平成２２年度　大学院・生命理学研究科博士前期課程　入学試験

生命科学専攻　英語

英語　第１問

次の文章を読み、問１－３に答えなさい。

I.

Ozone is a relatively simple molecule, consisting of three oxygen atoms bound together. Yet it has dramatically different effects depending on where ozone resides, it can protect or harm life on Earth. High in the atmosphere about 15 miles (24 km) up ozone acts as a shield to protect Earth's surface from the sun's harmful ultraviolet radiation. Without this shield, we would be more susceptible to skin cancer, cataracts, and impaired immune systems. Near Earth's surface, where ozone comes into direct contact with life forms, it primarily displays a destructive side. It is a harmful pollutant that causes damage to lung tissue and plants—it is a major constituent of smog.

The amounts of "good" and "bad" ozone in the atmosphere depend on a balance between processes that create ozone and those that destroy it. An upset in the ozone balance can have serious consequences for life on Earth. Scientists are finding evidence that changes are occurring in ozone levels—the "bad" ozone is increasing in the air we breathe, and the "good" ozone is decreasing in our protective ozone shield.

II.

As winter arrives, a vortex of winds develops around the pole and isolates the polar stratosphere. When temperatures drop below -78°C (-109°F), thin clouds form of ice, nitric acid, and sulphuric acid mixtures. Chemical reactions on the surfaces of ice crystals in the clouds release active forms of chlorofluorocarbons (CFCs). Ozone depletion begins, and the ozone “hole” appears.

Over the course of two to three months, approximately 50% of the total column amount of ozone in the atmosphere disappears. At some levels, the losses approach 90%. This has come to be called the Antarctic ozone hole.

In spring, temperatures begin to rise, the ice evaporates, and the ozone layer starts to recover.

cataract（白内障）， pollutant（汚染物質）， stratosphere（成層圏）， vortex（渦）

column amount of ozone in the atmosphere（大気の鉛直気柱に含まれるオゾン量）

問１　下線部「存在場所により異なるオゾンの効果」について簡潔に説明しなさい。

問２　「存在場所により異なるオゾンの効果」に関して危惧されている事を簡潔に記しなさい。

問３　オゾンホールが形成される仕組みを簡潔に記しなさい。

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生命科学専攻　英語

英語　第２問

以下の文章を読み、問１—２に答えなさい。

Hooke claimed that when experimenters looked through a microscope, all they needed to transcribe nature directly onto paper was "a *sincere Hand*, and a *faithful Eye*, to examine, and to record, the things themselves as they appear". To reinforce Bacon's biblical message of human fallibility, his first plate exposed the imperfections in objects produced by humans: under his microscope, a honed razor looked jagged, a needle's point became blunted, and a full-stop lost its sharp edge.

Yet in practice Hooke found that "a *sincere Hand*, and a *faithful Eye*" were not enough to capture Nature exactly as she is.① For one thing, microscope images were often ambiguous, so attempts to decipher them were shaped by individual expertise and personal interpretation. "The Eyes of a Fly in one kind of light appear almost like a Lattice, drill'd through with abundance of small holes," Hooke remarked; "In the Sunshine they look like a Surface cover'd with golden Nails; in another posture, like a Surface cover'd with Pyramids; in another with Cones." An observer needed a fine instrument, but also the skill to judge when it was yielding the right answers.

Hooke realized that further problems were introduced when he tried to reproduce what he saw on paper.② *Micrographia*'s readers were removed from the original specimens by two intermediaries: Hooke himself and his engravers, whom he tetchily accused of making inaccurate copies. And unlike the colourful microscopic world that he observed through his lens, Hooke's illustrations were in black and white, mostly free-floating on the page rather than confined within the circular boundary of an eyepiece.

Hooke（Robert Hooke、顕微鏡図譜 "*Micrographia*" を発刊）,
Bacon（Francis Bacon、英国の政治家、哲学者）
fallibility（fallibile（誤りを犯し易い）の名詞形）,
hone（砥石で研ぐ）,
jagged（（物が）ぎざぎざの）,
full-stop（終止符）,
decipher（（難解・不明瞭な文など）意味をつかむ）,
expertise（専門的技術や知識）,
intermediaries（媒介）,
engravers（（文字意匠などを金属・木・などに）彫りつける職人、彫金師、彫刻師）,
tetchily（tetchy（気難しい）の副詞）

問１　下線部分①を説明する具体例を記しなさい。

問２　下線部分②を説明する具体例を記しなさい。

生命科学専攻　英語

英語　第３問

細菌は細胞膜の外側に細胞壁を保持する。その結果、両者の間にペリプラズムと呼ばれるスペースが形成される。このスペースは、細菌が効率良くエネルギーを獲得するために不可欠である。細胞壁を消失した細菌について書かれた以下の文章を読み、問１－２に答えなさい。

While many types of bacteria do lose their cell wall during parts of their life cycle, only two groups of prokaryotes have succeeded in losing their cell walls permanently, yet lived to tell the tale. It's interesting to consider the extenuating circumstances that permitted them to do so.

