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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN, BUILDING EDITION.

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THE SANTIAGO CAMPAIGN.

It is gratifying to learn that several thousand troops have been dispatched to assist in the reduction of Santiago and the capture of Cervera's fleet, and that a second division will follow at an early date. It is stated that the force includes a battalion of engineers, some batteries of light and heavy artillery and several detachments of infantry. Accompanying the troops is a complete engineering equipment. The heavy batteries are supplied with 5-inch siege guns and the light batteries carry 3·2-inch guns.

This indicates that the plan of campaign contemplates the reduction and capture of the forts at the entrance of Santiago Harbor, a step which, as we pointed out last week, is absolutely essential, if it be true that the entrance channel has been thoroughly mined by the Spaniards. It would be taking a needless risk to send our ships one by one through a narrow channel sown with mines. By the capture of the forts we can obtain possession of the cable connections which control the mines, and with the firing station in our hands and the guns silenced, our fleet could enter the inner harbor intact and give battle to Admiral Cervera's ships in the best possible fighting condition.

Since the successful reconnaissance made by Commodore Schley, our squadron off Santiago has been strengthened by the arrival of Admiral Sampson with several powerful ships. The combined fleet before Santiago now includes the first-class battleships "Iowa," "Massachusetts" and "Oregon," the second-class battleship "Texas," the armored cruisers "Brooklyn" and "New York," the protected cruiser "New Orleans," the unprotected cruiser "Marblehead," the auxiliary gunboats "Mayflower," "Eagle" and "Vixen," the auxiliary cruiser "Harvard," the torpedo boat "Porter" and other craft of less importance. The guns in the four battleships, two armored cruisers and the protected cruiser available for an attack on the fortifications are more powerful and probably more numerous than those on the fortifications and the "Christobal Colon." There are mounted in these seven ships no less than one hundred and eight guns of 4-inch caliber and upward, the list including eight 13-inch, six 12-inch, thirty-eight 8-inch, twenty 6-inch, twelve 5-inch, four 4·7-inch and twenty 4-inch. The concentrated fire at close range of this tremendous battery, forty-two of which are rapid-fire guns, aided by an attack by the siege guns of our troops on shore, should make short work of the fortifications, powerful as they are. What was left of the forts would be easily carried by assault from the rear.

The fall of Santiago and capture or destruction of the Spanish fleet in the West Indies would be as decisive and far reaching in its effects as the brilliant victory of Dewey in the Philippines.

SMOKELESS POWDER.

Although the war is not many weeks old, it has been waged long enough to impress upon the combatants many important truths which were understood in a vague way before the conflict, but were never appreciated at their full worth until now. We have drawn attention in a previous issue to the lessons of Manila Bay, chief among which is the vital importance of good marksmanship as the decisive factor in a naval fight. The excellent work of our gunners was nothing more than we all expected; it was in keeping with the traditions of our navy, and in the present war, just as in all those that preceded it, the efficiency of our gun crews is the result of much patient and careful practice at the targets during the ordinary routine of peace maneuvers and cruises.

It is our duty, however, to draw attention to the fact that our ships are laboring under a serious disadvantage in having to use the smoke-producing and obsolete brown powder with which they are supplied, instead of the modern smokeless powder, which is in universal use throughout the world. In every engagement which has taken place, not even excluding the Manila fight, eyewitnesses have noted the fact that our ships were speedily enveloped in dense clouds of smoke produced by the fire of their own guns. The smoke in some cases hung like a pall about the ships, completely shutting out the object of attack from our gunners and preventing them from observing the flight of the projectiles. This was the case at times at Manila, it seriously impaired our work at San Juan, and the same trouble occurred in the recent reconnaissance at Santiago. The objections to brown powder were powerfully illustrated in the last named conflict, owing to the fact that one of the ships, the "New Orleans," was using the smokeless powder (cordite) which has been adopted in the English navy. She was not at any time shrouded in smoke, and eyewitnesses spoke in glowing terms of the accuracy and rapidity of her fire.

