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 Edition (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, corner Franklin Street, New York.

NEW YORK, SATURDAY, MARCH 24, 1900.

THE SUPREMACY OF THE MODERN MAGAZINE RIFLE.

When the military attachés who are following the operations of the South African war return from the scene of hostilities, they will bring with them a mass of information which, in its intrinsic value, in the profound effect which it will have upon future military operations, will be without a parallel. Not even the great battles of the Franco-German war, or the heroic defence of Plevna against the battalions of Russia, taught so many lessons as have been spelled out in that great school of instruction upon the broad veldt and amid the kopjes and precipitous mountains of South Africa.

No period in the world's history has witnessed such rapid improvement in the implements of war as has marked the last quarter of a century; and it is due to the initiative of the Boer military advisers, native and European, that there is represented in the present struggle not merely every type of weapon of attack and defence, but the most modern of each type that could be procured in the markets of the world.

The important facts established thus far by the war are the supreme value of the magazine small-bore rifle, especially when used with the spade in defence; the necessity of keeping the artillery thoroughly up to date in respect to its range and mobility; and the increased importance of cavalry in the strategy and especially in the tactics of modern warfare. Although we are dealing just now with the magazine rifle, we would mention, in passing, that though the British artillery in the Natal campaign (with the exception of the more modern naval guns) was of a type brought out only a few years ago, it was so far outranged by the French and German guns of the Boers that the attacking forces were placed at an enormous disadvantage. So, too, the earlier operations of the British were rendered inconclusive for the lack of mounted troops, turning movements being out of the question, and any temporary advantage gained through well-considered maneuvering being more than offset by the remarkable mobility and rapidity of concentration of the burgher mounted troops. It was not until the call for cavalry had been answered that the deadlock was broken, General French and his army of eight thousand cavalry completely turning the tide of war in less than thirty days.

But most significant of all was the revelation of the terrible power of the modern magazine rifle in the hands of a skilled marksman who has a spade and a bandolier of cartridges ready to hand. It's great range, its accuracy, and rapidity of fire, and the invisibility resulting from the use of smokeless powder, enable an entrenched body of men to surround themselves with a murderous zone of fire within which, unless there is ample cover, it is simple suicide for an attacking force to enter. This zone, whose outer fringe extends in open and level country fully two miles toward the enemy, is so wide that the attacking force is sprayed with bullets long before it is close enough to see the entrenchments, to say nothing of the troops that man them. On the other hand the various ranges over which the attack is advancing are staked and measured, enabling the defence to adjust its sights with mathematical precision, the attacking force, during the first mile or more of its advance is, to all intents and purposes, fighting in the dark.

The situation was graphically drawn by Julian Ralph in his now celebrated description of the Modder River battle, where for ten long hours a whole army lay prone upon the earth to escape annihilation from the storm of Mauser bullets that swept the plain. "In engagement after engagement," he writes, "our men have thrown themselves upon the veldt, moved to do so by a hail of bullets around them, and then have fired away for hours at a time at the noise or the flame of the enemy's fire, in trenches which they cannot see." The day of the direct frontal attack, except in cases of absolute necessity, as at San Juan Hill or in the recent storming of Pieter's Hill, is over; and where cavalry or a preponderance of numbers are not present to favor a flanking movement, the attack must henceforth obey the mandate of the magazine rifle, and halt.

The Mauser rifle, which has found such an able exponent of its powers in the Boer soldier, is of a later pattern than that used in the Spanish-American war. It has a caliber of a little over a quarter of an inch (0·276) and fires a bullet which is 1·18 inches long and weighs 11·2 grains, with a muzzle velocity of 2,388 feet per second. At 40 feet from the muzzle the bullet will penetrate 4½ feet of deal. It has an extreme range of 2½ miles, and its trajectory, or curve of flight, is so flat that the space completely swept for infantry is 1,969 feet, and for cavalry 2,297 feet.

