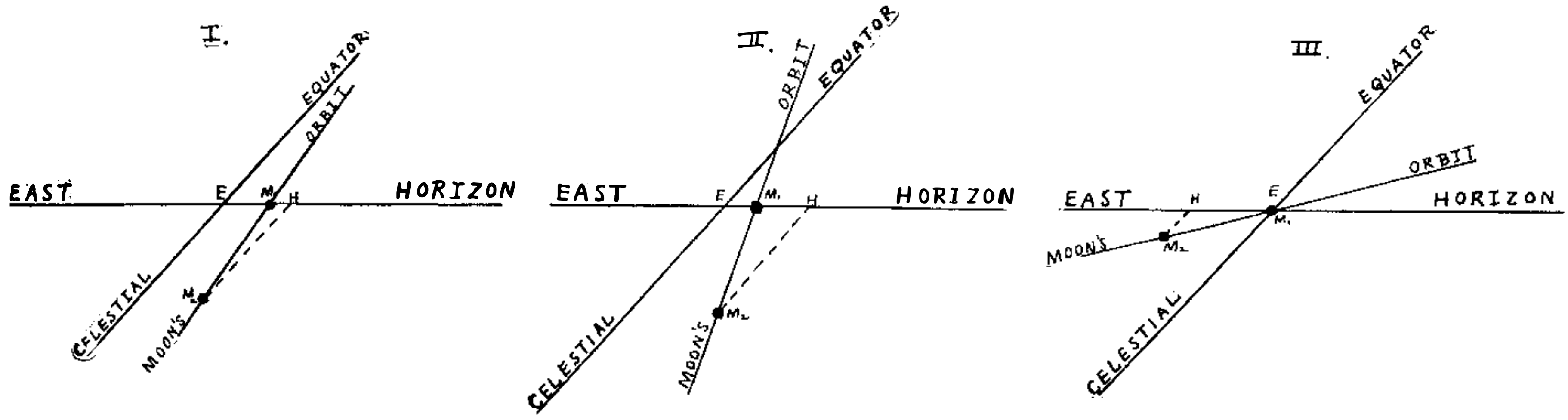
THE HARVEST MOON.

BY ARTHUR B. TURNER, PH.D.

If we imagine a plane passed through the earth's equator and produced to cut the celestial sphere, we obtain a circle called the celestial equator. Again, suppose another plane, which touches the earth at your point of observation, to be produced to cut the celestial sphere. We thus obtain a second circle called the horizon. The accompanying diagrams represent to the observer facing the east these two circles cut by the orbit of the moon, and they show how the inclination of her path varies during the month. The fact that the moon does travel in an eastward direction around the earth is shown by the earth having to turn, on the average, 51 minutes more than a day between one moonrise and the following one. The high and low tides are also delayed by about the same amount, and indicate an eastward motion of the moon. This extra turning of the earth to catch up with the moon is called the retardation of her rising and it is when this retardation is smallest and the moon is full, that we have the phenomena of the harvest moon and the hunter's moon. In the diagrams E represents the east point, M_1 the position of the moon on the horizon, M_2 the position of the moon a day later; M_1 M_2 being the arc through which she has moved eastward in that time. M_2H then represents the arc through which the earth must turn to bring the moon on the horizon on the next day. The time it takes the earth to turn through this arc is the daily retardation. It is evident that M_2H is smallest when the moon's orbit is least inclined to the horizon. Now, for the harvest moon it is also essential that the moon shall be full; as the horizon, equator, and the moon's orbit should be situated approximately as in Fig. III. These conditions are satisfied in the autumn about the time of the equinox. Then we have the full moon rising for several successive evenings about the same time and nearly in the same place. The result is that these nights have the moon shining for a longer time than usual, and consequently we say the nights are more brilliant. From the diagrams it can easily be seen that the lengthening of the nights also increases with the latitude of the observer, so that in Norway and Sweden the moon's orbit may actually coincide with the horizon. In this case the moon will rise at absolutely the same time for a considerable number of successive evenings. When the harvest moon occurs in the first part of September, the farmers, especially in England, utilize these beautiful evenings to complete their labors in the field. In the latitude of New York city the daily retardation can be as small as 23 minutes and as great as 1 hour and 17 minutes. For the last full moon of October 2 the least retardation was 29 minutes.



