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 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.

A COMPRESSED-AIR LIFE-LINE CANNON.

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.

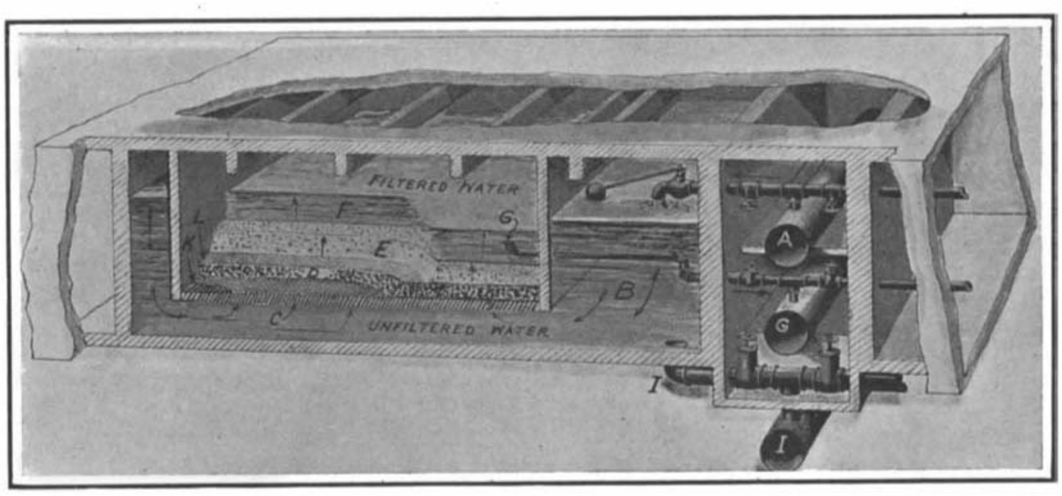
The first attempt to reproduce the processes of nature was made in the year 1839, at the Chelsea Water Works at London, England. Large open basins were constructed, in which was laid a bed of sand several feet in thickness. The water to be filtered was introduced above the bed, and allowed to strain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

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the goat that passed intact were the horns, the hoofs, and a piece of sash rope four feet long attached to his neck.

We recently had a big reticulated python, which passed the hoofs of a pig. They were shown to Dr. W. T. Hornaday, the director of the New York Zoological Park, who identified them as the hoofs of the Bornean wild pig, of about forty pounds weight. A ship's captain, in bringing over a large reticulated python, found in the excrement the quills of a Javan porcupine, lying in the same relative position they occupied on the animal's body. The reptile must have begun with the head, extending the coils backward over the body, and pressing the quills down horizontally in their natural state of rest. Evidently, this is a species of prey a snake could not disgorge.

Our small snakes feed largely on frogs, toads, and fish; the anacondas feed extensively on fish; king snakes and king cobras eat other species of snakes; but I have never known a boa or python to take a cold-blooded animal. We often keep small snakes and iguanas with the boas and pythons, but they never take any notice of them. In a state of nature their prey consists largely of small deer and antelopes, lambs, kids, pigs, other mammals weighing less than a hundred pounds, and any bird that may be large enough to attract their attention. That their prey does not always submit without a fight is shown from the number of broken ribs that are found in the skeletons.

We have an artificially mounted skeleton of a twenty-two foot reticulated python, in which there are thirty-seven ribs that show well-marked fractures, and a number of others that show indications of fracture. Some of them have been broken two and even three times. In one, the ends have slipped past each other for about a half inch, and the two sides are knitted together. In one place there are five fractured ribs in succession. A peculiar feature about these broken ribs is that they always occur toward the posterior quarters of the snake. It is probable that the animal responsible for these fractures is the Bornean wild pig. Doubtless the reptile usually seizes the pig near the head, and throws his coils about the shoulders. The posterior limbs are thus left free, and with these he fights desperately till life is crushed out, frequently, as is plainly evident, doing serious damage to his assailant.

In conformity to their attenuated form, snakes have a large number of vertebræ and ribs. A peculiarity of the skeleton is that there are but two cervical vertebræ. The atlas and axis, or first and second bones of the spinal column, next to the head, bear no ribs, but they start with the third vertebra. Neither are there any lumbar or sacral vertebræ. In the reticulated python there are 361 vertebræ. Of these, 2 are cervical, 37 caudal, and 322 dorsal. The caudal vertebræ all bear transverse processes, the proximal ones long and broad, diminishing gradually toward the tip of the tail, but they do not disappear, even on the last distal vertebra. It may be that these are but ribs ankylosed to the vertebræ. It is sometimes difficult to distinguish just where the ribs end and the transverse processes begin. This is true in the Indian python. As already intimated, there are 322 pairs of ribs. However, it is highly probable that this number will not hold constant. Even in man there may be thirteen, eleven, or as few as nine pairs. At least one human skeleton has been known with twelve ribs on one side and thirteen on the other.

