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NEW YORK, SATURDAY, NOVEMBER 18, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE OFFER TO BUILD THE PANAMA CANAL BY CONTRACT.

Among the subjects that will form the subject of discussion by the board of engineers that are now engaged in deciding what type of canal shall be built at Panama, one of the most important is the proposal that was made by Mr. Lindon W. Bates, of this city, to build the whole Panama Canal by contract. We have already referred in previous issues to Mr. Bates's plans for excavating the canal; and it is upon these plans that this engineer is prepared to put in a bid, and give an adequate bond to the government, for the completion of this stupendous work within contract time. The proposal is made in a three-fold form, and it includes plans for three different methods of constructing the canal: one with a 96½-foot level, another with a 62½-foot level, and a third with a 26½-foot level. Mr. Bates's proposal differs radically from any that have yet been proposed, either by the French company or by any of the subsequent commissions and boards that have investigated the problem. Briefly stated, it involves the substitution of large, artificially-formed lakes, rendered navigable by dredging, in place of considerable sections of the canal as originally planned. The two most important of these lakes would be located at the terminals of the canal, and would open directly into the ocean by means of locks. Mr. Bates claims that the formation of these two lakes would greatly improve the sanitary condition of the canal zone, by substituting large bodies of fresh water in place of the existing swamps. A further advantage is claimed from the fact that the character of the dams to be built and their location is conducive to more rapid work than can be done under most of the existing plans, while the speed of transit of vessels through the canal would be greatly increased by the more direct course that can be sailed through the lakes, and the general reduction of curvature. Mr. Bates estimates that the comparative cost and time for completion of the three types of canal would be as follows: For a canal with a 26½-foot level, $135,000,000 and nine years' time; for a canal with a 62½-foot level, $125,000,000 and eight years' time; while for a 96½-foot level canal, seven years would be required and a total expenditure of $111,500,000. These estimates are for the engineering and construction work, pure and simple, and do not include the cost of government administration, sanitation, or policing.

Judging from the great success which has attended the construction of our railroads, and the more costly of our engineering works, there can be little doubt that the canal could be built more expeditiously and more cheaply under the contract system than by any other; and we cannot but think that if any responsible contractor, having a wide range of experience in work of this general character, can be found, who can command the financial backing and give to the government adequate bonds for the completion of the work, it would be best for the interests of the country to let the work by contract, and if possible, in a single contract. We have recently had proof in the city of New York of the excellent results that follow from placing these great engineering works in the hand of one single qualified man. We refer to the successful completion by Mr. McDonald of the $35,000,000 contract for the New York Subway, within the contract date set for completion. We give this opinion without any reference to the particular plan offered by Mr. Bates or any other engineer. The present board will decide once and for all what type of canal shall be built; but when their opinion has been delivered, the next important question will be as to by whom and by what system of management this enormous work shall be put through. We believe that the interests of the country and of the canal would be best served by letting the whole work by contract, in a single contract, if possible, subject to the oversight and final arbitrament of the engineering staff, and leaving the general administration, the sanitation, and the policing of the canal zone in the hands of the government, and preferably of the War Department.

THE SUEZ CANAL EXPLOSION.

Details have come to hand of the methods adopted when the steamship "Chatham," which recently sank in the Suez Canal with a load of dynamite on board, was removed by blowing up the vessel. Some curiosity has been expressed as to the way in which the detonation of this large amount of high explosive was made at once certain and safe, and we are indebted to an Egyptian paper published on the day after the removal of the wreck, for an accurate description of the greatest explosion of dynamite on record. The steamship "Chatham," when it took fire and was scuttled in the Suez Canal, had on board about 100 tons of dynamite, as well as a supply of detonators. The blowing up of the ship was accomplished by means of large mines, each containing 300 pounds of explosive and fitted with the proper electric fuses. One of the mines was placed by divers in the hold in which the cases of dynamite had been loaded, and the other mine was lowered into the hold containing the detonators. Cables were led from the mines to the shore, where they were connected to two of the telephone wires on the banks of the canal. The firing station was located three miles from the sunken wreck, and after the circuits had been tested by sending a small current through electric resistance fuses, the mines were fired. An enormous column of water and debris immediately arose, and ascended continuously for five seconds, the estimated height of the column being over 1,500 feet. The report of the explosion reached the firing point in sixteen seconds after the firing key had been depressed, and it was noted that the report was not particularly loud. The earth tremor, however, was felt almost instantaneously, in fact, while the firing key was still depressed. Although half a minute after the explosion the greater part of the debris had fallen, the air continued for over two minutes to be obscured with what looked like a mist. Although telephone wires were torn from the posts opposite the explosion, the blast was not sufficient to throw down the posts themselves. The water of the canal overflowed the surrounding country for a thousand yards in every direction, and fragments of the ship were distributed over a circle 1,200 yards in diameter. The enormous downward thrust of the explosion was shown when soundings came to be taken over the spot where the ship had lain. Here was found a huge hole, 73 feet in depth. This is the greatest explosion of dynamite ever recorded, the nearest approach to it being the blowing up of Hell Gate in 1876, when 50 tons of high explosive was detonated, and the accidental explosion some years ago of 30 tons of dynamite at the port of Lisbon.

