

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 $\frac{3}{5}$ ths 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.