How it comes that our ships, with the one exception mentioned, are supplied with old fashioned powder when powder of a far more efficient type has been in use in other navies for five or six years is a question that we are unable to enter into fully at this time. There has been a reluctance on the part of our authorities to supply the ships with high explosive powder, because of its dangerous character; but of late years improved powder of this class has been carried on foreign warships in all climates and weathers with perfect safety, and the time has surely arrived when we can venture to adopt that form of smokeless powder which our experts have determined to be the best.

The advantages of the smokeless over the old type are many and valuable. The discharge of a brown powder, especially in the larger guns, is accompanied with enormous volumes of dense, opaque smoke, whereas the smokeless powder produces only a faint mist or haze, which is quickly dissipated. The one produces a large amount of residue which fouls the gun, the other produces but little residue and leaves the gun practically clean for the next round. The smokeless powder is far more powerful weight for weight, the charge of brown powder for our 12-inch gun weighing 425 pounds, whereas the charge of cordite for the 12-inch wire gun weighs only 167½ pounds. Smokeless powder burns very slowly, giving off its gases gradually, maintaining a fairly even pressure throughout the whole bore of the gun, thereby enabling a high muzzle velocity to be obtained with a comparatively low maximum pressure in the gun; whereas the brown powder burns more quickly, producing a less uniform pressure throughout the travel of the projectile in the bore. Fifteen tons to the square inch is the limit of pressure which our guns are designed to stand in service. With brown powder this pressure is reached at the instant of firing, the charge is less gradually converted into gas, and as the projectile travels along the bore the pressure rapidly falls, owing to the increased volume of the space behind the shot. With the smokeless powder, a much higher velocity may be obtained without exceeding the normal pressure of fifteen tons. This is due to the fact that the powder burns more slowly, more gas being given off as the shot travels along the bore. The pressure is maintained at a high level up to the time that the projectile leaves the muzzle, and consequently the velocity is proportionately increased. The muzzle velocity of the 6-inch gun on the "Massachusetts," which uses brown powder, being 2,080 feet per second, whereas the 6-inch gun on the "New Orleans," using smokeless powder, has a muzzle velocity of 2,642 feet per second.

By the introduction of smokeless powder the muzzle velocity of our guns could be raised from 400 to 500 feet per second without exceeding the safe maximum pressure for which the guns were designed. Increased velocity means a more level trajectory and a greater penetration. When to these advantages are added a smokeless discharge and the ability of the gunner to take note where the projectile strikes, the immense superiority of the smokeless powder is manifest.

Excellent smokeless powders have been produced in comparatively small quantities by our government experts; but the private manufacturers have not as yet turned out successful smokeless powder in large quantities. If they apply themselves to the task in good earnest, they can undoubtedly equal or surpass the products of European factories. It is to be hoped that a healthy rivalry will spring up in this important industry, and that before long an efficient, stable and thoroughly reliable smokeless powder will be in general and exclusive use in the heavy guns of both our army and navy.

THE CENTRIFUGAL METHOD OF COLLECTING PLANKTON, THE BASIS OF FOOD SUPPLY FOR AQUATIC ANIMALS.

The Rhode Island Experiment Station is carrying on investigations, not only on land, but also on water farming, since in the near future increasing attention must be given to all possible sources of food supply for man.

As indicated by his annual report for 1897, Dr. Field has been experimenting upon reliable methods for determining the relative economic value of water areas (i. e., of ascertaining how many fish, crabs, oysters, clams, etc., any given particular area of water can sustain). This is of special interest to Rhode Islanders as a relatively large area of the State is shallow water particularly adapted to aquiculture, i. e., marine farming.

The conditions governing the occurrence and growth of the microscopic plants and animals which constitute the fundamental food supply of the edible marine fish and shell fish are manifold, and necessitate local observations and records. Yet the conditions warrant this labor, for in its scientific and economic aspects the question is one of great importance. It has been shown that water areas under cultivation yield per acre a far larger quantity of nitrogenous food for man than does a corresponding area of land.

