THE MANUFACTURE OF SUBMARINE CABLES.

The new cable-works of Siemens & Halske, probably the best equipped of their kind in the world, were opened August 1, 1899, and have since been in constant operation. Goods are brought to the works by water as well as by railway. For this purpose a canal has been cut which extends from the river Spree to the factory. Railway traffic between the freight depot and the works is effected by a steam ferryboat which transports at once two railway cars. The cable-works are built on piles and consist of a horse-shoe-shaped structure, the inner, open courtyard of which contains a number of extensive halls connected with all parts of the lower story. The workshops, sample-rooms, and offices are so arranged that the workmen can readily pass from one into the other, which arrangement is specially valuable in cable-works, since the transport of half-finished cables over an open court, exposed to the weather, is thereby avoided.

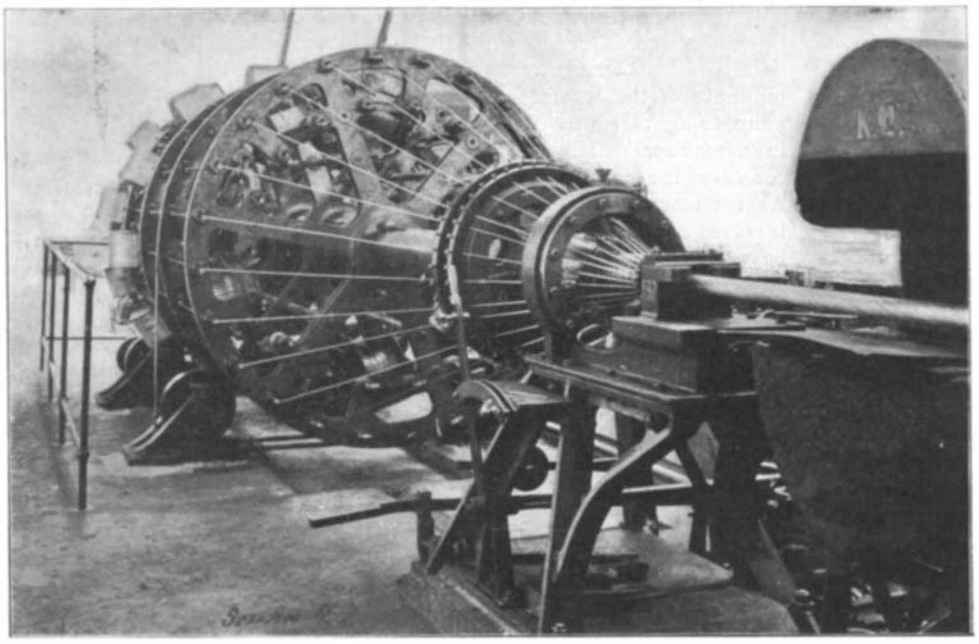
The process of manufacture proceeds from north to south. Each division may in itself be considered a small cable plant of its own. The entire cable-works are chiefly used for the manufacture of lead-covered fiber cables. In addition, the gutta-percha and rubber-covered cables, as well as double-insulated telephone cables, are made in the main building. Covered and braided wires of different kinds for installation purposes, and for the building of machines and electrical purposes are produced in large quantities.

The Braiding Machines.

Manufacture of Heavy Cables.—After the wire has been weighed out in the storerooms, it is taken to the wire-winding drum and there reeled on coils, which are called bobbins and which fit into the cable-machine. In the stranding-room the copper wires are united on the cable-stranding machines and finally covered with insulating material, jute being usually employed.

Adjoining the stranding department are the impregnating and lead-pressing room, situated in the middle of the halls constituting the plant. Here the jute-covered cables are freed from all moisture in vacuum drying-boxes, and are then thoroughly impregnated with insulating material in large kettles. In the background of one of our illustrations, the vacuum-boxes are seen; in the foreground the impregnating-kettles are pictured.

