nish 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.

A New Incandescent Lamp.

A new incandescent lamp with a zirconium filament is announced in Germany. Prof. Wedding, the well-known physicist, recently presented a lamp of this kind to the Electro-technical Society of Cologne. The details of the process are as follows: To obtain the filament he submits oxides of zirconium and magnesium at a high temperature to the action of hydrogen, which gives an alloy of a more or less constant composition. This body is then pulverized, and by adding a cellulose solution it is transformed into a plastic and homogeneous mass. It is from this mass that the filaments are drawn. The latter are carbonized in an atmosphere which is free from all traces of oxygen, and then present a metallic appearance. It is said that one pound of zirconium will furnish 50,000 filaments. The new lamp is to be placed on the market at the price of $0.37. Under regular working, the zirconium filament consumes a current of 2 watts per candle-power, which is less than for the usual carbon filament. The zirconium lamps are made at present to run with a current of 37 volts, and three of them can be conveniently placed in series across the usual 110-volt circuit. Another type uses 44 volts, and five lamps are connected upon a 220-volt circuit. To obtain a high candle-power lamp they place several filaments in the same bulb and the lamp is then connected directly upon a 110-volt circuit. Experiments which have been made with the lamp show that it has a life of 700 to 1,000 hours.

ELECTRIC MAIL AUTOMOBILES.

The post office department of Paris is now using several electric mail wagons which are designed to transport the mail matter in larger quantities and at a greater speed. These now run within the city limits, and distribute the mail between the main post office and the different branch offices which lie throughout the city. Our engraving shows one of these new automobiles, which have been specially built for the purpose by Mildé & Co., one of the leading electrical houses of the city. The new car has the advantage of running at a considerably higher speed and at the same time carries a larger quantity of mail matter—nearly half as much again as the horse vans which were formerly used exclusively for this purpose. These latter are still in use, but it is expected that they will be eventually replaced by the electric van. The latter contains about 45 cubic feet of available space in the interior for the mail matter. The automobile chassis which has been designed for the purpose carries the electric motor, which is built in compact form and entirely inclosed, in the center of the car. The differential device is contained in the same case with the motor. Chain driving is employed from a sprocket on each end of the differential shaft to a large sprocket mounted on each wheel. On the chassis is mounted a box body of considerable size which contains the accumulator cases in the lower part and above this the remainder of the space is used for the mail matter. Access is given to both compartments by a double door in the rear. The accumulator cells are contained in a single box, which can be easily slid out and replaced by a new one. The driver's seat, along with the steering wheel and the controller for the motor circuits, is placed high in the front.

ONE OF THE ELECTRIC AUTOMOBILE MAIL WAGONS IN USE IN PARIS.

ELECTRIC TRUCK WITH MOTORS IN WHEELS TRANSPORTING UNITED STATES MAIL.

It was decided to construct fifteen electric automobiles of the above pattern and put them in regular operation within the city limits in order to give them a good trial and especially to compare them with the horse vans, both as regards economy and speed of running. The new automobiles commenced the regular service about the first of November last, under the direction of M. Duboys, who is the chief of the mail transportation department. Since then the cars have been running very successfully, and all are in accord that they are a great improvement over the old system. Some 15 miles an hour is adopted as the highest speed which can be safely used within the city, but the motors can drive the cars at least as high as 25 miles an hour. Owing to the increased speed over the former system, the mail can be collected from the different post offices at a later hour and in like manner the mail can be distributed sooner, so that the schedule of collecting and closing the mails can be changed some thirty minutes in either direction, and this is a great point in favor of the new system. The increased capacity is another advantage which is appreciated by the post office department. A charging station for the accumulators used on the cars has been installed in the main post office building. The sets of batteries are double, so that while one case of cells is being used on a car, the second is being charged at the station. When the car arrives with an exhausted battery, the latter is at once replaced by a fresh one, without any loss of time. The batteries last for half-a-day's run, and the cars come in for charging twice a day, about noon and at night. The weight of the new cars is given as follows: The automobile proper, including the chassis, body, and mechanism, represents 2,220 pounds, while the accumulators weigh 1,320 pounds. The load of mail matter is 1,430 pounds, and two attendants 310 pounds, which makes somewhat over 2½ tons in all.

Automobiles for the transportation of mail matter are being experimented with by several of the leading governments, and gasoline mail cars are now in use in Berlin, Vienna, and in some of the rural districts of England. On the Isle of Man letters can be posted on a 'bus that travels across the island and carries the mails. The French government is the first to make use of electric automobiles for this purpose, despite the fact that machines of this type are now used so extensively for commercial purposes in this country, where they were first adopted for such service and where they are rapidly being perfected for it. That our own government does not take steps to improve its mail transportation facilities shows how unprogressive it is. Recently a large publishing house in New York, which has a government mail clerk constantly on duty for weighing and dispatching its mails, tried the experiment of making use of a novel electric truck driven by all four wheels, a picture of which is seen on this page. This truck carried a four-ton load of mail bags a distance of two and one-half miles and returned empty—thus covering a distance of five miles—in 58 minutes running time. It cut in half the time taken by horse-drawn vehicles, while the cost for current at six cents per kilowatt was about one cent per ton-mile of load carried. The truck itself weighed about four tons, hence including this weight, eight tons were moved at a cost for electricity of only half of one cent per ton-mile. This compares favorably with a gasoline truck, while there is not nearly so much wear and tear on the mechanism, or so many parts to get out of order.

The novel feature of the electric truck illustrated is not so much the motors in the wheels as the manner in which they drive the latter. The armature shaft is placed horizontally within the wheel, parallel to its plane; and a bevel pinion on each end of the motor shaft meshes with a bevel gear ring attached to the wheel. There are two rings facing each other; one pinion meshes with one of these rings, while the other meshes with the opposite ring. The thrust of one pinion against its ring is balanced by that of the other pinion against its ring. As these two forces are equal and opposite, they form a couple, the result of which is to relieve the armature bearings of nearly all pressure and thus reduce friction to a minimum. So great is this reduction of friction, because of the forces that produce rotation of the wheel acting equally on opposite sides of the bearings, that careful tests have shown an efficiency of transmission of 99 per cent up to 16 per cent overload. When it is remembered that the efficiency of a well-cut spur gear is only 85 to 90 per cent, and that in most modern electric trucks a double reduction is employed, it can readily be seen that there is a saving of about 25 per cent in transmission losses alone by employing the "couple gear" with single speed reduction. That the total efficiency of the vehicle is increased, also, by using four separate motors instead of two seems to be demonstrated by a 30 per cent decrease in current consumption when compared with an ordinary truck of like size.

The life of the battery and motors is greatly lengthened, also because they are never overloaded to any serious extent. The Exide battery on the present truck has been cleaned but once in the fifteen months the vehicle has been in service, and during which time it has covered something like four thousand miles.

So successful has been the manufacture of military rifles at the factory established in Quebec by Sir Charles Ross, that it is now proposed that Canada shall make her own cannon. The purpose in establishing the rifle factory in Quebec was to make the Dominion independent of English manufacturers, who, in the event of the interruption of communication, might be unable to supply rifles for the Canadian troops as rapidly as desired. The results have been entirely satisfactory. Now that the Canadian artillery is to be enlarged and re-armed with a more modern gun, it is held by military experts that the new ordnance should be made in the Dominion.