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 well-nigh 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.

Automobile News.

There will be an exhibition of automobiles at Copenhagen from April 11 to 27, 1902, under the auspices of the Danish Automobile Club and Society for the Promotion of Industrial Arts. It will be held in the building of the last-mentioned society. The exhibition is designed principally to show automobiles. Some space will be given to motor cycles and articles relating to the driving of automobiles. The exhibition is intended to attract visitors from all the Scandinavian countries.

It is generally believed that petrol is liable to explode if kept in a hot place. But this is an illusion. Petrol flashes at the ordinary temperature of the atmosphere, or even at a low temperature, but this does not mean that under any circumstances whatever petrol is capable of flashing spontaneously without the presence of a flame. What is known technically as the flash point of a petroleum product is that temperature at which, when gradually heated in an inclosed cup, it will give off such an amount of inflammable vapor as will ignite when brought into contact with a flame. If a flame is not present petrol may be safely heated to any temperature, and yet will not ignite.

M. Deutsch, who offered the famous Deutsch prize won by M. Santos-Dumont, has made a laudable although unsuccessful attempt to do away with the cruel butchery in the bull ring caused by the use of a motor-car, in which the picador is seated, driven by M. Deutsch's chauffeur. The motor-car had its wheels armored and was driven into the ring amid great applause from the public. The bull was afraid of the car and allowed himself to be chased around the ring, his sole desire being to get out of the way of the unnatural monster. Only once, and then more by accident than by purpose, the bull turned on it, but immediately after receiving a prick from the picador he continued his ignominious flight.

Alcohol motors are now coming into use for heavy hauling wagons and tractors. One of the newest machines of this type has been built by the Société d'Automobile at Nancy. It made its trial trip lately on the roads between the different villages, especially for the transport of grain and flour to and from the mills of the district, and in one case it mounted the heavy grades of the village of Ludres with a load of 8,360 pounds of flour, and on another trip took a load of 8,140 pounds of grain. An average speed of 5½ to 6 miles per hour has been reached over the routes in the neighborhood of Nancy, which are quite steep in places. This is another case where alcohol motors have been used with success for the heavy automobiles.

An unusually fine display of automobiles has been seen at the last Automobile and Cycle Show held at Paris during the latter half of December. It is undoubtedly the handsomest display of machines that has been made so far. Most of the automobiles were of the gasoline type, and while there were few striking novelties a great number of carefully designed machines and up-to-date racers could be seen. The attendance was unusually large and shows the increasing interest which the public is taking in the question of automobiles. King Leopold III. of Belgium made a trip to Paris for the occasion and visited the Show often. The immense floor space of the Grand Palais was entirely covered with the stands, and in the basement was a special exhibition of automobiles and fixed motors driven by alcohol. Another feature was the aeronautic section, where the history of dirigible balloons as well as the latest forms of airships could be studied. A further account of the Show and some of the leading types of machines will be given later in the SUPPLEMENT.

The Fire Department of Hanover has lately been provided with a fine automobile equipment, including a fire-pump worked by a gasoline motor, a hook and ladder set and a steam fire-pump. In the first two of these the automobile is of the electric type with batteries, and in the last a steam automobile is used. The electric automobile and pump is designed to carry 6 or 8 men. Two motors drive the rear wheels by direct gearing, the use of two motors giving an advantage in case of a breakdown. The speed of this automobile is about 10 miles an hour, and it will cover 15 miles on a single charge. The batteries, disposed under the seat, comprise 42 cells in three wood boxes. The total expense for this form of automobile fire-pump is estimated at $250 annually. The hook and ladder has the same type of electric automobile. As to the steam pump, it will deliver 250 gallons of water per minute. The pump is of the two-cylinder type and is placed just back of the driver's seat. Between the pump and boiler, and mounted on the rear axle, is a small steam engine which drives the vehicle, with transmission by chain gearing. The boiler is heated by a gas-burner. The pump carries 5 men, sitting and standing, and makes about 12 miles an hour.

Engineering Notes.

A diamond drill boring 4,800 feet exists in Johannesburg, South Africa.

Residents on Park Avenue, New York, will be pleased to learn that such good headway has been made with the excavation of the tunnel for the Rapid Transit Subway between 34th and 42nd Streets, that it is expected that the headings will be driven through in about one month's time. This will mean the practical completion of one of the most important sections of the rock excavation.

The Trinity House Brethren have decided to erect a new lighthouse at Dungeness, a prominent point of the southern coast projecting into the English Channel. At this point the sea deposits huge quantities of shingle during the course of the year, with the result that the present lighthouse is now so far inland as to be practically valueless. The new lighthouse will be the third that has had to be constructed at this point. The first was erected in the reign of James I. by a goldsmith named Allen. Some twenty years ago it had retreated so far in shore that it was pulled down, and a new one was built by Wyatt at the expense of the Earl of Leicester on the model of the famous Eddystone. In the last sixty years the second lighthouse has receded about half a mile from the coast, and although its fixed light is visible for fifteen miles it is becoming a danger to shipping. The cost of the new lighthouse will be $30,000.

Steady progress is being maintained in the development of the gold mining industry of Rhodesia. The yearly output, according to the latest report of the British South Africa Company, now approximates the value of $3,750,000. The output for November was 16,308 ounces. The mining industry of Rhodesia is ripe for immediate expansion, and now that the railways of the Cape Colony are practically freed from interruption it has been possible to arrange for the immediate delivery in Rhodesia of the mining machinery and stores which have been accumulating at the ports. North of the Zambesi great progress has been made during the past two years. It is hoped shortly to throw the country open to prospectors, when, in view of its vast extent, and of the fact that deposits of gold, copper, and coal have already been met with, it is anticipated that the development of the country will proceed rapidly. The condition of the natives has also been greatly improved, and now a native can earn from $100 to $200 a year in the mines, in addition to his food.

