SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845) ..... $3.00 a year
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Monthly (Established 1885) ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, APRIL 4, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE BLOOD OF ALL RACES.

Ethnologists of the Smithsonian Institution have investigated the Filipinos, with results that are of rare interest to science. They have called attention to the fact that in the veins of the tribes of the archipelago flows the blood of all the races and varieties of mankind. The Smithsonian Institution is giving special instructions to those intending to explore the caves of the Philippines for crania, and to search for other ethnological data.

In the make-up of the composite Filipino, the darker substratum has been supplied by Negrito, Papuan, and African negro. A copper tint and fighting blood have been furnished by Malay and Polynesian. A lighter hue and certain arts have come from Japanese, Chinese, and Cambodian. Hamite, Semite, and Aryan have stamped their image upon the islanders. Even an ancient stream of Caucasian is traced by ethnologists; and, stranger still, perhaps, the discovery has been made that a rivulet of American Indian blood found its way to the cosmopolitan veins of the Filipino through the channels of two centuries of uninterrupted commerce between Mexico and Peru and the archipelago.

In view of this converging of racial streams in the Filipino, scientists of the American Bureau of Ethnology hope that a detailed investigation of the habits, implements, relics, beliefs, legends, etc., of the various tribes of these islands will be undertaken. In addition to exploration in search of prehistoric crania in caves, the purpose is to make a comprehensive collection of native hammers, saws, adzes, clamps, and every primitive implement representative of stages of invention between the stone age and modern times. It is expected, too, that instruments of prehistoric engineering may be found.

It is known that some of the Filipino tribes are skillful metallurgists, inheriting doubtless from ancient Malay artisans dexterity in fine hand processes. It is hoped by the scientists that additions to one of the most interesting chapters in human history will be made through discoveries in the Philippines of the secrets concerning the ancient arts of working metals. Collections are to be made of the early poetry, tribal proverbs, legends, folklore, and all literary material, particularly that which will reveal the influence of the invasion from India that took place several centuries before the Christian era.

The anthropologists who are to attempt the untangling of the record of centuries of race interfusion in the Philippines realize that they have a very big undertaking on their hands, but this gives added zest to the research. A special request has been made of officers of the United States to assist in collecting everything that may help to throw light on the story of the early savage navigators who cruised in the channels of the archipelago. In answer to inquiries, the United States Treasury Department has assured the scientists about to embark on ethnological work in the Philippines that collections brought back for the Smithsonian Institution will not be subject to duty.

FINAL LESSONS OF THE GERMAN AMERICAN WAR GAME.

With the publication in the current issue of the SUPPLEMENT of the fourteenth of our series of articles on the naval war game between the United States and Germany, we reach the close of this most interesting and instructive struggle. Our readers will, of course, have formed their own conclusions as to the lessons to be learned therefrom; and that the publication of this matter has awakened widespread attention, and has served the useful purpose of instruction as to the relative strength of our own and the German navy, is shown by the large number of letters that have reached this office from all parts of the United States, some of which we have from time to time made public.

PANAMA CANAL.—It will be generally agreed that the most important fact brought out by the war is the great strategical advantage which would have been conferred upon this country by the existence of the Panama Canal. It was because we had no short cut to the Pacific that the Germans, in the early stage of the conflict, were able to concentrate an overwhelming and homogeneous force of battleships at Manila, and practically wipe out the heterogeneous fleet of battleships, monitors, and cruisers which had been hastily assembled for the defense of our naval base in the Far East. In that fight we lost four battleships, two monitors, and four cruisers; and it was only after sufficient time had elapsed for us to concentrate in eastern waters the three battleships of the "Maine" class, together with the "Alabama" and "Kearsarge," that we were able to stem the tide of disaster by winning a signal victory off the German base at Kiao Chau. After our success in the Pacific, there was another long delay, pending the arrival of two battleships of the "Maine" class from the Far East by way of Cape Horn. Had the Panama Canal been in existence, we could have concentrated a force off Havana which would have insured the early destruction of the German fleet in the West Indies; and the victory that was ultimately secured would have been more decisive than it was.

