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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.

Card - H.G.H. Carded E. F.

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 varnish or paraffin. When paraffin is used, however, the wall should be neither sized nor oiled before painting, and the colors should be mixed with a minimum quantity of thin size. When dry they are covered with melted paraffin, hot enough to sink well into the wall before solidifying, a condition which is made known by the instantaneous disappearance of the gloss. Additional coats of paraffin are then applied until a permanent gloss is produced, and the surface is finally polished with a woolen cloth. Such mural paintings are very permanent, as the chemically-inert paraffin protects both the wall and the colors.—Condensed from Der Stein der Weisen.

THE HEAVENS IN JUNE.

BY HENRY NORRIS RUSSELL, PH.D.

With the recent astronomical periodicals comes fuller information about the two new satellites of Jupiter. Thanks to the zeal of Prof. Perrine, a sufficient number of observations of each of these bodies has been obtained, before Jupiter got too near the sun to be seen by night, to enable their orbits to be roughly calculated. This makes it certain that these faint specks are really moons of Jupiter and not merely small asteroids which happened to be near him when the first photographs were taken. It will also make it easy to find the satellites again when Jupiter reappears in the morning sky by telling us where to look for them.

The results which Prof. Perrine has announced are somewhat remarkable. The sixth satellite (which is the brighter of the two) is about seven million miles from the planet, and takes about 250 days to complete a revolution. The outermost satellite previously known (the fourth) is only one-sixth of this distance from Jupiter and its period is about sixteen days.

The seventh satellite, which is much fainter, revolves in an eccentric orbit, at a mean distance of about six million miles, with a period of some 200 days.

The planes of the orbits of these two satellites are considerably inclined to that of the orbit of Jupiter, to the orbits of the inner satellites, and to each other.

They are both very small bodies. The sixth satellite, which is of the 14th magnitude, has been seen with the 26-inch telescope at Washington, and is therefore within the power of a number of instruments. The seventh satellite is estimated as 16th magnitude—about as bright as the new satellite of Saturn—and can only be seen with one or two of the very largest telescopes. They are so far from the planet that they might have remained undiscovered for centuries had it not been for photography.

From their brightness, as compared with the larger satellites, Prof. Perrine concludes that the sixth satellite is 100 miles or less in diameter, and the seventh about 35 miles.

It is not yet known whether these two new satellites revolve about the planet in the same direction as the other five. How this may remain indeterminate, when so much is known about their orbits, appears from the following considerations: We can tell by watching the satellite go once round Jupiter (or even part of the way round) how far to the left and right of the planet it goes, how long it takes to go round, and so on; but we cannot tell merely by looking at it whether it is nearer to us than Jupiter, or farther away, whether it is approaching us, or receding from us—and this is just what we need to know to determine the direction of the satellite's motion. To solve the problem we must wait a year or two, until Jupiter has moved some way along his orbit, so that we see the orbits of the satellites at a different angle. Then, by combining the two views of the orbit, we can tell which is the nearest part of it in the same way in which the stereoscope, by combining two views of a landscape, enables us to pick out the nearer objects.

It will be of great interest to see whether these two satellites go backward, like Phœbe, the outer satellite of Saturn, which they so much resemble in other ways, or have a direct motion like the general run of satellites.

The brightest objects in the evening sky are Arcturus and Mars. At 9 P. M. in the middle of this month they are both close to the meridian, Arcturus being about 20 deg. south of the zenith (in the latitude of New York) and Mars about 35 deg. lower down. The planet is brighter and redder than the star. To the right of Mars and nearly at the same level is Spica. The other stars of Virgo are higher up and farther west. Below them is the little group of Corvus. Leo lies in the west at a moderate altitude. Below him is Hydra, whose long tail stretches to the meridian under Mars. Ursa Major is high up, extending northwestward from the zenith. Castor and Pollux are still visible in the northwest and Capella is just setting still farther to the north.

On the meridian below Virgo can be seen a part of Centaurus. Its two brighter stars, which almost equal Arcturus, can only be seen from points south of latitude 30 deg.

