The biplane on the wire, balanced on two guys.

The machine in the air after leaving the wire.

Launching an Aeroplane from a Wire

The New Curtiss Naval Flying Machine

BY far the most serious problem which confronts the Navy Department in its effort to utilize aeroplanes is the difficulty of providing a suitable launching and alighting gear. Every one knows nowadays that before it can really fly, an aeroplane must be in motion; that, like any soaring bird, it must make an initial run in order to get up speed. Alighting on land has always presented its difficulties; indeed, it may be safely said that the landing chassis as we know it is capable of much improvement. How much more difficult must it be to land on water?

The first experiments which were made in our navy with the aeroplane involved the use of a rather extensive platform on the forecastle of the scout cruiser "Birmingham." Down this platform, at a fairly steep angle, Ely in a Curtiss biplane, ran on November 8th of last year, and for the first time in history succeeded in launching a flying machine from the deck of a

warship. Two months later he succeeded in starting from and alighting upon the "Pennsylvania."

Remarkable as this achievement was, it is obvious that warships cannot carry about with them platforms of such size. In action, every piece of unnecessary apparatus, every incumbrance, is simply tossed overboard. The platform unquestionably would have to go with the rest, if the ship is to be fought at all.

Mr. Glenn H. Curtiss seems to have succeeded in overcoming these difficulties, by adopting the hydroplane construction. He has shown that it is possible both to start from the water and to alight upon it with comparative ease and safety. In a word, he devised a type of flying machine peculiarly adapted to the needs of the navy.

The problem of providing a suitable launching gear, which can be used when the water is too rough for the hydroplane float, seems now to have been solved with

equal felicity. At Hammondsport, on Lake Keuka, Curtiss has been making experiments which show that it is possible to launch a hydro-aeroplane from a wire cable. Perhaps the most successful trials were made by Lieut. Ellison. According to Mr. Curtiss, it would only be necessary to stretch one wire from the boat deck of a battleship down to the bow. On this cable the hydroplane glides down, being kept from falling by two auxiliary wires which support the wings until the machine gets up sufficient headway to keep its own balance by means of the ailerons or other control.

Such a launching gear does not interfere in any way with the guns or armament and can be stowed away after it has served its purpose in a very short time.

The experiment shows that whenever the sea is too rough to permit the hydroplane to rise from the waves, it can always take the air by means of the cable.

Submarine Cables and Longitude Determination

The Improvements Devised by Colonel Bourgeois

By Jacques Boyer

AN accurate comparison between two astronomical clocks, situated at a great distance from each other, can be made by overland telegraphy, by means of which the time signals given by both clocks are recorded, side by side, on an electric chronograph at each station. The ordinary electric chronograph is provided with two pens, or writing points, operated

by electro-magnets, so that each pen makes a distinctive mark on the same uniformly rotating cylinder or moving strip of paper, when the circuit of its electro-magnet is made or broken. Usually one pen marks the time by the local clock, while the other records signals made by the observer, on the passage of a star over the wires of the transit instrument or the

occurrence of any other event. For the determination of longitude, the electro-magnet of the second pen is connected with the clock at the distant station.

In order to determine the difference of longitude between two stations by this method, it is necessary to transmit from each station to the other currents

(Continued on page 305.)

The double chronograph.

Apparatus for determining longitude by cable.

THE EMPLOYMENT OF SUBMARINE CABLES IN THE DETERMINATION OF LONGITUDE

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The Harvest Moon

(Continued from page 293.)

angle of $66\frac{1}{2}$ degrees to the plane of the ecliptic; and moreover the plane of the moon's orbit, which is inclined at an angle of a little over 5 degrees, has a retrograde motion, making a complete rotation in 18.6 years. The diminution of the retardation of the rising of the harvest moon is also variable, and dependent upon the latitude of the observer and the position of the moon's orbit. When the moon is midway between the nodes its direction of motion is parallel to the plane of the ecliptic. When it is at or near a node (which may be either ascending or descending) the direction forms an angle of about 5 degrees with the ecliptic.

The plot shows the positions of the earth (E) and of the moon at the dates of full moon—September 8th and October 7th; and also of new moon on September 22nd. The moon's orbit rotates in the direction of the arrow without the orbit; the arrow within the orbit is the direction of the moon's motion. Figs. 1-4 represent the moon's orbit projected on a plane which is perpendicular to that of the ecliptic, and parallel to the earth's axis. The scale is enlarged and shows the relative diameter of the earth and of the moon's orbit. Fig. 1 shows the plane of the orbit seen edgewise. In Fig. 2 the ellipse represent the orbit after one-quarter of a rotation. Fig. 3 shows the plane of the orbit, again seen edgewise after one-half of a rotation. The ellipse Fig. 4 shows the orbit after three-quarters of a rotation. One-quarter of a rotation more brings the orbit back again to the position Fig. 1. Fig. 5 is the position of the orbit in September of this year, and is situated between those shown at Figs. 2 and 3. It is a view looking in the direction of the arrow A. In each of the illustrations the direction of the moon's motion is indicated by an arrow showing that part of the orbit which is near to, or farther from the reader.

