Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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NEW YORK, SATURDAY, JANUARY 15, 1887.

Contents.

(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 576.

For the Week Ending January 15, 1887.

Price 10 cents. For sale by all newsdealers.

WAR AND INVENTION.

In view of the possibility—not to say strong probability—of war between two or more of the great European powers, it is desirable to note the immediate effect of such a war upon American interests. Its influence upon grain, stocks, petroleum, cotton, and manufactures will be, or has already been, discussed by the daily newspapers; but its importance to American inventors would be very great, and they will naturally be alert to take advantage of every opportunity if war should come. At first glance, a superficial thinker might imagine that war would interest a limited circle of inventors, those who deal with arms, ammunition, projectiles, great guns, armor, war ships, torpedoes, and similar weapons or defensive devices; but this would be taking a narrow view of the field open to the fertile inventor. Indeed, it is impossible, in the limits of a single article, to particularize and discuss the great array of devices with which the inventor could profitably deal just before and during a great war. It will be necessary, therefore, to treat the subject of war inventions under classified heads, and extend this article over more than one issue.

Of course, as the primary object of war is to overpower the enemy, and as that result is reached by killing or disabling men and by destroying fortifications, ships, railroads, and other important public property, the first place in war invention is properly given to engines of war, their equipment and their auxiliary attachments. Then would naturally follow the defensive class of inventions—forts, armor, floating batteries, and guns, carriages, and shields for barbor protection. But connected with these in operation, though not necessarily a part of them, are a thousand and one devices in almost every channel of inventive research; and doubtless it will be necessary to do little more than to suggest them, or to imply their want, to induce hundreds of active minds to follow up the suggestion to a practical and profitable result.

In arms, there is a pressing demand—hitherto only partly and unsatisfactorily filled—for magazine small arms. It is true that Germany has adopted the converted Mauser, and has armed a number of her troops therewith; that France has also manufactured several thousands of modified breech loaders; that Austria has appropriated about four millions for the conversion of her present breech loader into a magazine gun; and that Great Britain is only deterred from expending an enormous sum on magazine guns by the fact that no satisfactory arm has yet been presented to her, although a few thousands of the Martini-Henry have been altered to carry seven cartridges in the stock. But in all these countries, military experts unhesitatingly admit that, while it may be, and doubtless is, a necessity to manufacture some kind of a magazine gun in order to keep pace with their possible antagonists, it is a practical certainty that all the present issues will be recalled and replaced by a more perfect weapon as soon as it is invented.

The improvement of heavy ordnance, armor, shells and other projectiles, fuses, ammunition, and fortifications, offers a wide field. Similarly, the construction of ships, both armor-clads, fast cruisers, rams, torpedo craft, and floating batteries, presents opportunities for novel designs and valuable invention, such as could make the fortunes of scores of inventors. All the varieties of mechanical contrivance needed for driving and working ships, pumping, steering, lighting, handling shot, shell, and torpedoes, and loading and pointing the heavy guns—all these openings for inventive talent are made more accessible to inventors by the outbreak of a war.

Of course, attention is centered on explosive substances. While new combinations may be worked out to produce greater explosive effect with more certainty of safety to the operator, there are numerous improvements possible in our mode of treating those explosives already known. A great deal is yet uncertain as to the proper kind of charge of gunpowder for both ordnance and small arms. It is claimed that even in field pieces a considerable quantity of powder is blown out of the gun unconsumed, and therefore wasted. There are many experiments needed to determine the proper size of grain and quality of powder used, and also the weight of charge for given weights of projectile, diameters and lengths of barrel. For small arms the test under water seems to present the most uniform and otherwise most satisfactory conditions. A tank strongly built, 12 feet long, 2 feet wide, and 3 feet deep, would enable a careful experimenter to make innumerable comparisons, such as: With a given charge of powder, to determine the weight of ball that will have the greatest range; with a given ball, to determine the most effective weight of powder; with given charge and ball, to compare the range of different rifles; to compare different lengths of bore in the same rifle, varying the powder charge both in quantity and character until the best conditions for each arm and length of bore have been learned. These are only a few of the important tests that may be made.