The writer points out that attempts to collect the matter in suspension in samples of water, for strictly accurate determination, either by biological methods with nets and filters, or by chemical means, have been prolific of errors, and that practically little advance has been made, chiefly owing to inadequate methods of collecting, the average error being at least fifty per cent.

By the use of a special, large centrifugal machine,

devised by Dr. C. S. Dolley, of Philadelphia, and by him sent to Dr. Field for trial, the error in the results is practically eliminated. This machine, driven by hand or by motor, quickly separates all the suspended matter, living plants (including the bacteria), animals and inorganic matter, in such a way that it can readily be weighed, the total volume determined, the number of particles counted under the microscope and tables be made for comparison showing the economic yield of any given area of water. A number of suggestions are made as to possible improvements of the machine, but great stress is laid upon the centrifugal method.

In closing, Dr. Field suggests that such means may be valuable for collecting the microscopic plants and animals which constitute the food of the just hatched fry of so many species of fish, thus increasing the efficiency of the methods of artificial propagation of food fishes.

The Old Tide Mills of Brooklyn.

It will be of interest to many New Yorkers, and will possibly be news to some, to know that within the boundaries of the greater city, and within the limits of the Borough of Brooklyn, there still exist landmarks of bygone times and industries, in a good state of preservation, and dating back to the early Dutch colonial period. Among these are the grist mills, three of which yet stand, all of them still in working order. A word or two concerning their origin will perhaps prove interesting.

The earliest settlers in Brooklyn, pushing their explorations through the densely wooded heights near the river and beyond the forest-covered hills now occupied by Prospect Park, found in the level and comparatively treeless stretches of arable land beyond Flatbush a region reminding them of their native Holland, requiring but little labor to prepare it for the production of crops.

Ancient records show that the first land on Long Island to be occupied under a grant from the authorities of New Amsterdam was in and near the present village of Flatlands.

To quote from Stiles' History of Brooklyn: "In June, 1636, Jacob Van Corlaer purchased from the Indians a flat of land, and, on the same day, Andries Hudde and Wolfert Gerrittsen purchased the flats west of Corlaer's. These purchases were confirmed by a grant from the director, Wouter Van Tweller. The owners at once commenced planting, and the place became in time the village of Amersfoort, or Flatlands."

The erection of mills for grinding their grain became necessary, and, of the earlier structures, the three mentioned remain. They are all similar in type and are operated by the rise and fall of the tides. The construction of a dam and water gate on one of the many creeks emptying into Jamaica Bay, with a short sluiceway to divert the waters to the mill wheel, was a simple operation, and was the means resorted to. As the tide rose, the open gate allowed the water to accumulate above the dam, and with the closing of the gate just before the ebb, the stream passing through the sluiceway operated the large undershot wheel, and thus furnished a steady and reliable source of power during each ebb tide.

A visit to one or the other of these old tide mills will prove of interest. The oldest is situated on Garrettson's Creek, on land forming part of the original Gerrittsen grant in 1636, and was built not long after the first settlement. It may be reached by the Kings County elevated road (Brighton Beach trains), stopping at Neck Road station and walking (or wheeling) eastward along the Neck Road about one mile to the shore of the creek. The rough-hewn timbers and weather-stained clapboards are in excellent preservation and bid fair to last for years, unless the iron hand of improvement decrees demolition. The wheel and the primitive machinery inside the mill are in good condition and capable of doing effective work.

The same may be said of the Vanderveer mill, near Canarsie, which stands beside the creek emptying into Canarsie Bay, and may be seen by the excursionist on the train from East New York, just after crossing the creek midway between the points mentioned and about five hundred yards to the left of the track. This old structure is still used by the Vanderveer family, descendants of the first settlers, on whose farm it is located.

The third mill is found on Spring Creek, at the end of Montauk Avenue, Twenty-sixth Ward (station on Kings County elevated railroad), and while of later construction than the others, still dates back to ante-revolutionary times. It has a more modern exterior than the others, having been frequently repaired, but the timbers and the old-fashioned machinery are those of the original mill. This is also in working order and is still used by the farmers of the neighborhood. A quaint and picturesque hamlet of fishermen's boat houses has grown up along the banks of the creek and furnishes a wealth of interesting material for the artist and the camerist.

