reason that when a body is suddenly set free from the outer edge of a revolving disk or carriage, that body, owing to the centripetal force, will follow a curved path, therefore, the projectile carriers are mounted to admit of a certain amount of outward play in order to counteract to a certain extent their tendency toward a curvilinear trajectory. The gun can be used as a mortar for high angle fire or close siege work, and is also adapted for long range. The journals on each side of the wheels are provided with flanges and concentric disks (see Fig. 2) which revolve on sleeves extending on the inside of the journals. These concentric disks have the firing bolts attached to the peripheries (see Fig. 5); and they are adjusted by caps and set screws to the journal flanges, the whole being surrounded by an annular rim, indexed with the degrees of two quadrants, so that by adjustment of the concentric disks, the alidades attached to the sleeves through which the firing bolts slide will point to the degrees of elevation or depression desired.

The gun can be discharged at any angle in the vertical plane, while the arc of fire in the horizontal plane is the same as in any other piece of ordnance. The tripping device on the rotary disk is arranged in such a way that the shell can be discharged at the point previously fixed upon; this being entirely arranged before discharge by the position of the quadrant. The tripping devices for two of the carriers are located upon the right hand disk, and those for the other two carriers on the left hand disk, whereby two of the shells may be discharged at a time, the other two being left in the carrier until it is desirable to discharge them. The four shells may be discharged in rapid succession, and the trajectory of each being practically identical, each successive shot will add to the destruction done by the preceding one. One peculiarity of the gun or engine, as it might perhaps more properly be called, is its comparative noiselessness. There being no expansion of gases and no vacuum, there is no report of any kind, the only sound being the whiz of the shell as it passes through the air. There is neither flash nor smoke, report nor recoil, and there is nothing to apprise an enemy of the whereabouts of the gun, and the destroyer might come in the midst of an enemy unseen and unheard. It is hoped that a thorough trial of this new gun will be made, from which data may be obtained concerning the efficiency, range, and practicability of this as a weapon of warfare.

The combination shot and shell designed to be used in this engine is of regulation shape, having a solid steel head for the purpose of producing the greatest penetration upon impact. It is provided with a steel rod or precussion striker, extending through the center, one end of which is adjusted in the apex of the ogival head, while the other end rests against a precussion primer, which upon impact explodes the charge of explosive, thereby producing a double blow by impact of the shot and by the subsequent explosion.

The shot can also be exploded submarine, being provided with a device which will produce an explosion in case the target should be missed. Should that target be a ship, that effect would thus not be wholly lost.

Finish for Redwood.

A prominent dealer in redwood supplies the following formula and directions for treating redwood finish. We understand it is a practice that has been indorsed by successful experience in San Francisco. Take 1 quart spirits of turpentine, add 1 pound corn starch, add ¼ pound burnt sienna, add 1 tablespoonful raw linseed oil, add tablespoonful of brown japan. Mix thoroughly, apply with a brush, let it stand say fifteen minutes, rub off all you can with fine shavings or a soft rag, then let it stand at least twenty-four hours that it may sink into and harden the fibers of the wood; afterward apply two coats of white shellac, rub down well with fine flint paper, then put on from two to five coats best polishing varnish; after it is well dried rub with water and pumice stone ground very fine, stand a day to dry; after being washed clean with chamois, rub with water and rotten stone, dry, wash as before, clean, and rub with olive oil until dry. Some use cork for sandpapering and polishing, but a smooth block of hard wood like maple is better when treated in this way. Redwood, according to a Californian's idea, will be found the peer of any wood for real beauty and life as a house trim or finish.

Lighting by Means of Accumulators.

At Springfield, Mass., the electric light company have recently put into their works on Taylor Street the system of the Electrical Accumulator Company, of New York, composed of 378 large cells, which take up a floor space of about 20 by 15 feet, and they stand about 8 feet high. The company are able to store electricity enough in the accumulators to run 500 lights ten hours. In this way they are able to do more work with the same amount of engine power, as the engines can be used to store up electricity during the day for use in the night, and then the same motive power can be used to propel the arc dynamos at night.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 678.