The Birmingham gun trade is suffering severely from Belgian competition. Belgian-made guns, inferior in quality, are placed upon the English market stamped with an English name, so that they are often mistaken for English goods. Under the existing law reasonable protection is not afforded either to the British maker, the dealer, or the public. The continental makers are making strenuous efforts to secure the home trade in the United Kingdom, as well as the colonial and foreign trade; and, aware that English guns command a higher price, they copy the English styles. The number of proof-houses in Great Britain is increasing, and therefore the variety of proof-marks is increasing, so that the possibility of distinguishing the foreign from the home-made article is very difficult. Belgian makers resort to the practice of having their guns proved in London in order to get an English name on them. An attempt to remedy this grievance was made by the promotion of a bill by the proof-house authorities, by which guns were to be plainly stamped with the name of the country in which they had been manufactured, but the bill for some reason was abandoned.

In the British government Board of Trade Journal appears a report upon the twenty locomotives that were supplied by this country for use upon the railways of Burma, India. According to the locomotive superintendent, taken on the whole, the engines may be described as good, but at the same time he complains about the boilers, which contain several minor defects. At first the boilers did not steam freely and the coal consumption was extravagant. The company which built them, it is stated, in endeavoring to adopt certain British designs for details went somewhat astray. Among other things, the fact was apparently overlooked that in reducing the size of the engine the size of the engineman and the fireman remained the same as on the standard gage. Some strong criticisms are made concerning certain details of the workmanship. The accuracy with which interchangeable parts have been made is nothing like so exact as those of British manufacture. The local engineers were all very much astonished at this, as for years it has been maintained that in duplicate work we are far ahead of any other country. It is also stated that while material used in the construction of the engines is of a very high quality, yet in certain parts the makers have used material which can only be described as distinctly bad.

Electrical Notes.

Push buttons and annunciators have given place to the time-honored practice of clapping hands to summon a page in the House of Representatives.

At the last meeting of the Manchester Association of Engineers it was pointed out that the size of electrical plants is steadily increasing, and where only a few years ago 500 horse power plants were considered large, more than double this amount is now common. Nearly twenty years ago the Messrs. Ferranti urged the employment of 10,000 horse power installations, but capitalists could not be found to take them up. Plants aggregating much higher powers than the last are now in use (but not as units) in electrical railways.

A wireless telegraphic installation is being made on the Zugspitz, the highest summit in Germany, and the postal station at Ebisee at its base. The altitude of the observatory is nearly 2,290 yards above sea level. The station will be very important, as the meteorologist who occupies it is completely cut off during the winter months, and telephonic communication cannot be depended upon, owing to the liability of the cable being frayed by coming in contact with the sharp edges of the rocks. The Slaby-Arco system of wireless telegraphy will be used.

The Manhattan Elevated Railroad Company has begun to build a much-needed station at One Hundred and Tenth Street, which will be a model station. It would be impossible for the trains drawn by locomotives to stop on the curve, but there will be no difficulty when the road is converted to the electrical system. The elevated structure is at its highest point at this curve. Eight passenger elevators will be required to handle the traffic, though only four will be installed at first. The station will be of red brick and granite, and the roof will be of Roman tiles. The platform will be long enough to accommodate a six-car train.

The French government is seeking to devise a method of economizing the cost of its system of lighthouse lighting, since it is considered that this department is too expensive. In 1873 the best French lighthouses were illuminated by mineral oil, and the most powerful light equaled only 54,000 candles. In 1883 the electric light was introduced, by which means the illuminating power was greatly increased. In the case of Calais lighthouse the illumination was increased to 820,000 candles. At the present day, owing to the rapid progress maintained in connection with lighthouse illumination, a light equal to nearly 3,000,000 candles is produced, and which is capable of piercing fog.

The new underground electric railway of Paris has proved such a great success that extensions of the system are contemplated. A new line is to be opened at the beginning of 1902 from the Porte Dauphine to the Place de la Nation, traversing the outer boulevards. Another important extension is to start from the Palais Royal to the Place du Danube, following the line of the Avenue de l'Opera, the Rue Lafayette and other important thoroughfares, a total of about four miles and a half, with fourteen stations. The present line from the Porte Maillot to the Porte de Vincennes—both its extremities touch the Ceinture Railways—is merely the trunk of a system that will eventually push its branches into every part of the city. The Metropolitan will then offer to its passengers more accommodation than all the other public means of transportation put together, even including all the boats on the Seine. Every day over this short railroad, which is eight and three-quarter miles long, 140,000 passengers are carried. The company has received sanction from the Prefect of Police to run more trains to meet the increasing traffic.

An interesting lecture upon the various uses of electricity upon railroads was delivered by W. Langdon, the well-known electric expert of London, before the British Institute of Civil Engineers. Upon the various railroad systems of Great Britain there are at present in use 7,182 arc lamps and 85,683 incandescent lamps. Electric energy applied to power purposes aggregates 10,527 horse power. The total mileage of telegraph wire employed for railway purposes approximates 113,000 miles, excluding wires maintained for the Post Office, which represent another 86,000 miles. The number of telegraph instruments is 158,286. In telegraphy there has been a steady, continuous growth. As traffic and competition develop, so increase the demands on the telegraph service. No form of instrument has, however, proved of greater service in working the trains than the telephone. It has, in fact, become indispensable on all the trunk roads. In the interlocking of the electric block signaling instruments with the mechanical signals comparatively little progress has been made. The London and South-Western and the South-Eastern, and Chatham and Dover railroads have shown the greatest advance in this respect. Electric-lighted railway carriages are rapidly coming into vogue. Some 3,000 vehicles, chiefly fitted with Stone's system, are now running.