THE SUBMERGED TORPEDO TUBE.—The second lesson of the war is the enormous value of the submerged torpedo tube on battleships and cruisers. The majority of the German vessels engaged were fitted with a submerged tube located on the longitudinal axis of the vessel, at the point below water where the fore-foot rounds up into the ram. The German naval constructors were early to perceive the immense advantage of the submerged torpedo tube and all of their latest ships, both battleships and cruisers, have been so fitted. Our own vessels, unfortunately, did not carry a submerged tube, and the above-water tubes, because of the great risk of the explosion of the torpedoes by the rapid-fire guns of the enemy, had been in many cases removed, leaving our ships with at best only a very limited torpedo armament. This disparity not only seriously hampered the American admirals in the disposition and handling of their vessels, but in some battles it proved the undoing of our fleets. In a cruiser engagement that took place in the Atlantic early in the war, the issue was suddenly decided by a swift movement of the German cruisers, which enabled them to torpedo four of our cruisers in succession, the German boats being able to cross in front of our line at sufficiently close range for using the torpedo, without being themselves exposed to torpedo attack. In the whole war we lost, by torpedoes fired from the warships themselves, no less than eight battleships and cruisers against a loss to the Germans in battleships and cruisers by torpedoes from our own ships, if we exclude the submarines, of only one cruiser.

TORPEDO BOATS AND DESTROYERS.—The torpedo boat, moreover, fully established itself as a most effective element in modern warfare. In the battle off Manila early in the war, after our fleet had been thrown into disorder, the German torpedo boats were sent in to give the final *coup de grace*, which they did by sinking three battleships and two monitors. Then again, in a night action between two approximately equal fleets of cruisers and torpedo boats (in which, because of a similar ruse adopted by each fleet, each group of torpedo boats was enabled to get in among the enemy's ships) the entire force on both sides was wiped out, every cruiser and all the torpedo boats but one being torpedoed and sent to the bottom. Extraordinary as this result appears, it was considered by the umpires that under the tactics adopted it was perfectly possible. In this conflict alone ten cruisers were sunk by torpedoes, besides a dozen or so torpedo boats.

MONITORS IN ACTION.—The war served to demonstrate once more the comparative uselessness and, under certain conditions, the absolute encumbrance of monitors, when they form a part of the line of battle. On more than one occasion the speed gage remained with the Germans because of the obligation that the American admiral was under to keep down the speed of his battleships to that of the slow monitors. This was one of the contributory causes to the defeat at Manila; and although in the last fight of the war, as described in the current issue of the SUPPLEMENT, the monitors proved to be extremely hard to hit, and although their 12-inch guns did frightful execution upon the German battleships, it is a question whether the small target that they afforded was not more than offset by their comparative unhandiness and lack of maneuvering ability. Furthermore, it is a fact that in this battle, while the German line was moving at an uniform speed of 15 knots, our own line, because of the slowness of the monitors, was moving only at a little over 7 knots an hour, or only half as fast.

SUBMARINES.—In the great deciding battle of the war, victory was snatched from the German fleet by the sudden entrance of the submarines into the fight at the very moment when the remaining German ships were closing in, themselves badly disabled and with speed greatly reduced, for the closing stroke. This result will naturally be very pleasing to those who pin their faith to the submarine; but it must be remembered that their effective work was due to most favorable weather conditions, for the day being particularly fine, and the sea smooth, it rendered the successful operation of the submarines possible. Moreover, these same weather conditions were distinctly favorable to the monitors, which, had the sea been rough, could never have concentrated such an effective fire as they did against the German line.

GUNNERY.—Although the American navy was conspicuously weak in torpedo attack, the greatest credit is to be accorded to its gunnery, which proved almost as destructive to the German fleets as the German torpedoes did to our own. To the concentration of fire from our heavy guns is to be attributed the loss of two German cruisers and of six of the finest of the German battleships, in our victorious action off Kiao Chau; and in the successful battle that closed the war, it was the terrific mauling received by three battleships, the "Wettin," "Mecklenburg," and "Woerth," that rendered them easy objects of attack at the close of the battle by our submarines. As far as our own ships are concerned, we lost six cruisers and five monitors, as the direct result of gun fire, the vessels being either sunk, or so completely disabled that they were obliged to strike.

SPEED.—There can be no question that the possession by the Germans of the speed gage in certain of the conflicts of the war was of enormous advantage; and it was only when matters were evened up in this respect, in the battle won by us off Kiao Chau, a victory due largely to the good speed of the "Maine," "Missouri," and "Ohio," that we were able to turn the tables and maneuver to good effect. If the lessons of the war teach anything, they teach the folly of building battleships or cruisers whose speed is below the average speed of any possible enemy. Eighteen knots should be the lowest contemplated speed of our future battleships; and it is quite a question whether it will not prove to be an advantage to sacrifice some weight of gun fire for the sake of an additional knot of speed. The admirals on both sides seem to have aimed at placing their line of battle in a position which would enable them to concentrate the whole fire of the fleet on the head or tail of the enemy's line, disabling his ships in detail; and such a feat is only possible to the fleet which has a higher average speed and general greater mobility.