For the Week Ending December 29, 1888.

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DOGS THAT LEARN TRADES.

The dog corps, long since established in the French army, has been recently much increased, so efficient have these little soldiers become. At an early stage of the trials they gave satisfaction as advanced posts, scenting or hearing a stranger approaching even in the darkness, and quickly learning the difference between a friendly and a foreign uniform. The latest trick the military dog has learned is that of carrying dispatches between distant sections of an army or reliefs or re-enforcements presumably advancing through hostile country. The system is an offshoot of the dog smuggler system, which is described in the current number of *Blackwood's*, and the steps by which the animals are taught to understand what is wanted of them are best shown by reference to that article.

The smuggler in broad day walks across the frontier, his dog by his side, leaving the latter at the house of his accomplice and returning without him. When night falls, the dog is given a beating and turned loose to find his way home. Next he has a small packet fastened to his collar, and gradually the burden is increased. Then half a dozen or more are employed at the same time; the most intelligent being given no burden, that he may the more readily act as a scout for the others. He goes ahead, they keeping well back, till he gives them the signal that the coast is clear. The customs dog from its earliest years is made to play hide and seek with bags of coffee, rolls of lace, packages of tobacco, and the like. They do not bark, being taught to sit silently in ambush and give a low growl or simply cock up their ears and point the true direction of the advancing pack.

The French army dogs, mastiffs, like the smugglers' dogs, though first they must be taken from point to point to find them again, when they get to understand the idea, and what is wanted of them, will find a distant column or command with little difficulty if given the general direction, unless it be at too great a distance, and carry messages to and fro with commendable zeal.

"A POSSIBLE REVOLUTION IN MEDICINE."

Most people have read of the bacteria and of the discoveries concerning them made by Pasteur and Koch. The subject seems generally to be regarded as belonging to the doctors—an interesting phase of the progress of our time and something for students to sit up late over, but not directly interesting to lay minds. This seems to be a grave error, for, in a recent paper on "A Possible Revolution," Dr. Austin Flint says that by a knowledge of the bacteria nearly all human ills of a physical nature may be cured or prevented. Hence there is no secular subject that may fairly be looked upon as more engaging and timely. Slowly, but surely, there is working a revolution in the science and practice of medicine and surgery. He thinks a time will come when the cause will be known of every infectious disease; when they will be preventable, or having broken out, will be easily curable; and, best of all, when it will be possible for the intelligent physician to afford protection against all such diseases as scarlet fever, measles, yellow fever, whooping cough, etc.

Indeed, there need not be any epidemics, and even constitutional diseases will be curable if only the progress in the science of bacteriology should go on at the present rate, because, in a figure which the Doctor borrows from the French, "The higher one ascends, the further off seems the horizon." That is to say, the further we go in bacteriology, the greater appears the promise. In the last few years there has been a really remarkable advance, "an evolution of knowledge," the author calls it. There is "Pasteur's work with the fermentations, his discovery of the microbe which breeds in the silkworm a peculiar disease, and especially the isolation of the microbe of the carbuncular disease of sheep—which sometimes attacks man. These give a powerful impulse to the study of bacteriology." Koch's part in the bacteriological era would seem, from what our author says, to be somewhat similar to that of Ampere in electro-magnetism; he supplemented Pasteur's discovery, as Ampere did Oersted's.

Bacteria, which are now known to be vegetable and not animal growths, are to be found in large numbers in the intestines even of the most healthy, and it is in knowing the nature and habit of these that will enable the student to prevent their inroads when the condition of the system leaves it disarmed. Even now, so we are told, consumption can no longer be called incurable, fermentive indigestions are successfully treated by means of a class of remedies known as disinfectants. In many of the skin diseases is found an organism at work; in diphtheria the germs are at work in the mucous membrane. In both cases the physician now addresses himself particularly to dealing with these germs. Among the diseases in which, our author says, the presence of bacteria has already been surely traced, and their influence depressed or destroyed, to the relief or cure of the patient, are: Tuberculosis, diphtheria, typhoid fever, yellow fever, relapsing fever, the malarial fevers, certain catarrhs, tetanus, nearly all contagious and skin diseases.

