SCIENCE.—SUPPLEMENT.

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SEACOAST DEFENCES.

THE two excellent and valuable articles on seacoast defences which have been placed before the public within a few days of each other — the one by Lieut. Eugene Griffin of the corps of engineers, in the *Journal of the military service institution*, and the other by Capt. F. V. Greene of the engineers, in *Scribner's magazine* — should suffice to convince the most devoted advocate of a 'peace policy,' and the most economical of legislators, that something should be done by the authorities, and that speedily, as a mere matter of insurance if nothing more, to protect our defenceless seaports. Lieutenant Griffin's paper is more technical than Captain Greene's, as might be supposed from the fact of its being published in a magazine devoted exclusively to military interests; but while Captain Greene's article is popular, it is not superficial, and by a comparison of the two the intelligent reader can gain an excellent insight into the subject. Lieutenant Griffin summarizes the arguments against coast defences under three heads: 1. The navy should constitute our defence; 2. Torpedoes alone suffice to close any channel; 3. Earthen batteries of sufficient strength can be hastily thrown up in case of war. He then answers these objections by showing that the office of the navy is not defensive, but offensive: it should protect our commerce on the high seas, and injure that of our enemies. Moreover, fixed guns on land have many advantages over guns on floating supports. The second argument proceeds from entire ignorance of the nature and object of torpedoes. They have been introduced to offset the advantages gained by the attacking party in the invention of the screw-propeller. Their function is to harass an enemy's ships, and prevent them from running by batteries. Instead of being a substitute for fortifications, torpedoes presuppose the latter. The plea that earthworks can be thrown up as rapidly as need be, is shown to be equally flimsy. In winter no suitable earthworks could be thrown up at all in our northern states. And supposing the largest available force to work day and night, it would take more than a week to construct the seventy-foot parapet. What this means is evident when we remember that Bermuda is only seventy-one hours' steaming from Savannah, sixty-six hours from Charleston, and fifty-eight hours from New York; that a British fleet could get from Halifax to Portland in thirty-one hours, and to Boston in five hours more, or from Vancouver to San Francisco in ninety-six hours. Similarly a Spanish fleet at Havana is within forty-five hours of New Orleans. Then, as Lieutenant Griffin points out, the modern theory is to make war sudden, sharp, and decisive, and to make the defeated party pay all the expenses. The billion of dollars which Germany exacted from France in 1871 would be but a fraction of what we should have to pay to any hostile power that had our great seaports at its mercy.

We have on the Atlantic and Pacific and lake coasts "a series of great cities containing an aggregate population of more than five million souls, and destructible property which is carried on the assessors' books with a valuation of $4,000,000,000 (and which probably has an actual value of nearly twice as much), yielding annually a product in manufactured goods alone valued at over one thousand million dollars." Captain Greene shows that every man, woman, and child of this great population, and every dollar of this vast accumulation of wealth, is in danger of destruction by a hostile fleet. As he puts it, the problem is one of national insurance on life and property. Now, the usual annual premium on policies of insurance on life or property, with good risks, is from one to one and one-half per cent. In Captain Greene's judgment, less than half that percentage, computed on the sum total of property exposed, — say, $20,000,000, — expended annually for six years, would give us a complete system of insurance; that is, it would suffice to erect harbor defences stronger than any ships which could be brought against them, or, with an expenditure of $10,000,000 annually for six years, — a sum which is only about three per cent of our annual appropriations for the support of the government, — fully three-fourths of the lives and property on our coasts could be placed out of danger.

To these considerations Lieutenant Griffin adds the teaching of history, which is that the surest way to avoid war, with all its attendant ravages and losses, is by so thorough a preparation that no weak point is exposed to an enemy's attack, and no temptation is offered to his cupidity.

