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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.

ALTERNATIVE PLANS FOR THE PANAMA CANAL.

An engineering work of the great size and complicated character of the Panama canal should be the subject of most exhaustive examination before the final plans for its construction are adopted. To the lay mind it might seem that already time and expense enough had been incurred in preliminary investigations; but to the engineer it is well known that in hydraulic works of the magnitude of the Panama canal, it takes years to acquire that intimate knowledge of climate, topography, and sub-surface conditions, which is absolutely essential before he can say, "I will build this work upon such a plan, for such a cost, and within such a time."

That the last word must not be too hastily spoken in the matter of selecting the general plan of this canal, is shown by the fact that Mr. Lindon W. Bates, one of the most experienced of American engineers in work involving heavy excavation, has recently presented to the President two alternative plans for the construction of the canal, which have so much to recommend them that they are certain to receive most careful consideration from the canal commission. The leading illustrated article of this issue gives a clear account of the plans for a sea-level canal that are tentatively favored by the present commission; and they form the basis of comparison in the present sketch of Mr. Bates's suggestions. The first of his projects involves the construction of two large terminal lakes, one extending from Mindi near the Atlantic Ocean to Bohio, a distance of 12 miles, and the other reaching from La Boca to Pedro Miguel, a distance of 5 miles. These two large reservoirs would afford about 17 miles of lake navigation, and because of the higher speed at which ships could travel in crossing them, would reduce the time of transit three hours below that which would be necessary to pass through the proposed sea-level canal. Entrance to the lake at the Atlantic end would be by locks with a lift of about 25 feet. One advantage of the lake would be that a large area of swamp land would be covered by fresh water, and a fine interior harbor created for vessels; moreover, all excavation of the channel along the sailing route could be performed by floating dredges. The canal between the two lakes, thus formed, would be excavated through the divide at the same level as the lakes, there being thus a single summit level of plus 20 from the Mindi dam on the Atlantic to La Boca dam on the Pacific. At Gamboa, which is about midway between Bohio and Pedro Miguel, Mr. Bates proposes, for control of the Chagres, the construction of a dam provided with under-sluiceways, with provision for discharging one-half of the flood waters of the Chagres River to the Pacific and one-half to the Atlantic. The great advantage of this plan over the one proposed by the present chief engineer of the canal is that it will be possible to receive the sudden floods of the Chagres in a reservoir that is normally empty, and permit them to escape at will.

The second project offered by Mr. Bates provides for four locks, with a summit elevation 52.5 feet above mean sea level. This plan, in addition to dams at the Atlantic and the Pacific end of the canal, calls also for the erection of dams at Bohio and at Pedro Miguel, and the creation of a lake at Bohio with a surface level of 52.5, which is entered by locks with a lift of about 30 feet, and which extends for 15 miles to the foot of the Culebra divide. The canal is cut through the divide with the same surface level as that of Bohio Lake, descent being made at Pedro Miguel to the 20-foot level, which extends from Pedro Miguel to the Pacific. Briefly stated, the first scheme will consist of two lakes and a connecting length of canal, all at an elevation of 20 feet above mean sea level. The second scheme will consist of two terminal lakes at an elevation of 20 feet above mean sea level, and a summit lake and length of canal with an elevation of 52.5 above mean sea level.

A comparison of these two projects of Mr. Bates with the sea-level canal recommended by the present chief engineer, shows that unless there are some physical features that would prevent its execution, either of the new plans would have several important points of advantage over the sea-level plan. For in the first project there would be 17 miles of lake navigation, and in the second 26 miles (over one-half the length of the canal), as against an all-canal navigation in the case of a sea-level canal. The time of transit of large vessels would be reduced from say 12 hours to about 9 hours, and the time of completion from ten years, which is the most optimistic estimate of the chief engineer, to eight years. Finally, judged on the question of cost, Mr. Bates estimates that there will be a saving of about $85,000,000.

The fact that an eminent engineer, as the result of an independent investigation of the problem, should be able at this late day to present a scheme that has so many admirable features, certainly shows the wisdom of the President in determining to call in some of the most eminent engineers of Europe to act in a consulting position with our own engineers in choosing the final plans for the canal. So monumental is this work, so far-reaching will be its effects upon the commerce of the world, that the plan upon which it is built should be not merely a good one, but the very best possible for the conditions.

AN ATTACK ON THE WIRE-WOUND GUN.

An ex-lieutenant of the British navy has created not a little stir in naval circles by writing a series of letters to the London Times, in which he tries to throw discredit upon the wire-wound gun. These letters were based upon the fact that some guns of this type in the British navy had developed a crack in the liner, the thin inner tube which carries the rifling, and had been sent to the gun factory to be relined. It must be admitted that on the face of it the mere statement that some 12-inch guns had "cracked," sounds ominous. But when we come to examine into the construction of these guns, the location of the cracks, and their effect upon the strength of the gun, we find that the defects are of such minor consequence that the strength of the guns is not in the least affected. As a matter of fact the very powerful powder, cordite, used in the British navy exercises such a rapid scoring effect on the liner, that after a certain number of rounds have been fired, the guns must be returned to the factory for relining. The scoring of the gun is the penalty which the authorities are willing to pay for the sake of using a powerful explosive, whose bulk is not much more than half as great as that of the less powerful propellants which do not score the guns so severely.