The Scientific American for 1889.

READ WHAT THE PUBLISHERS SAY.

The increasing circulation of the SCIENTIFIC AMERICAN enables the publishers to improve the paper every year, while the subscription rates are kept at the lowest possible figure. The year just closing bears witness to these facts; and with a still further increase of patrons for the coming year, which we are encouraged to expect, still greater improvement may be expected. We look upon our readers as our friends, for whom we are willing to devote our time and our best energies, and for enquirers through our "Notes and Queries" column we do incur large expense to secure accurate information. The recipes and directions offer practical hints in engineering and physics and in every department of science. The large number of beautiful wood engravings which embellish each number of this paper speak for themselves; in fact, our tens of thousands of regular patrons, some of whom have taken the SCIENTIFIC AMERICAN from its infancy, more than 40 years ago, know without being told how the quality of the paper has advanced with its years, until it has attained an eminence and circulation to which none other of its class at home or abroad approximates. We would remind our readers that this number closes a volume, and with it the subscription of several thousands of our patrons expires, and before the end of another week we trust that every one will not only renew his own subscription, but include some friend, the manager of his works, some worthy employe, an apprentice, or some bright boy who has a taste for mechanics or some special department of science. It will make a useful as well as an acceptable New Year's gift, and the recipient every week for a whole year will be reminded of the donor's good deed, and will, undoubtedly, be a more intelligent and better man from the instruction he will derive from its weekly perusal. Price only $3 a year, and for so small a sum we shall feel disappointed if several thousand more names are not entered on our subscription books for 1889 than were recorded in 1888.

Bursting of the New Steel Gun.

Before this gun was tested I predicted that it or any other cast steel gun would be a failure. My reasons for this were that no cast steel gun could be made that the metal would be of regular tension. In 1869 I visited the steel works of Mr. Krupp, in Essen, Prussia, where I was at that time fortunate enough to see them forging the largest ingot of steel that, up to that time, had ever been made in the world. It weighed 82,500 pounds, and was being forged under the then largest and heaviest steam hammer ever made, the hammer of which alone weighed more than 50 tons, and struck a blow of more than 100,000 tons; when forged, one-third of the upper or pipe end of the steel was cut off.

Mr. Krupp explained that no mass of molten metal of near that size would be of uniform tension when cooled, because the outside must cool faster than the center, and shrink on it like a band shrunk on it. Then the center shrinks from that in cooling. He also said that, in order to forge the steel for a gun, it was necessary that a steam hammer be of sufficient weight to move the metal clear to the very center at every blow in order to leave it of uniform tension; that if a hammer that was itself too light, in forging that the outside would be enlarged more than the center, and it would be also of unequal tension.

During the war I lived in Trenton, N. J. At that time a gentleman, then living in New York, received an order for a cast iron cannon to be of 8 inch bore. The cannon was constructed with deep spiral ribs extending around the breech, and it was of immense weight. It was taken about three miles below Trenton in a dugout made by the Camden and Amboy Railroad Company for a fill in building the road. It burst at the first charge, the breech going into three pieces, one, weighing many tons, more than half a mile into an oat field. I was on the ground on the Sunday after and saw the wreck.

During the war I was in Washington, and in front of the war department building was a Rodney gun. It was a gun made by shrinking rings over the breech to a little below the charge. While I stood there, among numerous other curious visitors, and all apparently admiring the gun, Fred Sickles, of Sickles cut-off, came up and looked it over. A gentleman in the crowd said: "Mr. Sickles, what do you think of it?" Said he, "Well, it will never stand seven charges. It will crystallize by unequal tension right where the rings terminate."

I had the curiosity to watch the result of the first Rodney gun. It was put on the Naugatuck and burst, just as Sickles said it would, at the fifth round.

I am, therefore, of opinion that no cast gun will ever be a success. Failure will not be in consequence of imperfect annealing, but of improper tension.

J. E. EMERSON.

Collisions in Fogs.