Nevertheless, despite its deadly nature, the magazine rifle is a merciful weapon, and paradoxical as it may seem stands second only to the Red Cross as an alleviating agency of the horrors of war. For in the first place the wounds inflicted, unless it hit a vital point, are mere pinpricks compared with the effects of the old large-bore rifles, and in the second place the impossibility of fighting with any hope of success in the open has driven the soldier to cover, with the result that desperate as has been the bravery on both sides in this end-of-the-century struggle, the percentage of losses has been the lightest in the history of warfare.

NEW YORK'S WATER SUPPLY—PRESENT AND FUTURE CAPACITY.

At the present juncture, when the notorious attempt of a private corporation to obtain absolute control of all possible sources of New York's future water supply is under discussion, a review of the present condition and future possibilities of the existing water supply systems of Greater New York will be of special interest. This, the greatest of all important questions of municipal administration, should receive the early and undivided attention of the three millions of inhabitants whose health and comfort it so vitally affects, and it is the duty of every citizen in the presence of such a momentous problem as has been raised by the proposed Ramapo scheme to acquaint himself, at least in a general way, both with the present condition and the future possibilities of the city's water supply.

In making the present necessarily brief review of the question, we cannot do better than consider separately the water supply of each of the five boroughs which compose the consolidated New York city of to-day. Of these, by far the most important are the Boroughs of Manhattan and the Bronx, whose sources of water supply are topographically closely related. The two million inhabitants of these boroughs depend for their supply upon three watersheds, those of the Croton, the Bronx, and the Byram Rivers. The drainage area of the Croton River and its tributaries above the Croton Dam is 338 square miles. The records of the past thirty-three years show an average annual rainfall of 48 inches with a maximum of 63·5 inches in 1888, and a minimum of 38·6 inches in 1895. The average total annual supply from the Croton watershed, supposing the whole amount to be utilized, is about 147,000,000,000 gallons. Prior to 1870 there was no reserve supply of this great total held in storage except in the small lake formed by the Croton Dam, from which the Old Aqueduct drew its water. Subsequently to that date various storage reservoirs have been formed across the different streams in the watershed, until at present there are eight in active use, with the total capacity of 40,500,000,000 gallons. Below these, two or three miles from the mouth of the river, is the great Croton Dam, to be completed in 1902, which will provide an additional storage capacity of 25,000,000,000 gallons. In the operation of the reservoirs the policy is to keep them full to the lips of the dams, only drawing upon the water thus stored on such days as the demands of the city exceed the flow of the Croton River. As the minimum average daily flow of the Croton River, in the driest of the last thirty-three years, was 250,000,000 gallons, and the daily consumption of water by the city is 98,000,000 gallons, it will be seen that there is an ample margin of supply over the demand. In the last report of the Department of Water Supply of the City of New York, it was stated that the department is prepared, in case of necessity, to deliver a daily water supply of 200,000,000 gallons for two hundred consecutive days, irrespective of the natural flow of the Croton River.

The supply of water for the Borough of the Bronx is derived from the Bronx River with a drainage area of 13⅝ square miles, and the Byram River with a drainage area of 8⅙ square miles, and the daily supply at present amounts to 14,000,000,000 per day from the former and 19,000,000 gallons per day from the Byram River. The water is conveyed to the city from the Croton watersheds by means of two aqueducts—the Old Aqueduct, with a capacity of 80,000,000 gallons per day, and the New Aqueduct, with a capacity of 300,000,000 gallons per day. The Bronx and the Byram Rivers conduits deliver 20,000,000 gallons per day, bringing up the total daily conduit capacity to 400,000,000 gallons.

