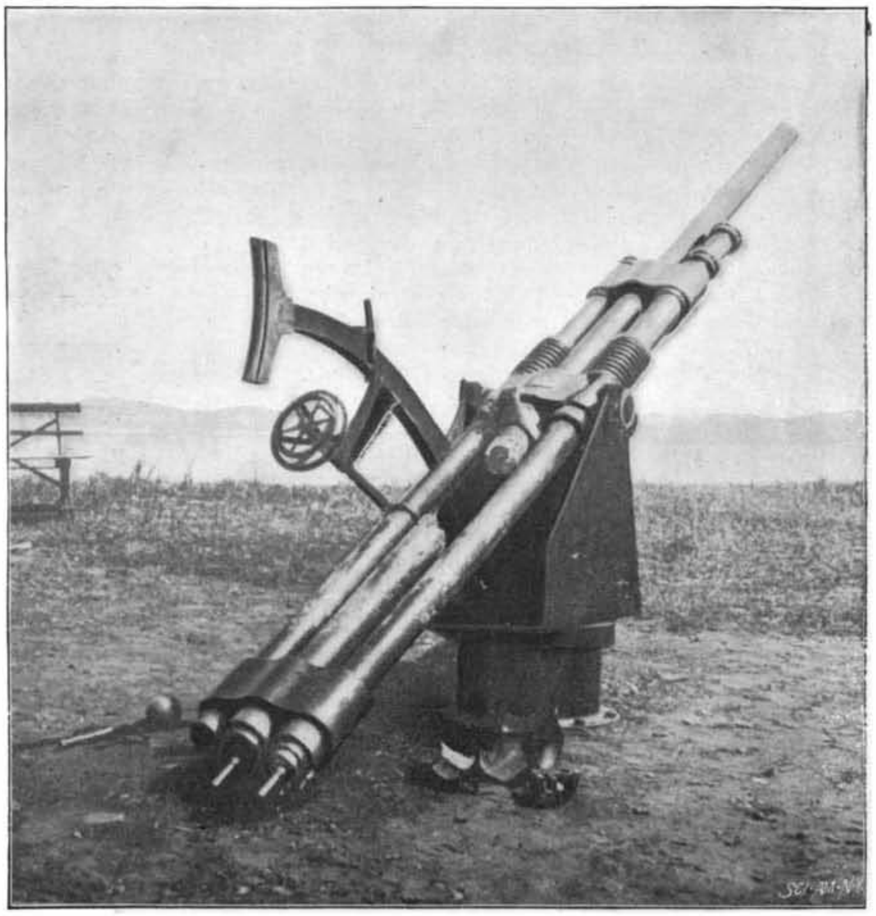
THE DUDLEY POWDER PNEUMATIC GUN.