The comfort and health of soldiers and sailors have become among the most important conditions of military and naval success. The healthy, well fed, and well clothed man will be effective at the end of a campaign, while the same amount of labor and hardship might kill or disable three men whose welfare had been neglected. Consequently, improved food and clothing will be readily adopted by military authorities. It is not to be expected that any one will try to invent or discover a food like Zucci's mysterious liquid, to sustain life without other sustenance; and the mere preservation of food is already brought to high perfection; but it is not impossible that a condensed, but palatable, food, of great nutritive value in proportion to its weight and bulk, would be acceptable to a war-making power for use on forced marches, especially now that promptness and speed are so important, and that the rapid moving of great bodies of men has been rendered so difficult by the necessity of moving their supplies with them. Equipments and accouterments are also susceptible of improvement. In the first two years of the civil war thirty-five patents were granted for inventions connected with the slinging of accouterments alone, but a great advance on those ideas is still possible.

It is a well known fact that inventions for preserving the health of the soldiers and sailors in war time have not kept pace with the devices for killing and wounding them. The application of sanitary laws to camps and ships may profitably be studied. The demand for all the articles needed in hospitals and on the field for the treatment of the wounded and the sick would be enormously increased by a general European war. Ambulances, stretchers, tourniquets, bandages, splints, surgical instruments, disinfectants, anæsthetics, and artificial limbs are a few of the subjects deserving attention.

The limited, yet important, use of the balloon during the Franco-Prussian war, 1870-71, showed that much might be expected of this machine in future wars. It is true that little progress toward perfection has been made, and the balloon to-day is but little better than in the days of Montgolfier and Pilatre de Rozier, about 100 years ago; but this fact is all the more reason for encouraging inventive genius to devote itself to the balloon, especially for use in war. In the Franco-Prussian war it was found that balloons could be penetrated by bullets at a height of 3,000 to 3,600 feet; but the escape of gas from one bullet hole was so slow that the balloon might descend several miles from where it was hit. At a height of about 8,000 feet the best shots failed to hit the balloon, and that height was regarded as sufficient to insure safety from an enemy on the ground. It is not improbable that late improved firearms, machineguns, and shell rockets would destroy a balloon, even at a higher elevation than 8,000 feet; and anyhow it would be easy to invent counter balloons for attacking observation balloons sent up by an enemy, or shell balloons sent up to drop enormous projectiles into camps and cities. Some such devices are sure to be used in any great war if they give a reasonable promise of effectiveness.

All kinds of successful signal plans will be required in war time. During our civil war the Signal Corps performed work whose importance has never been popularly known or appreciated. Thus, at Allatoona Pass, in 1864, when General Hood swung back upon General Sherman's line of communication between Nashville, Sherman's base of supplies, and Atlanta, his headquarters, there is no doubt that, but for the Signal Corps, the pass would have been taken and held in such force that Sherman's whole army might have been unable to carry it. The Confederates held every road to the north, and there was a mere corporal's guard at the pass, upon which they were rapidly moving. But from Kenesaw Mount to the next Union signal station, 15 miles to the northwest, the little signal flags flashed a message over the heads of the enemy to Rome, where General Corse's brigade was waiting orders. Corse reached the pass just in time to repel one of the most bloody assaults of the war, and Sherman's communications were saved. Thus the importance of accurate and improved signal work has been demonstrated.

(To be continued.)

PROMOTION BY SENIORITY.

Whether or no an officer should be promoted because of seniority or merit is a question which just now is attracting some attention in military circles; and justly, too, for, in the present attempt at reorganization of army and navy, it would seem essential that some reward be offered for efficiency and diligence. The necessity was long ago seen for offering to the men in the ranks of the army some inducement for the exhibition of zeal and soldierly qualities, and a law was passed making it possible for merit, regardless of length of service, to obtain a commission. But once an officer, nothing will avail, either in the army or navy, to press merit to the front. Capacity and industry may receive acknowledgment by detached and special service, just as favoritism or influence often brings a staff appointment; but when the service is performed, the officer returns to his old place, and waits to get from time what faithfulness has failed to secure.