THE HARVEST MOON.

THE NEW ROUTE TO IRELAND.

BY L. H. YATES.

There is all the romance of daring enterprise about the new route which the Great Western Railway Company of England have recently opened. For many years it has been felt that the rocky point of Fishguard on Pembroke coast, and Rosslare on the Wexford coast of Ireland, were the natural extremities of the most direct line of communication between the sister isles. Brunel, the great engineer of the Great Western system, saw this as far back as 1845, but the difficulties that faced him, besides want of funds, brought his plans to a standstill, and Milford Haven, a natural harbor, was chosen instead. Ten years ago, however, the project was revived, and in 1898 the Great Western of England and the Great Southern and Western of Ireland entered into an agreement, in which the English company engaged to take over all undertakings regarding the building of a new harbor at Fishguard, to build and own the steamships, and to link up their railway system on the English side, while the Irish company were to convert Rosslare into a suitable harbor and to construct a direct railway thence to Waterford. From Waterford the connections with Cork, Killarney, the West, and Dublin were to be made direct, in order that the whole of Ireland might benefit from the increased traffic that should result. What the construction has involved on the English side can be realized only by looking back over the eight intervening years, to what Fishguard was then—a face of rock, sheer down to the sea, and a rough, scattered hamlet.

The bay is in the form of a crescent, the coast-line being one of irregular projections, but without natural harborage or shelter. It is exposed to gales from the north and northeast, but protected from the more frequent southwesterly winds which trouble the southern ports. The extent of the bay from west to east is about three miles, and the general depth of water is from 30 to 70 feet, according to the distance from shore. There is sufficient depth of water all over the harbor to accommodate in safety vessels of the largest draft at all states of the tide, with excellent anchorage, the bottom being sand mixed with mud. Because of exceptional climatic conditions, this side of the coast is especially free from fog. Unfortunately, as much cannot be said for the Irish coast.

The construction of the new harbor has necessitated the making of a quay space, half a mile in length, of an average width of 250 feet, and in the beginning, since there was no foothold for them, the men had to be slung in cradles to commence boring. Drills, cranes, and tools had to be lowered in pieces as a space for them was cleared, before blasting operations could begin. When a small terrace had been cleared by hand steam drills were brought into use, and finally a complete installation of 8-horse-power pneumatic drills was put down. Blasting was effected by boring deep holes of small diameter into which charges of explosive were placed, and by detonating mines of black powder in a T-shaped tunnel, which, being built up, was discharged by electricity. One of these mines brought down 113,000 tons of rock in huge blocks. The total amount of rock excavated has been estimated at something like two and one-half million tons, the larger blocks being picked up and transported to form the quay wall, the smaller ones being used for the construction of the breakwater and for ballasting purposes.

The foundations for the quay wall were excavated by suction dredges, with a Priestman grab-hopper following to remove the shingle down to the rock. The rock surface was then leveled by divers, and filled up with concrete. On this the wall was built, the blocks being laid by means of a "Titan" crane. The block work of the wall reaches up to within 3 feet of high-water mark, the upper part being made of mass concrete. In this a cattle gallery has been formed by a cantilever of reinforced concrete. This gallery is 10 feet high by 6 feet in width, and on the seaward side is inclosed by gates hung between fender piles of karri wood. The gallery is connected by subways and ramps with a line of 68 pens on the inside of the quay-space, so that dealing with cattle may be effected without interference with other traffic. Along the quay-wall are nine electric cranes for lifting cargo, mails, etc., directly from the steamer to the quay or train, and *vice versa*. There is also a 21-ton electric crane, capable of lifting a loaded coal car and tipping it into a steamer or lighter. The immediate proximity of the South Wales coal fields makes Fishguard a most favorable port for bunkering purposes, and it is intended to quote special low rates for carriage of coal from the pits.

