descriptions. The author has prepared for this contingency by providing references under each genus to the "Flora Australiensis" and the "Flora of New South Wales," and has arranged his system and nomenclature according to the last named. Ferns and fern allies are included, but of monocotyledons the families of rushes, sedges, and grasses are left out.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Magnetic Storm and Aurora on February 9-10.

A MAGNETIC storm was recorded at the Kew Observatory (National Physical Laboratory) on the afternoon of February 9 and early morning of February 10 larger than any that has occurred since October 31, 1903. The curves were slightly disturbed during the whole of February 9, but the storm may be regarded as commencing with a rapid movement of a few minutes of arc in the declination needle at 2.15 p.m., with a synchronous sudden rise of 45 γ (1 γ=0·00001 C.G.S.) in the horizontal force. The storm lasted an unusually short time, being practically over by 3 a.m. on February 10, but several large rapid movements were recorded. The largest declination movement occurred between 8.19 p.m. and 8.45 p.m. on February 9. During these twenty-six minutes the needle moved 57′ to the west and then 73′ to the east, the extreme westerly position being reached at 8.34 p.m. The most easterly position during the storm was reached at about 10.55 p.m., when the trace was off the sheet for a few minutes. The range during the storm actually shown on the sheet was 1° 38′. Between 1.13 a.m. and 1.45 a.m. on February 10 the needle moved steadily, without sensible oscillation, to the west, this movement reaching 1°. The rate of movement was practically uniform from 1.13 a.m. to 1.33 a.m., when it accelerated so suddenly that the curve resembles two straight lines inclined at a finite angle.

In the case of the horizontal force, the force fell more than 355 γ between 8.25 p.m. and 8.33 p.m. on February 9, when it went off the sheet for a few minutes. Between 8.40 p.m. and 8.49 p.m. it increased fully 240 γ. The total range during the storm exceeded 480 γ.

The vertical force, though less disturbed than the other elements, showed a range of 325 γ, the highest and lowest values being attained at 6.25 p.m. on February 9 and 1.48 a.m. on February 10 respectively. The most rapid change took place between 8.25 p.m. and 8.42 p.m. on February 9. The storm was doubtless associated with the aurora, which seems to have been widely observed on the evening of February 9. CHARLES CHREE.

AN unusually beautiful display of aurora borealis was seen here (51° 56′ N. lat., 2° 35′ W. long.) between 6.30 p.m. and 11 p.m. on Saturday evening, February 9. At about 6.30 p.m. I became aware that the north-western sky, instead of darkening after sunset, was becoming lighter, and the quivering upward rays showed that it was the northern lights. The aurora was at its best between 8 p.m. and 9.30 p.m., stretching half across the northern heavens from Cetus to Leo, from the horizon upwards towards the zenith, some of the curved flashes reaching to Jupiter.

This aurora was characterised by the brilliant soft whiteness of its light, occasionally tinged with pale green, which filled the north-western and northern sky from the horizon to a considerable elevation, from which at times long rays shot up; but more generally the lights appeared as curved, wavy bands rushing up to the zenith, and hanging there for a few seconds as white, cloudy patches in the clear sky among the brighter stars. Between 8.45 p.m. and 9.15 p.m. the colour about Ursa Major and Leo was a dull, faint red. The aurora was not watched after 11 o'clock, but by that time it had greatly diminished in brilliancy, and the sky was becoming cloudy.

I may add that for some weeks I have been noting the sun-spots, of which lately there have been a considerable number, and on the morning of February 9 one near the middle of the sun's disc was so large that I afterwards saw it with the naked eye through smoked glass.

E. A.

Dadnor, near Ross, Herefordshire, February 11.

The Flight of an Elongated Shot.

WOULD any reader of NATURE kindly enlighten me on the following points in the theory of projectiles?

(1) Whether one is right in supposing that a bullet or shot of the modern pointed cylindrical form, when fired at any angle of elevation *in vacuo*, would preserve the original direction of its axis of rotation, so that at the end of its flight its long axis would be considerably inclined to its line of flight.

(2) Whether a similar shot fired through the air would be acted upon by a couple tending to produce rotation about an axis perpendicular to the plane of the trajectory, the magnitude and direction of this couple depending upon the form of the projectile and the position of its centre of gravity, a zero value being possible; and whether the effect of this couple would be to produce rotation about an axis in the plane of the trajectory and perpendicular to the long axis of the shot, so that the point of the projectile would be deflected downwards and to the right or left.

(3) Whether, if the above suppositions are correct, any successful attempts have been made to keep the long axis of the shot tangential to its trajectory during the whole course of its flight, by giving it a particular form, and varying the density of its parts in a particular way.

P. D. STRACHAN.

Philippolis, Orange River Colony.

THE answer to proposition (1) is best given for the most general case. A body projected in any manner in a field of gravity *in vacuo* will move so that the centre of gravity (C.G.) describes a parabola, while the body moves about the C.G. so that to an observer seated at the C.G. the body has the motion described by Poinsot, in which the momental ellipsoid rolls on a fixed plane. The normal to this plane is the axis of resultant angular momentum, and this axis preserves a direction fixed in space, while the body moves about it. When this axis coincides with a principal axis, the body appears to be spinning steadily about the axis, but a closer observation reveals always a precessional and nutational motion.

The question in the limited form of proposition (1) presupposes a body of perfect uniaxial symmetry spun accurately about its axis; but such a condition cannot be realised in practice any more than it is possible to balance a pin on its point, and so it is better to replace this ideal state of proposition (1) by the penultimate state, in which the spinning body, like a sleeping top upright, has steadiness almost perfect.

With this limitation the axis of an elongated shot would move parallel to itself, on the whole, if fired in a vacuum as stated in proposition (1). But if fired in air, as in proposition (2), a couple arises as soon as the axis is oblique to the direction of motion, tending to place the axis of an elongated shot broadside to its motion and at right angles to the tangent of the trajectory, and this couple acting on the rotating shot will cause the axis to precess about the tangent. Even in the absence of air resistance and gravity, the resulting motion is of great complexity where the body is influenced by the stirring up of the surrounding medium, and the special case of a figure of revolution, discussed by Kirchhoff and Clebsch, is more complicated than the gyroscopic motion of a top spinning in a smooth cup.

The problem defies analysis when gravity and air resistance are taken into account; all we can say is that the frictional drag damps the nutation, and causes the axis of the shot to follow the tangent of the trajectory very closely, the point of the shot being seen to be slightly above the tangent and to the right, with a right-handed spin. The conditions of proposition (3) are secured then