In the southeast is Scorpio. The three stars which lie near the creature's head and the red Antares at its heart are all visible, but its long tail extends below the horizon. The tangle of stars above and to the left of Scorpio form the constellations Serpens and Ophiuchus. Through them runs a branch of the Milky Way.

Farther north is a line of fine constellations. Aquila is low in the east. Its principal star, Altair, is flanked by a smaller one on each side. Higher up and farther north is Lyra, which contains Vega, the brightest star in this part of the sky. Between Vega and Arcturus are Hercules, marked by a figure shaped like the keystone of an arch, and Corona, whose stars form a semicircle. Below Vega, to the left, is Cygnus. Cassiopeia is beneath the Pole. Cepheus on the right.

THE PLANETS.

Mercury is morning star till the 24th, when he passes through superior conjunction and becomes an evening star. He is not well seen at any time during the month.

Venus is morning star in Aries and is very conspicuous, reaching her greatest brightness on the 2d and rising between 2 and 3 A. M. all through the month.

Mars is the principal feature of the evening sky. He is on the border of Virgo and Libra, and comes to the meridian at 9.50 P. M. on the 1st and at 7.50 on the 30th. He is still quite near opposition, but is gradually receding from us, and his distance increases from 51 to 63 millions of miles during the month. He is nearer at the present opposition than he has been for some years past (though not so near as he will be next time) and his surface will doubtless be carefully scrutinized.

Jupiter is morning star in Taurus, rising about 3 A. M. Venus is slowly overtaking him, but they will not be in conjunction till next month.

Saturn is in Aquarius and rises about midnight.

Uranus is in opposition on the 24th. He is very far south, being in R. A. 18 h. 10 m., dec. 23 deg. 41 m., about 3½ deg. south of the fourth magnitude star μ Sagittarii.

Neptune is in conjunction with the sun on the 30th and is invisible.

THE MOON.

New moon occurs at 1 A. M. on the 3d, first quarter at 8 A. M. on the 10th, full moon at 1 A. M. on the 17th, and last quarter at 3 P. M. on the 24th.

The moon is nearest us on the 13th and farthest away on the 25th. She is in conjunction with Jupiter and Mercury on the 1st, Mars on the 13th, Saturn on the 22d, Venus on the 28th, and Jupiter again on the 29th. The conjunction with Saturn is close.

At 10 P. M. on the 21st the sun reaches his greatest northern declination, and enters the sign of Cancer, an event described by the almanacs with the conventional phrase "Summer commences."

Cambridge, May 9, 1905.

ELECTRICITY AND BREAD.

The power of the electric current to decompose certain substances in a singular way has led to an important development of electro-chemistry. In this connection experiments have recently been made in Paris, seeking an improvement in bread making.

Laboring under the mistaken impression that the whiteness of wheat bread determines its quality—that the whiter the bread the better—the Parisian public has for years been growing more and more exacting on this score, and therefore the fineness of grain flour has been gradually approaching a limit. The public has, as a consequence, received a less nutritive food, it being a known fact that the core of the wheat grain, which is the chief constituent of bread, while producing the whitest flour, at the same time contains the smallest amount of albumen and is thus least nutritious.

There has recently been raised the hope of obtaining a whiter bread by aid of electricity, for which purpose the flour was brought in contact with electrified air, whose ozone possesses efficacious bleaching properties. A report to the Academy of Sciences at Paris on the result of an experiment with flour treated in both the ordinary way and by electricity, under similar conditions, explains that the flour subjected to electric influence was much whiter in color, but that its taste and odor were far inferior to those of flour treated by the ordinary method. The amount of phosphorus was the same in both, but the quantities of fatty and acid substances varied largely. Thus, in flour treated by electricity the fatty substances proved rancid, glutinous, and of a less yellowish color, and instead of retaining their usual aromatic, yellow state, became oxidized and partly converted into white sebacic acid, which could be dissolved in alcohol. The glutinous substances were discolored and changed.

The bread made from this flour was whiter than usual, but of inferior taste, and the experiment serves to demonstrate that electric treatment, while successfully turning flour whiter, injures it.

The number of persons employed in the United Kingdom in mines underground in 1904 was 681,683, against 676,746 in 1903; and the numbers above ground were 165,870 and 165,320 respectively.

