

line about a dozen miles apart, and the current is reduced in pressure from 33,000 volts to 1,090 volts for use on the three-phase canal trolley line. The three transformers installed in the substation are connected in delta, and each has a capacity of 150 kilowatts. The substations are 60 feet long, 25 feet wide and 25 feet high, the basement being 7 feet high, and the main floor transformer room 18 feet high. There are seven Baldwin-Westinghouse 20-ton three-phase locomotives to be used, most of which are now in operation. The drawbar pull is 9,600 pounds starting, the coefficient of adhesion being 25 per cent, the voltage on the trolley line 1,100 volts, and the frequency of the current 3,000 alternations per minute. The motors are of 80 horse power capacity each and are wound for 200 volts, which voltage is obtained by further step-down transformers located upon the locomotive. With the two induction motors operating in tandem the speed is about 4 miles per hour, but with one motor only in operation the maximum speed is 6 miles per hour, and the locomotive will haul a full load 10 hours continuously without a maximum rise of temperature of the motors beyond 75 degrees. The transformers on the locomotives are arranged with proper connections for supplying the required current to the motors when the trolley circuit has a pressure of 390 volts, which is the potential used within the city limits of Cincinnati for absolute safety. F. C. P.

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

It is not an easy matter to impart variety to a long series of descriptions of the starry heavens. The moon and planets, to be sure, come and go, and their changing phases and aspects succeed one another quickly enough; but from year to year the stars are altogether the same.

It is only when their positions are determined with the greatest possible accuracy, and when such observations made at long intervals are compared, that we can show that the stars are not absolutely fixed in space. Even then, the great majority of the stars in any catalogue show no certain evidence of any measurable change of position, although they may have been under observation for a century. But, nevertheless, there are many stars which are found to have a small but unmistakable "proper motion" among their neighbors, and in a few cases this motion is so rapid that it might be proved from the telescopic observations of a single year.

From the standpoint of the naked-eye observer, even such motions are of no account, as it would be some centuries before any change in the star's position would be noticeable, unless it happened to be very near another star, or in line with two others. The greatest known proper motion belongs to a star in the southern hemisphere, too faint to be seen with the naked eye, which moves over more than eight seconds of arc every year. Even at this rate the star takes over 200 years to travel a distance equal to the moon's apparent diameter. A smaller change than this in the position of an isolated star would hardly be detected by mere eye-estimates.

In general, we can therefore be certain that the constellations appear just the same to us as they did to the Egyptian and Chaldean astronomers, and as they will appear five thousand years hence. There will be a different pole-star then as the precessional motion of the earth's axis will cause it to point in a different direction from its present one, but the grouping of the stars themselves will be unchanged, though their position relative to the horizon will be altered.

Only one or two changes in the starry heavens would be great enough to strike the eye, if we could suddenly see them as they will be five thousand years hence. Sirius at that time will be nearly two degrees farther south than he is now, and Arcturus will have moved toward Spica by about 3½ degrees, so that the configurations which these bright stars form with the neighboring small ones will be perceptibly different.

But by far the most important change will be one in the southern constellation Centaurus. Its two brightest stars, Alpha and Beta Centauri, are now about 5 degrees apart and the line through them points westward toward the Southern Cross. Both stars are above the first magnitude, and are very conspicuous. Now Alpha Centauri is moving westward, at the very rapid rate of one degree in about a thousand years, while Beta, which is really enormously more distant than Alpha, has very little proper motion. Consequently, after about 4,500 years, Alpha Centauri will be almost directly between us and Beta, and the apparent distance of the stars will be but a small fraction of what it is now, while the line joining them will be at right angles to its present direction and the whole aspect of that part of the sky will be different.

But this is exceptional. There are a few stars which move faster but none of them are bright enough to be at all conspicuous. On the other hand, there are many groups of stars, such as the Pleiades,

which keep together in their motion, so that they will retain their general appearance for centuries. The principal stars of Orion (except for the red Betelgeuse) form such a group, and their motion is so exceedingly slow that all the observations that have yet been made of them hardly enable us to say definitely that they are moving at all. It is practically certain that Orion will look almost exactly the same after 100,000 years as it does now, and it is not improbable that the constellation could still be recognized a million years hence.