Likewise the teeth of the python are numerous. In the upper jaw there is a row of teeth in the maxillary, and a second row, set at considerable distance inside the first and imbedded in the palatine bones. In the lower jaw there is but one row of teeth, that of the inferior maxillary, but it is really double, as there is a line of tiny teeth just inside the larger ones. The teeth are all acutely conical in form, smooth and with no cavities, depressions, or ridges, and set so that they point toward the back of the mouth. They serve merely for catching and holding the prey. As there are no particles of decaying food on the tooth to be carried into the wound and produce blood poisoning, a bite from one of these monsters usually heals quickly.

In seeking his prey, the python depends much more on his sense of smell than on that of sight. It is always dangerous to go near these big snakes with the smell of any bird or mammal on the hands or clothing. When they are hungry and scent their natural food, they will strike at the first thing they see moving. They will even strike at inanimate objects which have come in touch with their natural prey. One evening we were feeding a big python. For some reason it dropped the prey, and to get him to return to the chicken, a woolen duster was pushed toward his head. Instantly he struck and seized the duster in his teeth. His jaws had to be pried open to make him let go. Under similar circumstances, a python seized and swallowed a blanket. After retaining it for two days, he disgorged the article, rolled into a compact wad.

The sense of taste in the serpents is very keen. If chickens are kept in a dirty box, these reptiles will refuse to feed on them. If a python bites into the crop of a chicken containing bad-tasting matter, he will drop the chicken. To test the sensibilities of the serpents, a black snake was once given a stale egg. This species is very fond of eggs, but no sooner had the shell broken in his stomach than he commenced vomiting, and continued till the stomach was completely evacuated.

It is a common belief that snakes are so plentiful in India, that one can scarcely walk about without stepping on them. This is erroneous. It is possible to live for considerable periods of time in that country without so much as catching a glimpse of a snake. And this is especially true when we confine our references to the big pythons. Dr. Hornaday spent two years hunting in India and Borneo, and yet he declares he never saw but one python, and that was a small one. The pythons are timid and shy, and lie coiled among the foliage of trees or shrubs, or in the dense grass on the ground. They never attack man or the large animals so long as they are unmolested.

THE FILTRATION OF CITY WATER SUPPLY.

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K, of steel wire mesh; then a bed of charcoal *D*, followed by a fine screen, *L*, of fine mesh copper; and above this is laid the bed of sand *E*. It will be seen from the above description that this form is a modification of the slow sand system, with the direction of the flow of the water reversed.

Although, normally, the system operates under a very small head of water (the difference of the water level in the outer and inner chambers), as the sediment accumulates in the filtering medium, the height of water in the outer reservoir increases, and there is an automatic adjustment of conditions to overcome the increased friction in the filter bed, but this in practice does not exceed eight inches. The Jerome Park reservoir filters pass through 15 gallons per hour per square foot of filtering surface, which is about five times as fast as the flow through an ordinary slow sand bed. This means that the total area of filter bed required would be only one-fifth of that necessary by the ordinary gravity system.

The advantages of this system are, first, that the slow flow of the water through the outer chamber permits about 60 per cent of the impurities to be deposited there, leaving the filter bed to deal with the remaining 40 per cent only.

Secondly, most of the remaining suspended matter is deposited at the lower surface of the bed.

Thirdly, whereas in slow sand filtration the suspended matter is forced about two feet down into the bed, in the system being tested at Jerome Park it is found that after fifteen months' continuous operation, the suspended matter penetrates four inches only into the sand bed.

Fourthly, instead of removing the sand with great labor, as is necessary in slow filtration, the outer basin is discharged by opening a valve, and the pure filtered water, rushing through the bed, thoroughly cleanses the same.

Fifthly, the valuable biological action, which characterizes slow sand filtration, is also secured in this system, through the presence of the carbon and the septic stratum of sand which is formed in the lowest portion of the bed.

In conclusion, it may be stated that by a series of analyses made at the Jerome Park plant by Dr. John C. Sparks, the water expert, of the water before and after filtration, it was found that although there was an average of 262 organisms present for each cubic centimeter of the unfiltered Croton water, after it had passed through the filter bed, the total organisms were reduced 99.2 per cent; there was no trace of *B. coli communis*; and the water was free from odor, color, taste, or sediment.

An International Exhibition of Inventions.

An international exhibition of recent inventions will be held at the Michael Manege, St. Petersburg, from April to June, 1909. The exhibition is being organized by the Society of Military, Naval, and Rural Sciences. The object of the exhibition is to bring before the notice of the Russian public the latest inventions pertaining to technical science and national economy.