In his annual report to the National Board of Steam Navigation, President Cheney shows that there were in 1887, 84 casualties to vessels from collisions in fogs; 100 in 1886, 120 in 1885, 92 in 1884, and 59 in 1883. He gives a statement by Captain H. C. Taylor, U. S. Navy, who says:

The general idea on shore and among seafaring people who do not reflect and observe closely is that, if you are going slower, you can stop easier; if going at a high rate of speed, it takes longer; but the real fact is that, for all purposes of avoiding impending collisions, it is impossible to stop at all when at high speed, within any period needed to avoid collision.

Those who have practically tried it, know that when a large seagoing vessel is rushing through the water 12 or 13 knot speed, that the first effect of the propeller or paddle wheels backing is in no way perceptible. The momentum of the ship begins to be lost by the natural resistance of the water, and when checked somewhat, the effect of the screw commences to be felt, and not before. No heavy vessels (whose momentum becomes so great as their speed increases) should go more than six knots per hour in a thick fog, if they hope to avoid collision; and a speed of eight to nine knots renders avoidance impossible.

The investigations and experiments of Captain Colomb, R.N., with many steam screw vessels, of different size, and moving at different speed, show that the average distance in which a steamer will stop after suddenly reversing the engines is four and one-half times the ship's length.

Some experiments made with the SS. Aurania, 480 feet long, and moving at a speed of thirteen knots, showed that she came to a dead stop in three and six-tenths times her length, after reversal of the engines.

The case of the Aurania is a very favorable one, and indicates that, though not at full speed, she stopped in one-third (1,728 feet) of a mile. All of us who are familiar with thick fogs will realize the uselessness of stopping only after one-third of a mile has been covered.

Experiments with the SS. Oregon gave the same results; the time to come to a dead stop being 3 minutes and 59 seconds.

The mean results of many trials with different sized vessels, and moving at different speeds, show that to stop a vessel in the shortest possible space, the helm should be put hard over the instant the engines are reversed. If this is done, the vessel will lose way and come to a state of rest when she has changed her heading four points. She will then have moved ahead a little less than *three times her length*, and will have transferred *one length*; that is, her stern will be just clear of her original course.

The dragging action of the rudder, as mentioned above, is well known to all seafaring people, and can generally be utilized to avoid collision, unless danger exists on both bows. But we must remember that the above results were obtained largely in quiet weather and smooth water; and a strong breeze or rough sea is liable to alter the above results as to the movement of the ship's head.

Manufacture of Hydraulic Cement.

According to Dr. Michaelis, the foremost cement expert now living, the raw materials, when dried at 212° F., consist essentially of 75 to 79 percentum (by weight) of carbonate of lime and 24 to 20 per cent of silicate of alumina (clay). These, when burned, represent 62½ to 67 per cent of lime and 33½ to 29 per cent of silicates (silica, alumina, oxide of iron), leaving 4 per cent for accessories. After the hardening of the hydrated cement, a transformation, by complicated reactions, has taken place into hydrated silicate of lime, as the most important ingredient, in hydrated aluminate of lime, ferruginous lime, hydrate of lime, basic sulphate of lime, and carbonate of lime.

Some of the phases during the burning, as well as during the hardening process, are of interest and importance.

The constituents being pulverized are mixed into a homogeneous paste, balled, dried, and burned by exposure to a quick white heat, equal to the melting point of wrought iron. This causes first the expulsion of the chemically bound water and carbonic acid, and next a softening of the whole mixture. During the calcination alumina and oxide of iron, which acted in the clay as bases, assume the role of acids toward the lime, the calcined oxide of iron acting as a flux in the fire. A preponderance of alumina favors the production of a quick-setting cement, while an increase of iron has the opposite effect, since it arrests the eager absorption of water by the lime, which causes it to swell.

