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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

THE SENATE PANAMA CANAL BILL.

It is gratifying to note that the international canal question is finally to be settled in a way that we have contended was the only practical one, that is in favor of the short Panama route—a route also favored by the Isthmian Canal Commission. The Senate on the 19th instant passed the Panama Canal bill by a vote of 67 in favor to 6 against.

The radical change in sentiment as here illustrated, in comparison with the Hepburn Nicaragua House bill, may be largely accounted for by the masterly way in which the Canal Commission placed the result of its investigations before Congress, sufficient to convince many men of a practical turn of mind of the several advantages of the Panama route. In addition to this the recent terrible disaster at St. Pierre, Martinique, caused by the tremendous volcanic eruption of Mont Pelée, fixed in the minds of many the futility of constructing a canal in a region having a record for volcanic disturbances and earthquakes.

Thus when the merits of the Panama Canal became fully known and the possibility of its acquirement for a reasonable sum and the probability of securing the desired right of way on equitable terms, there was an irresistible sentiment created in its favor which is reflected in the nearly unanimous vote of the Senate. In the debate preceding the vote the shortness of the Panama Canal as compared with the Nicaragua was emphasized as one of the important points of its advantage—49 miles, as against 183. The depth is to be 35 feet. The principal provisions of the Senate bill are:

1. That the President is to acquire for the United States, at a cost not exceeding \$40,000,000, all of the rights, privileges, franchises, concessions, grants of land, rights of way, unfinished work, plants, and other property owned by the New Panama Canal Company of France on the Isthmus of Panama and all its maps, plans, drawings, records on the Isthmus of Panama and in Paris, including all the capital stock, not less, however, than 68,862 shares of the Panama Railroad Company, owned by or held for the use of said canal company, provided a satisfactory title to all of said property can be obtained.

2. That the President is to acquire from the Republic of Colombia exclusive and perpetual control of a strip of land not less than six miles wide from the Caribbean Sea to the Pacific Ocean, and the right to use and dispose of the waters thereon, and to excavate, construct, and perpetually to maintain, operate, and protect thereon a canal of such depth and capacity as will afford convenient passage of ships of the greatest tonnage and draught now in use, from the sea to the ocean; this control to include the right perpetually to maintain and operate the Panama Railroad, if the ownership thereof, or a controlling interest therein, shall have been acquired by the United States; also jurisdiction over the strip and the ports at the ends thereof, to make the necessary police and sanitary rules and regulations, and to establish judicial tribunals to enforce the same. The President also may acquire such additional territory and rights from Colombia if deemed necessary.

3. \$40,000,000 is appropriated to pay for the property of the New Panama Canal Company and a sufficient amount to pay Colombia for the territory acquired from that country for building the canal. The President is then, through the Isthmian Canal Commission, authorized by the act to proceed with the construction of the canal, utilizing as far as practicable the work already done. The canal is to be supplied with all necessary locks and other appliances. Provision is made for the construction of safe and commodious harbors at the termini of the canal, and for such works of defense as may be necessary for the safety and protection of the canal and harbors.

4. In the event that the President is unable to secure a satisfactory title to the property of the New

Panama Canal Company and the control of the necessary territory from Colombia, and after first having obtained for the United States exclusive and perpetual control by treaty of the necessary territory from Costa Rica and Nicaragua, he is then to have authority to begin the construction of the canal over the Nicaragua route on the same general conditions as apply to the Panama Canal. An appropriation is provided for compensation, through a treaty, to Costa Rica and Nicaragua for rights and concessions they are to grant.

5. An appropriation of \$10,000,000 is made to begin the project, and by a further provision all appropriations are not to exceed in the aggregate the additional sum of \$135,000,000 if the Panama route be adopted, or \$180,000,000 should the Nicaragua route be selected.

6. In any agreement made with Colombia, Nicaragua or Costa Rica the President is authorized to guarantee them the use of the canal and harbors, upon such terms as may be arranged, for all vessels owned by those countries or by their citizens.

7. An Isthmian Canal Commission of seven members is created, to be nominated by the President and confirmed by the Senate. They are to have charge of construction of the canal and are to be subject to the direction and control of the Executive. Four of the seven are to be skilled in the science of engineering, one is to be an officer of the army, and one other an officer of the navy. Authority is given for the employment of engineers from the army and civil life and other necessary persons. The commission is to make reports to the President and to give Congress such information as may be required.

8. Outside of the \$10,000,000 appropriated authority is given for the issue of \$130,000,000 2 per cent 20-year gold bonds exempt from taxation in denominations of \$20, or a multiple of that sum, to be sold at par and open to popular subscription, the proceeds to be used on the construction work as required.

