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奈良女子大学
807語　40分

解答・解説 ▶ 本冊 p.104

／50点

次の英文を読み，設問に答えなさい。

Waste recycling is usually assumed to be an invention of the environmental movement, as modern as the blue plastic bags we now fill with shampoo bottles and soda cans. But it is an ancient art. Composting* pits were used by the citizens of Knossos in Crete four thousand years ago. Much of medieval Rome was built out of materials taken from the crumbling ruins of the imperial city. (Before it was a tourist landmark, the Colosseum served as a kind of quarry.) Waste recycling — in the form of composting and manure spreading — played a crucial role in the explosive growth of medieval European towns. High-density collections of human beings, by definition, require significant energy inputs to be sustainable, starting with reliable supplies of food. The towns of the Middle Ages lacked highways and container ships to bring them sustenance, and so their population sizes were limited by the productivity of the land around them. If the land could grow only enough food to sustain five thousand people, then five thousand people became the ceiling. But by plowing the earth with their organic waste, the early medieval towns increased the productivity of the soil, thus raising the population ceiling, thereby creating more waste — and increasingly fertile soil. This feedback loop transformed the wet lands of the Low Countries*, which had historically been incapable of sustaining anything more complex than isolated bands of fishermen, into some of the most productive soils in all of Europe. (1) To this day, the Netherlands has one of the highest population densities in Europe.

Waste recycling turns out to be an indicator of almost all complex systems, whether the man-made ecosystems of urban life, or the microscopic economies of the cell. Our bones are themselves the result of a recycling scheme pioneered by natural selection billions of years ago. All complex organisms generate excess calcium as a waste product. Since at least the Cambrian times*, organisms have accumulated those calcium reserves, and put them to good use: building shells, teeth, skeletons. (2) Your ability to walk upright is due to evolution's capacity for recycling its toxic waste.

Waste recycling is a crucial attribute of the earth's most diverse ecosystems. We value tropical rain forests because they lose so little of the energy supplied by the sun, thanks to their vast, interconnected system of organisms exploiting every tiny phase of the nutrient cycle. The cherished diversity of the rain-forest ecosystem is not just a quaint case of biological multiculturalism. (3) The diversity of the system is precisely why rain forests do such a brilliant job of capturing the energy that flows through them: one organism captures a certain amount of energy, but in processing that energy, it generates waste. In an efficient system, that waste becomes a new source of energy for another creature in the chain. (That efficiency is one of the reasons why clearing the rain forests is such a shortsighted move: the nutrient cycles in their ecosystems are so tight that the soil is usually very poor for farming: all the available energy has been captured on its way down to the forest floor.)

Coral reefs display a comparable capacity for waste management. Corals live in a mutual alliance with tiny algae*. Thanks to photosynthesis*, the algae capture sunlight and use it to turn carbon dioxide into organic carbon, with oxygen as a waste product of the process. The coral then uses the oxygen in its own metabolic cycle. Because we're aerobic* creatures ourselves, we tend not to think of oxygen as a waste product, but from the point of view of the algae, that's precisely what it is: a useless substance discharged as part of its metabolic cycle. The coral itself produces waste in the form of carbon dioxide, nitrates, and phosphates*, all of which help the algae to grow. (4) That tight waste-recycling chain is one of the primary reasons coral reefs are able to support such a dense and diverse population of creatures, despite residing in tropical waters, which are generally nutrient-poor. They are the cities of the sea.

There can be many causes behind extreme population density — whether the population is made up of angelfish or spider monkeys or humans — but without efficient forms of waste recycling, those dense concentrations of life can't survive for long. Most of that recycling work, in both remote tropical rain forests and urban centers, takes place at microbial* level. Without the bacteria-driven processes of decomposition, the earth would have been overrun by dead bodies many ages ago, and the life-sustaining envelope of the earth's atmosphere would be closer to the uninhabitable, acidic surface of Venus. If some rogue virus wiped out every single mammal on the planet, life on earth would proceed, largely unaffected by the loss. But if the bacteria disappeared overnight, all life on

the planet would be extinguished within a matter of years.

*composting < compost「堆肥をつくる」
the Low Countries: the region of Europe comprising the Netherlands, Belgium, and Luxembourg
Cambrian times「カンブリア紀」 algae < alga「藻類」 photosynthesis「光合成」
aerobic「好気性の」 phosphates < phosphate「リン酸塩」 microbial「微生物の」

問1 下線部(1)の理由を，本文に即してわかりやすく日本語で説明しなさい。(12点)

問2 下線部(2)の具体的な内容を，本文に即して日本語で説明しなさい。(10点)

問3 下線部(3)を和訳しなさい。(14点)

問4 下線部(4)を和訳しなさい。(14点)