From the kettles, the impregnated cables are transferred to the lead-press and covered with a seamless lead jacket. The lead may be either warmed sufficiently to attain a certain degree of plasticity, or may be pressed about the cable wires while cold, but under considerable pressure. When the cable has been thus covered with lead, a careful test is made to determine whether insulation is complete and effective. It is the primary purpose, however, thoroughly to ascertain whether or not the lead covering is absolutely air-tight; for the entrance of moisture into the insulating fiber would produce disastrous results.



Armaturing Machine.

A cable which has satisfactorily withstood the insulation test is now taken to the armaturing department and is there wound with iron wire or enveloped with an iron mantle. In one of our front page illustrations a machine is shown, the purpose of which is to wind this protecting wire jacket around the cable. Upon this protective envelop fiber is spun which is then impregnated with an insulating material. It is the purpose of this insulated-fiber covering to protect the armature from the damaging influence of the earth wherein the cable is to be placed. The fiber-winding machine is illustrated. The cable, after having been finally drawn through a bath of lime-water, the purpose of which is to destroy the adhesiveness of the impregnated fiber, is wound upon large wooden drums and is then transferred to the southern end of the building ready for shipment.

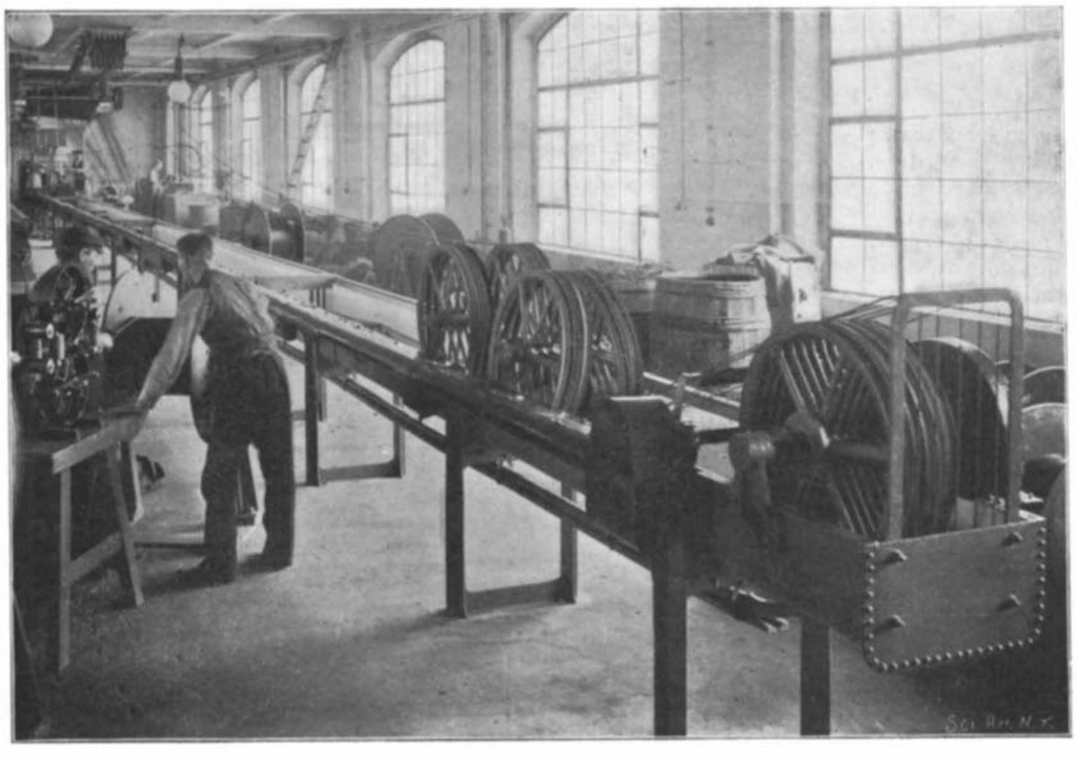
It will be observed from the picture reproduced that the bobbins on two of the winding-machines, the first and the last, are mounted in different positions. The bobbins of the stranding machine have what may be termed a planet-motion, or in other words, preserve the same axial relation to a cable at all times. By reason of this arrangement, twisting of the individual wires forming the core of the cable is effected. In winding the armature, which consists of flat wires, the cross section of the wires prevent such a disposal of the bobbins. For that reason the bobbins in the armaturing machine are rigidly mounted. The steel band outer jacket, which is wound upon some cables, serves the primary purpose of protecting the interior windings from mechanical injuries. The wire jacket, on the other hand, is used upon cables which are subjected to some tractive force. Subfluvial cables are subjected to a double winding of protective wire, for they are liable to be injured by ships' anchors.