The provisions above stated appear to give the President ample authority to proceed with this great work in a common-sense, business-like way, while much will depend upon the character of the Commission whom he appoints as to whether the vast expenditures necessary for construction will be reasonable and economical or extravagant. As the personnel of the Commission must be confirmed by the Senate, it is to be presumed only the best men will be selected.

The assurance that a canal is positively to be constructed on a practical and economical basis with funds provided in part by popular subscription will create a national enthusiastic interest in it and insure its success. Its commercial advantages to this and foreign countries cannot be over-estimated. We trust that the differences between the House of Representatives and the Senate may be satisfactorily adjusted by the usual conference committee in the hope that by the next celebration of Independence Day the wishes of the country in respect to this great undertaking may be carried out.

THREE PHASE TRACTION IN AMERICA.

The announcement that the Whitney syndicate has joined hands with Ganz & Co., of Buda-Pesth, is fraught with more promise for the future of electric traction in the United States than many of us may be willing to admit. For years the Buda-Pesth firm has been identified with the growth of electrical traction in Europe. Not only did it install the first underground trolley, but it developed the three-phase system for roads of standard gage.

The number of electrical roads in this country of standard dimensions can be counted on the fingers of one hand. Probably, without exception, all of them use the direct current. In Europe, on the other hand, the foremost electrical engineers have adopted the alternating current, with results that have been most gratifying from the standpoint of economy and efficiency.

Readers of the SCIENTIFIC AMERICAN will recall the article we published some time ago on the Valtellina road, in Italy. That road was converted from steam to electrical traction by the Buda-Pesth firm. After having been in continuous operation for over one year and a half, the company was able to announce that the three-phase electrical equipment had cut down the operating expenses fifteen per cent. Unfortunately, the Valtellina line had hardly been opened, when the London underground contracts were let. In the bitter fight in which Mr. Yerkes and the American advocates of the direct current finally triumphed, the merits of the three-phase system were ably and strongly put forth by its adherents. The Board of Directors of the London Underground, after a careful investigation, decided in favor of the three-phase system. But the strenuous protests of the Americans resulted in the submission of the controversy to a board of arbitrators, who rather weakly decided that the Buda-Pesth plan was too new.

It may be that the London controversy, however, brought home to the Whitney syndicate the merits of

three-phase traction. At all events, it is encouraging to find that American engineers are willing to try a system of which as yet they know next to nothing, and which has been offered to them as a vast improvement on their own; and it speaks well for the Buda-Pesth firm if sagacious American men of wealth are willing to invest millions in a plan which originated in Europe and developed there to its present importance.

TWO REMARKABLE RAILWAY RUNS FROM NEW YORK TO CHICAGO.

Probably no more praiseworthy feat is recorded in the annals of American railroading than the performance of the trains sent by the New York Central and Pennsylvania Railroads over the roads between New York and Chicago. At a speed which sometimes exceeded 80 miles an hour, and which averaged some 50 miles an hour including all stops, these trains, traveling east and west, covered the respective distances of 980 and 912 miles three minutes ahead of the schedule time of 20 hours.

With these two remarkable records, American railroads hold the record for fast, long runs. On the Orleans & Midi Railroad, the Sud express travels 486 miles from Paris to Bayonne in 8 hours 59 minutes, averaging 54.13 miles an hour. That is probably the fastest train in the world for the distance. But the length of track is little more than half that traversed on the shortest route between New York and Chicago. Other famous European runs that deserve mention are those made in England by the East Coast express and the West Coast express. The former runs to Edinburgh, and the latter to Glasgow from London. Both travel at an average speed of 50 miles an hour; but the distance covered is only about 400 miles.

It is difficult to award the palm to either of these new American trains. The New York Central's express covered a longer distance at a higher average speed than the Pennsylvania train. On the other hand, the Pennsylvania train, although its route was shorter and its average speed not more than 45½ miles an hour, encountered heavy grades in crossing the Alleghany Mountains. The officials of both roads claim that the journey from New York to Chicago could easily be covered in 18 hours.

GOVERNMENT IRRIGATION.

One of the best measures that has become a law in the beginning of this twentieth century is the scheme providing for the irrigation of the thousands of square miles of arid lands located in our Western States and Territories under government supervision, embodied in the bill recently passed and signed by the President and known as the Irrigation Bill.

The bill is based on the idea that the proceeds of sales of public lands shall be assigned from year to year to the building of irrigation works under contracts approved by the Secretary of the Interior, but only when there is sufficient money on hand to insure the completion of the work.

