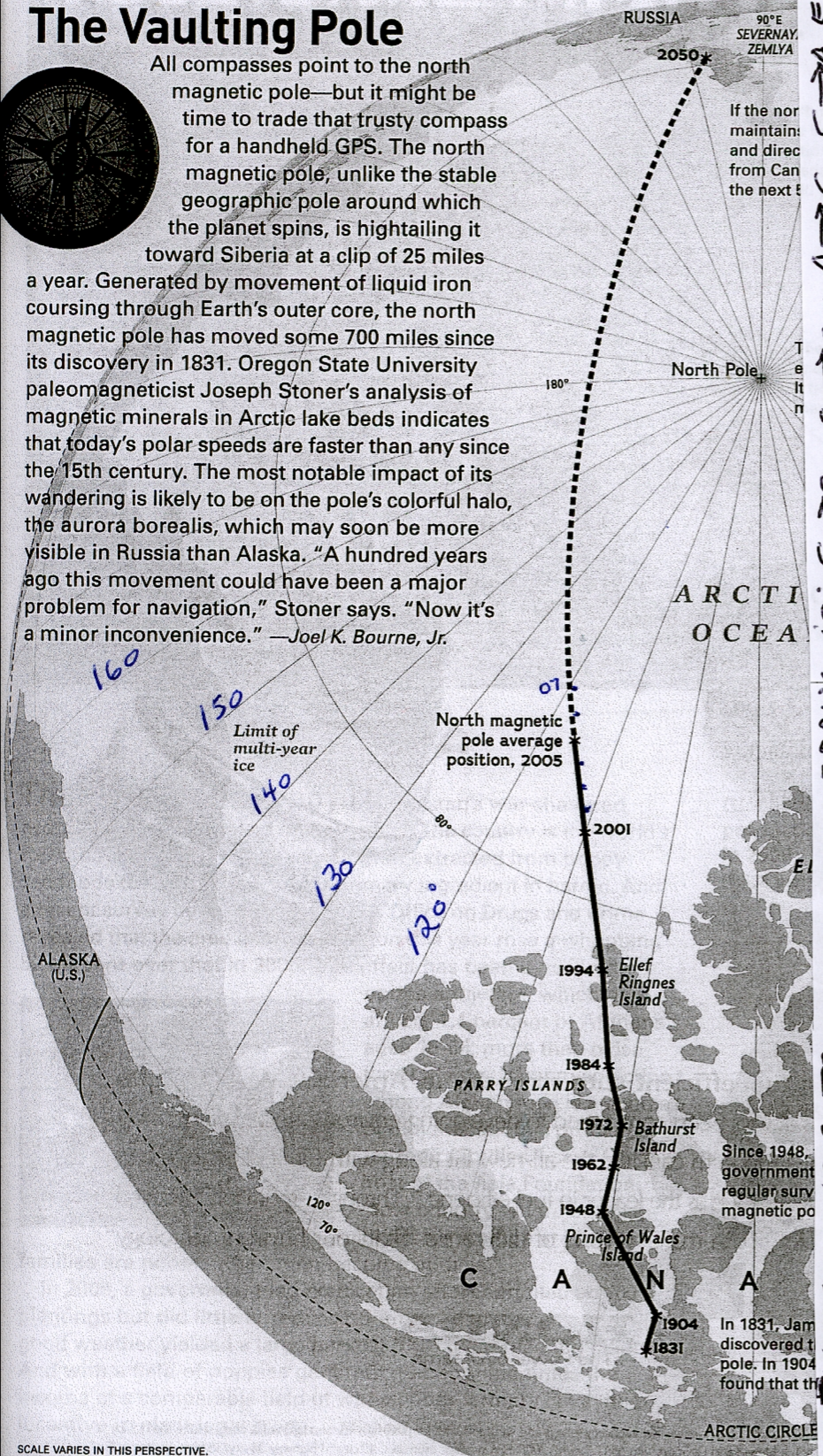
GEOGRAPHY

The Vaulting Pole

All compasses point to the north magnetic pole—but it might be time to trade that trusty compass for a handheld GPS. The north magnetic pole, unlike the stable geographic pole around which the planet spins, is hightailing it toward Siberia at a clip of 25 miles a year. Generated by movement of liquid iron coursing through Earth's outer core, the north magnetic pole has moved some 700 miles since its discovery in 1831. Oregon State University paleomagneticist Joseph Stoner's analysis of magnetic minerals in Arctic lake beds indicates that today's polar speeds are faster than any since the 15th century. The most notable impact of its wandering is likely to be on the pole's colorful halo, the aurora borealis, which may soon be more visible in Russia than Alaska. "A hundred years ago this movement could have been a major problem for navigation," Stoner says. "Now it's a minor inconvenience." —*Joel K. Bourne, Jr.*



SCALE VARIES IN THIS PERSPECTIVE.
NGM MAPS
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Solving Spherical Triangles

[NOTE: LINEAR TRANSPOSITIONS APPLY - i.e.; C→a, a→c; A→C, C→A, ETC]

1. You must know three parts of a spherical triangle to solve for the other three parts. As is traditional, we use capital letters (A, B, and C) to represent the angles, and lower case letters (a, b, and c) to represent the sides, where side a is opposite angle A, and so on.

2. If you know the three angles, then you may solve for the sides by using the law of cosines for angles:

$$\cos c = \frac{\cos C + \cos A \cos B}{\sin A \sin B}$$

3. If you know the length of two sides (a and b) and the size of the angle between these two sides (C), then you can solve for the third side (c) by using the law of cosines for sides:

$$\cos c = \cos a \cos b + \sin a \sin b \cos C$$

4. If you know the length of one side (c) and the two angles next to that side (A and B), then use the law of cosines for angles:

$$\cos C = -\cos A \cos B + \sin A \sin B \cos c$$

5. If you know the length of the three sides, then use the law of cosines for sides:

$$\cos C = \frac{\cos c - \cos a \cos b}{\sin a \sin b}$$

6. Suppose you know two sides (a and b) and the size of one angle other than the one between those two sides (for example, suppose you know angle A). Then use the law of sines to find angle B:

$$\sin B = \frac{\sin b \sin A}{\sin a}$$

This is the ambiguous case. In general, there will be two possible values of B, one greater than 90° and one less than 90°. You will need additional information to determine which possibility is correct for your situation. Once you know the value of B, find side c from this formula, which comes from combining the law of cosines for sides with the law of cosines for angles:

$$\cos c = \frac{\cos a \cos b - \sin a \sin b \cos A \cos B}{1 - \sin a \sin b \sin A \sin B}$$

Then use the law of sines to find angle C.

7. Suppose you know two angles (A and B) and a side other than the one between those two angles (for example, suppose you know side a). Then use the law of sines to find side b:

$$\sin b = \frac{\sin B \sin a}{\sin A}$$

(However, this is another ambiguous case; in general there are two possible values of b.) Once a, b, A, and B are known, use the formula from rule 6.