At 9 P. M. on September 15, the zenith is occupied by Cygnus, which any one can easily identify as a large cross of stars lying in the Milky Way. The bright star northwest of Cygnus is Vega, and that nearly south of it is Altair. Below the latter is Sagittarius, whose most conspicuous configuration is the little inverted "milk dipper," on the eastern edge of the Galaxy.

Arcturus is near the horizon, a little north of west, and most of the other stars of Boötes are visible above him. The semicircle of Corona Borealis, and the quadrilateral which forms the central part of Hercules, lie between Arcturus and Vega. Ophiucus and Serpens fill the southwestern sky, and a few stars of Scorpio are on the horizon below them.

On the meridian, below Cygnus, is the small but conspicuous group of stars which forms the constellation Delphinus. Lower down is Capricornus with its pair of double stars, which point almost toward Altair. Saturn is below them on the left, and is far brighter. Jupiter, which is some 45 degrees further east, is brighter still, and cannot be mistaken for anything else, especially as he is very much alone in one of the duller parts of the sky. The bright star southwest of him is Formalhaut, in the constellation of the Southern Fish.

North of Jupiter—that is, toward the pole-star—is the great square of Pegasus. From its northeastern corner a line of second-magnitude stars runs through Andromeda and Perseus, and points toward Capella, which has just risen in the northeast. Below this line is the oblique triangle which marks the head of Aries.

Cassiopeia is above and to the right of the pole, in the direction of Andromeda. Cepheus is above her, and Ursa Minor and Draco are on the left of the pole. Ursa Major is below them, the dipper being in the only position in which it seems to be right side up.

THE PLANETS.

Mercury is evening star throughout September, but is in an unfavorable position, being far south of the sun. He reaches his greatest elongation on the 7th, when he is 27 degrees from the sun, rather farther than usual. He crosses the meridian more than an hour and a half after the sun, but sets only 45 minutes later. He will consequently be very hard to see, except with a telescope in the daytime. After the middle of the month he rapidly approaches the sun, and disappears from view.

Venus is evening star until the 17th, when she passes through inferior conjunction (that is, between us and the sun), and becomes a morning star. She is, however, not exactly in line with the sun, but is farther south. She will be invisible to the naked eye except during the first few days of the month just after sunset, and the last few days just before sunrise.

Mars is evening star in Libra and Scorpio, but is not now conspicuous. He sets at about 9 P. M. on the 1st, and at about 8:30 on the 30th. At the end of the month he is quite near Antares but both objects are too low to be well seen.

Jupiter is in opposition on the 12th, and is visible all night long. He is in Aquarius, much farther north than last year, and consequently more conspicuous. The markings on his surface, and the changing configurations of his satellites, make him one of the most fascinating of telescopic objects. The most interesting occurrence among his satellites which is visible to us during the month is a transit of the fourth satellite, and a simultaneous occultation of the third, which takes place on the evening of the 10th. Transits or eclipses of one of the satellites are visible almost every night. Their exact times may be found in the Nautical Almanac.

Saturn is in Capricornus and comes to the meridian at about nine o'clock in the middle of the month. He is also a very fine telescopic object.

Uranus is in Ophiucus. He is in quadrature with the sun on the 15th and can only be observed west of the meridian, as he crosses it before dark.

Neptune is in Gemini and is also in quadrature, but on the other side of the sun on the 30th.

THE MOON.

Full moon occurs at 7 P. M. on the 6th, last quarter at 8 A. M. on the 14th, new moon at 11 P. M. on the 20th, and first quarter at 8 A. M. on the 28th. The moon is nearest us on the 18th and farthest away on the 3d, and again on the 30th. She is in conjunction with Saturn on the 3d, Jupiter on the 7th, Neptune on the 15th, Venus on the 20th, Mercury on the 22d, Mars on the 25th, Uranus on the 27th, and Saturn

again on the 30th. None of these conjunctions are at all close.