According to Mr. Newlands, the Representative from Nevada who has promoted the legislation on this subject, this bill is very complete and comprehensive in its scope and automatic (so to speak) in its plan of action.

It is estimated that during the next thirty years at least \$150,000,000 from the proceeds of the sale of lands will be available without further appropriations for public irrigation works.

The bill makes the present receipts from public lands, including those of the last fiscal year, stated to amount now to some \$6,000,000, immediately available and the average annual sum of \$3,000,000 (likely to be constantly increased) can be used each year for a steady continuation and enlargement of any work for which contracts are made.

The plan further provides against the acquirement of large tracts of land by individuals or companies by limiting the area to be owned by one person to 160 acres, subject to the provisions of the national homestead law, including its limitations, charges and conditions.

At least half of the arid land so acquired must be improved by irrigation and the owner must reside on or near the land.

After a plan of irrigation of a tract of land owned by several parties has been completed at government expense and the works are in order, the owners will be required to pay back to the government in not less than ten annual installments the estimated cost of the construction of the works, the money so paid to be returned to the general reclamation fund. Eight hours is fixed as a day's work, and Chinese labor is forbidden.

The public arid and semiarid lands mentioned are in the Territories and States of Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington and Wyoming.

The effect of the bill should be to encourage the settlement of the great wastes in a few of the States and greatly to increase their agricultural products. The

Department of the Interior is not limited to any particular plan of securing the requisite supply of water for irrigation purposes, but must conform to the State laws bearing on this subject in providing for any given plan. The law is certain to make valuable land now considered valueless, and promote Western agriculture in a way to insure lasting benefit to the country.

THE HEAVENS IN JULY.

BY HENRY NORRIS RUSSELL, PH.D.

The summer evening skies, though not perhaps equal to those of winter, present at this season a noble spectacle. To identify the principal constellations, we may begin with the two brightest stars in sight—Vega and Arcturus. The former of these is nearly overhead at 9 o'clock in the evening in the middle of July, while the latter is some distance to the westward. Starting from Arcturus toward Vega, we first reach the little circlet of stars which is known as the Northern Crown. Next comes a keystone-shaped figure which marks the constellation Hercules. Following the same line beyond Vega, we come to Cygnus—a fine cross of stars in the Milky Way. The bright stars rising in the east below this belong to Pegasus.

In the Milky Way, to the right of Cygnus, the bright Altair shows the position of the constellation of the Eagle. Below this is Sagittarius. Its most noteworthy feature is a little inverted "dipper," known as the Milk Dipper, because it lies in the Milky Way.

Scorpio, the finest of the zodiacal constellations, is due south. The brilliant red star Antares, at the creature's heart, and the long curving line of the tail, streaming down to the horizon and then bending upward again, make this one of the easiest star groups to recognize when once learned. Above it are the large but rather formless constellations of Ophiuchus and Serpens. The conspicuous isolated star in the southwest is *Spira*, the brightest one in Virgo. Leo is setting, a little north of west. Ursa Major is well up on the left of the pole, the Great Dipper being the highest part of the constellation. The Little Dipper is right above the pole-star. Half-way between its bowl and Vega is the head of Draco, whose long coils may easily be traced through the space between the Great and Little Bears. In the Milky Way, low down on the right of the pole, is Cassiopeia.

THE PLANETS.

Mercury is morning star throughout July. On the 15th he is farthest west of the sun, and about this time he can be seen a little north of east, about an hour before sunrise. By the end of the month he disappears again in the sun's rays.

Venus is morning star in Taurus and Gemini, rising about two hours earlier than the sun.

Mars is also morning star, though far away and faint. On August 1st he is in conjunction with Venus, being about $1\frac{1}{4}$ deg. north of her—not quite so close as he was last fall. As the moon is close by at the time, there will be something worth looking at in the eastern sky that morning.

Jupiter is approaching opposition, and is conspicuous in the southeast in the latter part of the evening. On the 15th he rises at about 9 o'clock, and is due south at half-past 1.

Saturn is in Sagittarius, and is in opposition on the 17th. It is interesting to note that at this time the earth passes directly between Saturn and the sun, so that as seen from the planet it would appear to transit across his disk. It may help us to realize how small a body the earth is, in comparison with even the solar system, when we find that it would appear to an observer on Saturn as a black dot barely two seconds of arc in diameter—too small to be seen at all without a good-sized telescope.

Uranus is in Ophiuchus, well placed for evening observation. Neptune is morning star, too near the sun to be well seen.