Manufacture of Spun and Braided Wires.—In the main buildings spun and braided wires are manufactured. As an insulating material, silk and cotton are used. We have shown a spinning machine, which serves the purpose of winding insulating fiber upon dynamo wires. The braiding-machines cover the wire with a hose-like casing, and operate much in the same manner as knitting machines. By a combination of spinning or braiding and by impregnating the fiber with insulating material various qualities and kinds of cable are produced. Conductors which are subject to wear or to certain mechanical influences which may injure them, are covered by the braiding-machine with fine steel wire. Street-railway cables which serve the purpose of connecting the motors with the line conductors require no such highly-efficient protection, and are, therefore, covered merely with the outer envelop of braided fiber. Certain kinds of cables are braided with an insulating material which is impregnated with a fireproofing liquid. It has been found that in certain installations, the insulation of short-circuited cables is easily ignited, and that soon the entire fibrous covering of a cable is burnt off. The fireproofed cable, on the other hand, would prevent the spreading of the flame.

Besides the braiding-machine, the stranding-machines should be particularly mentioned; for by their means a core of flexible conductors is wound upon the finest of copper wires.

The Manufacture of Gutta-Percha and Rubber Cables.—In the making of a gutta-percha cable, it is first necessary to prepare the gutta percha. For this purpose the heated material is kneaded by a special machine until it becomes plastic. The softened gutta percha is then transferred to a press resembling the lead press previously mentioned. By the use of suitable nozzles, the gutta percha is pressed around the wire in the form of a seamless jacket. One of our illustrations pictures a machine of this character. The wires, which have been provided with their jacket by the apparatus in the background, are then passed over rollers partly through the open air and partly through a long trough containing water, the purpose of which is to harden the gutta percha.

The costliness of gutta percha has been the chief reason for the utilization of rubber compounds, and especially of India rubber. If India rubber be used, vulcanization is necessary. For this purpose the rubber is kneaded together with sulphur or some sulphur-containing substance, which, by proper heating, combines with the rubber to deprive it of its adhesive properties and impart to the manufactured rubber many of the valuable qualities of gutta percha. Like the gutta-percha cables, the India-rubber-covered conductors are made by pressing the material around the wires in a seamless envelop. Sometimes the wires



Gutta-Percha Press.

THE MANUFACTURE OF SUBMARINE CABLES.