The Borough of Brooklyn is supplied with water on an entirely different system from that in use for Manhattan and the Bronx, the difference being due to the topography of the watersheds and the intervening territory through which the supply is conveyed to the distributing systems. The New York supply flows by gravity from the source to the distributing mains, while only a portion of the Brooklyn system consists of a gravity supply, a large percentage being pumped into the conduits from wells and from bodies of water which lie below the level of the conduits. With a few exceptions the Borough of Brooklyn derives its entire water supply from a watershed within the boundaries of the county in the present Borough of Queens, which embraces the southerly slope of the central ridge of Long Island and the plains which extend south of it to the shores of Jamaica and Hempstead Bays. Its total area is 150 square miles. Within this area are located seventeen separate ponds or reservoirs for the storage of water, which have a total area of 491 acres and a total storage capacity of 1,283,000,000 gallons. During the last twelve years it has been necessary to supplement this water supply by means of wells and pumping plants, and these have grown so rapidly that at present there are sixteen stations which draw water from 963 wells of from 2 to 8 inches diameter. The total daily capacity of these wells is 57,500,000 gallons.

The avarage daily Brooklyn supply for the year 1898 was 93,573,500 gallons, while 10,500,000 gallons were received from private water companies of which the Long Island Water Company and the Flatbush Water Company are the most important. This makes a total supply of 104,073,500 gallons for a population of 1,179,100 souls, at the per capita consumption of 88·3 gallons.

Comparing now the water supply of Brooklyn with that of Manhattan and the Bronx, we find that in the latter borough the daily use of water rose to 243,000,000 gallons for a population of slightly over 2,000,000, or a consumption per capita per day of 121 gallons. To quote the words of the Department of Water Supply in their Annual Report, the Brooklyn rate of 88·3 gallons per capita "is very liberal and ample for all purpose of comfort, health and safety" the per capita consumption of 121 gallons of Manhattan and the Bronx being considered as "altogether extravagant and unnecessary," the department being of the opinion that "enormous quantities are carelessly and wantonly wasted without any possible benefit in any direction."

Manhattan and the Bronx, however, as we have seen, have a liberal margin to go upon, the average annual supply being 147,000,000,000 gallons, as against a consumption for the year 1899 of 92,000,000,000. In the Borough of Brooklyn, on the contrary, the per capita rate of consumption must necessarily be diminished, since the population will continue to grow whether extensions of the water system are made or not. The needs of the immediate future can be met by sinking additional wells at the existing pumping stations, by an increase in the capacity of pumping machinery, and by an enlargement of the conduits. The time, however, is not far distant when it will be necessary to acquire additional watershed area to meet the future growth of the borough.

The Borough of Queens is supplied from four public water plants with a combined daily capacity of 3,347,000 gallons, and about 1,500,000 gallons are supplied under a contract with the Citizens' Water Supply Company. The department is of the opinion that the anticipated growth of this borough will demand large additions to the present capacity of the water supply, proportionate and incident to the necessities for increasing the Brooklyn supply. As any additional supply for the Borough of Brooklyn will have to pass through the Borough of Queens, it will be advantageous to treat the two systems as one in any scheme of enlargement.

The problem in the Borough of Richmond, like that in the Borough of Queens, is, of course, relatively insignificant compared with that of the Bronx, Manhattan, and Brooklyn. There is one small public water plant at Tottenville with 1,000,000 gallons daily capacity. There are also two private water companies which, combined, are pumping a daily supply of 6,500,000 gallons. The problem of the future supply as regards this borough is not to be considered as pressing.

In summing up then, we find that Manhattan and the Bronx, with a daily per capita consumption greater probably than that of any city in the world, have still at command an annual surplus of supply over consumption of 67,000,000 gallons; while the Boroughs of Brooklyn and Queens are practically without reserve at the present consumption per capita of 83·3 gallons. No immediate anxiety need be felt for the future water supply of the Borough of Richmond. In a future issue we shall consider the notorious Ramapo scheme and its bearing upon the interests of the second greatest city in the world.

AMERICAN EXPERIMENT STATIONS AT THE PARIS EXPOSITION.

Among the many economic exhibitions that our government will make at Paris especial interest attaches to that of the United States Experiment Stations, from the fact that it will show the great progress made by them since the Paris Exposition of 1889, when the stations made only a small showing, as they were just beginning active operations under the Hatch Act. The arrangement and shipment of this exhibit, which has just been perfected was in charge of Dr. W. H. Evans, of the Office of Experiment Stations, at Washington, who also supervised the preparation of the charts and photographs exhibit, and will go to Paris to install the exhibit.