Those familiar with the military or naval station will scarcely fail to have been struck with the relative difference in the capacity and performance of the various officers. One devotes all his spare time to the study of some special department of the art of war; let it be small arms, heavy guns, torpedoes, powder, propulsion of ships, construction of forts, or the like. Another, and perhaps his superior officer, does not do anything save what is actually required of him in the discharge of his duties. He cannot find the road to diligence himself, nor is willing to take it when it is pointed out by others. But if his commission antedates the commissions of those who do work, he is secure. Let him devote a modicum of time to his studies—just enough to pass a possible or pending examination for promotion—and they cannot hope to pass him.

The annals of the civil war clearly illustrate how pernicious is this system of promotion by priority. Regular officers, of high rank too, were constantly found incapable of important command. They were slow and often stupid, neither progressive nor alert; their chief ambition and occupation was to see that the ordinary routine of discipline was maintained, wholly forgetful that this was but secondary, and not the main object of keeping men afoot and ships afloat in time of war.

They could let an enemy escape or neglect to follow up an advantage, and lay themselves down to rest with ardent satisfaction that at least good order and military discipline was being observed throughout their commands; that aboard their ships the daily routine of detail and assignment was working smoothly, or in their camps that the proper disposition and alignment of tents was rigidly enforced.

There is another side, however, to this question of promotion by seniority, and one that should not be overlooked in its discussion. There are evils and abuses in the system of promotion by preferment quite as menacing, perhaps, as those which inhere in that of promotion by seniority. They are caused by favoritism and political influence. It is surely less disheartening to an officer, less demoralizing to a corps, to see merit go unrewarded than to witness incapacity go forward through the pressure of political "backing," or because of the whim or favoritism of a commanding officer. In the navy, because of the technicality of the duty, favoritism could perhaps do little to press incapables into important positions. It might serve to give them easy and pleasant posts, and that much it does at present; but in the army, promotion by seniority being displaced, influence and favoritism might, up to a certain point, lead to gross injustice, while yet its effects would scarcely be discernible, save to those immediately interested. As an example of this, a second lieutenant in the army might be jumped over the heads of several files of more efficient officers, and made a first lieutenant, without such change materially endangering the proper ordering of a company or of the regiment of which it formed a part. But should an incapable naval lieutenant be promoted to a position where he was called upon to exercise the functions of navigating or executive officer, his incapacity would be at once apparent, might imperil the safety of his ship, and could not, therefore, be endured.

It would seem as if some means might be found of promoting, and thus encouraging, the efficient and faithful and industrious officer, whether in the army or navy, and, at the same time, maintaining a safeguard against unjust discrimination. Then, even the boy who is at Annapolis or West Point, and who to-day has little to look forward to, might, if possessed of soldierly qualities, ambition, and ability, be enabled, before his hair has turned white with age, to make a name for himself, and there would be nothing left for indolent officers, whether old or young, but to apply themselves to their profession or leave it.

MAN AND THE WILD ANIMAL.

Those who have carefully observed the management of wild animals in menageries, zoological gardens, and in the pens of the animal dealers, must, at times, have been astonished at the ease with which hired men, comparatively unarmed, subdue beasts which we have been taught yield only to the blazing rifle, and fight gamely until death. A lion escapes from his cage, and crouches at the darkened end of the menagerie. Remembering the stories we have read of the ferocity of this beast and of the terrible scenes at the lion hunt, we can imagine only one mode of action. The keepers should arm themselves with rifles, hide behind barriers, and open a rapid fire upon him. To our surprise, they don't do this. They simply wheel a great cage up to him, fall upon him with clubs, and thrash away until he enters it.

A few weeks ago, an anaconda 17 feet long broke away while being carried across a public park in New York city. With vivid pictures of the exploits of this reptile in the Amazon watershed before our eyes, we expect to see him fall upon the nearest human being, infold him in his toils, and crush him to a jelly. Surely, it will take armed and resolute men to capture him! No; on the contrary, this is not required; and it must have been with a feeling akin to disappointment that those who had read of the ferocity of the anaconda saw one man, armed only with a blanket, advance and seize him by the throat, while two others, also unarmed, grasp his tail, and then the trio, still holding on, carry him through the streets and thrust him back into the den whence he had been taken.

