

平成 19 年 度 入 学 試 験 問 題

生物化学専攻 英 語

[注意事項]

1. 試験開始の合図があるまで、この問題冊子をひらいてはならない。この冊子は、表紙を含めて計7頁からなる。
2. 解答には、必ず黒色鉛筆（または黒色シャープペンシル）を使用すること。
3. 問題は全部で4問ある。その4問全てに解答せよ。
4. 答案用紙は、各問につき1枚、合計4枚配布してあるから、確実に配布されていることを確かめること。
5. 各答案用紙の所定欄に、科目名（英語）・問題番号・受験番号および氏名を必ず記入すること。
6. 解答は、各問ごとに答案用紙1枚を使用すること。
7. 答案用紙は、採点の際、点線で切り取られるので、裏面も使用する場合には、点線の上部を使用しないこと。
8. 答案用紙には、解答に関係ない文字、記号、符号などを記入してはならない。
9. 解答できない場合でも、答案用紙に科目名・問題番号・受験番号および氏名を記入して提出すること。
10. 問題冊子の余白は自由に使ってよいが、答案用紙に草稿を絶対書き込まないこと。

この問題冊子は試験終了後に回収します。以下の欄に受験番号と氏名を記入すること。

受験番号		氏 名	
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[第1問]

次の「The mad technologist」と題する文章 (Editorial, *Nature* **441**, 908, 2006) を読み、問題 (1) ～ (3) に答えよ。

Cinema has been around for more than 100 years now, but the world has not tired of it. According to the Motion Picture Association of America, 9.6 billion tickets to the cinema were sold around the world in 2004. Film was, arguably, the single most important artistic medium of the twentieth century. Its resonance and power alone make it an object worthy of study.

It is also an art that technology has rendered possible. More than an opera, a play or a novel, film is a technological product, spawned directly by the inventions of electricity and celluloid. Before the Lumière brothers' *cinématographe* showed moving images of Lumière factory workers knocking off work for the day, the groundwork was laid by the invention of the pinhole camera and Eadweard Muybridge's motion-capturing photographs, for example.

So how does this most modern of media see science? On-screen, apart from a few earnest biopics of Louis Pasteur or the Curies, scientists are often portrayed as comically inept eccentrics or evil geniuses bent on world domination. They frequently re-enact Frankenstein-creator Mary Shelley's lesson about playing god — and are almost as frequently dispatched by their own twisted creations.

Yet scientists are less interested in creating things than in finding things out — discovering new species, rather than manufacturing them. Many 'mad scientists' on film are really engineers of one kind or another. They are technologists.

(A) This muddling of science and technology is common, and it could be argued that scientists haven't helped things by claiming full credit for technologies — such as nuclear power or modern medicine — that they merely made possible through their discoveries. If we tease science and technology apart, we find that pure scientists are often treated kindly by film-makers, who have portrayed them sympathetically, as brooding mathematicians (*A Beautiful Mind*) and heroic archaeologists (*Raiders of the Lost Ark*).

It is technology that movie-makers seem to fear. Even the best-loved science-fiction films have a distinctly ambivalent take on it. *Blade Runner* features a genetic designer without empathy for his creations, who end up killing him. In *2001: A Space Odyssey*, computers turn against humans, and *Star Wars* has us rooting for the side that relies on spiritual power over that which prefers technology, exemplified by the Death Star. Why would an inherently technological medium seem to be so wary of its own creator?

Modern technology has changed lives considerably, as becomes clear when we consider that television has been around for only about 70 years. No doubt technology has improved lives in ways that can easily be felt and measured. But it takes some getting used to. Many people find the constant introduction of new gadgets and the faster pace of life alienating and exhausting. It may be that our first completely technological art form is the one best suited to exploring how we feel about modern life.

At any rate, the mad scientist is not the only image of science. Films such as *Primer* and *Schläfer* have given the world a more realistic look at scientists, albeit ones with rather more interesting lives than most. There is drama and pathos to be found in the laboratory, even without the wild hair and insatiable desire to rule the world.