At their recent meeting in Minneapolis, in 1897, the Association of American Agricultural Colleges and Experiment Stations, adopted a resolution in favor of a co-operative experiment station exhibit at the Paris Exposition. A committee was placed in charge of the matter and the stations were invited to contribute materials and charts illustrating special features of their work and results, original pieces of apparatus, models, designs, etc. As prepared, this material was shipped to Dr. True, Director of the Office of Experiment Stations, in Washington, who made a collection of photographs and publications of the stations, a monograph on the experiment station enterprise of this country, and looked after the temporary installation of the exhibit and its final shipment.

This commendably comprehensive exhibit contains the following, among other features :

A photograph exhibit of about 750 selected pictures of station buildings, grounds, laboratories, apparatus, experimental plants, herds, and other features, and a collection of photographs of the station directors and staff members, mounted in groups on sheets of heavy cardboard, 22 by 28 inches, is displayed in portfolios of twenty-four each.

A series of root cages from the North Dakota station, shows the formation of the roots of maize, wheat, flax, and brome grass ; models of sweet potatoes, peppers, apples, and plums exhibited by the Iowa and Minnesota stations illustrate varietal differences ; and an exhibit of salt bush from the California station show species of proved value for strongly alkaline soils. Electrical devices for determining the salt content, temperature, and moisture content, and a series of samples illustrating the typical agricultural soils of the United States, represent the work of the Division of Soils of the United States Department of Agriculture. The California station sent six typical soils of that State, and specimens showing the results of mechanical analyses of each type of soil, and Hilgards' soil elutriator for mechanical analysis.

Animal and vegetable fats, chemically pure proteids separated from the seeds of various plants, a collection of one hundred weed seeds, an insect cabinet, a gas desiccator for drying hydrogen gas used in moisture determination, models of round and stave silos an apparatus for the rapid cooling of wines, a pressure apparatus for experiments with solution under very high pressure, a model of the Atwater-Rosa respiration calorimeter and a full-sized bomb calorimeter are included in the exhibit.

California furnishes an olive exhibit, of fifty samples of olive oils and over two hundred samples of olive pits used in the classification of varieties of olives ; and Alabama sends a collection of mounted specimens of cotton of seventy-two selected and cross-bred varieties.

Original apparatus for investigations in vegetable physiology are shown, including an auxanometer for experimental work on the rate of plant growth ; an apparatus for determining the rate of transpiration of plants, from the West Virginia station ; and a centrifuge, used to study the effect of gravity and centrifugal force upon germinating seeds, from the Indiana station.

A principal exhibit is that of the dairy industry, including cheese models from the New York State station, showing the effect of the fat content of the milk on the size of cheese produced; a collection of forty-eight cultures of dairy bacteria, from Connecticut; the original Babcock milk tester, two more modern forms of the apparatus for hand and power operation, with a complete collection of the apparatus used in the Babcock test. The Scovell milk-sampling tube, Wisconsin curd test, Marshall rennet test, acid bottles, and other minor apparatus are also included.

Irrigation, a subject to which this country has given much profitable attention, is represented by an exhibit of apparatus and models, containing a hydrophore to determine the amount of silt carried by water; a nilometer, used to measure the amount of water passing through streams, flumes, and ditches ; a current meter, water register, etc.

The enormous literature of the experiment station work, greater in extent than that of all other countries combined, is represented by a large number of charts and enlarged pictures showing the result of experiment station work on a wide range of subjects, a complete set of bound bulletins and reports numbering several hundred volumes, and many miscellaneous publications of the stations, together with over one hundred books on agricultural subjects written by station officers.