HIGH VELOCITIES AND GUN EROSION.

The biggest problem in the development of war material at the present time, is to overcome the terrific erosion which burns out the inner tube of our modern high-velocity guns. The success of Admiral Togo in defeating the enemy by long-range rifle fire has directed attention more than ever before to the advantage of high velocity and big guns. There are two ways in which the punishing range of the gun can be extended; one is by increasing the velocity of the projectile, and the other is by increasing its weight. The disadvantages of increasing the weight are that less ammunition can be carried per gun, and that the loading of the gun is somewhat slower and its rapidity of fire is reduced. On the other hand, if the muzzle velocity be increased, the same striking energy can be developed at the same range without any increase in the weight of the projectile, and if a powder containing a high percentage of nitroglycerine be employed, there need be no serious increase in the weight of the charge. The United States government prefers to use a powder with less nitroglycerine than is present in the English cordite; but although it has succeeded in obtaining as high, and a little higher velocities at the proving grounds, this result is gained at the cost of using a powder charge that is over twice as heavy, the cordite charge for a 12-inch gun weighing 141 pounds, and our nitrocellulose charge weighing for the same gun, 350 pounds.

Nature, however, demands a heavy toll from those artillerists who seek to secure greater range by higher velocity; for in order to secure high velocity, the powder pressures within the gun must be raised to such a degree that the corresponding temperature plays the Old Harry with the inner tube, the white-hot gases melting it away, just as a block of ice is melted by a stream of boiling water. Up to a certain limit, pressures and temperatures may be raised and velocities increased without serious injury to the lining of the gun; but above that point the inner tube begins to deteriorate, the rifling is burnt out, the projectile fails to rotate on its axis, and begins to tumble end over end in its flight.

We do not hesitate to say that to-day the greatest problem in the development of artillery is the prevention of gun erosion.

There are no great mechanical difficulties to be encountered in getting high velocities. There are to-day at Sandy Hook under test by the Board of Ordnance of the army, two 6-inch wire-wound guns, each of which has shown muzzle velocities far in excess of anything that is used either ashore or afloat to-day. One of these is a design by Gen. Crozier, the present head of the Bureau of Ordnance, and the other is the well-known Brown wire-wound gun, the distinguishing feature of which is its inner core of laminated steel plates. We have before us some of the results that have been obtained during the tests of the latter gun at Sandy Hook. These include sixty-five rounds fired with powder charges of from 32 to 72 pounds, with corresponding muzzle velocities of from 1,913 feet per second to 3,380 feet per second, and with powder pressures ranging from 12,274 pounds per square inch to 43,370 pounds to the square inch. The high velocity of 3,123 feet per second was reached in the fourth round, and in the rounds from that up to the sixty-fifth round the velocities have ranged from 3,200 feet per second up to 3,380 feet per second, and most of them have been over 3,300 feet per second. We understand that structurally the gun has shown no signs of weakness whatever; and the indications are that, were it not for the erosion troubles, the pressures could be carried up to 3,500 feet per second, and the gun would prove to be perfectly well able to carry these velocities in service. Unfortunately, in both this gun and the Crozier gun, which has been tested simultaneously with it, that universal enemy of the artillerist, erosion, is getting in its destructive work. Thus we are once more reminded that the question of the ultimate practicable velocities of our guns is a question for the chemist, the metallurgist, and the powder expert to determine. We are squarely up against the fact that our steel makers cannot provide an inner tube that will endure the terrific heat engendered by modern smokeless powders. Furthermore, our artillerists admit that they do not know what is the exact explanation of erosion, whether the action is mechanical or chemical, or both. This is a field that will well repay investigation. The remedy may be found in the projectile, or in the tube or liner, or in the powder; but probably a careful study of the question of proper obturation will give the quickest solution of the difficulty.

THE ELECTRICAL VALUE OF WIND POWER.