Besides dealing with the general question in the way indicated, both Captain Greene and Lieutenant Griffin discuss the various problems presented

by the great advances made in the apparatus both for attack and for defence in recent years. The absurd inadequacy of most if not all of our present fortifications is pointed out; for those of them that were erected about 1812 had only to withstand a 42-pound projectile fired with a muzzle energy of 800 foot-tons by a 10-pound charge of powder, and those built at the outbreak of the rebellion had only to withstand a 450-pound projectile fired with a muzzle energy of 9,000 foot-tons by a 130-pound charge of powder. The 16-inch rifle of 1886, which is 45 feet 6 inches long, weighs 115 tons, and fires a projectile weighing 2,300 pounds with a muzzle energy of 55,000 foot-tons by the explosion of 800 pounds of powder, would make short work of the best of them. The bombardment of Alexandria in 1882 is cited as an instance of what might quite readily happen to us. The defences of Alexandria were quite similar to ours, and their armament far superior to any that we have; yet eight English ironclads made their evacuation necessary after one day's bombardment.

Our forts, excellent during the masonry and earthen ages, have never been replaced in the iron age. On the other hand, twenty-eight of the Gruson cast-iron cupolas, which have been found efficient against the heaviest projectile, have been constructed in the harbors of Germany, Austria, Belgium, and Holland within a few years. Lieutenant Griffin's treatment of modern seacoast defences is very thorough, and, we should fancy, authoritative. He appends to his article a very valuable table, showing the name, age, displacement, draught, speed, class, thickness of armor and style of armament, of every foreign vessel available for offensive operations against the United States. The list is most imposing, and includes 71 English ships, 50 French, 14 German, 24 Russian, 19 Italian, 15 Turkish, 13 Austrian, 7 Danish, 7 Dutch, 5 Spanish, 6 Brazilian, 3 Japanese, and 3 Chilian. In the face of all this, "since 1875 not one penny has been appropriated for the construction of seacoast defences. The annual appropriation of $100,000 for preservation and repairs, increased to $175,000 since 1881, has not even suf ficed to preserve our unfinished works, and our defences are actually in a worse condition to-day than they were ten years ago."

METEOROLOGY IN CALIFORNIA.

THE ninth biennial report of the California state board of health (Sacramento, 1886) contains, besides much immediately pertinent to its office, several valuable descriptions and tables concerning meteorological data, which the members of the board wisely deem of importance in their professional studies. First in value is a long table of monthly rainfall, both for the past year and for the mean of several years, compiled by Lieut. W. A. Glassford, in charge of the Pacific coast division of the signal service. This is similar to the newspaper list prepared by the same officer, to which reference was lately made in *Science*, but it is here presented in more extended and convenient form. The weak spot in this table is the absence of any indication that the numerous stations possess good gauges, uniformly placed and well observed. On account of the difficulty in identifying the position of many of the stations, it would be of much service to readers at a distance if such a table as this could be reduced to graphic form in a series of monthly maps. They would necessarily be only provisional for the present, as some records are much shorter than others, so that the means are not properly comparable; but even these values would doubtless present a truer picture of west-coast precipitation than any yet prepared. It is to be hoped that similar tables and diagrams of temperature means may also be attempted.

Sergt. J. A. Barwick of the Sacramento signal office contributes a review of the meteorological conditions of his city for the past year, and a table of its temperature and rainfall since 1853 and 1849 from records early established by Drs. Logan and Hatch. The mean seasonal temperatures for 33 years are, spring, 59°.5; summer, 71°.7; autumn, 61°.5; winter, 48°.3; for the year, 60°.2. The extremes of the mean annual are 57°.5 (1880) and 62°.8 (1864). The absolute maxima rise to 103° or 105° in July and August, and the minima fall to 21° or 22° in January or February. The mean annual rainfall for 38 years is 19″.64, varying from 8.44 (1877) to 34.92 (1844): the mean for July is 0″.03; August, 0.003; December, 4.65; January, 3.84; February, 2.80; March, 2.91; counting the years by seasons, from July to June inclusive, the annual amounts range from 4.71 (1850–51) and 7.79 (1863–64) to 36.00 or a little more (1849–50, 1852–53, 1861–62). These pronounced contrasts of seasonal fall and great variations in the annual total show how completely unlike the western coast climate is the eastern and central. Sergeant Barwick presents also brief monthly notes of significant features, all of interest and value, but easily increased in both respects if the phenomena described were viewed in a broader way, from a more physical and less statistical stand-point. Annual and monthly averages show general planetary or continental relations; monthly extremes usually result from cyclonic disturbances, and should be stated in connection