動物のようにもキノコのようにもなる生物、変形菌（粘菌）は、その奇妙な生態が多くの生物学者を魅了してきました。日本では、*Nature* 誌への掲載論文数約 50 本を誇る学者、南方熊楠（みなかたくまぐす）（1867 年～1941 年）が知られています。

今回は、変形菌の学習能力についての記事を取り上げます。左ページの Topics に目を通してから、英文を読んでみましょう。

NEWS

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Cellular memory hints at the origins of intelligence

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変形菌の子実体

1 Learning and memory — abilities associated with a brain or, at the very least, neuronal activity — have been observed in protoplasmic slime, a unicellular organism with multiple nuclei.

2. When the amoeba *Physarum polycephalum* is subjected to a series of shocks at regular intervals, it learns the pattern and changes its behaviour in anticipation of the next one to come[1], according to a team of researchers in Japan. Remarkably, this memory stays in the **slime mould** for hours, even when the shocks themselves stop. A single renewed shock after a 'silent' period will leave the mould expecting another to follow in the rhythm it learned previously. Toshiyuki Nakagaki of Hokkaido University in Sapporo and his colleagues say that their findings "hint at the cellular origins of primitive intelligence".

3. It is well-established that cells receive, interpret and adjust to environmental fluctuations, says microbiologist James Shapiro of the University of Chicago, Illinois. But if the results stand up, he says, "this paper would add a cellular memory to those capabilities".

4. The organism chosen by the Japanese team could scarcely seem less promising as a quick learner. *Physarum polycephalum* is a slime mould belonging to the Amoebozoa phylum. It moves at a steady rate of about one centimeter per hour at room temperature, but this changes with the humidity of its environment. It slows down in drier air, and Nakagaki's team used this sensitivity to stimulate learning.

5. The team found that when the mould experienced three episodes of dry air in regular succession an hour apart, it apparently came to expect more: it slowed down when a fourth pulse of dry air was due, even if none was actually applied. Sometimes this anticipatory slowdown would be repeated another hour later, and even a third. The same behaviour was seen when the pulses were experienced at other regular time intervals — say, every half hour or every 1.5 hours.

6. If the dry episodes did not recur after the first three, the amoeba's sense of expectation gradually faded away. But then applying a single dry pulse about six hours later commonly led to another anticipatory slowing in step with the earlier rhythm.

7. The same team has previously shown that these amoebae can negotiate mazes and solve simple puzzles[2,3]. So the new finding adds to "the cool things *Physarum* can do", says applied mathematician Steven Strogatz of Cornell University in Ithaca, New York.

8. Like all living organisms, slime moulds have built-in biochemical oscillators, like the human body clock. In other kinds of slime mould, these oscillators can create periodic ripple patterns in response to environmental stress, helping the organism coordinate its movements. Nakagaki's group thinks that the versatile rhythmic sense of *Physarum* stems from many different biochemical oscillators in the colony operating at a continuous range of frequencies.

9. The team's calculations show that such a group of oscillators can pick up and 'learn' any imposed rhythmic beat, although the knowledge decays quickly once stimulus ceases. The calculations also show that a memory of the beat can stay within the system, and be released again by a single, later pulse — just as the researchers observed.

References

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