The electrical utilization of wind power has obtained considerable popularity in Europe, and for several years now the Danish government has been conducting a series of experiments with windmills, to ascertain the relative amount of electrical power that can be generated thereby. In this country similar experimental tests have been tried, and although the instances are not numerous and are somewhat isolated, the data furnished indicate a useful future for this form of prime mover. This is particularly true of the agricultural regions of the West, where innumerable windmills have been constructed in the past ten years for irrigating purposes. The question of harnessing these windmills to motors for the generation of electric light, and even power, is likely to receive the attention of the farmers within the next few years.

Probably one of the first experimental efforts made to utilize wind power for generating electricity was that of Dr. Charles F. Brush, the inventor and pioneer in electrical experiments, who installed a windmill plant at his home in Cleveland in 1889, to light his house and laboratory. This windmill generating station is in use to-day, and during its sixteen years of operation, has furnished an excellent example of what may be expected of windmill motors in that section of the country. The fact that the wind power and variation differ considerably in the several States should be taken into consideration, and the value of this form of prime mover may prove more profitable in one section than another. The constant or average wind velocity for the year must be considered, rather than for a month or season.

The simplicity of the windmill generating plant is one of its chief features. In Dr. Brush's plant the dynamo is connected by pulleys, so that fifty revolutions are made to every one of the windmill, and the normal speed of the former is 500 revolutions a minute. In an ordinary wind with a velocity of 8 miles an hour this windmill works the dynamo to its normal speed, developing a load of 12,000 watts. Unfortunately, however, a wind velocity of 8 miles an hour cannot be depended upon steadily in the vicinity of Cleveland, and a storage battery is necessary for equitable operation. The average wind velocity for the United States is given at 8 miles an hour, but in many parts of the country a velocity of only 4 and 5 miles is maintained throughout the summer. The dynamo of the Cleveland plant is arranged to be automatically put into operation at 330 revolutions per minute. The working circuit opens automatically at 70 volts and closes at 75 volts.

In the basement of the house twelve batteries of 34 cells each are installed, and these are charged and discharged in parallel. With each having a capacity of 100 ampere-hours, it is possible to light 100 16-candle-power incandescent lamps. The successful working of this plant for lighting the house and laboratory has demonstrated the value of a windmill generating set for light loads.

The question of the general construction of the windmill itself has been the subject of considerable experiment. In this respect the Danish experts reached the conclusion that a curved wing would develop nearly twice as much power as the plane wing. This is better stated thus in figures: While the maximum power obtained from a curved wing was 108 gramme-meters per second per square meter of surface, the power obtained from a plane wing was only 42 gramme-meters. Grooved wings gave power equal to curved wings, and this form of windmill wing has been used ever since in all of the Danish tests. Four wings make the most convenient form of windmill in use, and a constant proportion between the length and width of the wings gives the highest results. Thus, to secure the most satisfactory surface area, the width of each wing should be from one-fourth to one-fifth the length, and the greatest width should be about three times as great as the narrowest part. The greatest width of the wing is placed in front, so that the wind is caught and carried toward the center, where it finds ready space for its escape. In such a windmill the tip of the wing should develop a speed 2.43 times that of the wind when working. The windmill plant at Wittkeil, in Schleswig, has demonstrated certain facts that carry out the foregoing statements. In this case the windmill has an enormous wind surface. The diameter of the windmill is about 40 feet, and an effective wing space of nearly 1,000 square feet is presented to the wind. The windmill develops 30 horse-power with a normal speed of eleven revolutions per minute. It operates a shunt dynamo that makes 700 revolutions per minute, and develops 160 volts and 120 amperes. This full load is developed when the wind is blowing at the rate of about 8 miles per hour. The windmill furnishes electricity to light the town of Wittkeil, and small motors and lamps are connected to the storage battery, which maintains a voltage of 110. The battery has a capacity of 66,000 watt-hours. This plant has proved so satisfactory that it is being enlarged, and as a permanent lighting station it is likely to prove of unusual importance in the development of modern electricity by windmills.

In the adaptation of the windmill generating plant to commercial purposes in this country, experiments have taken some peculiar forms. In order to eliminate the storage battery, the windmill must be able to store up its energy in some other way. A number of methods to do this have been suggested. At present the extra cost of constructing the storage battery makes the initial cost of the plant more expensive than the first cost of an oil or steam-driven plant. After the first installation the cost of operation is very little, and if it were not for the constant oversight required of the storage battery, the plant would work entirely without any watchman. The storage battery requires the attention more or less of an electrical expert, and the labor question enters into the problem of operation. By eliminating the storage battery, the cost of installation, the repair items, renewals, and the labor item would all be reduced. One patent tested in this country was to utilize a compressed-air plant in connection with the windmill. The dynamo is direct-connected to the air compressor, and the power thus stored up could then be utilized as needed. But in this case the extra amount of mechanism increases the cost of installation even more than the storage battery. The compressor, moreover, requires pretty constant watching, and the windmill generator thus approaches no nearer the self-regulating and operating machine than before.