On September 20 there is a total eclipse of the sun, but it is exceedingly improbable that the total phase will be observed, since the track of the shadow is confined to the southern Indian and the Antarctic Oceans. The eclipse is visible as a partial one in the eastern part of South Africa and in Madagascar (where the sun rises eclipsed), and in the southern portions of Australia and New Zealand.

SCIENCE NOTES.

Recent statistics have shown that Germany heads the list as a reading nation, and Russia is falling to zero. In 1893, 23,607 books were published in Germany, as compared with 8,082 in Russia. In regard to newspapers, the inhabitants of the United States are catered to by 22,000 journals, while Russia, with a population of 130,000,000, has only 800. The figures are easily accounted for by the censorship. In Germany the actual number of professional writers is estimated at 12,000, of which number 400 are poets. In behalf of France the assertion is made that she provides the international literature, inasmuch as half the copies of French novels printed are exported, while two-thirds of her historic and scientific works also cross the frontier.

A German scientist, G. Thilenius, has recently brought out some interesting conclusions in regard to the pigmy race, of which some specimens are still met with in the central part of Africa. It is probable that the pigmy races have existed also in Europe, at least in some parts of it. This conclusion is arrived at from the examination of numerous skeletons which have been found in the region of Breslau in Silesia. These skeletons are in a rather bad condition, but it is possible to form a good idea of the height of the individuals which must have existed at least one thousand years ago. Their height is considerably below the ordinary average, being about 4 feet 9 inches, which represents the mean figure for a whole group of skeletons. Similar remains have been found in other parts of Europe not far from the above region; thus Kollman, of Bâle, describes the remains of pigmies which have been found in Switzerland. In this case the average height reaches as low as 4 feet 6 inches. Gutmann has also described the pigmy remains which were found in Lower Alsace, near Colmar. These are still smaller, and the height of many of the specimens is but 4 feet. The pigmy race must be considered as composed of well-formed specimens and not in any way degenerate or pathologic. They seem to have persisted in Europe until a comparatively recent epoch. The pigmies of Silesia appear to have been the contemporaries of the Romans and slave races and to have existed until the year 1000 A. D. At present no specimens are to be found in Europe, and it is only in the central region of Africa that the pigmies are still to be seen.

The British Marine Biological Association has acquired a steam trawler of 200 tons burden for the purpose of investigating the currents and physical phenomena of the North Sea relative to the fisheries therein, in accordance with the International Conference held at Christiania last year. At this congress a comprehensive programme of research was drawn up, to be undertaken jointly by the several powers interested, and it was arranged that the various countries should dispatch specially equipped steamers four times a year, to a specific area in the North Sea, so that simultaneous investigations of the temperature and other physical conditions of the sea over the whole of the area might be made. In the intervals between the periodic crises it was also arranged that special fishing experiments and biological operations were to be carried out. The British government commissioned the Scottish Fishery Board and the Marine Biological Association to carry out the British part of the investigations, and Parliament authorized an award to be equally divided between the two, to defray the cost of the work. The steamer which the British section has acquired has been rechristened the "Huxley," and is 116 feet long, with a speed from ten to twelve knots an hour. The Plymouth laboratory of the Association will be the headquarters of the steamer during the quarterly cruises, and the hydrographic material and the collections of floating life will be investigated there. For the purpose of the North Sea work a small laboratory has been established at Lowestoft, where the fishery work of the North Sea and the investigation of the bottom life will be undertaken. One of the duties of the naturalist on the "Huxley" will be to liberate fishes bearing numbered labels in different parts of the British area. This part of the work is to be carried out on a large scale by all the participating countries, in the hope of throwing light on the migrations and growth of food fishes in the North Sea. The work of the various countries will be published in summary form in annual reports by the International Council.