When partial vitrification sets in the heat is promptly stopped, since a higher heat or a continued oxidizing heat of the normal temperature will ruin the cement, which now requires rapid cooling as much as it did a quick heat before. At this stage the softened lime is alloyed with the softened clay, while neither is in fusion yet. A disposition for the formation of new combinations of lime, with silica, alumina, and oxide of iron, is induced without allowing these nascent combinations to be fully consummated, because they, as crystalline bodies, would impede the subsequent hydration and the dense interlocking of the molecules during the setting or crystallization processes. Under these conditions the lime, though not chemically combined, is engaged and kept out of harm's way.

The high temperature of the kiln has gradually condensed the mass and most prominently the silica. The globular texture attained in moderate heat was simultaneously transformed into a laminated semi-vitreous texture.

The Portland cement owes its high reputation largely to such physical changes. Globular texture makes contact by points, while laminated texture achieves more intimate contact by surfaces. In our case it secures in strata of height 50 per cent more cementing substance than a mass of globular particles.

This close packing intensifies cohesion, of which the high tensile strength is the exponent. After cooling the clinkers are ground to impalpable, dense, drossy, steel-hard powder, having a specific gravity of 3·0 to 3·15. A few weeks' storage seasons the product and makes it ready for use.

Manufactures in Japanese Prisons.

A visitor to a Japanese prison in Tokio thus recounts, in the *Pottery Gazette* (London), a portion of his experiences: Then we visited a workshop where *jinrikishas* were being made, then one where umbrella handles were being elaborately carved, then one where every kind of pottery, from the rough porous bottle and jar to the egg-shell teacup, was rolling from a dozen potters' wheels, and then came the great surprise. Two days previous I had visited the house of the most famous maker in Japan of the exquisite *cloisonne* ware—the enamel in inlaid metal work upon copper—who rivals in everlasting materials the brush of Turner with his pigments and the pencil of Alma Tadema with his strips of metal. And I had stood for an hour behind him and his pupils, marveling that the human eye could become so accurate, and the human hand so steady, and the human heart so patient. Yet I give my word that here in the prison at Ishikawa sat not six but sixty men, common thieves and burglars and peace breakers, who knew no more about *cloisonne* before they were sentenced than a Hindoo knows about skates, doing just the same thing—cutting by eye-measurement only the tiny strips of copper to make the outline of a bird's beak, or the shading of his wing, or the articulations of his toe, sticking these upon the rounded surface of the copper vase, filling up the interstices with pigment, coat upon coat, and fixing and filing and polishing it until the finished work was so true and so delicate and so beautiful that nothing except an occasional greater dignity and breadth of design marked the art of the freeman from that of the convict, *C'etait a ne pas y croire*—one simply stood and refused to believe one's eyes. Fancy the attempt to teach such a thing at Pentonville or Dartmoor or Sing Sing! When our criminal reaches his prison home in Tokio, he is taught to do that at which the limit of his natural faculties is reached. If he can make *cloisonne*, well and good; if not, perhaps he can carve wood or make pottery; if not these, then he can make fans or umbrellas or basket work. If he is not up to any of these, then he can make paper, or set type, or cast brass, or do carpentering. If the limit is still too high for him, down he goes to the rice mill, and seesaws all day long upon a balanced beam, first raising the stone-weighted end, and then letting it down with a great flop into a mortar of rice. But if he cannot even accomplish this poor task regularly, he is given a hammer, and left to break stones under a shed with the twenty-nine other men out of 2,000 who could not learn anything else.

Amphibian of the Coal Period.

Professor Bickmore, in a recent lecture on "The Period of Reptiles and Mammals," in the Museum of Natural History, this city, presented on a screen illustrations of the footprints of one of the amphibians of the coal period. The illustration was a drawing from the great slab of bluestone which belongs to the museum, and was taken from the stone quarry at Turner's Falls, Mass. The animal itself, Mr. Bickmore explained, was one of those which roamed in great numbers along the Connecticut Valley during the carboniferous period. This one had left its footprints in the mud, and the impression having been subsequently filled with sand, the cast was preserved when the clay became hardened into stone.

From fossils of the animal, which have been obtained in other portions of the valley, it appears to have had an elongated body, about fourteen feet long, on four legs. It moved mainly on the hind feet, the fore legs being shorter, and lived partly in the water and partly on the banks of the stream.