FLIGHT
& AIRCRAFT ENGINEER

DOPPLER'S PRINCIPLE.

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A CLEAR explanation of this principle has been given by S. T. G. Andrews in connection with the change in pitch of the note of an aeroplane. The formula obtained, however, applies only to an observer who has managed to get in the way of an aeroplane, whose observations, assuming even they were fit for publication, would not be very reliable.

In short, the aeroplane is in the air and the observer on the ground, and there will always be distance between them even when they are at their nearest points to one another. Only when an aeroplane is at an infinite distance will the sound waves reach the observer with the velocity of sound plus the velocity of the plane approaching, or minus the velocity of the plane receding.

Diagram 1.—Let the speed of the plane be 80 miles per hour (roughly 100 feet per second).

ON is the height of the plane, A, B, C, . . . give the positions of the plane at successive intervals of a second. AB = BC = . . . therefore give the velocity of the plane in feet per second.

OA is the distance of the plane from the observer at the start, ON the distance after eight seconds. AP, BQ, CR . . . give the spaces described towards the observer, in successive seconds.

It will be seen that these are all less than 100 feet and moreover *get progressively less.*

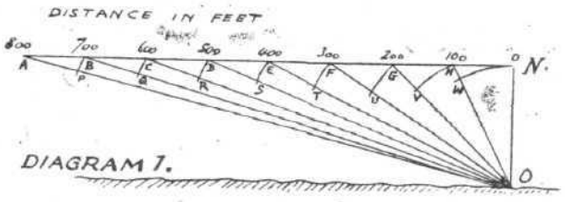

DIAGRAM 1.

In other words the plane *approaches at a decreasing* rate, until at N it has ceased to approach at all, when it then begins to *recede at an increasing* rate.

Diagram 2.—Along the horizontal axis is set off distance measured along the ground from the observer. Along the vertical axis is set off the velocity of the plane towards or away from the observer (*i.e.*, along the " line of sight ").

Four graphs are drawn for the same plane at different heights. In each graph the velocity decreases to zero when the plane is overhead—where the note heard is the true note of the plane, it then becomes minus. The velocity also tends towards 80 miles per hour as the distance gets greater.

No. 1 graph is hypothetical and shows the note changing *instantaneously* from high, through true, to low, *à la* M. Doppler.

No. 4 graph shows a nearly uniform descent in pitch. Graphs intermediate between 1 and 4 give intermediate effects. These graphs apply to planes not passing directly overhead, if the height is measured obliquely.

It will be seen that for planes most easily heard—those

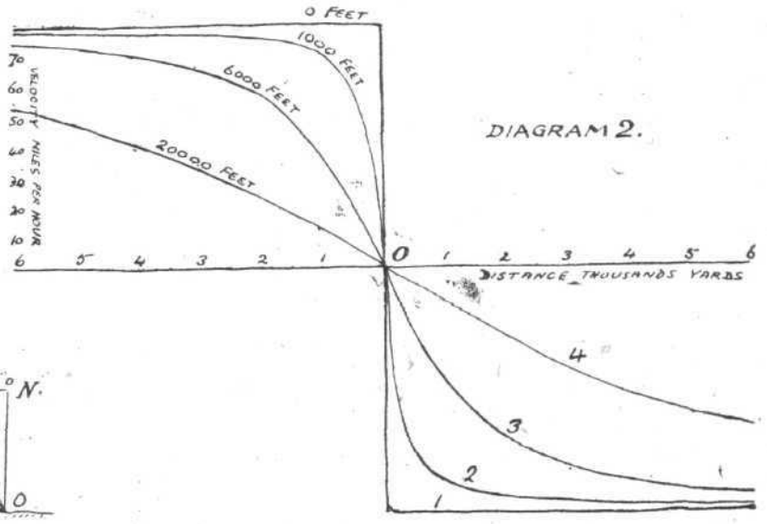

DIAGRAM 2.

flying below 6,000 ft.—the fall of the note will be most marked when the plane is within 2,000 yards of the observer. In conclusion it is insisted, that only when the actual velocity of the plane through the air is rapidly increasing, and the plane is diving along the line of sight, could the note ever be heard to *rise.*

[N.B.—Wind would only serve to increase or decrease the 80 miles per hour by a *constant* amount.]

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THE WORK OF THE R.N.A.S.

A FEW particulars are now available relating to the work which naval aircraft performed during the month of September. The total distance covered by the patrols was over 170,000 miles, of which 90,000 miles was covered by seaplanes and 80,000 miles by airships. On seven occasions ships, which were being attacked by submarines, sent S.O.S. signals, which brought seaplanes to their assistance in time to save them by compelling the submarines to dive. Several hundreds of ships were convoyed during the month by aircraft, and in no single instance has a submarine dared attack a ship while under aircraft escort. The number of submarines attacked and destroyed by our aircraft cannot be published, but a few words may be said as to the method of attack. When a destroyer sights a submarine some five or six miles away he goes full speed to the attack at about thirty miles an hour, so that the submarine has ten minutes or so in which to dive beyond the reach of the destroyer's depth charges. But when a seaplane sights a submarine at the same distance he flies to the attack at anything from 80 to 100 miles an hour, so that the submarine has only three or four minutes before bombs begin to fall round her. It is not suggested that destroyers have been superseded by the seaplanes as the enemy of submarines. On the contrary, the two very often work together, and their co-operation usually spells disaster for the " U "-boat.

A seaplane recently sighted a German submarine on the surface, flew directly over her before she had a chance to dive, and dropped a bomb on her tail, which was seen to make a large hole in the deck. Immediately afterwards the seaplane pilot saw through the mist three more German submarines, in line abreast, followed by three German destroyers and escorted by two German seaplanes. All six vessels fired their anti-aircraft guns at our seaplane, but the German seaplanes did not attack, because they could not get through the barrage put up by the fire of their own destroyers and submarines. Our seaplane turned, dropped another bomb on the wounded submarine, saw her sink amidst a pool of oil, in which fragments of her floated, and then retired from an unequal contest, at the same time sending a wireless message as to where three of the enemy's destroyers were to be found.

The mere presence of the seaplane has many times saved a merchant ship when a submarine has been attacking it. Moreover, when the tragedy has actually occurred and the torpedo has found its mark, it is the seaplane which is the first to see the shipwrecked crews in their boats, to send wireless messages for assistance and to direct the rescuers to the right spot. It is the seaplanes and the other aircraft which first sight the deadly mine, and so help the minesweepers in their task. In a word, it is the naval aircraft which has been, and is, saving the lives not only of those who traverse the seas but of every man, woman, and child in the British Isles, who would otherwise be threatened with starvation. Without a constant stream of new aircraft to replace the inevitable heavy wastage in machines, the struggle against the German submarines will be prolonged, food will become dearer, and last but not least, the lives of our sailors will be needlessly lost.