

The Lost Traveller's Circle

SIR,

One of my colleagues engaged in meteorological research raised the question of whether coriolis force due to the Earth's rotation could affect a man walking, and thus account for the old stories of travellers lost in deserts who walk round in circles.

I am not certain whether such a theory has been put forward before nor whether there are in fact authentic cases of this travelling in a circle and that the right-handed circles are confined to the northern hemisphere and the left-handed ones to the southern hemisphere. I have, however, calculated that the phenomenon, if it occurs, would be of the right order of magnitude; e.g., assuming the force to have its full deflective effect, a man walking at 3 m.p.h. in latitude 30° would describe a circle of $11\frac{1}{2}$ miles radius in 24 hours.

Some comment on the plausibility of the theory would be welcome.

P. M. SHAW.

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Comment on Mr. Shaw's letter was invited from a number of people whose replies are given below.

From L. C. W. Bonacina:

It is well known of course that persons lost in fogs and snowstorms are supposed to move in circles; but the only way to test the reality of the phenomenon mentioned by Mr. Shaw would be to direct a large number of blindfolded persons to walk a lengthy prescribed course in ignorance of the reason for the test. In fact I would urge a scientific test of this kind before anything else is done on the subject.

Without any thought of deflective force I have often tested my ability to follow a straight course with eyes shut and certainly have never felt conscious of any more inclination to swerve to the right than to the left. 'Personal equation' is probably very important in this matter.

Geostrophic or coriolis force is included among the numerous theories to explain the insoluble problem of bird migration. It appears also to be a factor in the erosion of river banks, and I believe railway engineers have to take it into account.

From Frank George:

It is certainly remarkable that the coriolis force should lead to a walker's going round in a circle of the right size in 24 hours. There are, however, other possible reasons for the bias in the lost travellers' orientation: a small persistent slope of the ground over sections of his route, the wind, and so on.

But it must also be noted that if he were unable to know whether he was going in a constant direction or not there would be purely *random* changes in his course. Suppose for example that he is liable to put his next foot down $\frac{1}{2}$ inch out of alignment at the end of each 30-inch pace; then this introduces a probable error of 1° in alignment at every step. By an elementary principle of statistics, his probable error in alignment at the end of n paces is $1^\circ\sqrt{n}$.

On this assumption, after 32,400 paces he is as likely as not to have turned through 180° . After 129,600 paces he is as likely as not to have turned through 360° .

At 3 m.p.h. and, say, 2000 paces to the mile, he will be doing 6000 paces per hour. Therefore he is as likely as not to have turned through 180° in $5\frac{1}{2}$ hours, and through 360° in $21\frac{1}{2}$ hours.

The alleged tendency of lost travellers to walk in circles is not therefore significant of any controlling force, but if it were established that they do indeed tend to turn right-handed in the northern hemisphere and left-handed in the southern hemisphere, then there would be a good case for the proposition mentioned by Mr. Shaw.

From Dr. R. d'E. Atkinson:

It is far from obvious to me what the effect of coriolis force would be on a pedestrian. The principal force to which he is subject is neither this nor centrifugal force, but gravity; and he will always lean over as necessary, so that the resultant of all three (if all three are acting) passes through his feet. If he is forced to move in a straight line he will 'bank' just enough to cancel the coriolis force only, and will thus have the sensation of walking upright on a side-slope. (This sensation will of course be far below the level of consciousness, at any ordinary speed.) Whether in the absence of all controls and landmarks he would in fact start circling to the right, and, if so, how sharply, I do not feel able to guess; a bicycle, I think, might even turn 'uphill', i.e. left, in such a case, but that is certainly a different problem. It may be that he would really circle right just enough to make his total 'bank' be zero; however, in practice it would be impossible to discover anywhere a surface so level that its chance tilts were not far greater than the very small angles involved in any pedestrian case, and I think Mr. George's analysis, modified to take into account the slow changes of direction induced by slightly rolling ground, would explain all known cases, including (I imagine) a large number in which the traveller does *not* come back to his starting-point at all, or comes back far too soon.

It may be noted that if coriolis and centrifugal forces do just balance, the radius of the circle is proportional to the speed, so that the time required to describe it is independent of the speed and is determined by the latitude alone. I doubt if this is what happens.

From W. A. W. Fox:

It appears to me that the contribution of the coriolis effect to the wander in circles is of the wrong order of magnitude. It is possible to wander in circles even in a small area, such as a ten-acre field, if the visibility is nil.

I think that one must discriminate between maintaining direction by eye and by ear. Directions maintained by eye depend on a sufficiency of landmarks and a good visual memory for their relative position. Coriolis should not affect the accuracy since I doubt if the eye could detect an apparent ground slope of 1 or 2 minutes of arc (cf. coriolis vertical error) and even if it did, whether this would be interpreted as an acceleration rather than a local ground contour. By eye it is obviously possible to maintain a line of very small curvature, e.g. of many miles radius.

When using the auditory senses it is not possible to maintain a straight line over any appreciable distance. I have checked this fact by trying to walk along the centre of a straight country road in complete darkness. It is impossible to do this for more than about 50 yards without hitting the edge of the road when conditions are such that the sky cannot be distinguished from the hedgerow. I am assuming that I am a normal subject in this respect.

The auditory directional sense would not appear to depend on acceleration related mentally to the vertical since there is no independent horizon reference. I suggest that it is purely angularly sensitive, e.g. a liquid swirl system working in a horizontal plane, analagous to a compass bowl in which the magnetic element is replaced by a fine antennae system detecting the apparent liquid-rotation in a turn. The sensitivity of such a system is limited by viscosity and surface friction and is of a low order (compare the ease with which giddiness can develop).

These remarks are not essentially scientific since I cannot speak with authority on a matter which is primarily physiological.

From Wilfred Thesiger:

I have travelled on a camel for days in Arabia and the Sudan across flat featureless ground plains. I have found that all camels, when checked, will always bear slowly but persistently off the course in the direction of their homeland—a fact well known to the Arabs. But I have also found that I myself can develop an all but irresistible mental bias in certain directions (on one occasion in the Sudan travelling south I recollect it was towards the east) which is strong enough for me to interfere deliberately with the guide by pulling off in that direction. Had I been by myself, I am convinced I should have deviated very seriously. As I was riding a camel it is unlikely that the cause was a physical one such as coriolis force. I am left wondering whether even a civilized human being retains unconsciously a certain homing instinct which comes into play under such conditions.

A RADAR INSTRUCTION VESSEL

SIR,

Due to my badly worded letter your note in the *Record*, on 'A Radar Instruction Vessel' on page 268, Vol. 2 of the *Journal* is a little incorrect.

My letter to you was to state our agreement with Captain Daragan and to show that the School of Navigation had been thinking on parallel lines. It was not in response to his letter that we bought and started to fit out our Radar Instruction Vessel. We had had the idea for some years and in May 1946 I obtained permission to acquire. The craft was bought in May 1948, twelve months before Captain Daragan's letter appeared.

Yours faithfully,
G. W. WAKEFORD,
Director.

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Warsash, Near Southampton.