The asteroid Vesta, as we mentioned last month, comes to opposition on the 14th. It is in Sagittarius, and is moving parallel to a line drawn from Saturn to the middle of the bowl of the Milk Dipper, but about a degree below this line. On July 1st it is about 1 deg. southwest of Saturn, and on the 31st it is 3-5ths of the way toward the Milk Dipper. It is of the 6th magnitude, and is consequently just visible to the naked eye under favorable conditions. Without a very good star-map it will be necessary to sketch the stars visible in this region with a field-glass and pick out the asteroid by its motion.

Vesta is the brightest—though the third in order of discovery—of the hundreds of small planets between Mars and Jupiter. It revolves about the sun at an average distance of 220,000,000 miles, and takes about three years and eight months to complete its journey. At the present opposition it is nearer than usual, being 203,000,000 miles from the sun, and 109,000,000 miles from us. While it is ordinarily just too faint to be seen by the naked eye, this unusual nearness carries it just within the limit.

In the most powerful telescope Vesta, like a few others of the brighter asteroids, shows a perceptible

disk. According to Prof. Barnard's measures, it is about 200 miles in diameter, so that it is decidedly a world in miniature.

On so small a body the force of gravity is much less than on the earth. A man, if he could exist on the surface of Vesta, would weigh about 1-50th of what he does here, and his capabilities would be correspondingly increased. This would have some interesting consequences. An athlete, for example, could easily jump to a height of 300 feet or so, coming down with no more jar than after a six-foot leap on earth. A batted ball, which here rises to a height of a hundred feet, and drops into the fielder's hands after a flight of five seconds or so, would on Vesta, if struck as hard a blow, rise a mile high, stay in the air more than four minutes, and drop nearly four miles away. A cannon-ball, fired at the usual speed, would fly clean off into space, and never come back at all.

Clearly life on such a planet would be rather remarkable. However, as it is almost certain that the asteroids have no atmosphere, such calculations as we have just been making really belong to the realm of idle speculation.

THE MOON.

New moon occurs on the morning of the 5th, first quarter on that of the 12th, full moon near noon on the 20th, and last quarter on the night of the 27th. The moon is nearest us on the 4th, and farthest off on the 16th. She is in conjunction with Venus on the 2d, Mars on the 3d, Mercury and Neptune on the 4th, Uranus on the 17th, Saturn on the 20th, Jupiter on the 21st, and Mars and Venus once more on the morning of August 1st.

FORCED AND SHRINK FITS.

BY C. D. KING.

Forced and shrink fits have long been used by engine, ordnance and machinery builders, the forced fits being obtained by driving with a heavy weight or by hydraulic and screw presses. While it was once the custom to taper the holes and shafts in forced fits, it is now conceded to be much better to have them perfectly cylindrical throughout.

If we wish to shrink a sleeve or ring of metal onto a shaft or tube, we bore the hole a trifle smaller than the diameter of the shaft to go in it—1-80 inch per foot of diameter of shaft is a common practice, then by heating the sleeve, we expand it, hole and all being increased in diameter until it will slip onto the shaft. When it cools it is in a state of tension, and the shaft inside of it is compressed, the amount of tension or compression depending upon the difference in the diameters of the two pieces. If we attempt to pull the sleeve off the shaft, it is found that we require a large amount of force to do it. Both sleeve and shaft were brought to a smooth finish apparently, where they were to fit together, but upon careful examination with a microscope, we find numerous irregularities on those surfaces that are to come together. The irregularities are mostly annular groovings formed by the lathe tools and files. Now when we shrink the sleeve on, in cooling, the little projections on one piece will sink into the depressions in the other and *vice versa*. Thus the sleeve is firmly locked upon the shaft. Reasoning from the above analysis we conclude that the surfaces in contact should be finished rather roughly to the touch, so that the irregularities and minute groovings of one piece may hold more firmly on those of the other.

It has been found in the crank-pin fits for locomotives, that if the pin and hole are finished to very smooth and true surfaces, the pin will be pressed in by a force of six tons per inch of diameter, but when they are rougher the force may have to be increased to as much as nine tons for each inch of diameter. This leads us to conclude, that it will be more difficult to withdraw a rough piece than a smooth one, and consequently more difficult for it to work loose, although the tension in the crank and the pressure on the pin may be nearly the same as when the pin was smooth, which is a most desirable feature. Inasmuch as heating and cooling tend to change the form of pieces, and if they are of cast iron, is apt to crack them, we prefer the forced fit where practicable, but the turning of the fits must be done accurately, and they must be truly round. They must also be of uniform diameter throughout, and not tapered in the least. Both the commencement of the hole, and the end of the piece to go in it, should be slightly rounded so as to start in readily. When one piece is forced into another as described above, the little projections have a tendency to be rubbed backward on one piece, and in a forward direction on the other, forming, we could say, little ratchet teeth. If we provide a shoulder or collar on one of the pieces for the other to stop against, we have the pieces pretty effectively locked against working loose.