Even far away Hawaii comes in for its share of the honors, with an exhibit of samples of rocks, lavas, lava products, soils, varieties of sugar cane, and samples of agricultural products, such as coffee, rice, and sugar. In the breadth of its conception and its complete setting forth of the marvelous results attained in this country in one decade this exhibit is destined to be a revelation to students and economists from other lands.

AN ADMIRALTY BOARD FOR THE NAVY.

It is announced that in a few days there will be promulgated an order, signed by Secretary Long, which will create a board of officers of high rank, corresponding to the General Staff or Admiralty Board of European naval powers, with Admiral Dewey at its head. It is stated that this board will constitute a permanent strategic committee, whose duty it will be to maintain the navy at a high standard of efficiency, to arrange for home defence, and for the operation of our fleets, and in times of war to advise the government as to the proper strategy to be employed. The General Staff is to consist of six ex-officio members, all of them naval officers. At the head of it will be the Admiral of the navy. It will also include the Chief of the Bureau of Navigation, the Chief Intelligence Officer of the navy and his principal assistant, and the President of the War College and his principal assistant ; the three other members are to be officers of the grade of a commander or higher.

The General Staff must meet in Washington once a month, and twice in the year it must be in session for at least a week. It will be kept fully informed as to naval matters abroad, and it will be concerned with the considerations of plans to be carried out in the event of war with certain foreign nations. The General Staff is also expected to advise the Secretary of the Navy in matters pertaining to our naval establishment. While it will not supersede the Board of Construction, it will act in general along parallel lines and will consider and advise upon subjects dealt with by that Board. Our readers will see in the organization of the General Staff, the perpetuation in many respects of the functions of the Naval Ward Board of the late Spanish-American war. That, however, was a temporary organization; whereas the General Staff, by reason of its perfect familiarity with and study of possible problems which would arise in a naval war, would be in every way better furnished for the emergency than its predecessor.

THE NEW NAVAL PROGRAMME.

The most satisfactory feature in the naval programme agreed upon by the House Committee on Naval Affairs, is that the secretary is authorized to contract for armor plate at $545 a ton, for the purpose of completing the ships, the construction of which has been delayed by the unfortunate armor plate controversy. The amount required is 7,400 tons. It is very gratifying to see that there was a majority in the committee which was in agreement with the government experts in believing that it would be foolish policy for the government to undertake the construction of an armor plant, whose cost would not be less than $5,000,000. It was urged by these gentlemen that unless provision were made for supplying armor to the ships which are now awaiting it, it would be foolish to enter upon the construction of new ships, as an unarmored battleship was for purposes of active service worse than useless.

The committee is in favor of the construction of two new battleships and three armored cruisers of about the same size as those authorized in the naval programme of last year, and three protected cruisers. The battleships will be 13,000 to 14,000 tons and the armored cruisers about 1,000 tons less in displacement. The designs, as far as they were made known last year, appeared to be admirable in every respect, and ou. only regret is that the new programme does not call for twice as many of these ships as have been recommended. Of protected cruisers we can only say that we sincerely hope they will not be a repetition of the very inferior design represented by the "Denver" class. Sixteen-knot unarmored vessels may commend themselves as a profit-earning contract to the contractor, but for the practical purposes of a modern navy they will prove to be of very limited value.

The question of sheathing the new ships is left to the discretion of the Secretary of the Navy, and the important question of the construction of ships in the Government navy yards to which we made lengthy references in our last issue, was passed over. As the law requires the letting of contracts for new vessels to the lowest bidder, the matter as far as the House Committee on Naval Affairs is concerned, stands where it was. It will be necessary for the Secretary of the Navy to obtain specific authority before he can authorize a warship's construction in our navy yards. It will be remembered that the department was in favor of the construction of several gunboats, but owing largely to the recommendations of Admiral Dewey, who is opposed to the construction of gunboats and in favor of the construction of more battleships, the committee compromised the matter by reporting in favor of the battleships, as stated above, although more vessels of that type have not been recommended by the Department.

TONING LANTERN SLIDES AND BROMIDE PRINTS BY FERROCYANIDE OF COPPER.

