upper layers of the equatorial current appeared to have been raised unchanged through the height δh. Provided that the polar air was not more than 2 or 3 km. in depth, anticyclones formed in this way would be "warm" anticyclones, and would possess the features associated with such. But there are almost certainly cases where the encroaching polar air extends right up to the base of the stratosphere, and these appear to have all the characteristics of the cold, rapidly-moving anticyclone. This cold air, passing as it does into latitudes warmer than those where it acquired the main features of its existing temperature distribution, is heated from the bottom upwards, and becomes sufficiently unstable to provide within itself moderate rain and much cloud, but probably not persistent heavy rain. (It seems likely also that anticyclones do reach us in which there is either no polar surface air or only a negligible amount. Their formation was probably a much more gradual though similar process, and took place in more southerly latitudes.)

Mr. Dines has referred to the difficulty of maintaining the polar air *in situ*. The patch of polar air with which we are dealing may be described as a roughly circular one of 1000 or more km. in diameter; in the case of a "warm" anticyclone we may limit its depth at the deepest part to 2 or 3 km.; in the case of a "cold" anticyclone the depth in the centre may include the whole thickness of the troposphere. It appears to be maintained *in situ, so far as it is maintained*, by the currents which produced it. But actually the motion of most "cold" anticyclones—*i.e.* those of the deep polar air—does strongly resemble that of the flat drop of mercury on the laboratory table.

This problem was dealt with hydrodynamically by Exner in 1918 (*Sitzungsber. Akad. Wiss.*, Wien IIa, 127, 1918, pp. 795-847). He assumed as the initial conditions the existence of a mass of cold dense air (at rest or in motion) covering a small portion of the earth's surface and surrounded on all sides and above by warmer, less dense air. Particular points made by him include—(1) that the rotation of the earth renders possible the maintenance (at a slight inclination to the horizon) of a definite fixed bounding surface between the cold and the warm air; (2) that if a long ridge of cold air divides into two ridges flowing apart like cold waves, then the square of the velocity of separation of these waves is proportional to the depth of the cold air and to the difference of density between the cold and the warm; (3) also that in such a case friction with the earth's surface results in a shallow cold film being left over the whole area traversed by the waves and in the consequent gradual reduction in the height of the waves.

There is another consideration which supports the view that an anticyclone is of complex structure, and that is the frequency with which the air above an "inversion" of temperature can be shown to be of different origin from that below. It has usually been said that the surface layers were being cooled by radiation, also that there was outflow of air in these layers, and that the upper air, descending and settling, was being warmed adiabatically. When, however, an attempt is made to apply numerical data, cases arise where the change of temperature at a given point in space appears to have taken place much more rapidly than can be provided for by the most favourable time scale of the assumed operating causes. But in particular it is difficult to see why these causes should lead rapidly to the formation of comparatively sharp discontinuities of temperature of the order of 10° F., and also how they can lead to other than a very unstable vertical distribution of temperature. It seems much simpler, being provided with air of about the appropriate temperatures to northward and southward respectively, to explain the formation of anticyclones and their temperature distribution by means of the horizontal motion and interaction of these "polar" and "equatorial" currents.

A. H. R. GOLDIE.

Wimbledon, S.W.19, March 8.

The Phantom Island of Mentone.

ON a fine dark night, looking towards the point of Mentone from the sea-front about the middle of the West Bay, the appearance is presented of a dark island rising out of the sea in the gap which separates the lights of Mentone from those of Bordighera, some ten miles distant. This "phantom island" appears to be about 200 feet high, and from its darkness one would imagine it to be thickly covered with vegetation, its sides rising steeply out of the water. It is directly opposite, and quite near the sea-front of Mentone, from which it is separated by a very narrow channel of water. It appears, in fact, to be quite close to Mentone.

The explanation of this curious optical illusion is comparatively simple. The lights of Mentone and those of Bordighera present the appearance of being ranged round a curved bay, and they throw their reflections on the water, but they are separated by the East Bay, which is not seen, and by a dark, unilluminated portion of the coast. The corresponding part of the sea is devoid of reflections, and the impression is produced of a dark obstacle breaking the continuity of the line of lights and of their reflections in the water. This effect has been seen by independent observers on several occasions.

G. H. BRYAN.

University College of North Wales,
March 6.

Ball Hardness and Scleroscope Hardness.

IN the ball hardness test Meyer found that $L = ad^n$. By combining this relation with Brinell's formula $H = L/A$, it can be shown that the hardness number when the ball is immersed up to its diameter is $\frac{2a}{\pi}D^{n-2}$. This value has been called the "ultimate hardness" (H_u), and is independent of the initial condition of the metal with regard to cold work.

Several attempts have been made to obtain a relation between standard Brinell and scleroscope numbers. The results have been more or less unsatisfactory. If, however, values of H_u be plotted against the scleroscope numbers of metals in the annealed condition, the points lie on a smooth curve which is independent of the ball diameter. The following results have been obtained by the writer using balls of 1 mm. and 10 mm. diameter:

Sample.	*a.*	*n.*	H_u.	Scleroscope No.	Ball diam.
Tin . .	5·53	2·185	5·4	3·5	10 mm.
Zinc . .	24	2·21	25	11	
Steel A .	74	2·288	91	27	
,, W .	185	2·292	231	51	
,, 4 .	262	2·292	327	64	
,, 3 .	342	2·293	428	73	
Armco .	94	2·164	60	21	1 mm.
Steel 2N .	112	2·185	71	23	
,, A .	150	2·247	96	27	
,, S90 .	264	2·298	168	41	
Manganese Steel . .	453	2·303	288	50	