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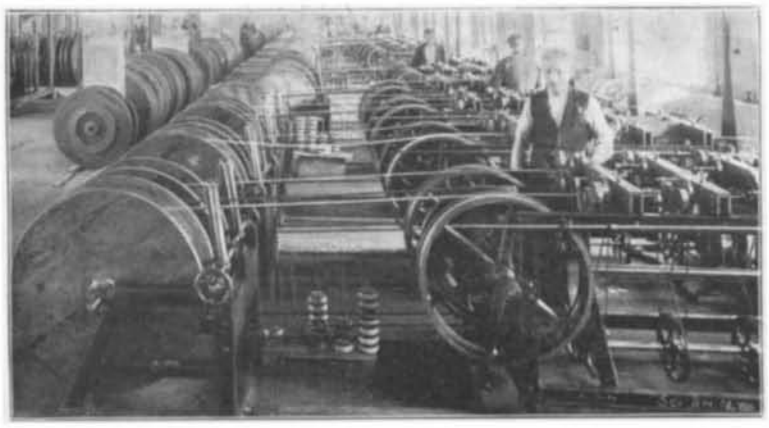
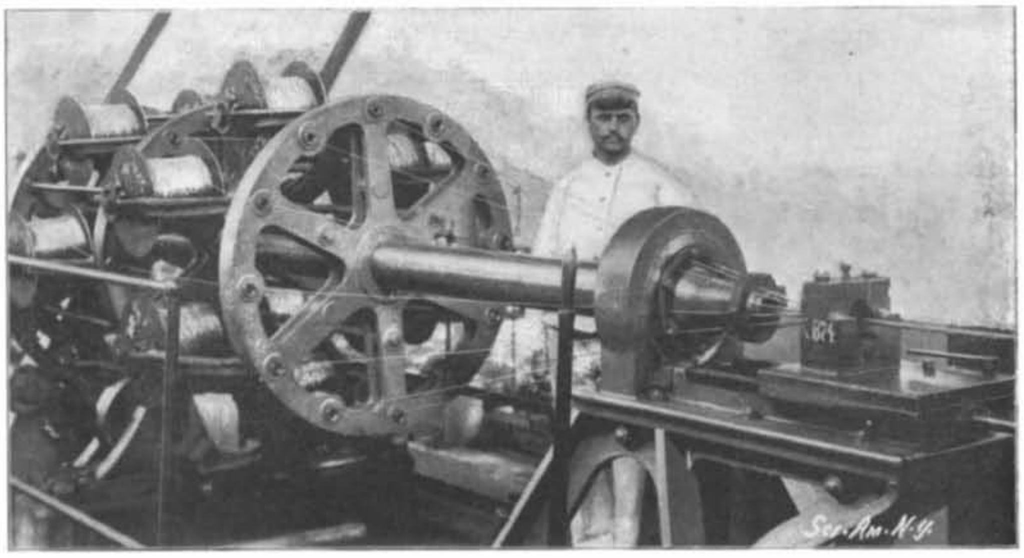
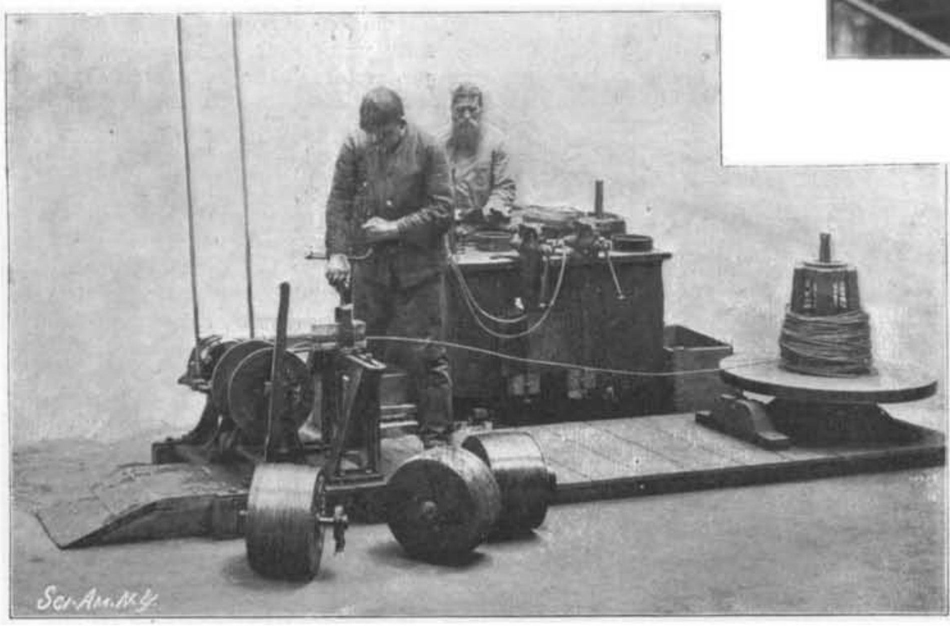