SCIENCE NOTES.

A rubber film glove, the feature of which is antiseptic qualities, has been devised for surgeons. The idea consists of immersing the hands in a weak solution of gutta-percha in benzine or acetone, or applying the solution to the skin of the patient. The purpose of the film is to seal the surfaces of either the hands or skin with an insoluble, impervious, and practically imperceptible pellicle, which will not allow the secretions of the skin to escape, and will not admit blood, pus, or secretions into the crevices of the skin. Such a protective measure for surgeons is preferable to working with rubber gloves, inasmuch as the sense of touch or pliability of the skin is not impaired in any way, as is the case when detachable gloves are used.

A report has been presented to the French Academy of Sciences by M. J. Violle "on the action of hail cannons." In this report is given for the first time some trustworthy information covering a wide area and for an extended period, thereby supplying conclusive evidence as to the utility of this means of avoiding or mitigating damage in the vineyards from hailstorms. M. Violle's report refers to the district of Beaujolais, where there are established twenty-eight societies for dispersing in this manner the hailstorms common to that region. Comparing the losses suffered in the period 1900 to 1904, since the introduction of the cannon, with those of the preceding ten years, from 1891 to 1900, the evidence strongly supports the view that the cannon firing is protective. It has been frequently noticed, M. Violle remarks, that both lightning and thunder are suppressed within the zone where cannon are used, although they may be raging just outside the area.

Some discoveries of valuable archæological interest have been made in the tombs of Luxor by Mr. Theodore M. Davis, of Newport, R. I., who has been annually wintering in Egypt for many years. Mr. Davis has become an enthusiastic Egyptologist, and has carried out a number of excavations. During his latest investigations in February last, he unearthed in the Valley of the Tombs of the Kings in Luxor the tomb of a daughter of Amenhotep III. and of the father and mother of his wife Queen Thy. The mummies of the father and mother had been carefully unrolled in the search for jewels and gold in ancient times, but nothing had been discovered. The tomb contained coffins covered with gold leaf, carved and gilded chairs, alabaster Canopic jars, religious symbols of fine quality, a large roll of papyrus, and a complete chariot with wheels, pole, and neck yokes. The body of this chariot was covered with gold leaf. A special interest is attached to the last named, as it is the only complete chariot that has yet been discovered. It has been removed to the Cairo Museum.

A discovery of great archæological interest has been made in the district of Umtali in Central Africa during some recent exploration. Extensive ruins of what apparently were buildings of some antiquity have been revealed. One of the most interesting objects unearthed is a structure shaped like a cairn, and unique in the history of the country since the establishment of white rule. It is twelve feet long and about the same width, with a small curious construction at one end. Notable features of the cairn are that each side—excepting one, which has been displaced by the growth of a large tree—bears traces of skilled handiwork. The material, which strangely enough differs in character, is dressed and faced throughout in artistic style. One side is composed entirely of quartz, while the others consist of soapstone and gneiss respectively. Whether the structure covers the remains of some distinguished ancient, or merely symbolizes some important event in early times, remains to be seen. The whole of the ruins, and particularly the cairn, are being carefully examined by an expert, in the hope that they may furnish a clew, if not the key, to the mystery of the ruins at Great Zimbabwe.

The Secretary of the Treasury has instructed the collectors of customs that the astronomical instruments exported from this country for use by various astronomical expeditions for observing the coming eclipse are to be readmitted free of duty. The order was the result of a long correspondence between the director of the Lick Observatory in California and the Secretary of the Treasury. W. W. Campbell, director of the Lick Observatory, contended that the astronomical instruments which will be used for observing the eclipse should be readmitted into this country free of duty. Nearly all were manufactured abroad. Secretary Shaw has ruled that although the articles would ordinarily be subject to duty the interests of science demand that the law be suspended. Among the articles to which the ruling applies are telescopes, mirrors, prisms, lenses, clocks, tents, photographic materials and all manner of tools. A number of educational institutions, including Harvard, Princeton, and the University of Indiana, and also the United States Naval Observatory will contribute equipment for the three expeditions. The Lick Observatory will take general charge of the expedition.