Not long since, the writer saw Mr. Thomson, a dealer in live animals, open a box containing an anaconda, quite as long as this one, take the reptile by the throat, and calmly examine his mouth, opened though it was in rage, to look for cancerous humors. Then from adjoining shelves he took python after python, each about 10 feet long, and examined them in like manner. Only last week, at the place of another dealer (Reiche), a big, powerful Syrian bear, a type known for its ferocity, was subdued without the firing of a shot. The bear broke through iron bars half an inch thick, and, standing up with his back against a cage of monkeys, thrust his terrible paws threateningly toward three keepers gathered about him. He didn't have a chance to use them, however, for he was belabored with clubs until glad to get back again into his cage. On a pedestal near the gate of the Cincinnati Zoological Gardens, there recently stood the stuffed figure of a donkey which, when alive, withstood the attack of a lion and beat him off. The lion, it seems, had broken out of his cage and escaped to a wood near by. On a grassy hillock adjoining, a donkey lay stretched in placid slumber—a slumber that was rudely disturbed by the lion, who, in a few bounds, was upon him. When the donkey felt the great mass of flesh descend upon him as if from the clouds, he was stunned and indignant, but not frightened, perhaps because he had never read any of the wonderful stories about the lion. He quickly recovered from the blow, and, rising, shot out both hind feet at the same time, and caught the lion squarely in the forehead. Badly hurt, the lion skulked off, and later the donkey died of the wound he received at the onset.

PHOTOGRAPHIC NOTES.

Development of Dry Plate Lantern Slides.—Plates having a sensitometer register of 12 or 13 are mostly used for making lantern slides, and it is generally advised that they be developed with the ferrous oxalate, or more commonly called iron, developer, if clear high lights and a warm brown color is desired.

The use of the pyro developer is now so general for negatives that it affords a great convenience to the amateur in case it can also be employed for the development of transparencies.

It is only within a recent period that it has been recommended for this purpose, one method being the use of dry pyro in connection with sulphite and carbonate of soda.

From some experiments we have lately made, we have ascertained that it is possible to obtain lantern transparencies of superior merit very easily and quickly by using Beach's sulphurous acid pyro and potash solutions.

We repeat the formula as heretofore published:

No. 1.—PYRO SOLUTION.

Sulphite soda chem. pure	4 oz.
Warm distilled water	4 oz.

When cool to 70° Fah., add:

Sulphurous acid	3½ oz.

And finally:

Pyrogallol	1 oz.

No. 2.—POTASH SOLUTION.

A.	Carbonate of potash chem. pure	3 oz.
	Water	4 oz.
B.	Sulphite soda chem. pure	2 oz.
	Water	4 oz.

(437 grains to each ounce of salt.)

Combine A and B in one solution.

To develop four 3¼×4 lantern slide plates at one time, place them in a 6½×8½ developing tray, then prepare a developer as follows: 3 ounces of water and 40 minims of No. 1 and 80 minims of No. 2; flow it over the plates.

In the course of three or four minutes development will commence and the image will appear very slowly. Continue the development until the shadows look quite black, otherwise the plates will fix out too thin. In case the development hangs back, a few drops of the potash solution should be added.

If the exposure is correct, a clear, crisp, blackish brown transparency will result. The method we employed was to place the printing frame holding the sensitive plate in contact with the negative, at a distance of two feet from the flame of a one inch wick of a kerosene lamp, making an exposure of from 25 to 40 seconds, according to the density of the negative. No staining of the plate appeared, which indicated that as long as sufficient sulphite of soda is employed, the pyro stain will be prevented; no after clearing solution of citric acid or alum was used. Several plates may be developed successively in the same solution. After a slight washing, the developed plate is fixed in a saturated solution of fresh hypo, then washed in changing water for one hour and dried. After mounting, it is then ready to be shown in the lantern. The process as a whole is exceedingly simple, and affords a pleasant and profitable amusement for long winter evenings.