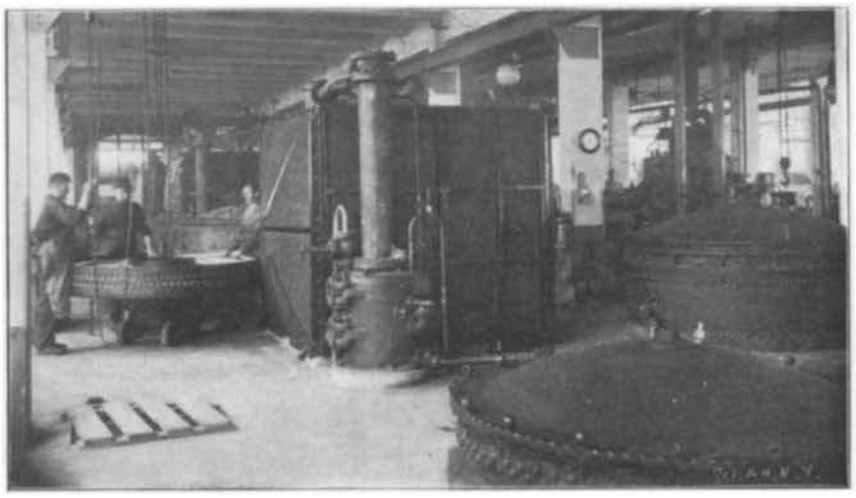
Spinning Machines.



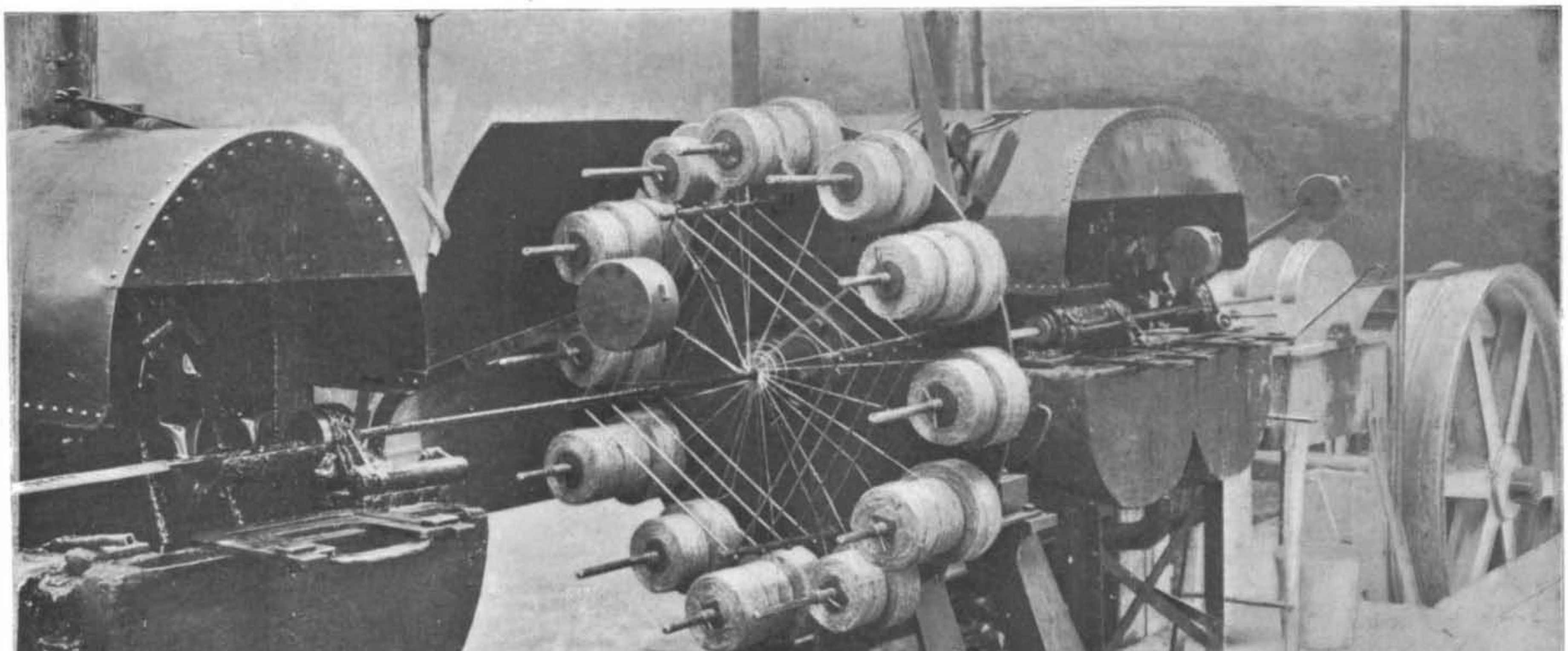
Stranding Machine.