The inventions exhibited relate to military and naval technics, agricultural science, ways and means of communication, constructive work, new industrial and factory appliances, electricity, household novelties and appliances for the prevention of fires. Inventions pertaining to the fine arts, medicine, chemistry, pharmacy, sport, etc., have also been included.

The minister of finance has given permission for the exhibitors to take advantage of the exemption tariff, No. 163, 1894, that is, free return transport of the goods exhibited.

Foreign exhibits will be admitted duty free on the condition that they be returned abroad within a period of two months of the date of the closing of the exhibition. A deposit equal to the duty payable must be made, which will be refunded when the goods are leaving the country.

Exhibitors must bear all expenses in connection with the delivery of exhibits to, and packing and returning from, the exhibition. They will also be charged for the space allotted to them, as well as for electric light, gas, and water required for the special illumination and working of their exhibits.

All exhibits will be entirely under the care of the exhibitors themselves. The committee will take general precautionary measures against loss and injury, or damage by fire, and will insure the building of the exhibition, but it will not be responsible for the safety of the exhibits, and in consequence invites the exhibitors themselves to insure their exhibits. Should the occasion arise, the committee will undertake to effect such insurances by special agreement.

The judging of the exhibits will be carried out with the utmost care; the experts appointed for the purpose are well known in the various fields of science.

Exhibits should be addressed to the Exhibition Committee of the International Exhibition of Latest Inventions, Nevsky 13, St. Petersburg, Russia.

New Automobile Speed Records in Florida.

At the seventh annual race meet upon the beach at Daytona, Fla., recently a number of new records were established. On the first day, March 23d, David Bruce Brown made a mile in 33 seconds in a Benz 120-horsepower racer, and thereby won the race for the Dewar trophy at a speed of 109.09 miles an hour. Strang, on a 30-horse-power Buick stock car, won the 100-mile race for such machines in 1 hour, 34 minutes, 1 1-5 seconds, at the rate of 63.81 miles an hour. The following day, in the 10-mile free-for-all race, Mr. Brown made considerably faster speed over the longer distance, as he covered the 10 miles in 5 minutes 14 2-5 seconds, at a speed of 114.5 miles an hour. Ralph De Palma on his Fiat "Cyclone," was second in 5:29 2-5. The previous record in this race was 6:15, made in 1905 by McDonald with a Napier machine. In the 5-mile invitation race, the German Benz driven by Robertson, beat De Palma's Italian Fiat. The Benz covered the distance in 2 minutes 45 1-5 seconds, or at the rate of 108.95 miles an hour, and thereby beat Lancia's record of 2:54 3-5, made in 1906 with a Fiat racer.

The last event of the second day was for stock cars of various piston displacements up to 400 cubic inches and over. The distance set for this race was 100 miles. Three of the six starters covered this distance, and one ran 120 miles, when the race was called off on account of rising tide. The 120 miles were covered by De Palma's Fiat, of over 400 cubic inches piston displacement, in 1 hour, 33 minutes, 44 3-5 seconds, at an average speed of 76.8 miles an hour. It covered 100 miles in 1:16:55, while the second car at this point—Strang's Buick—took 1:30:24, which corresponds to an average speed of 65.5 miles an hour. The Benz racer, the third car of the trio having over 400 cubic inches piston displacement, stopped early in the race on account of a seized piston.

On the last day of the meet the Fiat racer had a walkover in a 100-mile race, and thus secured for the third time—and therefore finally—the Minneapolis trophy. This trophy was won twice by Mercedes machines and twice by Napier racers, and its third winning by the Fiat car places Italy ahead of both Germany and England. The Fiat "Cyclone," which won it, is only a 60-horse-power machine, and yet it covered a mile in 36 seconds, as against the 33 seconds scored by the Benz 120-horse-power racer. The new record of 2 minutes 45 1-5 seconds made by the latter machine in the 5-mile race supplants that of 2:47 1-5 made three years ago by Marriott in a special Stanley steam racer.

Bicycles and motorcycles were in evidence more than ever this year at Ormond, and a new mile record of 43 2-5 seconds was made by Robert Stubbs, while 43 4-5 was scored by A. G. Chapple. The best previous record for this event was 45 1-5 seconds. A new kilometer record of 27 4-5 seconds was scored by Walter Goerke, who also won the 69-mile race for amateurs with motorcycles having a piston displacement of not over 61 cubic inches. Goerke's time in this race was 58 minutes 25 4-5 seconds, an average speed of 73.7 miles an hour. The best previous record was 68 miles 1,380 yards in 60 minutes, made on the Brooklands track in England. The 20-mile motor-cycle race was won by A. G. Chapple in 17 minutes and 25 1-5 seconds.

The $500 prize that was offered for a mile flight by an aeroplane was not won. Carl Bates, of Chicago, had a small aeroplane with a 10-horse-power motor at Daytona, but he did not succeed in making any flights, even under the nearly perfect conditions obtaining there.