The 12-inch wire-wound gun is assembled in the following manner: First there is the inner tube or liner, which is placed there to carry the rifling grooves and to protect the gun proper from the action of the white-hot powder gases. Then comes the main tube, or A tube, as we should call it in this country, a thick, heavy tube extending the full length of the gun from breech to muzzle, whose object is to carry the 100 miles of wire which is wound upon the tube, and which constitutes the actual strength of the gun. The wire is wound at a tension so great that the metal of the tube is thrown into a state of initial compression. This compression is such that when the gun is fired, the whole of the bursting or tangential stress is immediately transmitted to the wire, which has an ample margin of strength to take care of any legitimate pressures that are set up by the powder. In the English guns the A tube is forged and bored and turned from a single piece of metal. In the Brown wire gun, as manufactured in this country, the A tube is formed of a series of involute, overlapping, thin steel plates, and in this gun the wire is wound at such great tension on the tube that when the gun is fired, the metal of the tube never even passes from a compressive to a tensile condition. In both guns the wire winding is covered from breech to muzzle with a pair of outer steel tubes which serve to protect the wire from injury by shot or shell. In the gun as thus made up, the longitudinal stresses tending to pull the gun apart in the direction of its axis are taken care of by the inner barrel or A tube, and by the outer hoops, which are locked into one another. The bursting stresses are resisted by the wire-winding, assisted by the outer hoops, and the inner tube or liner is not called upon, in estimating the strength of the gun, to resist either of these stresses, tangential or longitudinal. So true is this, that the liner might be split through its entire length, as we believe happened in some of the guns in question, without impairing the strength of the gun.

The Scientific American holds no brief for the wire-wound gun, and we merely desire to place the full facts of the case before the public, especially at the present juncture, when the gallant little Japanese navy is having to depend upon guns of this type in the most momentous crisis of the war. We understand that the wire-wound guns of the Japanese have given excellent service, and that, in spite of the severe service to which they have been put, there has been no case of failure. As to the life of the wire-wound gun, it appears that when the first of the type were made for the "Majestic" class of battleships of the British navy, it was estimated that the inner tubes would not last for more than sixty to eighty rounds. But, according to the Admiralty, the equivalent of 162 rounds has already been fired from one of these guns, and others which have fired the equivalent of over sixty full charges, are still perfectly serviceable. In this connection it is of interest to note that the highest velocity yet attained in this country for a gun of large caliber was recorded not long ago in the army tests at Sandy Hook of the new Brown wire gun, when some rounds were fired with a velocity of over 3,300 feet per second. Another wire-wound gun, designed by Gen. Crozier for the army, is nearing completion, and will shortly be subjected to test.

THE PREPARATION OF SURFACES FOR PAINTING.

In preparing a panel of wood or cardboard for the reception of a painting in oil colors, it is desirable to make the ground agree with the layer which forms the painting in respect to expansion by heat and moisture, otherwise cracks are sure to occur in time. The panel may be painted with boiled linseed oil, which penetrates to a certain depth and is hardened by oxidation to a thin, tough coating, identical with the hardened oil in which the pigments are imbedded. A painting on such a ground may be exposed to great variations of temperature without danger of cracking. The preparation takes time, as the oil must become quite hard before the painting is begun. It is advisable to oil both sides of the panel and the edges, to prevent danger of warping from dampness. The best way to oil panels in quantity is to place them on edge, separated by small blocks of wood, in a tin vessel which is then filled with well-boiled oil, heated gradually from beneath to 110 deg. or at most 120 deg. C. (230 deg. to 248 deg. F.) and allowed to cool. The pores of wood and cardboard are filled with air, and both contain large quantities of water, the moisture in thoroughly air-dried wood amounting to 20 per cent by weight.

During the heating the air is first driven out, and then the water, which at 120 deg. C. may be assumed to be entirely expelled, and during the slow cooling the external air pressure forces the oil so deeply even into hardwood that panels a quarter or a third of an inch thick are saturated throughout. The panels are taken out and allowed to drain, and the excess of oil is removed with a cloth or brush. They are then kept standing on edge, without touching each other, for several months, in order to harden the oil in the interior as well as on the surface.

Paintings on panels thus prepared are not only uninjured by variations in temperature and humidity, but they may be cleaned by washing and are not attacked by insects, which often ruin unprepared panels.

Metallic grounds are little used by artists, although very small paintings are sometimes executed on plates of copper. Such plates, though strong, durable, and proof against dampness, are peculiarly liable to produce cracks in the paintings executed on them, because they expand or contract so greatly and so quickly with every change of temperature. This defect, however, can be remedied to a great extent by giving the metal a tough, elastic coating, for which purpose linseed oil is again employed. The plate is roughened with a fine file, slightly polished with pumice stone, washed, dried, and immediately painted very thinly with hot oil, which penetrates into all the irregularities and, when hardened, adheres firmly, the adhesion being increased by chemical action of the acids in the oil upon the copper, which thereby assumes a greenish tint. Three coats of oil are given, each of which is allowed to become quite hard before the next is applied.

The painting, therefore, rests on a tough, elastic coating of hardened oil, which protects it from the effect of expansion of the metal.

Sheet-metal signs and the lettered and decorated tin boxes in which small wares are sold soon become defaced when exposed to changes of temperature, particularly if the colors have been mixed with quick driers, as is generally the case. The process above described is too costly to be applied to most of these articles. A simpler method consists in giving the metal one coat of thoroughly boiled oil, or better drying oil, and grinding the colors in the latter without any special drier. The plates do not dry very rapidly, but this simple process is not only cheaper, but more effective in securing permanence than the use of colors ground in soft resin varnishes, as practised by some manufacturers.

Plaster and stucco are painted in both oil and distemper. The colors sink into the porous wall, and one spot may have to be repainted several times to produce the desired effect. This inconvenience is easily avoided by giving a preliminary coat of size for distemper, or of hot boiled oil for oil painting.

The finished painting should receive a coat of var-