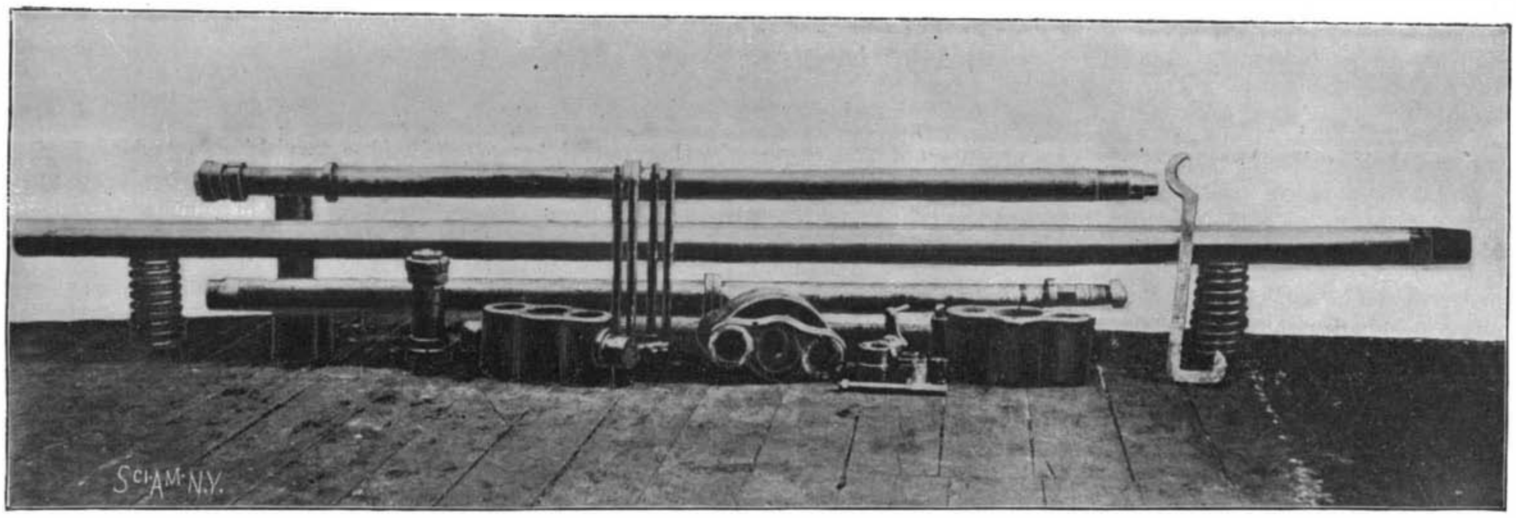
The SCIENTIFIC AMERICAN has given considerable attention in the past to the development of the pneumatic gun. A weapon adapted for aerial torpedo practice, one which could place with reasonable accuracy a torpedo containing from one to five hundred pounds of high explosive at any point within a radius of two miles, appeared destined to be a very effective weapon, especially for coast defense. The principal objection to the pneumatic gun was the extensive air-compressing plant required to operate it. The gun itself in lightness and simplicity was all that could be desired, but it was not self-contained. The Dudley powder pneumatic gun, manufactured by the Sims-Dudley Defense Company, of this city, has recently been brought to the attention of the public by a recent trial, in the course of which unfortunately a premature explosion of the shell took place. The trial was entirely successful, and the only effect of the accident was the bringing about of the abandonment of the type of fuse in use on the particular shell which exploded.

The Dudley gun operates on the pneumatic principle, but its air pressure is produced by the explosion of gunpowder, no air-compressing plant being required, so that the gun is self-contained and is a complete weapon. Two of our illustrations show various views of the gun mounted and ready for use, and one shows the parts of the gun disassembled. The heaviest

THE DUDLEY PNEUMATIC GUN—VIEW OF THE BREECH MECHANISM.



THE DUDLEY GUN AFTER THE EXPLOSION.



THE DUDLEY PNEUMATIC GUN TAKEN APART.

SIGHTING WITH THE DUDLEY PNEUMATIC GUN.

piece in a four inch gun weighs only two hundred and fifty pounds. This fact, in connection with the fewness of parts, so strikingly shown in the last named cut, gives an idea of the simplicity and practicability of the piece. The general features of its construction are these.

Three tubes constitute the principal elements. These lie parallel to each other side by side, as shown in the illustrations. The long central tube is the firing tube, and is the piece which weighs 250 pounds. The two side tubes are connected by an air passage at their forward ends, which ends are closed. The rear end of the left hand tube, also closed, is connected to the rear end of the central barrel or firing tube. The right hand tube and the firing tube have breech mechanism like that of a breech loading rifle.

The action and manipulation of the piece is simplicity itself. A metallic powder cartridge is inserted into the rear end of the right hand tube and its breech is closed. A torpedo is placed in the central tube, whose breech is then closed. The powder is fired. The air in the tubes is compressed by the gases generated from the explosion, the pressure rising to 850 pounds. The force of the explosion, cushioned by the two columns of air intervening between the powder and the projectile in the central tube, acts upon the projectile. With a slight noise and without a particle of smoke or flame the projectile is driven out of the barrel and passes smoothly through its trajectory. About the same effect is attained as with the regular pneumatic gun. The extensive air-compressing plant of the latter is, in the case of the Dudley gun, represented by a simple blank cartridge.

