Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

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

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

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NEW YORK, SATURDAY, OCTOBER 9, 1880.

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 249,

For the Week ending October 9, 1880.

Price 10 cents. For sale by all newsdealers.

AMERICAN NAVAL DEFENSES.

In a recent number of the SCIENTIFIC AMERICAN it was shown that the City of New York could easily be reached by the shells of a hostile fleet either from the outer bay or from the open sea. This possibility in case of war can be met only by constructing ships for an efficient navy. It is not New York alone that is in danger, for nearly every important city on our coasts runs an equal or greater risk, and, although it might be possible to protect one city by concentrating there all our available force, it is too much to expect that any general security can be obtained until our navy receives a large addition to its strength.

Take Boston, for example. There are supposed to be ample fortifications to protect it, yet it is even more defenseless than New York. Lying at a distance of less than seven miles from the State House, a war ship would be entirely outside of the effective range of any gun mounted to defend Boston to-day. And even the heaviest guns that might be mounted on shore in the future could not give adequate protection to the city. A hostile fleet of ironclads could quietly anchor in five fathoms of water between Deer Island and Nahant and still be within six miles of the wharves and warehouses of Boston, while the nearest fortification now in existence would be two miles away—too far for even the heaviest guns to penetrate armor of twelve inches. There are guns already existing known to throw more than seven miles, and others are estimated (although not proven) to have a range of twelve miles; therefore, with such guns, ironclads could take up any position within this last-named distance and destroy Boston without being exposed to the least danger from shore batteries. Even though heavy guns be mounted on Long Island, Deer Island, and Nahant, the enemy could still occupy a position less than eight miles from Boston and be two miles distant from the nearest battery on shore. Portland is worse off than Boston, and Portsmouth is now equally helpless, although the Isle of Shoals might furnish sufficient protection if it was heavily fortified.

Turning to the Pacific coast, San Francisco might at first sight appear safe, being sheltered by hills varying in height from 300 to 1,000 feet. But, in reality, these elevations would be no protection whatever. The distance from the wharves in the inner bay to deep water on the other side of the peninsula is about six miles. A Krupp gun of 30 centimeters caliber, with an initial velocity of 1,500 feet, and an elevation of about 20 degrees, will give a range of six miles. The highest point of the trajectory with this elevation would be 2,965 feet, or a height far more than sufficient to clear the summit of Lone Mountain, which is about 1,000 feet high. At a distance of eight miles the vessels of the enemy would be out of danger from any guns on shore, and would have the whole city of San Francisco at their mercy.

But it is said by many persons that, in these days of civilized warfare, no nation would wantonly bombard a city of non-combatants which they never could expect to take. Inasmuch as such bombardments have frequently taken place in the past, it is perhaps too soon to assume that they will not occur again; but, admitting that a city like Portland might, on the score of humanity, escape such a visitation, there is no reason to expect the same immunity for New York, Boston, or Portsmouth. There are large navy yards in close proximity to these cities—navy yards which it would be not only the right but the duty of a hostile admiral to destroy in any way within his power. Now, at the distance from which the bombardment of the Brooklyn, Charlestown, and Kittery navy yards would take place, there can be no question that shells would fall promiscuously all about the neighboring cities.

But, even supposing that such accurate firing should be possible as to confine all the damage done within the limits of the navy yards themselves, can we afford, at the opening of a great war, to have our three principal navy yards destroyed? And yet, unless before such a war comes on, they are utilized to build war ships to meet the enemy at sea, they might just as well perhaps be destroyed. Public opinion would then be so effectually aroused that there would be some hope thereafter of having a naval force somewhat more in harmony with our importance as a nation. The inland States have such a preponderance of political power that all matters relating to naval and maritime affairs have failed to obtain, of late years, the attention that they deserve. Not only are people living in the interior indifferent to these subjects, but Eastern men in public life have also strangely ignored them; yet a powerful navy and an extended merchant marine are matters of as vital an interest to the farmers of the Western prairies as they are to the Eastern merchants. Give us a really formidable navy, and no nation in the world will willingly be drawn into a quarrel with us; leave our coasts unguarded, our commerce unprotected, and there is no third-rate foreign power that cannot in one year inflict upon us more damage than we, in five years, could retaliate.

A navy cannot be produced in a few weeks—especially if our navy yards are laid in ashes—and it is really astonishing that the business men of this country do not act more resolutely to induce Congress to give us a navy worthy of the name. The experiments of foreign governments have been sufficient to demonstrate in general terms the kind of vessels needed, and these should be built at once. The inventive talent of the country should also be encouraged by an annual appropriation for testing such valuable improvements on existing models as would maintain our prestige on the sea.

