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, SEPTEMBER 25, 1880

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 247,

For the Week ending September 25, 1880.

Price 10 cents. For sale by all newsdealers.

COULD A HOSTILE FLEET BOMBARD NEW YORK?

In these days of modern ordnance, when rifled guns can send missiles weighing nearly a ton to distances never contemplated at the time when most of our harbor defense systems were projected, the question cannot fail to arise: Is New York safe from bombardment by a hostile fleet? England, France, Germany, or Italy, could concentrate a dozen heavy iron clads off Sandy Hook within three weeks of a declaration of war, and as we have absolutely no ships whatever to meet them at sea, we should have to depend upon our coast defenses and torpedoes for protection. Are our defenses sufficient to save our sea-coast cities from bombardment?

In view of the enormous ranges obtained by Herr Krupp with his new rifled breech-loading guns, the question also arises whether New York could not be shelled from the open sea, where the enemy would be far beyond the effective range of our forts. In the first place, how far can shells be thrown? For the purpose of bombarding a city it is unimportant that the aim should be accurate. New York could be terribly injured by any kind of stray firing, irrespective of the enemy's capacity to single out particular buildings as targets. But the Krupp guns have shown an extraordinary accuracy at long ranges. The 3½ and 4½ inch guns have given accurate results as high as 9,057 yards, the lateral deviation at this distance being less than 60 yards. Their extreme range, so far as any records have been made public, has not exceeded 11,000 meters, about 11,900 yards, or 6·8 miles. But it is claimed that the larger guns, from 8 inches to 15·75 inches in calibre, will give a much greater range. During our civil war General Gillmore threw shells from a 300 lb. Parrott gun into Charleston, a distance of eight miles. At the Centennial Exhibition in Philadelphia, Herr Krupp exhibited a 12-inch gun bearing the modest inscription: "Range 15 English miles." Probably it is allowable to stretch the truth at an International Exhibition, and so it is not unreasonable to allow ten miles as the outside limit of this gun's range. But Krupp's latest gun, 15·75 inches caliber, throwing a solid shot of 1,760 lb. weight, may very likely exceed even ten miles. In like manner the famous 100-ton guns furnished to the Italian government by Sir William Armstrong may have a range proportionate to their immense size, in which case 12 miles would not be an extravagant estimate for them.

Now let us examine the chart of the sea coast around New York Bay. There are three channels from the open sea to the Narrows. The main entrance passes close under the guns of an unfinished fort on Sandy Hook. The channel is deep and comparatively constant in depth. The Swash channel is about two miles from the Sandy Hook fort, and, at low tide, its depth will not permit the entrance of a vessel drawing more than 24 feet. The third channel is far distant from the fort, but it has a depth of only 14 feet. Now, while every effort would be made, by using torpedoes and other obstructions, to close the main and Swash channels against an enemy's fleet, it is not impossible that an entrance should be effected. Since torpedoes are available only when covered by heavy fire from guns on shore or on shipboard, the ships could proceed, in comparative safety, after passing Sandy Hook, until they approached Forts Hamilton and Wadsworth at the Narrows. The fort at Sandy Hook is only half begun, and it is of old and almost obsolete character, and therefore in the event of a hastily declared war it would not be likely to afford much protection. Hence the probability of a fleet passing has been considered; but it is far different at the Narrows. Without going into the particulars of the armaments of these forts it is sufficient to say that there are no vessels afloat that could approach nearer than one-half of a mile to these forts without being sunk by torpedoes, unless some skillful inventor shall devise a hitherto unthought of protection against these hidden and deadly machines. But at the distance mentioned the ships would be only seven miles from the battery, and if they could maintain their position there, and if they had guns with a range of eight miles, they could easily bring the lower part of the city to grief.

Assuming that a Krupp 71-ton gun was used, throwing a shell of 1,760 lb., containing a charge of 73 lb. of powder, the destruction would soon reach into the millions. One such shell exploding in a warehouse would wreck it from cellar to roof. Since it is very probable that a range of eight miles will be obtained in the near future, the invulnerability of the city in this direction depends upon the fort at Sandy Hook and the efficiency of our torpedo system.

But there is another direction whence the city could be reached if guns can be invented of sufficient range. From the Battery to the sea beach of Long Island, seven miles from the Sandy Hook fort and five miles east of Fort Hamilton, the distance is exactly ten miles, and one mile further brings one to the 25-foot line of soundings. In other words an iron-clad drawing twenty-four feet of water can approach within eleven miles of the Battery without exposing herself to the slightest danger of even being fired at. Consequently it needs only a gun to carry twelve miles to place the whole of Brooklyn and the wealthiest part of New York at the mercy of an enemy. Such a gun is not only possible but extremely probable; and, in view of the helpless position in which we should then be placed, in the absence of any navy to take the offensive, it might be well for our business men to take thought for the future by asking Congress to give them some form of protection in the event of war. It opens the widest field for the inventive genius of this country to exert itself to devise such protection.