The recoil of the piece is comparatively slight, and springs are provided to take it up. The gun experimented with is of four inch caliber, and with its mount weighs 2000 pounds, the mount alone weighing 750 pounds. The side tubes are three inches in diameter. Over 160 rounds had been fired from it up to the day of the accident, and after all this practice there is a noticeable absence of fouling. Fifteen ounces of Dupont square scale smokeless powder form the charge. The projectiles are of the familiar type used with the original dynamite gun. The body of the shell is a brass cylinder with pointed ends. To its front is attached the fuse; from its rear a tail piece extends which carries rings or vanes set at an angle so as to insure rotation. The entire shell, tail piece and all, is 52 inches long and fully charged weighs 32 pounds. In the main body, the brass cylinder just alluded to, the charge of nitroglycerine explosive is placed. In the forward end of the charge and inclosed in a metal case there is embedded a detonating charge of guncotton. In the center of the guncotton is a cylindrical case of fulminating mercury.

The Merriam fuse operates by inertia or by direct impact. If the shell strikes the water, the inertia operates the ignition. A steel ball within it is driven forward, owing to the retardation of the motion; and the ball by striking causes the detonation of one or more percussion caps, three being used to insure firing. The ignition of a tube of slow burning powder is thus effected, which communicates with the fulminating mercury and so explodes successively the guncotton and the main explosive in the shell The period of the explosion is determined by the slow burning powder; by altering it the time element can be regulated with the greatest accuracy.

For attack upon armor, instant detonation is required, and this is secured on the direct impact principle, by crushing in of the head, and the driving back of one to three firing pins, which ignite quick burning powder, the fulminate, the gun cotton and the main explosive in instantaneous succession.

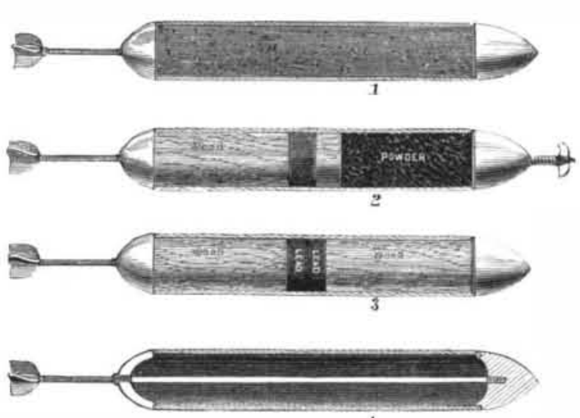
The element of safety is introduced in the Merriam fuse by a little windmill or vane on the front of the fuse. This is inclosed in a recess, whence it escapes as the shell leaves the gun, and instantly begins to turn, actuating a screw which has been screwed down upon the firing ball. After the shell has traveled a few hundred feet, the ball is free to work the instant the shell is arrested in its flight.

The shells are shown in one of the cuts. Fig. 1 shows the service shell packed with high explosive, the fuse vane being concealed within the forward cone. The rear cone is of aluminum. Fig. 2 shows a practice cone charged with gunpowder, lead ballasted, and with the fuse vane shown projecting from its forward end. It was with a shell of this type that the accident occurred. Figs. 3 and 4 are simple non-explosive practice shells, one of wood, the other of metal. The ballasting of the projectiles is of the greatest importance, as their steadiness of flight depends on the center of gravity being in a definite place.

The shell is placed in the tube without any sabot or packing, and it can be thrown about a mile and a half. The sighting mechanism operates with a level sight line, the elevation of the gun not affecting the line of sight. A fixed pressure, and consequently fixed initial velocity of about 700 feet, is employed, the range being determined by elevation. At near ranges a slight elevation with ensuing low trajectory is used.

