A LIFE-LINE AIR CANNON.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The ordinary rocket as a means of establishing communication between a wrecked ship and the shore in stormy weather has the disadvantage of being severely limited in its range of action, and when discharged in the teeth of a gale the deviation in the line of flight still further reduces the range. The question of establishing a more efficient and longer range system has occupied the attention of the British government for some time past, and a few months ago the department of the Board of Trade established a special committee of experts, for the purpose of examining and thoroughly testing various improved devices for throwing life lines, as well as other contrivances for connecting a wreck with the shore, so that the ordinary breeches buoy may quickly be brought into service for succoring those in distress.

Among the various contrivances investigated was an air cannon invented by Mr. Alexander J. Macleod of West Hartlepool, which attracted particular attention. The rough full-sized model used in these trials is shown in the accompanying illustration. It comprises a cannon mounted on a four-wheeled carriage for convenience of transport. Compressed air is used as the propelling agent for throwing the missile to which the life line is attached. The cannon is elevated through a wide angle by gearing, and mounted on either side is a crank wheel for use in compressing the air to provide the propelling charge. The two cylinders are mounted on the barrel of the gun and fitted with the usual pressure gage, a special valve being used to control the admission of the charge into the breech when desired.

The life line is coiled on a winch mounted in the front part of the carriage beneath the cannon, and fitted with special check action to prevent the line from paying out too rapidly while the projectile is in flight and thus becoming tangled. The barrel of the cannon is 5 feet in length, and the air-compressing mechanism is designed to supply sufficient energy to throw the line a maximum distance of half a mile under its full compression charge. It is not necessary to use the maximum compression charge when effecting communication over a shorter intervening space, the gage being graduated to fulfill various requirements as to range, while in heavy weather where increased resistance to flight is encountered, a greater charge than that which is normally adequate for the distance can be used.

This line-throwing apparatus, unlike the majority of such appliances, is particularly designed for attachment to ships. As is well known, vessels are for the most part unprovided with any line-throwing facilities, albeit that in the majority of instances, the possibilities of establishing communication between the wreck and the shore, from the ship itself, are greater than in the reverse direction, since the land offers a better target for the alighting of the line-carrying missile than the vessel, and the fact that in the majority of wrecks the wind is invariably blowing strongly on shore, so that the very agency which retards the flight of the rocket fired from the beach tangibly assists that thrown from the ship. But the use of a rocket apparatus and similar agencies from a deck is attended with great risk, especially if the ship be carrying an explosive or inflammable cargo. With the Macleod apparatus, owing to compressed air being the propelling agent, the cannon can be discharged in the closest proximity to any combustible cargo with absolute safety.

In the course of the trials at South Shields, where this system was first demonstrated, its safety and long range, combined with its applicability to vessels, attracted the especial attention of the investigating experts, who induced the inventor to repeat his experiments at Dundee, and these proved eminently successful. It is anticipated that this line-throwing appliance may be used on ships, not only for wrecks, but in other emergencies, where it is required to effect a communication over an intervening space under conditions which render the employment of a boat impossible.

Experiments to show the effect of rolling on the magnetic properties of steel were recently carried out in the German Reichsanstalt. It was found that the steel was more efficiently magnetic at right angles to the direction of rolling than parallel to it, and the differences were uniformly quite marked.

THE FILTRATION OF CITY WATER SUPPLY.

Although the customary method of building dams and impounding the water of springs and rivers will secure for a community an abundant supply of drinking water, careful analysis has proved that such a system offers no guarantee as to its purity; for not only will it contain a large amount of vegetable matter which has been carried into it from the surrounding watershed, but in cases where the drainage area is inhabited, it is liable to contain the germs of fatal diseases. Moreover, in localities where the reservoirs are filled by pumping water from an adjoining river, into which the sewage of towns and villages

A COMPRESSED-AIR LIFE-LINE CANNON.

located on the upper reaches of the river has been emptied, analysis shows that the disease-breeding germs may be present in fatally large numbers.

In looking for a suitable means for the purification of drinking water, we find that nature has provided an excellent object lesson in the natural water springs, and the process by which they are brought to their condition of clarity and sweetness. The purity of spring water is due to the slow filtration of the water through the sand, silt, and finely-divided mineral matter of the earth's surface, and the further purification which occurs as it rises to the surface in some distant and less elevated locality. The slow seepage of the water not only strains out the mechanical impurities, but it also assists a certain bacteriological action, which results in the almost complete elimination of harmful bacteria.