(問題)

(1) 下線部 (A) を和訳せよ。

(2) 上の文章を 3 行程度の英語で要約せよ。

(3) この内容について、あなたのコメントを日本語 10 行程度で述べよ。

[第2問]

次の英文は Watson と Crick による DNA の構造に関する論文（抜粋）である。これを読み、問題（１）～（３）に答えよ。

We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey. Their model consists of three inter-twined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons: (1) We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear what forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other. (2) Some of the van der Waals distances appear to be too small.

We wish to put forward a radically different structure for the salt of deoxyribose nucleic acid. This structure has two helical chains each coiled round the same axis. We have made the usual chemical assumptions, namely, that each chain consists of phosphate diester groups joining β -D-deoxy-ribofuranose residues with 3',5' linkages. The two chains (but not their bases) are related by a dyad perpendicular to the fibre axis. Both chains follow right-handed helices, but owing to the dyad the sequences of the atoms in the two chains run in opposite directions. The bases are on the inside of the helix and the phosphates on the outside.

(A) The novel feature of the structure is the manner in which the two chains are held together by the purine and pyrimidine bases. The planes of the bases are perpendicular to the fibre axis. They are joined together in pairs, a single base from one chain being hydrogen-bonded to a single base from the other chain, so that the two lie side by side with identical z-co-ordinates. One of the pair must be a purine and the other a pyrimidine for bonding to occur.

If it is assumed that the bases only occur in the structure in the most plausible tautomeric forms (that is, with the keto rather than the enol configurations) it is found that only specific pairs of bases can bond together. These pairs are: adenine (purine) with thymine (pyrimidine), and guanine (purine) with cytosine (pyrimidine).

In other words, if an adenine forms one member of a pair, on either chain, then on these assumptions the other member must be thymine; similarly for guanine and cytosine. The sequence of bases on a single chain does not appear to be restricted in

any way. However, if only specific pairs of bases can be formed, it follows that if the sequence of bases on one chain is given, then the sequence on the other chain is automatically determined.

It has been found experimentally that the ratio of the amounts of adenine to thymine, and the ratio of guanine to cytosine, are always very close to unity for deoxyribose nucleic acid.

It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material.

(問題)

- (1) Watson と Crick が提出した DNA の構造モデルは、Pauling と Corey のモデルとどう違うのか、両者を対比させながら 200 字以内で説明せよ。
- (2) 下線部 (A) を和訳せよ。
- (3) これは *Nature* 誌に掲載された論文である。読者向けの簡単な紹介文を 100 words 程度の英文で記せ (何が発見され、それがどういう生物学的意味を持つのかを明記すること)。

[第3問]

次の文の下線部を英訳せよ。

ダウン症候群 (Down's syndrome) は 21 番染色体を 1 本余分に持つことによって引き起こされる。21 番染色体には約 200-300 の遺伝子が存在するが、これらの遺伝子が余分に存在するとなぜ広範な表現型を引き起こすのかについてはまだ解明されていない。この症候群に見られる異常はかなり特異的であるので、ある特定の遺伝子の発現が増えることが原因であろうと考えられていた。最近、21 番染色体上の *DSCR1* と *DYRK1A* が相乗的に働き、発生を調節する転写因子である NFAT の核局在を妨げることが報告された。つまり、*DSCR1* と *DYRK1A* の遺伝子量が 1.5 倍に増加することによって、NFAT が標的遺伝子を活性化できなくなり、ダウン症候群の様々な表現型を引き起こすと考えられる。

[第4問]

次の文の下線部を英訳せよ。

話を現実の世界にもどすと、われわれはすべて、大なり小なり、社会の歯車として大きな社会機構の内に組み込まれ、あくせくと日常生活を送っている。こうした生活にとって、進化論のように金もうけはおろか、実際の役にもあまり立たぬ学問はとかく軽視されがちである。しかし、われわれが人類の由来を知りその未来に思いをはせるのは、人間だけに許された特権である。そしてこのような思考を助ける点で進化の研究は重要な学問分野である。これに関連して言えることであるが、われわれ一人一人は宇宙全体から見れば、時間的にも空間的にも無限小と言うべき存在でありながら、思考の過程を通してその頭の中に全宇宙を入れることができるというのは、実にすばらしいことではなかろうか。

(出典：木村資生「生物進化を考える」)