The gun was tested at Mattinicock Point on Long Island Sound on Monday, April 13, in the presence of General Nelson A. Miles, U. S. A., and of a very distinguished gathering. Five shots were fired into the water with fine effect in three which were charged with 92 per cent explosive. These were exploded successfully by Merriam fuses.

Target practice with dummy shells loaded with four pounds of gunpowder and with different fuses came next, in the course of which one of the shells exploded in the gun, blowing out a piece of the firing tube and slightly wounding two of those present. Had the premature explosion occurred with one of the fully charged shells, the results would have been most disastrous. As it is, the accident will simply lead to the discarding of the type of fuse which seems to have



THE PROJECTILES FOR THE DUDLEY GUN.

brought about the accident. One of our views shows the gun after the disaster, with a piece blown out of the central section of its firing tube.

A feature of the gun is the slight recoil, and consequently slight foundation needed to carry it. A couple of timbers to which the standard is bolted are ample. It could be established on a ship's deck without any additional bracing being required, and its simplicity and lightness of parts adapts it for field use. It places the pneumatic gun on a par with field artillery, something hitherto not effected.

Semi-Precious Stones.

Mr. George F. Kunz, the acknowledged authority on precious and semi-precious stones, communicates to the New York Sun the following interesting facts relative to the discovery and source from which collectors and museums obtain their specimens, and a description of the properties of which the different stones are composed.

Public interest in the fancy or semi-precious stones has increased greatly in America since the Centennial Exposition of 1876. Formerly jewelers sold only diamonds, rubies, sapphires, emeralds, opals, pearls, garnets, and agates, but now it is not unusual for the mineralogical gems, such as zircon, star sapphire, star ruby, tourmaline, spinel, or titanite, to be called for, not only by collectors, but also by the public, whose taste has advanced as much in precious stones as it has in art.

Spinel is the most valuable of the semi-precious stones, and is one of the few minerals that are ornamental and beautiful enough for gems in their natural state. No other stone has so wide a range of color, and each color in turn is represented by many distinct shades. The flame red and crimson stones have been mistaken and sold for rubies, but, although the hue may be vivid, yet it lacks the richness of the ruby. The orange red spinels are called rubicelles, the pink ones balas rubies, and a charming variety of blues, blue greens, inky blues, purples, and violets, terminating in the black spinel, called pleonaste, gives this stone a range of color almost unequaled.

One would little expect to find among the jewels of the queen of the ruby mines any other than true rubies; but the English officer who, in 1886, took the hairpin from the private chamber of Soup-Y-La, the Queen of Burma, in the palace of Mandalay, was surprised to find that the red jewel in it was not a true ruby, but a fine ruby spinel.

Beryl is one of the most lustrous and brilliant of gems, and occurs in a variey of shades of yellow, golden yellow, yellow brown, brown, green, sage, and grass green. Aquamarine is the term applied to the white, light green, light blue, and yellow green beryls, so called from their resemblance to the color of sea water. The yellow ones have been called golden beryls. All these varieties are often exceedingly beautiful and brilliant. The finest aquamarines are found in Russia, Brazil, Ceylon, Maine, New Hampshire, Connecticut, and Mount Antero, Colorado; at the last locality, at an elevation of 14,000 feet, almost on the line of perpetual snow.

The large aquamarine now at the Field Columbian Museum in Chicago, the finest ever found in the United States, is from Stoneham, Me. It is brilliant cut and weighs 133¾ carats. The color is light bluish green, and, with the exception of a few hairlike internal striations, it is perfectly clear. One of the finest known beryls is a superb blue green crystal, found in the Urals in 1820, weighing six pounds, and valued at $23,000. It is now at the School of Mines in St. Petersburg. Others worthy special attention are the one in the sword hilt of Prince Murat, sold in the Hope collection, and the frog of sea blue aquamarine on a jade leaf, shown at the Paris Exposition of 1878, and now in the James Garland collection in New York City.