ENORMOUS PERCENTAGE OF LOSSES.—Perhaps, after all, the most striking fact brought out by this war game is the frightful diminution of naval strength and international standing which will occur in both of the navies engaged. Out of a total of 49 ships engaged, Germany lost about a score, in which were included the very finest of her battleships; while out of the total of 53 vessels engaged on the American side, we lost no less than 29. While our loss was numerically greater, we did not lose so large a number of our best ships. The exhausted condition of the combatants at the close of the war is shown by the fact that, although the umpires decided that the advantage lay with the American navy, the mutual destruction had been so terrific that the German navy had but one effective battleship left and the United States but two; that is to say, there were in the combined fleets but three first-class battleships left at the close of the war, that were in condition to carry on the conflict. Consequently, two of the first-class navies of the world were reduced in a few months to a second-class position as regards their fighting strength; and since the work of battleship building is slow, it would take at least four or five years to bring these navies up to their strength at the opening of the war, and probably twice that length of time to restore them to their relative standing among the other great navies of the world.

Here is a consideration which we think must make very strongly for peace in all future international controversies. When the defeat of an enemy is attained at such a frightful cost and at such peril to international ranking, we look to see the very last resources of diplomacy exhausted before any war takes place between the leading powers.

VERTICAL TRANSPORTATION.

In considering recently the general subject of transportation, attention was called to the congested conditions of travel in a crowded city like New York, and especially to the fact that much of the discomfort arising therefrom is due to the immense increase in population within restricted areas, both in the residential and business portions of the city, which render the congestion at certain hours of the day so serious as to render travel in the city a struggle not always unattended with personal danger. This increase of population is due to the growth of our cities in a vertical sense—in the residential part of the city, by the erection of "flat" or apartment houses, a score of stories high, and in the business district by office buildings which have a height so great as to engulf in many cases even the steeples of neighboring churches. In the primitive town the one and only street was laid out horizontally. In the modern city the streets are often vertical. In a modern community like the Park

Row building in New York there are over six thousand inhabitants, with a vertical thoroughfare having twenty-five cross streets.

There are about a thousand offices in this building, with the top landing 294 feet from the ground floor. To provide transportation for these people, we find an equipment of ten elevators, each capable of carrying sixteen men, and making the trip to the top floor and back in three minutes. At this rate two hundred round trips a day are made by each elevator during business hours. On an average one need never wait more than eighteen seconds for a car, and a man at the top floor can reach the street in two minutes at the most. Each car averages sixteen passengers per round trip, and travels a distance of twenty-two miles a day. This means a total of 220 miles a day traveled by the cars altogether, or a distance stretching from New York to Washington. The elevator schedule in the Park Row building, as first arranged, provided for the running of five express cars and five locals. However, it was found that better time could be made even from the top floors when the cars were all run as locals, because since twice as many cars were thrown open to all the floors, the number of passengers taken on and off at each stop was decreased, and the saving thus occasioned more than overbalanced the time consumed by the slight increase in the number of stops.

A notable example of the use of express elevators may be found in the Broad Exchange building, New York city. In this building there are 1,400 offices, and eighteen elevators are provided for the transportation of the seven or eight thousand occupants. Half of these elevators make no stop between the first and eleventh floors, and the other half travel no higher than the eleventh floor. This arrangement affords greater economy of space, because, instead of continuing the elevator shafts of local cars up to the top of the building, the space from the twelfth floor up is employed for other valuable purposes.

From the foregoing it will be seen that while, as previously stated, the vertical growth of our cities was made possible by the use of steel in building construction, no such development would have resulted without the introduction of elevators to make tall buildings profitable.