The Holyoke Dam.

In a recent number of the *Transactions* of the American Society of Civil Engineers, an elaborate illustrated paper is given by Mr. Clemens Herschell, a member, on the work done for preserving the dam at Holyoke, Mass., in 1885. The dam belongs to the Holyoke Water Power Company. The second and present dam at Holyoke, that succeeded the first construction, which gave way in 1848, was begun and finished a year later. The length is 1,017 ft., or one-fifth of a mile. At the end are abutments of heavy masonry, between which the dam is composed of heavy timbers, which are built up so as to present on the upper side a surface of plank at an angle of 21 degrees 45 minutes to the water. The timbers, which cross the river transversely, are supported by other timbers at right angles, arranged in 170 sections, 6 ft. apart. The ends of these sloping timbers are spiked to the solid rock at the bottom of the river with 1¼ in. iron bolts, and 4,000,000 ft. of timber are contained in the structure, which, being under water, is protected from decay.

Gravel was filled in and pounded down at the foot of dam, which is protected also by concrete. The open spaces were packed solidly with stone to the height of 10 ft. The height of dam vertically is 30 ft. The sloped top is planked to a thickness of 18 in., in three layers of 6 in., all spiked and bound together. The rolling top or combing was covered with sheets of boiler plate extending the whole length of dam. The graveling on the bed of river begins 70 ft. above the dam, and is carried over 30 ft. of the sloping surface, which is 92 ft. in length from the foot to the crest.

A section of the structure shows the transverse and sloping timbers, and the filling of stone, and a description is given of the experiences of 1849 to 1868, and of the damaging effect of the falling water over the dam, which reached 12½ ft. in 1862. The fall of such a volume of water for 30 ft. naturally cut a seam in the layers of rock, and the falling over of logs of timber and ice did serious damage to the foundation and structure of the face of dam. It was found on inspection that the ledge had been washed out in places to a considerable depth, and caused the dam to be seriously undermined and the timbers to give way. To remedy these defects, an apron was built on the down stream in section exceeding the old dam. It was built of round logs laid up in perpendicular bins, 6 ft. square, and filled up to the top with stone, and covered at the sloped top with maple, beech, and other hard wood planks, 6 in. thick. The lower courses were built afloat, and in sections 150 ft. long, fitted to the irregular bottom of the river, and sunk by loading with stone. The effect of the apron has been to prevent further undermining action next the heel of the dam, though a new pool was formed below the dam.

The author goes on to describe the breaks in the crest of dam and the cribs used for repairing them. These cribs were sunk so as to inclose the breaks in the plank covering of dams, and consisted of boxes without top or bottom, the under side cut off on a level to fit the back of dam. Sketches of the large 40 ft. by 45 ft. crib used in 1884 to cover a hole in the dam are given. These are framed together with upright and horizontal pieces planked over.

The author describes other plans to meet breaks in the dam covering by subcutaneous injection of gravel, and the use of coffer dams to reach the crest of dam, by which means a length of a hundred feet, 20 ft. wide, could be laid dry. Drawings of the coffer dams used, a design for a stone dam, and several photographic views illustrate the work.

The Green Ray.

The green ray is a flash of emerald colored light, said to be observed sometimes for a second or half a second at the moment the sun's disk disappears below the horizon, and just when one sees only a very small segment of its surface. Tourists in Egypt and the Red Sea testify to the phenomenon. Some consider it objective, and others believe it to be subjective. According to a letter of M. De Maubeuge to M. Mascart, the well known French physicist, the phenomenon has been several times observed in the Red Sea at the rising of the sun. M. De Maubeuge particularly noticed it, he states, in October, and the first impression of his eye and that of his assistant was a beautiful emerald green. He has also seen it at sunrises behind mountains elevated from 1 deg. to 2 deg. above the horizon. These observations tend to prove that it is an objective phenomenon. He has also observed it at the setting of the sun. There was not the least cloud between the orb and spectator, and the air was pure, but humid. The same phenomenon has not been observed by him from the moon, Venus, or any star, although he has often looked for it in the tropics.