Fig. 6 is drawn to a very much larger scale, in order that the parallels of latitude on the earth's surface may be plainly visible; and to show some of the conditions which may affect the rising of the harvest moon. In order to bring the illustrations within the limits of the page, only a small part of the orbit and two positions of the moon are included. The distance from a to b, and from c to d, show the average distance traversed by the moon in 24 hours, when it reaches the maximum distance above and below the plane of the ecliptic. If the positions a and b (below the ecliptic) were equidistant from c and from the earth's center, the moon would rise on consecutive evenings at exactly the same time to an observer situated very near P on the visible hemisphere. Also if the moon occupied the positions c and d (above the ecliptic) under similar conditions it would rise at the same time on consecutive evenings to an observer situated very near P on the invisible hemisphere. In the first case the plane of the horizon passes through a and b; in the second it passes through c and d. In order to realize that the position of the observer in each case is near P, it must be remembered that the moon's distance from the earth is more than sixty times the earth's radius. The latitude of P is $66\frac{1}{2}$ degrees (the polar circle). It is a well known fact that the harvest moon rises at or about the same time on consecutive evenings, in the north of Norway and Sweden. From an inspection of Fig. 6 it is evident that there would be a retardation at lower latitudes—as for example that of New York at Q.

When the plane of the moon's orbit is in the position corresponding to Fig. 1 forming a small angle with the equator; and the moon on consecutive evenings is at f and g, the retardation of the moon's rising is evidently greater than when the direction of the moon's motion is parallel to the ecliptic. When the orbit is rotated into the position corresponding to Fig. 3, and the moon on consecutive evenings is at h and k, the plane forms a larger angle with the equator, and the retardation is diminished. The illustrations might be extended indefinitely; but in general those here given show that in high latitudes the retardation is less than in lower

latitudes; and that under favorable conditions at a high latitude, the moon may rise even earlier the second evening.

Fig. 7 shows the plane of the horizon when the moon is above and below the ecliptic; and also the positions of the observer p and p' at the time of moon-rise.

Submarine Cables and Longitude Determination

(Concluded from page 298.)

strong enough to operate the electro-magnets. This cannot be done when the stations are connected by a long submarine cable, because the impulsive currents are too feeble to affect any but extremely sensitive receiving apparatus.

This difficulty has been overcome by Col. Bourgeois, director of the geographical service of the French army, who was recently commissioned to devise a method of determining the difference of longitude between Brest, in France, and Dakar, in Senegal, which are connected by a cable about 2,800 miles long.

The receiving instrument employed in submarine telegraphy is the siphon recorder, invented by Sir William Thomson (Lord Kelvin). This instrument consists essentially of two very powerful electro-magnets between which is suspended, by two parallel fibers of cocoon silk, a small and light coil containing a great number of turns of very fine wire. The strength of the magnetic field is increased by a core of soft iron, fixed immovably inside the coil, which can turn freely without touching either the core or the electro-magnets. The coil, when no current is passing through it, is held parallel to the line of the magnetic poles by its bipolar suspension, but a positive or negative current causes it to deviate to the right or left from its position of equilibrium. A system of levers magnifies these movements and transmits them to a little glass siphon formed of a bent capillary tube. The short leg of the siphon dips into a vessel filled with a very fluid ink, and the long leg, which is drawn out to a fine point, moves transversely in front of a strip of paper, which is drawn along uniformly by clockwork. The ink is electrified by a small electrostatic machine and is therefore projected upon the paper in a continuous spray. When the siphon is at rest this spray marks a straight line parallel with the length of the moving strip of paper, but when the siphon is turned to right and left by the moving coil the result is a wavy line, the elevations and depressions of which correspond to the dots and dashes of the Morse code.

In Col. Bourgeois's method of determining longitudes by cable a double chronograph and a single siphon recorder are employed at each station. The chronograph is used to compare an auxiliary clock with the standard astronomical clock, while the siphon recorder is connected through a local battery with this auxiliary local clock and through the cable with the standard auxiliary clock of the distant station. Hence the jet of ink traces on the moving strip of paper a straight line interrupted by two series of indentations, each representing intervals of a definite fraction of one second, the odd-numbered indentations (for example) being made by the distant standard clock, and the even-numbered indentations by the local auxiliary clock, the error of which, with respect to the local standard clock, is known from the chronograph record. In the preliminary experiments it was discovered that the siphon recorder and the chronograph pen, both of which are connected with the auxiliary clock, are not equally quick in action, but as the difference is less than 1/100 second, it is of no practical importance. The indentations produced by the siphon recorder are less sharply defined than the marks made by the chronograph pen, but they are quite sharp enough for the determination of longitude.

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