HURRICANES AND BATH PLUGS

Lots of natural phenomena on the earth rotate. Have you ever noticed that the winds in a depression rotate anticlockwise, and the winds in an anticyclone rotate clockwise? Have you ever wondered why? Then read on!

The most spectacular example of such rotation is the winds in a hurricane (fig 1), which is an especially deep depression, the anticlockwise winds often exceeding 100mph. (Just to confuse everybody, a hurricane in the Pacific Ocean, west of the international date line, is called a 'typhoon'.)

So why all this rotation? The answer, in a couple of words, is the '**Coriolis effect**'.

Everybody knows that the earth is spinning, so all points on the earth (except the north and south poles) are constantly moving towards the east. However, the speed at which points on the earth's surface move to the east is not the same everywhere. The distance around the equator is (roughly) 24,900 miles. To go round once in 24 hours, points on the equator must move at a little over 1,000 mph. However, as you move away from the equator, the circumference of the earth gets less, and the speed of eastward travel becomes less, until at either pole it reduces to zero. At the latitude of Bosham, the circumference of the earth is 15,700 miles, so we are all moving towards the east at 655mph.

Fig 1: Hurricane Irene off the North American coast (September 2011), showing the direction of the winds

Suppose you are in Bosham, and you set off towards the south. The further south you go, the faster you would need to be moving, towards the east, to keep up with the rotation of the earth. If you don't speed up, you will fall behind the earth's rotation, and will thus move off towards the west. If you are firmly attached to the ground, on foot or in a vehicle, the ground itself will speed you up to match, and you wouldn't notice anything. However, if you are in the air, this will not happen. A wind which is blowing from north to south will be deflected towards the west, as it fails to keep up with the rotation speed of the earth (fig 2). Exactly the same happens, but in reverse, if air moves from south to north - it is deflected towards the east, because it is moving too fast for the latitude where it is going, since the earth's circumference there is less.

Thus, winds which blow from the north are deflected to the west, and winds which blow from the south are deflected to the east; you can now see how this causes a spiral motion of the air.

A depression is an area of low air pressure. Since the pressure is low, air moves into it from outside. Air which is moving into the depression from the south is deflected eastwards, due to the Coriolis effect, and air moving in from the north is deflected westwards. The resulting winds form a spiral, rotating anticlockwise. Conversely, an anticyclone is an area

of high pressure, and the wind rushing out from it will rotate clockwise.

For simplicity, the above explanation was based on the northern hemisphere. South of the equator, wind directions are reversed—clockwise for a depression, and anticlockwise for an anticyclone. What actually matters is not whether the winds are blowing north or south, but whether the winds are blowing towards or away from the equator.

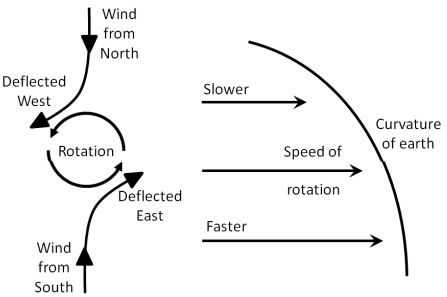

Fig 2: How the Coriolis effect deflects south winds to the east, and north winds to the west, causing air rotation where they meet

But what about bath plugs? The Coriolis effect doesn't just influence the flow of air—it also works with water. In theory, when water runs down the plughole in the bath, any water which is flowing from the north will be diverted to the west, and water flowing from the south will be diverted to the east, hence forming a spiral flow down the plughole. However, I said 'in theory'. The difference in the earth's rotation speed across the width of a bath is extremely small, and the Coriolis effect is tiny. A few years ago, the 'Scientific American' magazine did some tests, to see whether they could demonstrate the effect. They concluded that if there is any movement at all in the water, or if 'pulling the plug' disturbs the water, then that movement will overpower the Coriolis effect, and control the direction of rotation as the water runs out. However, under absolutely ideal conditions, they did demonstrate a difference in the direction of spiralling of water between the northern and southern hemispheres!

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