Letters to the Editor.

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The Cause of Anticyclones.

IN reply to Major Goldie's letter in NATURE of March 31, p. 429, the following figures may be of interest.

Defining an anticyclone as a region where the barometric pressure exceeds 30.20 inches (1022.7 mb.), there are 52 cases of anticyclones in the British Isles during the years 1909 to 1922 inclusive in which the results of registering balloon observations are available.

Expressed as a departure from the mean for the height and date, these 52 cases give $+1.6^{\circ}$ F. at 1 km., $+4.5^{\circ}$ F. at 2 km., and $+5.6^{\circ}$ F. at 3 km. for the mean departure in an anticyclone. At 1 km. there are 18 negative values, at 2 km. there are 16, and at 3 km. there are 13. Ten instances, or only about one in five, show negative departures at each height.

For cyclones with a barometer reading below 29.40 inches (995.6 mb.) the corresponding mean figures are -6.1° F., -8.3° F., and -9.7° F., with 3, 2, and 1 positive signs respectively, out of 27 cases.

The above figures, the results of observations published by the Meteorological Office, do not seem to me to point to the conclusion that in England anticyclones are formed by pockets of cold polar air, but another test is available.

As I understand the theory of the Polar Front, polar air should be cold and have a low relative humidity; cold because it comes from a colder latitude, and dry because it is gradually warming up without a fresh supply of water and hence has a decreasing humidity. Conversely, equatorial air should be warm and nearly saturated. Where, then, polar air lies under equatorial air and forms a discontinuity, the inversion of temperature should be associated with an increase of relative humidity in the upper layer. Actually, just the reverse is the case.

I have examined the published figures for the continent, where records of the humidity are available for the years 1910 and 1911 separately; both years are consistent, and the combined result of nearly 300 observations is as follows:—

Percentage value to the nearest digit of observations in which an increase of relative humidity accompanies a temperature inversion, 0 per cent. Cases of inversion with no appreciable change of humidity, 4 per cent. Cases with distinct decrease, 36 per cent. Cases with very distinct decrease, 22 per cent. In these results both surface inversions and those over 3 km. are excluded.

Since the figures are not published on a homogeneous plan, classification is difficult, but "No appreciable change" means 5 per cent. or under, and

"Distinct decrease" means a fall of 20 per cent. or more.

One solitary instance of an increase of humidity exceeding 5 per cent. (it was 6 per cent.) was found; it occurred at Vienna on December 6, 1911.

The continental figures are fully supported by many hundreds of kite ascents in England, and they prove that cases of warm damp air overlying colder and drier air are practically non-existent.

Thus it appears from the abundant observational material available that the lower layers of the atmosphere are almost always cold in a cyclone, and are

usually (three cases out of four) warm in an anticyclone; also that when an inversion of temperature occurs it is nearly always associated (58 cases out of 62) with dry rather than damp air above.

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Hypotheses of Continental Drift.

IN many recent discussions of Wegener's theory and of other geological hypotheses, the assumption has been freely made that any force, however small, can deform the earth to any assignable extent if only it acts long enough. To declare that this assumption is incorrect is scarcely possible, in the absence of much more accurate knowledge of the physical conditions within the earth than we at present possess; but there is substantial evidence against it.

We believe that mountains have stood for millions of years, indicating that the rocks at their feet can endure for that time stress-differences equal to the pressure at sea-level in the middle of a mountain. The strength of rocks at depths of 200 to 400 km. is almost certainly less, but no geodetic observations indicate that the strength is insufficient to support an uncompensated hill 200 metres in height; inequalities greater than this appear on the whole to be compensated, but the unexplained gravity anomalies remain almost the same whether we suppose that inequalities less than 200 metres in height are compensated or not. Other data, however, indicate that isostasy is not always perfect: Dr. Morley Davies has pointed out one, and I have shown that several otherwise uncoordinated data can be co-ordinated on the hypothesis that the rocks in the asthenosphere, though weaker than those near the surface, have a finite permanent strength. Accordingly, the hypothesis that the asthenosphere can be deformed to an unlimited extent by any small force acting for a long time is one to be regarded with great suspicion, and not to be accepted until it has been proved that it will account for more than appears to be explicable on the contrary hypothesis.

In conjunction with this hypothesis another is often utilised, which can be definitely stated to be inconsistent with physical knowledge: namely, that such a small force can overcome a much larger force acting for the same time in the opposite direction. In Wegener's theory, for example, not only is a small force supposed to have moved America across the Atlantic, but also the resistance of the ocean bottom to deformation is supposed to have caused the elevation of the Rocky Mountains. Now, given a sufficiently weak asthenosphere and enough time, it would be possible to twist the outside of the earth over the inside to any extent. So long as the layers of equal density remained symmetrical about the polar axis, no elevation or depression of rocks taking place, deformation could proceed undisturbed, America going steadily on its way without mountain-building or any other phenomenon observable by geologists. In order that mountain-building may take place, however, energy must be supplied to raise and lower the rocks affected against gravity; and to keep them in position, in spite of the tendency of gravity to restore the symmetrical form, the force required must be enough to overcome gravity and the strength of the surface rocks. The minimum stress needed to account for mountain-building is therefore greater than the pressure due to the weight of the mountain. Tidal friction and differences between the values of gravity at the tops and bottoms of continents are capable of producing stresses of