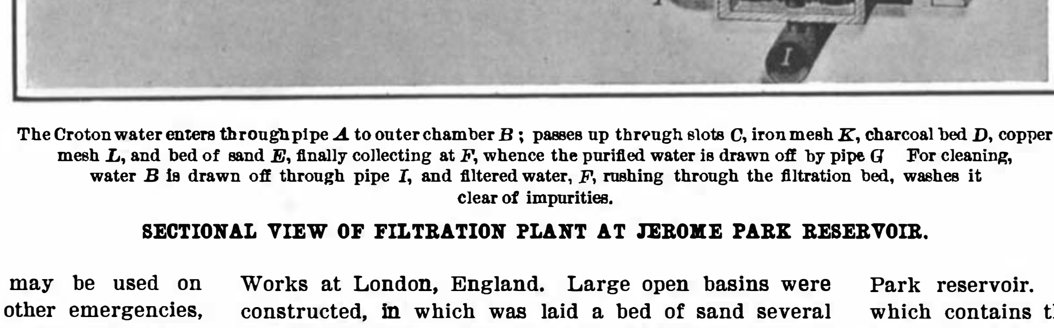
The first attempt to reproduce the processes of nature was made in the year 1839, at the Chelsea Water Works at London, England. Large open basins were constructed, in which was laid a bed of sand several feet in thickness. The water to be filtered was introduced above the bed, and allowed to strain through, the filtered water being collected in pipes laid at the bottom of the sand beds and led away to the distribution mains.

There can be no doubt that the reluctance of many cities to undertake the construction of filtration plants is due to the large first cost, and the subsequent cost of operation. Filtration by the method of allowing the water to strain by its own gravity through a closely-packed bed of fine sand, several feet in thickness, is necessarily a slow process; particularly as the rate of flow decreases with the steady accumulation of the deposited impurities in the upper strata of the sand bed. Consequently, for a given daily supply of water a large area of filters must be constructed. Moreover, in the course of a few months, it becomes necessary to discontinue the use of the sand beds, remove the upper foot or so of sediment-impregnated sand, wash it thoroughly in a special apparatus, wheel it back to the beds, and carefully level it off. This is a slow and costly process, and places the filter beds periodically out of service for a considerable length of time. Dr. William R. Smith, Principal of the Royal Institute of Public Health of Great Britain, evidently recognizes this fact when he sums up an indorsement of slow sand filtration with the following significant sentence: "It therefore obviously becomes a matter of serious consideration whether some other efficient means of filtration can be obtained, which can be relied upon to do satisfactory work on a limited area and at a moderate cost."

With a view to reducing the size of the plants by increasing the rapidity of the filtration, what is known as mechanical filtration is employed. In this process the sand bed is placed in a closed vessel, and the water is forced through it at a pressure of from 20 to 50 pounds to the square inch. To place the impurities in a better condition, a certain amount of alum is often added to the water, to coagulate the contained matter. Although this process serves to remove the mechanical impurities, it fails to eliminate those of a bacteriological nature, with the same thoroughness which marks the gravity sand filter. The difference between the two systems is clearly brought out in the report of a Senate committee made to the Fifty-sixth Congress on the question of the best system of filtration for the city of Washington, in which it is stated that mechanical filters have accomplished very little in the reduction of typhoid fever rates. A comparison is made of five European cities using water from sand filters with five American cities using mechanical filtration, in which the average number of typhoid fever deaths for the year 1895 per one hundred thousand of the population is shown to be 46.8 for the American cities, against 6 for the foreign cities.

Lest this comparison between foreign and domestic cities should be considered unfair, the committee prepared a table showing the average number of deaths from typhoid fever in several American cities before and after filtration, from which it appeared that while slow sand filters accomplished a reduction of 78.5 per cent in the number of deaths from typhoid fever, the reduction accomplished by mechanical filtration amounted to only 26 per cent.

The superior effect of slow sand filtration is due to the fact that both the anaerobic and aerobic bacteria are deposited in the upper layers of the sand bed, where the former destroy the latter. It may be further explained that bacteria are divided by Pasteur into two great classes—anaerobic and aerobic. The aerobic bacteria in water consist of the colon group (of which *B. coli communis* is the chief) typhoid and sewage streptococcus. The anaerobic germs have the power, when existing in quantity, of destroying the aerobic; the anaerobic being caught in the upper layers of the sand and near the surface of the water, where they are held in a favorable condition for this biological action to take place.



The Croton water enters through pipe *A* to outer chamber *B*; passes up through slots *C*, iron mesh *K*, charcoal bed *D*, copper mesh *L*, and bed of sand *E*, finally collecting at *F*, whence the purified water is drawn off by pipe *G*. For cleaning, water *B* is drawn off through pipe *I*, and filtered water, *F*, rushing through the filtration bed, washes it clear of impurities.

SECTIONAL VIEW OF FILTRATION PLANT AT JEROME PARK RESERVOIR.

The accompanying illustration shows the general principle of a system of filtration designed to secure all the germ-destroying action of the slow sand filter together with the advantage of sedimentation and consequent increase in capacity. A demonstration plant with a capacity of one hundred thousand gallons per day has been erected by the Municipal Filtration Company in the easterly half of Jerome Park reservoir. It consists of an outer chamber *B*, which contains the unfiltered water, and inner chamber *F*, in which the water collects after being filtered. Pipes *A* and *G* connect respectively with the chambers *B* and *F*, for feeding in the raw water and drawing off the filtered water. The water in chamber *B* is maintained at a slightly higher level, usually less than eight inches, than the level of the filtered water in the chamber *F*. This head insures a constant flow of the water up through the sand filter bed *E*. At the bottom of the chamber *F* is a series of slats *C*, placed at an angle of 45 degrees; above this is a floor,

(*Continued on page 278.*)