

Surface-Tension.

OWING to surface-tension, a surface of mercury supports easily a sovereign placed flat upon it. Care must, of course, be taken to avoid amalgamation.

I shall be greatly obliged if one of your readers will supply me with a formula for determining the size of the largest sphere of gold that can just be supported by mercury. As the numerical solution of the equation may be troublesome, I venture to ask only for the formula. C. T. WHITMELL.

Hyde Park, Leeds, November 3.

Exceptional Dryness of October, 1919.

METEOROLOGISTS have directed attention to the exceptional dryness of the past October. It is also interesting to note that the amount of drainage-water percolating through 20 in., 40 in., and 60 in. of soil in the open field for the month of October as recorded by the Rothamsted Experimental Station gauges is *nil*. The three gauges, each measuring 1/1000 acre, were built in 1870, and in no previous year is October shown quite dry, 1897 being the nearest with a reading of 0.001 in. The following are the figures for October:—

	20 in. gauge	40 in. gauge	60 in. gauge	Rainfall
Average of 50 years	1.848	1.798	1.669	3.233
Max. 1891 ...	5.589	5.716	5.479	6.764
Min. 1897 ...	<i>nil</i>	0.001	0.001	0.960
1919 ...	<i>nil</i>	<i>nil</i>	<i>nil</i>	1.073

The 50-year records show that October is one of the four months when the ground is wettest.

W. D. CHRISTMAS.

Lawes Agricultural Trust, Rothamsted
Experimental Station, Harpenden,
November 6.

SOUND RANGING.

SOUND ranging consists in the location of the source of a sound, such as the report of a gun, by means of measurements made on the sound-wave which spreads from the source. When it seemed probable, in the latter part of 1914, that the struggle in France was going to develop into trench warfare, the possibility of locating enemy batteries by this means was recognised, and many experiments were started independently to find a method of sound ranging which could be used in the field.

Suppose that there is a gun at the point S in Fig. 1. The report of the gun spreads as a spherical sound-wave, with a uniform velocity, and is received by stations at A, B, and C. If the time intervals between the arrival of the sound at A, B, and C are measured, a very simple construction gives the position of the gun. For instance, if the sound gets to B a time t_1 after it gets to A, and to C a time t_2 after it gets to A, circles are described around B and C the radii of which are equal to the distances travelled by sound in times t_1 and t_2 respectively. If a circle is found which passes through A, and touches the circles around B and C, the gun position will be at its centre. Therefore, by installing a series of observation stations along the front at surveyed positions, and recording the times at which the report arrives at these stations, it is possible to plot the position of the enemy battery on a map on which the

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observation stations are marked. This is the essential idea underlying sound ranging. Three stations only are necessary, but more may be employed in order to confirm the location.

There are other ways of plotting the gun position, given the time intervals. For instance, if the time interval between A and B is t_1 , the gun must lie on a hyperbola with foci at A and B which is such that the difference in the distances from the foci of any point on the curve is Vt_1 , where V is the velocity of sound. Another pair of stations give another hyperbola, and by finding where this intersects the first the gun position is determined. This was the method actually employed on the plotting-boards used by the sound-ranging sections. The hyperbola approximates so closely to its asymptote near the gun position that the asymptote can be used equally well, which makes the method a very simple one in practice.

The French Army started experiments in sound

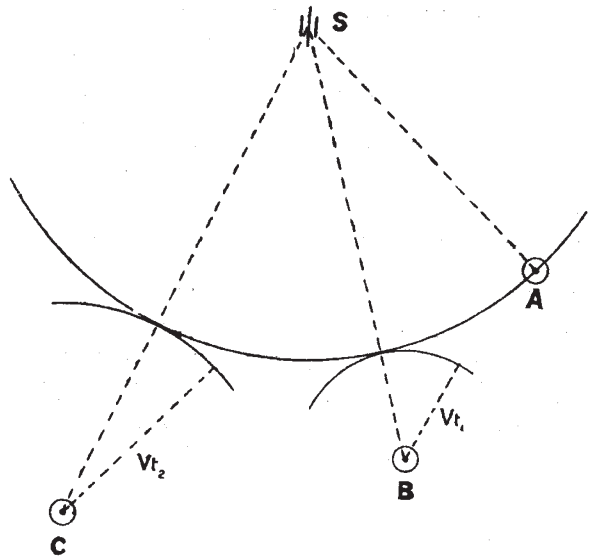


FIG. 1.

ranging in 1914, and obtained results which showed that the method was a promising one. From the very beginning development took place along two lines. Either observers were used, who recorded the time of arrival of the sound by pressing a key, or the sound was registered automatically by some form of microphone. In both cases the stations were connected electrically to a central station, where the signals sent by the observers or microphones were registered on a chronograph of some form. It was soon found that observers were not sufficiently accurate. They made errors amounting to one-tenth of a second, whereas it is necessary to time the arrival of a sound to 0.005 second in order to make a satisfactory location. This accuracy was attained by the system in which the arrival of the sound was registered by a microphone, and both in the French Army and ours a microphone system was finally adopted.