Public attention was first directed to the advantages of elevators at the time of the New York World's Fair in 1853, when Mr. E. G. Otis gave an exhibition of his patent safety device in the Crystal Palace. A great impression was made on the spectators when the inventor, after running his car to the top of the shaft, cut the supporting ropes and descended safely to the main floor. The next year Mr. Otis secured a bit of land at Yonkers on the Hudson, and began the business of manufacturing elevators. It was not until 1859 that the first independent elevator engine was built, and a dozen more years passed before the hydraulic elevator was developed. Since that time we have had one more important innovation, that of the electric elevator, which was first introduced to the public in 1888. At present there are five distinct types of hydraulic elevators. Of these, the vertical cylinder type is the oldest and most common. Another type which differs from this only in the position of the cylinder is the horizontal cylinder type, which is found useful where space in the shaft is more valuable than that in the basement. In these two types a pressure of 150 pounds to the square inch is commonly maintained. Where it is necessary to have the elevators scattered about in various parts of the building, the high-pressure inverted-cylinder type is most useful. The power which is developed in one portion of the building can, by this means, be more widely distributed, and the machinery may also be made more compact. Two other types, the pulling plunger and direct lift, complete the list of hydraulic elevators. In the pulling plunger type no counterweight is used, but the plunger is made heavy enough to raise the car by its own weight, while hydraulic pressure is exerted to lift the plunger when the car is descending. In the direct-lift elevator the cylinder and piston are situated in a shaft sunk into the ground a distance equal to the desired travel of the car. This type is commonly used for freight, though it makes an excellent elevator for passenger service as well where conditions permit, because no energy is lost in the transmission of power, but the piston acts directly on the car.

In electric elevators the driving means of course is an electric motor, which operates a winding drum through suitable gearing, but the most important feature of the electric elevator is the device for starting the motor. Of course, it would not do to provide a starting box on the car, for the careless operator would be too apt to suddenly turn on the entire current and burn out the motor. On this account automatic devices for gradually cutting out the resistance are provided. The operator has no control over the action of this device except to start, stop, and reverse the same.

Although a great many improvements have been made in the motor mechanisms of elevators, the safety device now commonly used does not differ materially from that which proved its worth thirty years ago, such changes as have been made being principally due to increased speed of travel and heavier loads now carried. When we stop to consider that more rides are taken daily on elevators than in the street cars of our cities, the safety of these conveyances may be appreciated. Accidents on elevators occur so rarely that the daily papers usually accord them the prominence of a front-page article with a glaring title.

A type of electric elevator which is coming into great prominence is the automatic elevator for private residences. This is operated by a set of push buttons, and requires no elevator man. If someone on the second floor desires to go up to the fifth, he first presses a button that brings the car, if idle, up to his landing. As soon as the car comes to a stop, and not before, the door at the landing is automatically unlocked, so that the person can open it and enter the car. The door must then be closed before the car may start up again. A button marked "Fifth Floor" is now pressed, and the car is started up automatically, stopping when the fifth floor is reached. While in motion the car throws out of circuit the buttons of all the floors except that to which it is destined, thus preventing interruption until the trip has been completed.

In closing we must not neglect to mention the escalators or moving stairways, which are growing in prominence as a means for carrying large crowds for short distances. This type of elevating device gives promise of a great future, and should prove an important factor in our progress toward the city of theoretically perfect development.

THE BRITISH BATTLESHIP CONSTRUCTION PROGRAMME FOR 1903.

BY OUR LONDON CORRESPONDENT.

Owing to the exceptional activity being displayed by the various great powers and the augmentation of their respective navies by the embarkation upon elaborate naval programmes, the Admiralty scheme of Great Britain for the present year is very extensive, in order to maintain the necessary superiority of the English navy, and to preserve the balance of power. The 1903 programme provides for the construction of forty-two new vessels of all descriptions, comprised as follows:

Battleships	3
First-class armored cruisers	4
Third-class cruisers	3
Scouts	4
Destroyers	15
Submarines	10
Coastguard cruisers	2
River gunboat	1
Total	42

The total cost of these new vessels amounts to $50,682,150, which is an excess over the sum similarly devoted to the 1902 building programme of $5,389,550, while the total sum to be expended upon the navy during the present year is $172,287,500, an increase of $16,010,000 upon the previous year.

In addition to the foregoing new vessels, which are to be laid down at once, the following ships are now in course of construction:

Battleships	11
Armored cruisers	19
Second-class cruisers	2
Third-class cruisers	4
Scouts	4
Sloops	2
Destroyers	19
Torpedo boats	8
Submarines	3
Total	72

And of these, six battleships, eleven armored cruisers, and the majority of the other vessels will be in commission before April 1, 1904. During the past year the British navy has been increased by the addition of 4 first-class battleships, 5 armored cruisers, 2 sloops, 4 destroyers, 3 torpedo boats, 6 submarines and one or two other minor vessels.