The name topaz generally suggests only a yellow stone, yet there are light blue and green varieties which have frequently been sold as aquamarines, though the topazes are heavier than aquamarines, and I have frequently detected the difference without opening the paper containing them. Topaz admits of a very high polish, and is very slippery to the touch. Strange to say, the yellow topaz when slightly heated becomes pink; heated further, the pink grows paler, and by long heating is entirely expelled, leaving the gem colorless. The sherry colored or brown topaz is bleached in a very short time by the rays of the sun, or strong daylight, and all the white topazes found in nature have been decolorized in this way. The topaz is found in granite rocks in Siberia, Japan, Peru, Ceylon, Australia, Brazil, and Maine, and in volcanic rocks in Colorado, Utah, and New Mexico.

One of the most beautiful of all gems, and one not known two decades ago, is the green garnet called demantoid, or "Uralian emerald," or "Bobrowska garnet," found at Poldnew aja, near Sysserk, in the government of Orenberg, Russia. It varies from yellowish green to an intense emerald color, and has such a power of refracting light that it shows a distinct fire like the diamond or zircon, and in the evening has almost the appearance of a green diamond.

Pyrope, or Bohemian garnet, has been long and extensively sought and worked in the region near Meronitz, Bohemia, where it is gathered from surface deposits and conglomerate rocks, coming from a decomposed peridotite. The gathering and cutting form a great industry in that country. Pyrope occurs under similar conditions in the diamond bearing rocks of South Africa, and also in Arizona and New Mexico; and from both these regions gems of rich color are obtained and sold under the name of Cape rubies and Arizona rubies. The African stones are larger than the American, and perhaps equal to them in color by daylight, but the latter are much richer by artificial light. Only the clear blood red color then remains visible, while the Cape rubies retain a dark tint, inclining to brown. About $5,000 worth of cut stones from Arizona are sold annually, and some peculiarly fine ones have brought from $50 to $100 each.

The torquoises of commerce come from Nishapur, Persia, the Desert of Sinai (Egyptian turquoise), and several localities in New Mexico. Those from Persia are of a softer blue and opaque; those from Egypt a darker blue and translucent, frequently changing to green; those from New Mexico are a fine blue, and fully half a million dollars' worth has been sold in the past five years. The best specimens come from Nishapur, where they occur in a clay slate. There is in the color of the best turquoises a peculiar quality partly arising from the fact that the delicate blue tint is mingled with a slight infusion of green and partly from a faint translucency of the stone. Turquoise is not opaque, thin splinters transmitting light easily, and cutting and scraping like ivory with a polished cut.

The true turquoise, which shows various hues and tones of blue, greenish blue, bluish green, is not to be confounded with the blue fossil turquoise, or odorntolite, which is a fossil bone, colored by phosphate or iron.

Turquoise often becomes green by age, as may be frequently seen in turquoise cameos of the Italian cinquecento. When green spots appear on turquoises the color can often be restored by allowing them to remain in a solution of equal parts of alcohol and ammonia, or embedding them for a time in fuller's earth wet with alcohol or water. These spots are often due to the absorption of grease or other fatty compounds which separate from the soap when the hands are washed, or to the action of perfumes which leave oily essences upon evaporation. Sometimes, however, they result from a natural change, and hence this beautiful gem cannot be guaranteed, although the owners of the American mines replace any stone that changes color within six months. In a coronation chair in the Kremlin are several old turquoises, some of which are beautifully blue, while others in the same chair have changed to green. Turquoise has been found all the way from Colorado to Peru.

Negative Varnish.

Dissolve eight parts of borax and two parts of carbonate of soda in one hundred and sixty parts of hot water, and dissolve in this thirty-two parts of bleached shellac broken up small. When this is dissolved add one part of glycerine dissolved in one hundred and sixty parts of water. If any deposit forms after a few days, filter off. This varnish can be run on the plate while it is wet, hence the plate dries once for all.—Photography.