Another method has been employed, which appears to contain some possibilities for the Western farmers, where windmills are already in use for pumping water for irrigating purposes. By means of storage tanks, the windmill pumps the water to a great height, and then the pressure developed by the falling water is utilized for driving a water turbine or wheel. In this case the dynamo is driven very much like any hydraulic generating plant, and ordinary motors and generating sets could be adapted to the work. The turbo-generating method of utilizing the windmill for electrical development would require nearly as much expense for initial installation as any of the other methods, but once in working order it would prove purely automatic and self-regulating. The great size of the tank required to develop sufficient horse-power to operate the generators is one of the drawbacks to this system. The loss of efficiency would be quite considerable, and the ordinary windmill now in use for electrical generation would have to be increased in size or supplemented by several others. Such a storage tank would, moreover, have to be large enough to hold sufficient water to run the turbo-generators for at least eight or ten hours consecutively. Even then the plant might be put out of work for ten hours or more through the failure of the wind. All would depend upon the average velocity of the wind in the region where the plant was installed. The storage of water by means of windmills in reservoirs on the hillsides has been suggested, thus furnishing an artificial supply of water for hydraulic purposes. In this case a sufficient number of windmills might be installed to pump the water in a huge reservoir that would never be exhausted. The results of such an experiment would certainly prove of interest to engineers, but it is somewhat doubtful if the returns would pay for the heavy outlay of funds for the windmills and the storage reservoir. Yet despite these many serious drawbacks to windmill electrical engineering, it is quite apparent that in the course of time the power of the wind will be used more and more for developing electricity, and with new mechanical methods better results are bound to follow.

ANOTHER NORTH POLE BALLOON EXPEDITION.

According to a notice in the Vossische Zeitung, Marcillac contemplates taking a trip to the North Pole by balloon, similar to that of the unfortunate Andrée. As a safeguard against such accidents as befell the latter, Marcillac intends to carry with him a wireless telegraph apparatus by means of which the balloon will be kept in permanent connection with the starting station.

As regards the technical particulars of the Marcillac scheme, it may be said that the balloon is to be provided with an electromotor capable of evolving driving power during 200 hours, which would be intended either to drive the balloon in the case of weak winds, or to impart to it a course different from the direction of the wind. The balloon is to receive from 5,000 to 5,500 cubic meters of gas, supplied by a novel apparatus in the car. Several instruments have been constructed by Marcillac especially for this expedition—for instance, an amenoscope for investigating the air currents; a velometer for measuring the speed of the balloon; a horn intended to give acoustical signals; and finally, what he calls a "thermogen," viz., a special device for counteracting the influence of the polar cold on the gas of the balloon.

Spitzbergen is to be chosen as starting-point, as in the case of the Andrée expedition. The cost of this trip is estimated at 90,000 francs, while that of the Andrée expedition was about double the above amount.

THE PREVENTION OF "COLDS."

Now that the season for "colds," coughs and neuralgic pains is with us, the careful man is on the lookout for such preventive measures as will guard him against the "eager and nipping air" that may prepare the way for a winter's sickness. It is the proper adaptation to his environment that must settle the question of his immunity against the ever threatening weather ailments.

With the changeable climate of our northern latitudes the task is often a difficult one. Thus a sudden drop in temperature is often followed by a veritable epidemic of catarrhal troubles.

The ordinary phenomenon of a "cold" is explained by a rapid cooling of the surface whereby the superficial circulation is temporarily arrested and internal congestions are produced. The primary effect is generally upon the mucous membranes of the nose, throat, and upper air passages. In consequence of this revulsion chilliness, lassitude, headache, sneezing and cough follow in turn, and the patient becomes generally miserable. Then, when it is too late, he doubts his resisting powers against draughts, cold rooms, undue exposure and the like, and is ready to resign himself to the coddling process for the remainder of the winter. Strange as it may appear, it is this misguided carefulness that explains most of the chronic catarrhs of the season.

First on the list of such causative agencies are our overheated and ill-ventilated apartments. Eminent medical authorities maintain that the sudden change from an overwarmed room to the cold air outside has more to do with the production of "colds" than all other supposed agencies combined. The air passages, after having been dried, and, so to speak, baked in our living rooms, are not only peculiarly sensitive to cold, but are in a condition least liable to resist the influences of the change.