The throwing out of a breakwater to protect the harbor from northeasterly gales has been one of the most difficult parts of the whole undertaking, as this required to be some 20 feet in height at high tide. Its total length is 2,000 feet, the breadth at base 300 feet, and at top 70 feet. In its construction about one and a quarter million tons of material, chiefly stones in blocks, have been used. The extent of deep water protected by this breakwater is 76 acres.

Every convenience designed to facilitate the transference of passengers and goods from steamer to train has been provided at Fishguard, as far as space permitted. The passenger platform is 800 feet long by 32 feet broad, and has five blocks of station buildings upon it, which when finished will offer every accommodation that can be desired. At low tide, passengers reach the steamer or quay by means of subways. There is only a short distance of about 12 feet which is not under cover. The electrical generating station, which provides power for working the cranes as well as for the admirable lighting, is situated in the angle formed by the termination of the quay wall and commencement of the breakwater. The works have all been designed and carried out departmentally under the able management of Mr. James C. Inglis, the general manager and consulting engineer of the Great Western Company, under whose care this line is making rapid advances.

A building estate is being laid out at the top of the cliffs, where housing for the large number of men employed by the company will be found. Fishguard is picturesquely placed, and the altitude of 300 feet above the sea makes it a bracing spot. A new branch line of railway has been laid down to avoid the steep gradients of the existing one *via* Rosebush, and by this "South Wales Direct Line" the distance from the Great Western Railway terminus, London, is brought down to 261 miles. Further improvements will take place later on.

Three new express turbine steamers have been built for the cross-Channel service, appropriately named the "St. George," "St. Patrick," and "St. David," and each is propelled by three Parsons turbines, driving separate shafts and propellers, capable of attaining a speed of 22½ knots an hour. Sleeping accommodation is provided for 250 first-class and 100 second-class passengers, with saloons and every convenience for comfort. The voyage between Fishguard and Rosslare is performed in two and three-quarter hours in reasonable weather, and there are no rocks to impede navigation.

Official Meteorological Summary, New York, N. Y., September, 1906.

Atmospheric pressure: Highest, 30.48; date, 25th; lowest, 29.65; date, 3d; mean, 30.09. Temperature: Highest, 90; date, 10th; lowest, 54; date, 16th and 25th; mean of warmest day, 80.5; date, 10th; coldest day, 60; date, 25th; mean of maximum for the month, 76.7; mean of minimum, 63.6; absolute mean, 70.2; normal is 66.4; average daily excess compared with mean of 36 years, +3.8. Warmest mean temperature for September, 72 in 1881; coldest mean, 61 in 1871. Absolute maximum and minimum for this month for 36 years, 100 and 40. Precipitation: 2.54; greatest in 24 hours, 1.04; date, 12th and 13th; average for this month for 36 years, 3.57; deficiency, —1.03; greatest precipitation, 14.51, in 1882; least, 0.15, in 1884. Wind: Prevailing direction, N.E.; total movement, 7,551 miles; average hourly velocity, 10.5 miles; maximum velocity, 35 miles per hour. Weather: Clear days, 13; partly cloudy, 8; cloudy, 9. Thunderstorms: Date, 3d, 12th, 13th, 22d.

The effect of electrical oscillations on iron in a magnetic field formed the subject of a paper recently read before the Physical Society by Dr. W. H. Eccles. In attempting to make precise measurements of the effect of high-frequency oscillations on iron held magnetized by a magnetic field, two main difficulties are met. The one is that arising from the fact that the oscillatory currents induced on the surface of the iron investigated shield the inner layers, and thus make the mass of iron affected a variable quantity. The other difficulty arises in the matter of producing oscillations of determinate and invariable character. The author has endeavored to meet the first difficulty by using oscillations so feeble that they affected only the outermost layers of the iron wires employed, and these even only slightly. The second difficulty has been met by using the oscillations produced in an open insulated solenoid by a single small measurable spark passed to one end of the solenoid.