Winding the Wire on the Bobbins.



Drying Apparatus.



Final Covering of the Cable with Insulated Fiber.

THE MANUFACTURE OF SUBMARINE CABLES.—[See page 87.]

are laid between two rubber strips, which are then rolled around the wire by a special machine into the form of a jacket. Certain kinds of cables are covered with rubber bands, very much as in the case of silk or other spun cables. After the conductors have received their rubber or gutta-percha protective casing, they are further covered with spun or braided material, or by a pressed mold of lead, depending upon the particular use to which they are to be placed.

Manufacture of Paper-Covered Cables.—Telephone cables are made on the principle that the capacity, even for great lengths, is to remain as low as possible. For this purpose an insulating material with the least dielectric constant is chosen. Dried paper has been found especially suitable. Telephone cables are, therefore, covered by a ribbon of paper reeled from a roll carried by a winding-machine. The cables after having been wound with paper are transferred to stranding-machines and there spun into multiple cables. A moisture-proof covering of lead, and, perhaps, an outer protective wire jacket, complete the cable.

Mortality Rate in the United States.

The statistics recently published by the Census Bureau of this country with regard to the death-rates are of exceptional interest, and are of a nature to give rise to hopeful views regarding the checking of the spread of disease, and perhaps even the extinction of some maladies, says the Medical Record.

The mortality rates given in the bulletin are those for 1890 and 1900, and the comparison between the death list of these periods shows conclusively that the efforts made by hygienists to lengthen the lives of American citizens have been attended with complete success.

The statement is made that the proportion of deaths to population has decreased within the dates mentioned by nearly 10 per cent, and that the average age at death of an American is now 38.2 years, as compared with 31.1 in 1890. This, of course, is a magnificent showing, and the only drawback to the picture is that the bettered conditions of living apply only to the larger cities. The country districts exhibit according to the bulletin no such relative improvement.

The most striking feature of the reports is the great reduction in the death rate from tuberculosis, which has fallen from 245.4 per 10,000 persons in 1890 to 190.5 per 10,000 in 1900, a gratifying proof of the efficacy of modern sanitation, and of the means now employed in fighting the disease. Diphtheria, cholera infantum, bronchitis, diarrhœa, and typhoid fever, also, for the same reasons, claim far fewer victims at the present time than in 1890, the decrease in mortality from these causes having been substantial and progressively steady.

On the other hand, pneumonia, as a factor in the death rate, occupies a more prominent position, there having been 191.9 per 10,000 deaths in 1900, and 186.9 per 10,000 in 1890. The cause of this increase in the occurrence of pneumonia has been on many occasions given in the Record and in other medical journals as undoubtedly due to influenza. This insidious malady has made rapid progress since 1890. In that year, the deaths directly attributed to it were, the census bulletin states, 6.2 per 10,000, while in 1900 the number was 23.9 per 10,000. The fact must also be taken into consideration that influenza peculiarly predisposes its victims to other diseases, notably to pneumonia, by rendering the system susceptible in a high degree to the ingress of disease germs.

Pneumonia as a sequel to influenza is also a most fertile cause of death, the vitality of the patient when seized being at a low ebb, and recuperative powers wellnigh used up by the drain put upon them by the former affection.

Cancer, again, has been conspicuously on the increase during the past ten years, as have kidney complaints, heart affection, and apoplexy. The activity of scientific men in different parts of the world, who are engaged in the investigation of the origin and causes of cancer, give rise to the hope that some of its unknown features may soon be definitely solved, and that, as a consequence, its treatment may be conducted upon more intelligent preventive and curative principles.