The opportunity of conveniently reaching and studying structures like these, suggestive as they are of the primitive times of the Hollander colonist, and their contrast to the nearby rush and bustle of the metropolis, is one not frequently afforded the city resident, and will repay one well for the time occupied in visiting them.

Death of Baron Lyon Playfair.

Baron Lyon Playfair, chemist, political economist, civil service reformer and parliamentarian, died in London, May 29.

The late Lord Playfair was born at Meerut, Bengal, India, in 1819. He was educated at the University of St. Andrew's and at a very early age took a special interest in the study of chemistry. After studying this science at Glasgow and Giessen, he was appointed, in 1843, Professor of Chemistry in the Royal Institution at Manchester. In the following year he was appointed on the commission to examine into the sanitary condition of towns and populous districts of England. After this service he was appointed chemist to the Museum of Practical Geology at London. In the great Exhibition of 1851–52 he was special Commissioner in charge of the Departments of Juries. In 1856 he became Superintendent-General of the Government Museums and Schools of Science and in the following year he was elected President of the Chemical Society of London. In 1858 he became Professor of Chemistry at Edinburgh University, and among his pupils was the Prince of Wales. He examined, in conjunction with Sir Henry de la Beche, the availability of the coals of the United Kingdom for the purposes of the navy and into the cause of accidents in mines. In 1847 he was President of the Civil Service Inquiry Commission and he sat several times in Parliament. He was a member of many learned societies and held numerous British and foreign orders. His scientific memoirs were considerable in number and importance and he also wrote on economical questions.

Men of Science as Regulars.

When the brigade of engineers, United States Volunteers, is commissioned, it will have among its ranks scientists, electricians, civil, mechanical and topographical engineers of national repute, including college professors and men prominent in the commercial world. A sufficient number of men have been procured for the first regiment, and other regiments are well advanced. Col. Gillespie, of the Corps of Engineers, U. S. A., will probably command the brigade. Col. Eugene Griffin, who is vice-president of the General Electric Company, with whom the idea of forming a volunteer engineering corps originated, will be colonel of the first regiment. Among the distinguished recruits are William B. Parsons, chief engineer of the Rapid Transit Commission of New York City; Dr. L. Duncan, professor of electrical engineering in Johns Hopkins University; Eugene Ellicott, secretary of the University of Pennsylvania and topographical and hydrographical engineer of the United States Coast Survey for a year. The men who have associated with Col. Griffin in organizing the regiment and who will probably be among its officers are Capt. G. W. Bramwell, W. G. Ramsay, F. M. Barstow, J. A. Steinmetz, Walter Abbott, general manager American Projectile Company, Lieuts. Rodman and Walke, explosive experts, and others. Men will be taken from every branch of mechanical skill. There will be engineers, blacksmiths, machinists, electricians, telegraphers, photographers, carpenters, railroad men and those skilled in the use of explosives, in the corps. It is expected that nearly all of the railroads and bridges in Cuba will be destroyed by Blanco's troops before the approach of our army of invasion, making plenty of work for the engineers.

Electricity at the Paris Exposition.

American electrical machinery manufacturers are to have the opportunity to furnish the Paris Exposition with electrical machinery to the value of $1,000,000. This opportunity is the result of efforts exerted by the special American commission sent to Paris to look over the ground and furnish advice regarding the American display there. Commissioner Hamburger, who has just returned to New York, said that it is evident that the French government desires to cultivate the friendliest relations with America, and an opportunity has again been given to our electricians to furnish electrical machinery to the amount mentioned above. A chance was formerly given American electricians to furnish electrical machinery, but, because of the absence of information, the American manufacturers did not respond quickly enough. Negotiations were then begun with manufacturers of other countries, and as far as America was concerned the matter seemed to be closed. This new contract will be awarded, notwithstanding the fact that, while Germany and Russia have each appropriated $1,250,000 to defray the expenses of a display, and England has appropriated $500,000, this country has not as yet voted any sum for the national exhibit or even appointed a permanent commission. It is said that the $1,000,000 worth of machinery would be equivalent to 40,000 electrical horse power, and this machinery would be a display and also prove a profitable transaction.