COMPRESSING AIR BY FALLING WATER.

Mr. J. P. Frizell, C.E., has recently given in the *Franklin Journal* a paper relating the results of some experiments made by him at St. Paul, Minn., upon the means of compressing air known as the *trompe*. The air is carried vertically downward in minute particles by a current of water which changes its direction to the horizontal, allowing the air then to rise to the top of the chamber through which the horizontal flow passes. At the falls of St. Anthony, in the Mississippi River, a shaft sunk some years ago was used for the experiments. This shaft was 36 feet deep, with clear dimensions of 6x14 feet inside. The apparatus consisted of a strong tank at the bottom of the shaft and two vertical channels rising to the surface. The one for the downward current of water had a section of 15x30 inches, the other, 24x48 inches. To supply the minute particles of air to the descending current, a siphon with small air holes was first used, but afterward the water was *aerated* (so to speak) by giving it a slight fall at its entrance.

In the tank the current was directed along the lower portion by a partition of plank placed 21 inches below the top. This partition was full of holes to enable the air to rise freely, and the space above it was called the air chamber. There was a hole at the level of the partition to enable the air to escape into the ascending shaft as soon as the air chamber was full, and made known this fact to the observers by the large masses of air rising to the surface. The capacity of the air chamber was 71·19 cubic feet. The difference of level in the surface of the water above and below the apparatus was 4·07 feet. But this head was greatly reduced for effective work as follows: Lost in fall to produce air bubbles, 1·000 foot; in resistance to movement, 0·443 foot; in slip, 0·653 foot; total, 2·096 feet; leaving only 1·974 feet available. But the effective power obtained by the experiments never exceeded 52 per cent of what it would have been if the water had been used directly to turn a wheel, nor do the experiments serve any practical purpose in showing the possibility of utilizing this means of obtaining power. Taking the formulæ as given by Mr. Frizell and applying them to a fall of 15 feet, only 76 per cent of efficiency is obtained, and with a fall of 30 feet only 81 per cent. Mr. Frizell's experiments are chiefly interesting as showing that this method of employing a waterfall is *not* economical nor practicable.

EMPLOYERS' LIABILITIES.

The tendency of legislation to throw safeguards around human life, and to hold railway corporations and others employing men in more or less dangerous occupations to the duty of making use of all available means to lessen the hazards of travel and labor, is well shown in the recent bill before the British Parliament, known as the Employers' Liability Bill. The object of this particular bill is "to extend and regulate the liability of employers to make compensation for injuries suffered by workmen in their service." It provides that in cases of injury resulting in death, the employer shall be liable, and the representatives of the injured party shall have the same right of compensation as if he had not been in the service of the employer. The limit of sum recoverable was first set at three years' earnings of a person in the same grade of employment in the district in which the injury was received; but in the House of Lords it was, on the motion of Lord Beaconsfield, reduced to two years.

By the terms of the bill the employer is liable for personal injury to a workman in cases where the injury is caused: (1) by reason of any defect in the ways, works, machinery, plant, or stock-in-trade connected with or used in the business of the employer; or (2) by reason of the negligence of any person in the service of the employer who has superintendence intrusted to him while in the exercise of such superintendence; or (3) by reason of the negligence of any person in the service of the employer to whose orders or directions the workman at the time of the injury was bound to conform, and did conform, where such injury resulted from his having so conformed; or (4) by reason of the act or omission of any person in the service of the employer done or made in obedience to the rules or by-laws of the employer, or in obedience to particular instructions given by any person delegated with the authority of the employer in that behalf; (5) by reason of the negligence of any person in the service of the employer who has the charge or control of any signal, points, locomotive engine, or train upon a railway."

New Discoveries on the New England Coast.

The United States Fish Commission's steamer Fish Hawk has made two dredging trips the past summer along the New England coast. The dredging was done chiefly between 150 fathoms and 325 fathoms, and the yield was immense. More additions were made to the marine fauna of New England than in the previous six years. The discoveries during the two trips were 30 crustaceans and 70 mollusks, more than half of them entirely new; also 33 species of fish, of which 12 are entirely new to science, representing four or more new genera; and 27 were strangers to the fauna of New England.

FOUR MILLION TWO HUNDRED THOUSAND tons of hot water, averaging 135° F., are annually pumped from the Comstock mines. To heat this mass of water by artificial means would require a consumption of over 50,000 tons of coal a year. The water from some of the deepest shafts, 3,000 feet, has a temperature of 157° F.

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