

verted into electricity. This fact is shown by the extension of the original plans to a long section of the railroad through the mountains as recently announced by President Hill. His present plans as announced contemplate the application of electricity to that portion of the road extending from Leavenworth on the east side of the Cascades to Skykomish on the west side, 66 miles. It is understood that if the electric motors prove as successful as anticipated, the electric system will be further extended so as to include the mountain division, from Everett on Puget Sound to Wenatchee, 141 miles. This would be the beginning of an electrization which might eventually include the entire mileage of the system.

The section of the road chosen for the first application of the experiment is the most difficult and expensive portion of the road to operate on the entire system. It runs through the wild and rugged Cascade where the grades are very heavy, and where every winter there are numerous slides of earth and rock which come down the steep mountain sides to cover the track and endanger the operation of trains. One of the most important causes of the Great Northern's desire to secure cheaper motive power is the fact that its tributary coal supply is very limited. In the matter of cheap fuel the Great Northern is being operated at a tremendous disadvantage as compared with the Northern Pacific or the Oregon Railway and Navigation Company, its Washington rivals. The Northern Pacific owns the largest coal mines in the State at Roslyn, thereby securing its fuel at a cost not exceeding \$1 to \$3.25 per ton. The advantage of the Oregon Railway and Navigation lies in its gravity route down the Columbia River from the Rocky Mountains. On the other hand, the coal used by the Great Northern costs about \$2.75 per ton for the ordinary product, while for the Crow's Nest Pass coal, which is used on all trains through the tunnel, the cost is much greater.

For about thirty miles of the mountain climb on the Cascade division each loaded train requires the assistance of one or two helping engines. The coal consumption of this division is something enormous, amounting to upward of 2500 tons a day, or nearly a million tons a year. With a difference of \$1.50 per ton in favor of the Northern Pacific, it will be readily seen that the older road has in the matter of coal supply alone a great advantage over its newer rival. As the water for the generation of the electric power for the operation of trains under the new system will be taken from one or more of the numerous rivers heading in the Cascade Mountains near the Great Northern lines, the innovation contemplated will reduce the coal bills of the division very greatly, if not eventually doing away with them entirely.

The details of President Hill's plan are now being worked out, and it is understood that active work toward the installation of the electric power will be commenced next spring. The successful long distance transmission of electric power generated at Snoqualmie Falls, forty miles from Tacoma, has been a powerful object lesson to the Great Northern.

The street railway systems of both Tacoma and Seattle, together with the electric lighting system of Tacoma and the vast machinery of the great Tacoma smelter, are all being operated successfully and economically with Snoqualmie power. A. W. C.

THE HEAVENS IN NOVEMBER.

BY HENRY NORRIS RUSSELL, PH. D.

Two astronomical events of great interest occur during the present month, but, unfortunately, one of them lies outside the range of our observation. This is the annular eclipse of the sun, which takes place on the 11th. It is noteworthy for the very long duration of the annular phase, which is, at maximum, a little over eleven minutes. The moon is so much farther away than usual that she hides only about 6-7ths of the sun's surface, even when she is directly in front of him, so that there will be plenty of light left to see by, even in the middle of the eclipse. The annular phase is visible along a belt of country about 200 miles wide, extending from Sicily past Cairo, over Arabia, Ceylon and Siam to the neighborhood of Manila. A partial eclipse is visible generally in eastern Europe, Asia, and northern Africa.

More interesting to us is the remarkable series of planetary conjunctions which happen later in the month, when the three brightest planets will be close together in the evening sky.

Jupiter has for months been slowly overtaking Saturn, and, just before he reaches him, Venus, whose eastward motion is much swifter, catches up with them both. She passes Jupiter on the night of the 17th, and Saturn on that of the 18th. The two are about a degree apart, while she is three degrees south of them, so that all three planets are crowded into a space no larger than the belt of Orion. The group which they form will be by far the most conspicuous thing in the evening sky, and will remain in sight for two hours and a half after sunset.