Fatigue in Reading.

The Psychological Review contains an article, "On the Conditions of Fatigue in Reading," which is of some practical importance, as well as of theoretical interest. The authors, Messrs. Harold Griffing and Shepherd J. Franz, of Columbia, following the idea suggested by Prof. Cattell in a well known paper, and supplementing his work, show how facility of reading is affected by size and quality of type, by "leading," by the intensity and quality of the illumination and by the quality of the paper. The result to which they come is that "the size of the type is the all-important condition of visual fatigue. No type less than 1·5 mm. in height (eleventh point) should ever be used, the fatigue increasing rapidly even before the size becomes as small as this." The intensity of illumination is "of little consequence within the limits of daylight in well lighted rooms. Very few intensities less than 3 to 10 candle-meters (a candle-meter being the light of a standard candle at a perpendicular distance of one meter) are sources of even greater fatigue than small type, and 100 candle-meters may be considered a type limit." The experiments on the relative legibility of different kinds of type were carried out by different methods, the results of which agree fairly well—by determining the times of reading certain passages, by finding the percentage of words which could be seen in certain phrases when cards containing them are exposed for a given time, by determining (through the falling chronometer) the time of exposure necessary for reading certain words in different type, or the amount of illumination necessary to see letters of different sizes. The experiments are of a careful character. But it would have been well in determining the effect of these various conditions to try a parallel series with nonsense words instead of real ones, so as to eliminate the element of familiarity, and the various accidental elements arising from special association, though this has been done in part by taking a considerable number of observers.

The Opening of the Omaha Exposition.

The Omaha Exposition opened on June 1, in the presence of 100,000 visitors. At 9.30 o'clock the parade started from the center of the city to the grounds. The Marine Band from Washington was there, and a hundred musical organizations from the various States of the Middle West contributed to the occasion. The parade was three miles long, consisting of officers and guests of the exposition in carriages and the semi-military organizations of all the great cities of Nebraska and adjacent cities. Rev. Dr. Nichols, of St. Louis, opened the exercises at the ground with prayer. President G. W. Wattles, John L. Webster, of Omaha, and John L. Baldwin, of Council Bluffs, made addresses. President McKinley then touched a button in the telegraph room at the White House, thus setting in motion the machinery of the Omaha Exposition.

Coast Signal Service.

The Coast Signal Service is now in operation from West Quoddy Head, Me., to the Mexican border, all the stations being connected by wire with the Navy Department. This service has the co-operation of the Lighthouse Service, Life Saving Service and Weather Bureau. Vessels passing any of the stations are required to signal by international code any news they may have of Spanish craft which they may have sighted at sea. Any precautionary news, such as an enemy within the waters of the United States, will be duly communicated to the vessels. Stations are at all the prominent points on the coast and may be known by the signals hoisted on a ninety-foot signal mast. Most of the permanent lighthouses, as well as the life saving stations, have telephonic connections with the coast signal stations and are equipped with international code flags and books.

THE German press is presenting a very different attitude in regard to the war than was attributed to it some weeks ago. Many of the most prominent journals have come out boldly advocating the justice and necessity of the course taken by the United States. In a recent issue of the Hanover Courier the following significant words may be found: "Nobody can find a reason for disturbing the friendship existing between the United States and Germany on account of the fact that this government is bringing to final execution the fall of a state which has become completely rotten through its own misdeeds extending through centuries, and it can only be considered as a happy accident in history that the part of executioner has fallen upon the United States."

IN the village of Saasen, Shepherd Johannes Stende and his wife are celebrating their diamond wedding in great bodily vigor amid the general rejoicing of the community. The husband is 90 years of age and the wife 83. The Emperor generously ordered a present of 30 marks (about $7.50) to be given to them.