A point in the manufacture of chainless bicycles, came recently to the attention of the writer, regarding the fastening of the gears to the crank shafts and rear hubs. The shafts and rear wheel hubs are

threaded externally with right hand threads. The gears are threaded internally with threads which fit so tightly that considerable force is required to turn them onto the shafts and hubs. A fixture is made purposely for this work with a chuck to hold the hub or shaft and a "crab" to hold the gear. A very long crank is used to get sufficient power to turn the gears into position. The force in back pedaling, it is found can never be sufficient to turn them off even to the slightest amount.

The minute irregularities of the external threads on the hub coming in contact with other irregularities in the internal threads of the gear, form, as it were, a ratchet with innumerable pawls preventing it from turning backward.

ENGINEERING NOTES.

Texas oil is to be used by the great Minneapolis flour mills instead of coal. From the experiments made it would seem that the use of oil is entirely practicable. A street railway company of Minneapolis and St. Paul is also conducting tests with Beaumont oil.

A marine engineer of Rochester, England, has patented a new system for steering twin-screw steamships. His device consists of a special throttle valve attached to each set of engines, the valves being connected by means of bell cranks and linkwork to a tiller. When the tiller is resting centrally an equal supply of steam enters each engine, but directly the tiller is deviated from its central position in either direction, the throttle valve fitted to one set of engines reduces the supply of steam, so that the propeller actuated by that particular engine revolves more slowly, the rotatory motion of the screw diminishing according to the degree to which the tiller is moved over.

The great scheme of the late Mr. Cecil Rhodes, the Cape to Cairo railway, is being pushed forward with all possible celerity. The road has been surveyed as far as the Zambesi River, which is to be crossed by a great steel bridge, having one span of 500 feet, at the Victoria Falls. The whole section from Bulawayo to the Zambesi, 275 miles in length, is to be opened next year. Locomotives for contractors' purposes are now running on it for a short distance north of the present terminus, and a railway exploration party has been dispatched over the railway route beyond Victoria Falls as far as Lake Tanganyika. For forty miles north of Bulawayo the embankment of track is more or less complete, bridging work on the Victoria Falls section is in progress, and about five miles of the line are finished. The work of connecting the Bulawayo and Salisbury sections is also progressing rapidly, and rails are already laid from Salisbury to Sebakwe, a distance of sixty miles. From the Bulawayo end of this line the railroad has reached the Arguza River, so that when this gap is filled and the line completed, as it is hoped it will be by the end of the present year, trains will be able to run from Cape Town to Beira via Bulawayo, Salisbury and Umtali.

Salt mining constitutes one of the staple industries of the little European country, Roumania. There are four mines in all. The most peculiar feature in connection with this industry is that the mineral is mined in three of the principal mines by convicts condemned to life and lengthy sentences of penal servitude. The reason for this is that crime in Roumania is practically unknown, and there is no death penalty. Under these circumstances the compulsory mining of the convicts is beneficial both to the government and the laborers. In the case of the mine in which convict labor is not employed, the quarrying is performed by peasants, the work being assisted as far as possible by the most up-to-date mechanical time and labor-saving appliances, for the employment of which skilled labor is essential. In all there are about one thousand convicts at work in the three mines. The laborers are not provided with any mechanical apparatus whatever, the whole of the work being performed by hand, each convict having to quarry a specific quantity of salt daily. The mines are controlled by a state official, whose position is similar to that of governor of a prison. The mines are thoroughly well ventilated, and illumined with electric light, so that the lot of the convicts is somewhat alleviated, though to those who are serving life sentences it represents a living grave. The mines are worked in galleries, and the pure white crystal presents a weird and peculiar aspect, especially in reflecting the fitful electric light. The main shaft terminates at the bottom in a huge apartment with a dome-shaped roof, and from which all the working galleries radiate. The mine contains a chapel and numerous other apartments, all cut out of the salt by the prisoners. The director keeps a record of the name of each convict who enters the mines, his conduct and the efficiency and quantity of his work. Periodically the King of Roumania visits the mines and examines the official record, and in those instances where the results warrant such action, he extends a free pardon to the prisoner, or at any rate reduces the length of his sentence, so that good conduct and efficient work is an incentive to a royal pardon.