Though these three heavenly bodies seem so near

together, their real distances from us are, of course, vastly different. Venus is very much the nearest, being but 74,000,000 miles distant. Jupiter is more than seven times as far away, his distance being 540,000,000 miles. Finally, Saturn is almost 1,000,000,000 miles from us—as far beyond Jupiter as Jupiter is beyond Venus.

It is to her nearness, both to us and the sun, that Venus owes her great brightness, for she is but one-eleventh as large as Jupiter, and, were she at his distance, she would not be as bright as the pole-star.

If she were as far off as Saturn, she would be invisible to the naked eye. It would be a mistake, however, to conclude from this statement that Venus, as she actually is, would be invisible from Saturn, for, in her present position, she receives from the sun about two hundred times as much light as she would if removed to Saturn's distance, and is correspondingly brighter. She would, in fact, appear considerably brighter to an observer on Saturn than Saturn himself does to us.

On the other hand, if Jupiter were in Venus' place, he would show, at favorable times, as a crescent about one-quarter the size of the moon, and would give us a pretty fair sort of moonlight. We may well be thankful, however, that such is not the case, for the attraction of so great a planet, so near us, might so change the earth's orbit as to bring us uncomfortably near the sun, or to send us so far from him that we should all be frozen.

Such a conjunction as the one which we now have the privilege of viewing is a rare occurrence. Jupiter revolves about the sun in twelve years, and Saturn in thirty. Twelve years hence, Jupiter will be in the same part of the sky as at present, but Saturn will have gone nearly half way round, and will still be ahead of Jupiter. It will take the latter twenty years in all to catch up with Saturn again, in which time he makes one and two-thirds revolutions to Saturn's two-thirds. So it will not be till 1921 that we will see Jupiter and Saturn close together again, and such conjunctions will recur every twenty years. But the two planets, when closest, may be in any part of the zodiac. Now, since Venus never goes more than about 45 deg. away from the sun, if they are more than that distance from him, they cannot be near Venus. If they are to be visible in the evening they must be east of the sun, and at least 15 deg. from him. This narrows down the region within which a conjunction like the present one is possible to about 30 deg., or one-twelfth of the whole circumference. It follows that, on the average, one conjunction of Jupiter and Saturn out of twelve will be such that an event like the present *may possibly* happen. But when such a conjunction occurs, Venus may not be in such a part of her orbit that she *actually does* come into conjunction with the others. There is only one chance in five or six that she will be. Therefore, on the average, only one out of sixty or seventy conjunctions of Jupiter and Saturn will be marked by the presence of Venus also. That is, such a display as occurs this month will happen, in the long run, once in about twelve hundred years. The actual intervals between two such conjunctions are very variable, some being much longer than the average, and some much shorter.

Jupiter and Saturn are closest on the 27th, when their distance is less than the moon's diameter. They will be very near one another throughout the last week of November.

There is a possibility that the lost Leonid meteor shower may turn up on or about the 13th of this month, but the chances seem to be much against it.

THE HEAVENS.

At 9 P. M. on the 15th, Gemini has just risen in the northeast, and Orion in the east. Auriga is above Gemini, and Taurus over Orion. Eridanus and Cetus fill up the southeast. Andromeda is directly overhead, with Cassiopeia on the north, Perseus on the east, Aries on the southeast, and Pegasus on the southwest. Aquarius and Capricornus are below and to the west of Pegasus, and Fomalhaut is the only conspicuous star lower down. Cygnus, Aquila and Lyra lie near the Milky Way in the west. Ursa Major is on the horizon below the pole, and Draco is above and to the right.

THE PLANETS.

Mercury is in conjunction with the sun on the 4th, and is invisible till the middle of the month. On the 20th he reaches his greatest western elongation, and is well seen as a morning star, rising nearly two hours before the sun.

Venus is evening star in Sagittarius, and increases in brightness throughout the month. Her conjunctions with Jupiter and Saturn have already been described. Mars is evening star, too faint and near the sun to be easily seen. Jupiter and Saturn are evening stars in Sagittarius. Uranus is too near the sun to be seen. Neptune is in Gemini, well placed for telescopic observation.

THE MOON.

