fatal accidents and a decrease of 77 in the number of deaths. In coal mining "falls of ground" cause nearly one-half of all the deaths underground. This form of accident is to a large extent preventable by a more systematic use of timber for support at the working face of the mine. Explosions are also to be set down as largely preventable. The men continue to take pipes, matches, and appliances for unlocking safety lamps into the mines; and there are, the report says, mine owners who do not introduce safety lamps where they are absolutely needed, and magistrates who persistently refuse to punish negligence and breach of rule.

THE Franklin Institute of Philadelphia announces the award of the following John Scott Legacy medals and premiums: William S. Burroughs, of St. Louis, for his calculating machine; Emile Berliner, of Washington, for his gramophone; Edward Brown, of Philadelphia, for improvements in pyrometers; Dr. W. C. Roentgen, for his investigation of a new kind of rays; Dr. Elisha Gray, for his telautograph; Pedro G. Salom and Henry G. Morris, of Philadelphia, for their automobile vehicle. The Elliott Cresson medal has been awarded to Hamilton Y. Castner, of Oldbury, for his electrolytic process for caustic and bleach.