The bulletin of the United States Census Bureau is a most satisfactory document, and the tale it tells is a feather in the cap of our city boards of health, and of our municipal reformers generally. There is yet, however, room for much improvement in the sanitary conditions of the large cities of America, particularly in the direction of wholesome dwellings for the poor.

A special train was recently used by President Cassatt on the Pennsylvania Railroad for the inspection of the lines west of Pittsburg. The train was equipped with a telephone service so arranged that communication could be had with each car on the train without the necessity of traveling from one car to another, says The Railway and Engineering Review.

Correspondence.

The Canal Problem.

To the Editor of the SCIENTIFIC AMERICAN:

I have read, with a great deal of interest, the various articles in your valuable paper of the 18th instant, bearing on the leading question of the day, viz., the canal from the Gulf of Mexico to the Pacific Ocean; and, as far as your explanation goes, would prefer the route across the Isthmus of Panama rather than at Nicaragua, but I wish to inquire if you have not omitted to mention two very important matters?

In the first place, is not the grant from Colombia to the present canal company only temporary, giving to the company the use and control of the canal for 99 years from and after its completion, when all right, title and interest in it will pass to Colombia in perpetuity? If such is the case, will not the same rule apply to the United States as the successor of the Panama Canal Company? And will that be a satisfactory condition to the people of this country in which to place this nation? Or is it not the almost universal feeling here that the United States, if it advances the money to build the canal, should be the exclusive and perpetual owner and manager of the same, allowing vessels of all nations to pass through in the interest of commerce, but reserving the exclusive control and management, especially in case of war in which this country might happen to be involved?

The other point I desire to mention is that of the French or other bondholders and stockholders who, I believe, hold bonds and stocks to the extent of about $300,000,000, and whose interests, as I understand, will not be settled or satisfied by the payment of the $40,000,000 demanded by the canal company, and who will consequently claim, or can claim, the payment of their bonds or stocks, provided any party of sufficient responsibility should become the owner of the canal.

If these are the facts, will it not be necessary, or at least wisdom, for the United States before entering upon or considering any proposition leading to the purchase of the interests of the Panama Canal Company to first require that these questions be settled in a manner satisfactory to this country, and then consider the advisability of making the purchase? As I understand it, no questions of this nature are involved in the Nicaragua route, and the point will be which route presents the least objections together with the most advantages, not only in a financial way, but also in all other ways which might be presented?

If the statements, as given, are correct, will they not have much bearing on the case when taken in connection with the statements in the articles in your paper? C. E. GILLESPIE.

Edwardsville, Ill., January 22, 1902.

[The Colombian government, to assist the transfer of the Panama property, has waived the prohibitions under the 99-year lease, and has offered the United States absolute control over a strip, five miles wide, along the route of the Panama Canal, the term of lease to be 200 years, with the right of renewal. After the old company failed its property passed into the hands of a liquidator (equivalent to our receiver) and the interests of the old company, which called for the payment of 60 per cent of the profits of the new company, are still under the care of the liquidator, who has agreed to the proposition to sell the Panama properties to the United States for $40,000,000.—ED.]

The Armament of Our New Warships.

To the Editor of the SCIENTIFIC AMERICAN:

Your special naval number suggests certain reflections on the progress of our navy and the direction in which it is developing of a somewhat pessimistic character. Heavy armament in proportion to displacement has characterized the American navy from its earliest days, and our naval constructors appear to be adhering faithfully to this tradition. The gun power of our new vessels is all that can be desired, but are we not sacrificing defensive strength to a dangerous degree in order to obtain this offensive power? What may have been a wise policy in the days of wooden sailing vessels may well be a very foolish policy in the day of steam-driven ironclads.

The "Georgia" class may fairly be taken as a type of the latest development of the heavy battleship, the ideal fighting craft of our naval constructors. Now, it is clear from your description of this class:

1. That its belt armor is not thick enough to resist a 12-inch shell which has traveled two miles—a greater distance than that at which naval battles are expected to be fought. Even an 8-inch shell would penetrate it at 2,000 yards.

