



and prized in all the world's navies until well into the nineteenth century, when sailors in danger could find out where they were by radio. Traditional long-distance sailors needed telescopes and charts, and pages and pages of tables, to help them work out where they were. Birds have to do all this in their heads, in their bird brains, on the wing. The problem conceptually is the same as we meet in discussing the diving of fish-eating seabirds (how they always fold their wings at exactly the right time). In each case the math is immensely complicated, once you spell it out. But presumably birds on the wing, not familiar with mathematics, don't spell it out. <sup>(3)</sup> They must have some practical rules that instantly translate the cues that are offered by the sun and stars and moon into directives for purposeful action.

Again, there are clues and stories that seem to be throwing some light. For instance, many kinds of birds are known to use star maps. In the early weeks of life the baby birds sit in their nests and study the night sky — and are somewhat confused if those early weeks are too cloudy. But they do not, as human amateur astronomers might do, spend their time learning the individual constellations\* — how to recognize Orion\* or trace the fanciful outline of Taurus\*, or whatever. Instead, they focus on the part that does not move as the night progresses, which in the Northern Hemisphere means the North Star. They can see, if they look at it long enough, that as the night progresses, all the stars in the sky, including the mighty Orion and the notional Taurus, seem to revolve around the Pole Star, which sits in the middle like the central part of a giant cartwheel. <sup>(4)</sup> Once they recognize the central part, the most fundamental problem is solved. The creature that can do this knows where north is and everything else can be figured out. I don't know what the equivalent would be in the Southern Hemisphere, but undoubtedly there is one. Navigation simply does not seem to need the details of astronomy.

\*constellation 「星座」 Orion 「オリオン座」 Taurus 「牡牛座」

問1 下線部(1)について、筆者が言おうとしていることを、本文に即して具体的に日本語で説明しなさい。(12点)

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問2 下線部(2)を日本語に訳しなさい。(14点)

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問3 下線部(3)を日本語に訳しなさい。(14点)

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問4 下線部(4)の意味を、本文に即して具体的に日本語で説明しなさい。(10点)

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