SCIENCE TEACHING IN SCHOOLS.

The Report of the Committee on Science Teaching in Schools, signed by Professors E. L. Youmans, A. R. Grote, J. W. Powell, and J. S. Newberry, and read before the American Science Association by Dr. Youmans, is a severe but not unjust arraignment of the unscientific methods by which science is usually mistaught in schools. The chief aim of the committee was to inquire how far the public school system has availed itself of the valuable aid which science offers in the proper cultivation of the minds of the young. The association aims to advance science by the promotion of original investigation, and is naturally interested to know whether the methods of the schools favor or hinder genuine scientific study; whether they foster the early mental tendencies that lead to original thought, or thwart and repress them.

That the latter is generally the case is only too evident; yet in every school the belief is that science is taught, and taught scientifically. The reason why fact does not conform to theory in this matter may be found in the single circumstance that the majority of teachers are untrained or contra-trained for scientific thinking, while the few who could be and would be glad to be scientific in their methods of teaching are prevented by the fixed requirements of the schools as developed on examination day. In the words of the committee, the old idea of a school is a place "where knowledge is got from books by the help of teachers, and our public school system grew up in conformity with this ideal. The early effect of grading was to fix and consolidate irrational methods. The sciences were dissimilated to the old practice, and the science teaching falls short at just the points where it was inevitable that it should fall short. The methods of school teaching and the habits of the teachers had grown rigid under the regime of book studies. As a consequence, the science teaching in the public schools is carried on by instruction. Through books and teachers the pupil is filled up with information in regard to science. Its facts and principles are explained as far as possible, and then left in the memory with the other school acquisitions. He learns the sciences as he learns geography and history. He is not put to any direct mental work upon the subjects of science, or taught to think for himself. As thus treated, the sciences have but little value in education. They fall below other studies as means of mental cultivation. Arithmetic rouses mental reaction. The rational study of language, by analytical and constructive tasks, strengthens the mental processes; but the sciences are passively acquired in their results. This is not scientific education, because there is no practice in the scientific method. Science, as a means of training the faculties, in the various ways to which they are severally adapted, is not taught in the public schools. It is not made the means of cultivating the observing powers, or of stimulating inquiry, or of exercising the judgment in weighing evidence, or of forming original and independent habits of thought. As remarked by Agassiz, the 'pupil studies nature in the school room, and when he goes out of doors cannot find her.' This mode of teaching science, which is by no means confined to the public schools, has been condemned in the most unsparing manner by all eminent men of science as a deception, a fraud, an outrage upon the minds of the young, and an imposture in education."

Futher on the committee justly remark that the failure to gain the benefits of real scientific study seems to have its source deep in the constitution of the public schools. In dealing with masses of children classification became necessary, which gave rise to grading and an elaborate mechanical system. The working of children in lots is a great convenience to the teacher, but it strengthens the method of verbal instruction, recitations, and lesson-giving. It is well fitted to impress the public with the idea that there is much done in the schools. There is a prescribed routine of operations and a display of order that is admired. But teacher and learner are subordinated to the system. It is machine work, and the machines make no allowances. Graduation assumes and enforces a uniformity among pupils that is false to the facts. Wide personal differences of capacity, aptitude, attainment, and opportunity not only exist among children, but they are the prime data of all efficient mental cultivation. In the graded schools, just in proportion to the perfection of the mechanical arrangements, individuality disappears; and with individuality goes originality. Science, if rightly pursued, is the most valuable school of self-instruction. From the beginning men of science have been self-dependent and self-reliant, because self-taught. They have been more hindered than helped by the schools. De Candolle, in his valuable book on the conditions which favor the production of scientific men, says that the discoverers, the masters of scientific method, have chiefly appeared in small towns where educational resources have been scanty, and that they have often been most helped by the poorness of their teaching, which means that the schools were not so perfect as to kill out all originality.

Where there is any cure for this state of things, whether it is possible for the lower schools to teach science scientifically, the committee does not say. The truth is education and schooling are and always have been radically at variance, meaning by education an orderly growth in right mental habits through the reasonable attainment of exact knowledge. In the child world there is no science; and the attempt to cram boys and girls with scientific information—science teaching as commonly understood and practiced—is