The same principle might apply to overheating the body by too much clothing and enfeebling the skin by confined perspiration. The exact contrary condition results from inurement to low temperature and the creation of a habit of natural resistance. The man who is accustomed to bare his throat to the blast never suffers from tonsilitis, and the one who is used to the cold morning plunge never knows a shiver, even in winter weather. The real moral is to face the cold with a bold front, to conquer rather than to shrink from it and be overcome in the end. The hardened man makes his skin an ever-ready adjuster to all variations of temperature. The feebler one can approach such a state of protection and may in the end equal it.

A like principle applies to exercise. With ordinary garments the well individual never suffers from cold while in motion, but the one who sits or lies in a cold room or in a draught from open door or window is sure to become a victim of his indiscretion.

These are simple enough rules in themselves, but few think of applying them to individual needs until reminded of their lost opportunities.

The worst of all is that a "cold" taken in early winter is apt to linger and thus prepare the system for even more distressing ailments. The very lack of vital resistance that invites the first attack of catarrh is apt to intensify the predisposition to subsequent colds. This in a great measure explains the prevalence of pneumonia during the inclement season. The microbe never attacks a healthy membrane, but lies in wait for the local debilitation which furnishes the soil for the seed.

No more forcible argument could be used in favor of preventive measures against the slightest respiratory trouble that may show itself at this time. Nothing lowers the vital resistance against all winter diseases more than the initiative and apparently insignificant "cold."—N. Y. Herald.

SCIENCE NOTES.

An important item in the extension of the work of the Bureau of Chemistry has been the establishment of inspection for imported food products. As a result food products imported to this country have been greatly improved. In former years the United States was regarded as the dumping ground for the refuse teas of the commerce of the world. Many years ago, in order to overcome this evil, a system of inspection of imported teas was established and has since been maintained. Under the beneficent working of this system Americans are now certain of being able to purchase pure and wholesome tea, since it is almost impossible for spurious and adulterated teas to find their way into this country. Congress has now extended this system of inspection to all foods, beverages, and condiments imported into the United States. There is every reason to believe that when this system is thoroughly established an improved condition comparable to that which has taken place in teas may be anticipated.

The bactericidal effect of wall-paints has been studied ately by Dr. Beaufils (see Revue Générale des Sciences) according to the following method: A layer of paint having been spread out on wooden boards or glass plates, a culture of microbes was placed on this layer after being dried, and the plate thus prepared was kept in the laboratory protected against dust. At regular intervals some microbe colonies were removed and spread out on an appropriate medium or used in inoculating animals. An unpainted check-plate served to ascertain the action exerted by the paint on the vitality and virulence of the microbes, this action being shown generally to be distinctly bactericidal while varying according to the nature of the painting. The colors of enameled porcelain are for instance found to be much more active than oil colors, especially in regard to the bacillus of tuberculosis. The fact that these paints exert a constraining action on the latter bacillus would seem to be the most important practical result of these researches.

When chloride of silver is exposed to sunlight it assumes a violet tint and gives off chlorine. A chemical change thus occurs, and the change of color must be attributed to the formation of a new compound. But there seems to be a great difference of opinion as to the nature of this effect. D. Tommasi, in taking up the question, considers that the chloride of silver, under the influence of the rays, undergoes a partial decomposition which is proportional to the surface, the exposure, and strength of the light. A very small quantity of silver chloride is transformed into Ag_2Cl or Ag_4Cl_3 (this chloride has been directly obtained by Von Bibra) which is finally decomposed into silver and chlorine by a long exposure to the sun, so that the violet chloride of silver contains variable quantities of $AgCl$ and the two chlorides mentioned above, and also metallic silver. As there are some differences of opinion as to many of the properties of silver chloride, M. Tommasi undertook the study of these properties, and gives the following results. The white chloride of silver when exposed to the sun in a glass-stoppered flask containing water saturated with chlorine, in a short time acquires a slight violet tint which does not become any darker on a long exposure. Here a state of equilibrium is formed between the action of the light upon the white chloride and the action of the chlorine upon the violet chloride, which has the effect of preventing the light from blackening the white chloride, and the chlorine to bleach the violet chloride. Again, dried white chloride in a sealed glass tube becomes violet when exposed to the sun and becomes white again when the tube is placed in the dark. When the dry violet salt is shaken with chlorine water in the dark, it whitens in a short time. He also finds that when the violet chloride is boiled with nitric acid, it is not bleached. Bromide of silver acts in an analogous manner, but the iodide is not affected by exposure to the sun.