The imperative and vital necessity of rapid construction is fully realized by the Admiralty, and in order that the vessels in the new programme may be constructed without any delay, such as necessarily arises in the government dockyards, all the vessels in the 1903 scheme, with one exception, will be built in private shipyards. In order that the new vessels may be turned out by the contractors completely equipped and ready for service, and in view of the up-to-date equipment of the private shipyards, the contractors will be required to complete the ships in all respects ready for commission, i. e., not only build the hull of the vessel, but supply the armament as well.

The estimates do not afford any indication concerning the design of any of the new ships, but it is generally understood that the battleships will possess the further improvements in respect of gun power on the "King Edward VII." class outlined in a recent issue of this journal, and that they will cost approximately $7,000,000 each. The construction of the ten submarines is to be hurried forward as quickly as possible. In their design they will embody several improvements, especially in the system of propulsion, the gasoline engines which in the existing craft have proved unreliable and generally unsatisfactory being superseded by improved propelling machinery. During the year $16,500,000 is to be spent on armaments, as follows: Seven 12-inch 50-ton guns, 23 of 9.2-inch caliber, 60 6-inch quick firers, and 159 smaller guns; but there will also be completed, including guns already ordered, 12 12-inch 50-ton guns, 11 of 9.2-inch caliber, 10 of 7.5-inch, 136 of 6-inch caliber, and 224 smaller weapons.

Concerning the royal naval reserve of merchant cruisers, the list is practically the same as before, consisting of the three White Star boats, "Oceanic," "Majestic," and "Teutonic"; three Cunarders, "Campania," "Lucania," and "Umbria"; four P. and O.'s, two Orient liners, two Royal Mail boats, the Pacific liner "Ortona," and the three Empresses of the Pacific. For these vessels a subsidy of $389,065 is to be paid. In addition to the above list there are 31 steamers belonging to these respective companies held at the disposition of the Admiralty without further subsidy.

The Admiralty have not lost sight of the applicability of liquid fuel to battleships, and experiments are being carried out upon the new turbine torpedo-boat destroyer "Velox" and upon two battleships. Great difficulty is being experienced in adapting liquid fuel to war vessels, since oil fuel is of no advantage to the navy, as compared with Welsh steam coal, unless the combination can be brought to such perfection as to render the fuel practically smokeless.

One of the most important new departures in the administration of the navy is the appointment of a small committee composed of the highest recognized authorities on marine engineering in the country, to be at the disposal, when required, of the controller of the navy, so that the Admiralty board may profit by any advice or suggestions that may be proffered relative to any questions concerning vessels.

Furthermore, a new squadron is to be created—the South Atlantic squadron—which will serve the southeast coast of America and the west coast of Africa, and use Gibraltar and Sierra Leone as its bases.

VULCANIZED TIMBER IN ENGLAND.

A considerable amount of interest has been aroused by the announcement, as the result of a prolonged series of experiments, of a method of so treating timber as to secure even from soft wood a largely increased toughness and hardness. The process is described as one of vulcanizing, comparable in some respects with Bessemer's process of converting iron into steel, and is the invention of Mr. Powell, a Liverpool merchant. The treatment to which the timber is subjected is, roughly speaking, that of saturation at boiling point with a solution of sugar, the water being afterward evaporated at a high temperature. The result is to leave the pores and interstices of the wood filled in with solid matter, and the timber vulcanized, preserved, and seasoned. The nature of moderately soft wood, it is claimed, is in this way changed to a tough and hard substance, without brittleness, and also without any tendency to split or crack. It is also rendered remarkably impervious to water. Hard wood similarly treated derives similar benefits. Moreover, it is claimed that the process may be completed and timber turned out ready for use in a few days.

"CALLITYPY."

Most of our readers will probably remember the discussion carried on in our correspondence columns on the possibility of using the ordinary typewriter for the purpose of making a matrix to cast printing types. Some of the critics of this plan contended that it would be impossible to bring the ends of the lines in absolute vertical alignment and that, furthermore, the difficulty of making corrections was insuperable. In the current SUPPLEMENT will be found an article by Jacob Backes on "callitypy," a new printing system, in which it is explained how the ends of the lines may be brought to register. In carrying out the system described, the printing plant used consisting of one or more writing machines of any standard make, sheets of white paper, a square, a ruler, firm white cardboard are the only utensils required. It is true that callitypy is to be used primarily for the purpose of making line engravings of typewritten matter as a substitute for direct printing without recourse to typesetting or line-casting. Nevertheless, the system shows that it is at least possible to overcome some of the objections which have been advanced to the use of the typewriter as a means of making the matrix for the casting of type.