Although the colors, various shades of black, produced by the ordinary development of lantern slides and bromide prints are so far satisfactory, it is apt to become monotonous when any considerable number is exhibited; and hence the desire, by some method of toning, to secure various shades of other and especially warmer colors.

Success in this direction has generally come through the use of some of the rarer metals, gold platinum iridium, uranium etc., although there always seems to have been a feeling that copper, itself one of the colored metals, should lend itself to a cheaper and probably better method than either of them.

It was easy enough to make the insoluble ferricyanide of copper, but the problem was to find a solvent by which it could be made and kept in solution so that the silver of the image could reduce it to an insoluble ferrocyanide, the coloring body, without at the same time staining the paper or acting on the gelatine.

And this has at last been accomplished. Mr. W. B. Ferguson, an accomplished chemist as well as a Q. C., after several years' experimenting, found the desired solvent in neutral potassic citrate, neutral citrate of potass, and at a recent meeting of the Royal Photographic Society, traced the devious paths through which he had been led to the desirable result; giving practical illustration of the ease by which prints could be toned to various colors from deep black to bright cherry red, the only modification being the time they were left in the solution; and showing lantern slides in all these colors. Through these paths it is needless to follow him, but it may be said at once that the discussion that followed showed that in the opinion of those present the method was the best, as it certainly is the cheapest that had yet been proposed.

The material, potassium citrate, copper sulphate, and potassium ferricyanide, is first made up into ten per cent solutions in which state they will keep indefintely, but should not be mixed until they are about to be used. The following is the formula, and the solutions must be mixed in the order prescribed :

Copper sulphate (10 per cent solution)	75 c.c.m.
Potassium citrate (neutral)	570 c.c.m.
Potassium ferricyanide	66 c.c.m.

Parts may be substituted for cubic centimeters by those who may not have metric measures, and if half drachms are taken for parts the result will be very close to the quantity prescribed.

To those having a doubt as to how best to set about making ten per cent solutions it will be sufficient to say, that as the dealers ounce contains 437·5 grains, all that is necessary to make that quantity into a ten per cent solution is to mark a bottle at the point reached by nine ounces and fifty minims of water, put the ounce into the bottle and fill with water to that point. Each measured minim of such a solution will contain one grain of the substance in solution. With liquids instead of solids, the bottle should be marked at the ten-ounce point, a measured ounce placed in the bottle and the bottle filled up to the mark with water.

In toning with this solution of cupric ferricyanide in potassium citrate, the soluble ferri salt is supposed to be by the action of silver of the image reduced to the insoluble ferro, which is deposited in situ; and being a bright red, the various shades of color arise from the black of the original image showing less and less through that red until it ceases to show at all. The method of toning is simplicity itself, all that is necessary being to place the developed fixed and washed slide or print in the solution and when the desired color has been reached, to wash in a few changes of water. After use the solution is thrown away.

DEATH OF A NOTED INVENTOR.

James G. Smith one of the pioneers of the telegraph died on March 13. He is best known for his invention in conjunction with Joseph B. Stearns of the duplex system of telegraphy. He was one of the first telegraph operators to receive by sound. He was born in New Hampshire in 1836. He served his apprenticeship under Joseph B. Stearns, and while in the office at Durham N. H., he took off by sound a three thousand word foreign news despatch for one of the local newspapers ; this feat brought him considerable fame. He started working the first repeaters in Utica, Cleveland, Louisville, and Pittsburg and during the Civil War was in charge of all dispatches going between New York and the South, and was virtually a government official. During the draft riots when his own telegraph lines were torn down, Mr. Smith was sent out with a force of picked men to keep the lines clear so that communication with Boston would not be cut off. He was connected with a large number of various telegraph companies and the duplex system which he invented in collaboration with Mr. Stearns was used on the line between Boston and New York, the company being known as the Franklin Company. Since 1885, Mr. Smith turned his attention to telephones entirely and the last days of his life were spent in working up patents and inventions in telephones.