One group, the *Mycoplasma*, comprises mostly parasites, many of which live inside other cells. *Mycoplasma* cells are tiny, with very small genomes. *M. genitalium*, discovered in 1981, has the smallest known genome of any bacterial cell, encoding fewer than 500 genes. Despite its simplicity, it ranks among the most common of sexually transmitted diseases, producing symptoms similar to *Chlamydia* infection. It is so small (less than a third of a micron in diameter, or an order of magnitude smaller than most bacteria) that it must normally be viewed under the electron microscope; and difficulties culturing it meant its significance was not appreciated until the important advances in gene sequencing in the early 1990s. Like *Rickettsia*, *Mycoplasma* have lost virtually all the genes required for making nucleotides, amino acids, and so forth. Unlike *Rickettsia*, however, *Mycoplasma* have also lost all the genes for oxygen respiration, or indeed any other form of membrane respiration: they have no cytochromes, so must rely on fermentation for energy. As we saw in the previous chapter, fermentation does not involve pumping proton across a membrane, and this might explain how *Mycoplasma* can survive without a cell wall. But fermentation produces up to 19 times fewer ATPs from a molecule of glucose than does oxygen respiration, and this in turn helps to account for the regressive character of *Mycoplasma*—their tiny size and genome content. They live like hermits, with little to call their own.

The second group of prokaryotes that thrive without a cell wall is the *Thermoplasma*, which are extremophile archaea that live in hot spring at 60 °C and an optimal acidity of pH 2. They would probably fare well in a British fish and chip shop, as their preferred living conditions are equivalent to hot vinegar. Lysnn Margulis once argued that *Thermoplasma* may be the archaeal ancestors of the eukaryotic cell, on the grounds that they can survive 'in the wild' without a cell wall; but, as we saw in Part 1, stronger evidence support the methanogens as the putative original host. When the complete genome sequence of *Thermoplasma acidophilum* was reported in Nature in 2000, it provided no evidence of a close link to the eukaryotes.

How do *Thermoplasma* survive without a cell wall? Simple: their acidic surroundings fulfill the role of the periplasm, so they have no need of a periplasm of their own. Normally, bacteria pump protons across the external cell membrane into the periplasm outside the cell, which is bounded by the cell wall. This small periplasmic space is therefore acidic, and its acidity is essential for chemiosmosis. In other words, bacteria normally carry around with them a portable acidic bath. In contrast, *Thermoplasma* already live in an acid bath, which is

英語　第３問つづき

effectively a giant communal periplasm, so they can relinquish their own portable acid bath. As long as they can maintain neutral conditions inside the cell, they can take advantage of the natural chemiosmotic gradient across the cell membrane. So how do they stay neutral inside? Again, the answer is simple: they actively pump protons out of the cell in the same way as any other bacteria, by cell respiration. In other words, as in most prokaryotes, the energy released from food is used to pump protons out of the cell against a concentration gradient; and the backflow of protons into the cell is used to power the ATPase, driving ATP synthesis.

In principle, the absence of a cell wall should not undermine the energetic efficiency or genome size of *Thermoplasma* but in practice the cells are somewhat regressive. Although they can measure up to 5 microns in diameter, their genome, of 1 to 2 million letters, encodes only 1500 genes, and is among the smallest of bacterial genomes; indeed, it is the smallest non-parasitic genome known. Perhaps the extra efforts needed to keep out a high concentration of proton saps the energy that *Thermoplasma* can afford to divert to replicating its genome.

the extenuating circumstances（(損害賠償などの) 軽減事由）,
hermits（隠者、世捨て人）,
thrive（(動物が) 成長する、(植物が) 繁茂する）,
fare（暮らす）,
communal（共同で使用する）,
relinquish（手放す）,
undermine（徐々に衰えさせる、害する）,
saps（徐々に弱める、むしばむ）

問１　*Mycoplasma*の遺伝子の特徴を具体的に、かつ簡潔に書きなさい。

問２　細胞膜を欠いた*Thermoplasma*のエネルギー獲得機構を簡潔に説明しなさい。

生命科学専攻　英語

英語　第４問

次の文は、2009 年 6 月 11 日に世界保健機関（WHO）のマーガレット・チャン事務局長が行ったインフルエンザパンデミック警戒レベルを phase 5から 6 に引き上げるとの宣旨の一部である。[1]から[10]に適当な単語を入れて意味の通じる文章にしなさい。

In late April, WHO announced the emergence of a novel influenza A virus. This particular H1N1 strain has [1] circulated previously in humans. The virus is entirely new. The virus is contagious, spreading easily from one person to [2], and from one country to another. As [3] today, nearly 30,000 confirmed cases have been reported from 74 countries. This is only part of the picture. With few exceptions, countries with large numbers of cases are those [4] good surveillance and testing procedures [5] place.

Spread in several countries can no longer be traced to clearly-defined chains of human-to-human transmission. Further spread is considered inevitable. I have conferred [6] leading influenza experts, virologists, and public health officials. In line [7] procedures set out in the International Health Regulations, I have sought guidance and advice from an Emergency Committee established for this purpose.

[8] the basis of available evidence and these expert assessments of the evidence, the scientific criteria for an influenza pandemic have been met. I have therefore decided to [9] the level of influenza pandemic alert from Phase 5 to Phase 6.

The world is now [10] the start of the 2009 influenza pandemic.

contagious（伝染性の）， inevitable（不可避な）