2. The same remark applies to the armor of barbettes and turrets.

3. It is also true that the casemate armor would be penetrated at two miles by the projectiles from guns of the same caliber as those which it is supposed to shield.

It is obvious that a battle between one of these vessels and another of equal strength would be determined either by a lucky shot penetrating the belt armor and disabling the motive power or by the successive disabling of the guns and the destruction of their crews—the armor of the gun positions being too thin to protect them from the fire of any but the secondary batteries; and both vessels would likely be damaged beyond repair, at least as long as that war lasted.

Is it not possible for our naval constructors to devise a more efficient fighting machine by increasing its powers of resistance? Our earlier battleships had armor 18 inches thick on belt and turret, and were built to resist guns of much less power than the gun of to-day. Krupp plates, it is true, are 25 per cent stronger than the Harvey plates, but the attacking gun has increased in power even more. If armor is of any value at all it would seem obvious that it should increase in thickness as the gun increased in penetration; if not, it had better be discarded and the weight put into additional guns.

The nation that will ultimately be victorious on the sea (if the victory is attained by the gun and not by submarines and other devilish novelties) will be the one that first appreciates the fact that one gun behind a shield that cannot be penetrated, on a vessel that cannot be sunk or crippled in its motive power, is more effective than a dozen which are imperfectly protected on a vessel which can be rendered helpless by a single lucky shot.

To illustrate, let a vessel of the type of the "Georgia" be opposed to one of equal displacement but one deck less in height. Raze the double turret of the "Georgia," discard all its 8-inch guns and half of its 6-inch and smaller guns and put the weight so saved into heavy armor, say, 18 inches for barbette and turret, 8 inches or 9 inches for casemate and 20 inches for belt armor. Such a vessel could be pounded all day by the "Georgia" without serious injury, while every shot it sent could go through the "Georgia's" casemates, and every 12-inch shell could penetrate turret, barbette and belt. Can there be any doubt as to the outcome of such a fight?

It is no answer to say that other nations are sacrificing defensive to offensive power in the same way that we are. While we were learning to build ships of war it was well enough to follow foreign models, even copying their errors. We have learned all they know and ought by this time to be improving on their methods, and no greater improvement can be made than to construct vessels that cannot be sunk and arm them with guns that are nearly, if not quite, proof against attack. T. W. BROWN.

Chicago, December 30, 1901.

[Our correspondent's argument in favor of heavier armor would have more weight if it were certain that all projectiles will strike normal to the surface. Unless they do so they will not perforate the armor mentioned by him at the ranges assumed. As a matter of fact, only a very small percentage of the shots fired will strike at all (two per cent at Santiago), and probably less than ten per cent of these will be normal hits.—ED.]

Railroad Device for Indicating Speed.

One of the French railroads uses a novel form of speed indicator for its locomotives in cases where on account of repairs, defective structure or lack of attendance the speed is to be kept within a certain limit. It not only shows the speed, but when this rises above the required point it acts automatically to throw on the air-brakes. One of the locomotive axles drives a small centrifugal pump which sends water from the tender into a small cylinder. The piston of this cylinder is raised by the water against the compression of a spring, and moves up or down according to the speed of the pump or of the locomotive. The piston is connected with a registering apparatus which thus traces a speed curve. When the speed rises above the limit the piston acts upon a device which is connected with the air-brake pipes, and a certain quantity of air is allowed to escape, thus throwing on the brakes.

M. Santos-Dumont made two excursions on the Mediterranean in his dirigible balloon, January 28, at 10 o'clock and 2 o'clock. He was followed on the first excursion by the sloop "Monte Carlo," and in the afternoon by a steam launch from the yacht "Varuna," owned by Mr. Higgins. In the morning M. Santos-Dumont made the circuit of the bay several times, and in the afternoon he executed a number of interesting evolutions. The trials are most important, and the success achieved is even more important than his winning the Deutsch prize. At one time he was so far over the open sea that it was thought that he intended to make the trip to Corsica. His airship will be fitted for long voyages later. The Principality of Monaco is having a wooden jetty constructed in the bay, so that the floating guide-rope can be grasped at the moment of the return of the airship.