Last quarter occurs on the night of the 2d, new moon on that of the 10th, first quarter on the morning of the 19th, and full moon on the evening of the 25th.

The moon is nearest us on the 25th, and most remote on the 11th. She passes Mercury on the night of the 9th, Uranus and Mars on the 13th, Venus on the forenoon, and Jupiter and Saturn on the afternoon of the 15th, and Neptune on the 27th. The moon, Venus, Jupiter and Saturn, all in close proximity, will afford a fine spectacle on the evening of the 15th.

SCIENCE NOTES.

Prof. William T. Richards, of Harvard University, has received a call to the newly established research professorship of chemistry in the University of Göttingen. It is especially gratifying to note that one of the greatest universities in Germany should offer the chair to an American.

About 250,000 pairs of glasses will be purchased by the State committee in Maryland for use in polling booths. Politicians have found that both in the city and country districts a large number of voters of the poorer classes can read sufficiently well to ballot, but their sight is so defective that in the dimly lighted booths they are unable to read the long list of contestants on the ballot. Capable men will be provided at every polling place to adjust the glasses for the voters.

A cheap and rapid method for concentrating the enormous quantities of blood collecting in abattoirs is described by its inventor in the *Technische Rundschau*. The blood is injected in a finely pulverized state into an oven-shaped chamber, open at the top, and brought into contact with a current of hot air ascending from below. All the water is evaporated in this manner, and the blood powder is carried to the receiving chamber. According to the inventor, the powder thus obtained is tasteless and contains 74.8 per cent of digestible albumen.

The committee has not yet decided whether M. Santos-Dumont is entitled to the prize of 100,000 francs or not. No decision will be made before November 1, as the competition remains open until October 31, so that if in the meantime another competitor should appear and fulfill the conditions he would share in the prize. The persons who are prominently identified with aeronautical matters are of the opinion that M. Santos-Dumont has really won the prize, and M. Deutsch is convinced that the commission will award it to the young Brazilian.

Carrier pigeons have been put to novel use by a physician of Rockland, Me. On one occasion he was called to an island some twenty miles distant to attend a patient who was seriously ill. To reach this island he was obliged to make a dangerous trip. Before he returned to the mainland he gave the family of his patient six homing pigeons which were to be used as messengers to inform him of the patient's condition. A pigeon was dispatched as often as necessary, carrying assurances to the physician of the patient's steady progress toward recovery.

A series of observations by the late Prof. A. von Kerner has been published on the variations in the time of the opening and closing of flowers. He states that the fact that some flowers remain open for a longer period in summer than in spring is not due to the direct influence of an increase in the light, but to a rise in temperature due to the absorption of light. With many flowers the opening is not the result of growth, but of changes in turgidity due to transpiration. In *Hemerocallis flava* and *Hibiscus trionum* the flowers remain open only for a single day in the summer, while in autumn they open for two or three days in succession.—Oesterr. Bot. Zeitschr.

A new explosive, which is safe from detonation, has been invented by M. Fiedler, of Moscow, Russia. His explosive comprises a fluid and a solid, and the two have to be mixed before they will explode. The former is composed of nitrol-benzol 80 parts and turpentine 20 parts. The solid consists of potassium chlorate 70 parts and permanganate of potash 30 parts. To form the explosive 20 parts of the liquid are added to 80 parts of the solid. The former is packed in soldered tins, and the latter in packets waterproofed with chromic glue. A very salient feature of this explosive is that even when mixed, should it become ignited by contact with flame, the substance will burn away quietly.

An English aeronautical engineer, Mr. T. Hugh Bastin, of London, is to make an attempt for the Deutsch prize. This aeronaut in his invention has emulated the movements of birds while in flight, thus following in the footsteps of Langley, Hargraves, and Lilienthal. He practically utilizes huge wings for driving his vessel through the air. The wings are immense framework structures, sufficiently rigid and strengthened to overcome atmospheric resistance, with a covering of silk. These wings or fans have two movements at right angles to the direction of flight, precisely the same as a bird, with the same results. The front of the machine is pointed, so that it can readily cleave its way through the air. In flying the aeronaut avails himself of the oscillating movements of nature.